



**BIOLOGY
GRADUATE STUDENT
SYMPOSIUM
2019**

**DEPARTMENT OF BIOLOGY
UNIVERSITY OF SASKATCHEWAN**

APRIL 8 & 9, 2019

PROGRAM AND BOOK OF ABSTRACTS



Welcome to Biology 990 Symposium, our showcase for the research of our M.Sc and Ph.D. students.

Presentations will be held over two days. First-year students present posters on Monday, April 8, 2019. Advanced students make oral presentations on Tuesday, April 9, 2019.

We wrap up our symposium with a light supper and social evening during which Scholarships and Awards administered through our Department will be presented to the best Poster and the best Oral Field and Lab based research. We expect to enjoy the presence of donors and supporters during this awards ceremony, and thank them for their kindness and generosity. We hope you enjoy this event, and look forward to a great scientific and social journey!

Ken Wilson
Coordinator
Biology 990 Symposium

Recipients of the 2018 BIOL PRESENTATIONS

Jessica Thoroughgood (Chilton): Best Poster Presentation

Rachel Parkinson (Gray): Best Oral Presentation, lab-based research

Stephen Srayko (Johnstone): Best Oral Presentation, field-based research

Recipients of the 2018 Biology Awards

Ana Gonzalez-Prieto (Hobson): *Gary Bortolotti Graduate Award in Ecology or Animal Behaviour*

Oghenemise Abirhire (Hudson): *Hammer Limnology Scholarship*

Rachel Parkinson (Gray) and Mohammad Naderi (Niyogi/Chivers): *Malcolm A Ramsay Memorial Award*

Zhihai Chi (Ambrose): *PRT Cell for Inc. Graduate Scholarship*

Kevin Bairos-Novak (Ferrari/Chivers): *R. Jan F. Smith Memorial Scholarship*

Hanie Khorshidi (Wilson) and Musharaf Hossain (Bonham-Smith/Wei): Sawhney Graduate Travel Award in Plant Biology

Yen Le (Ambrose): *Taylor A. Steeves Graduate Award in Botany*

Igor de Albuquerque (Wilson/Wei): *T.C. Vanterpool Memorial Travel Award*

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POSTER PRESENTATIONS

April 8, 2019

	STUDENT	SUPERVISOR	EVALUATORS
1.	Bell, Aaron	Phillips/Wardle	Chivers/Cota-Sánchez
2.	Amini, Mohammad	Benson	Wilson/Ambrose
3.	Ajiboye, Maryam	Chivers	Davis/Chilton
4.	Cosentino, Jess	Morrissey	Wiebe/Gurney
5.	Belliveau, Nick	Hugo Cota-Sánchez	Wilson/Ham
6.	Azam, Iqra	Benson	Wei/Davis
7.	Greuel, Ruth	McLoughlin	Davis/Carvalho
8.	Bryan, Tyler	Morrissey	Chivers/McKellar
9.	Fedoroff, Katherine	Ferrari	Ambrose/Wei
10.	Imtiaz, MD NOIM	Hudson	Chedrese/Benson
11.	Desnoyers, Christina	Gurney	Wei/Chilton
12.	Hamza, Faryal	Benson/Gray	Cota-Sánchez/Chilton
13.	Tanguay, Moriah	Gurney	Clark/Morrissey
14.	Hawkshaw, Deborah	Lane	McLoughlin/Morrissey
15.	Hsin, Jonathan	Ferrari	Lane/Angrini
16.	Tkaczyk, Simon	Wiebe/Chivers	Lane/McLoughlin
17.	Heyer, Gabriela	Lane	Benson/McLoughlin
18.	Neufeld, Branden	McLoughlin/Fortin	Wiebe/Ambrose
19.	Tu, Frankie	Benson	Wilson/Marchant
20.	Shephard, Nicholas	McKellar	Clark/Gurney
21.	Sarwar, Muhammad	Benson	Carvalho/Ham
22.	Zhang, Sinan	Gray	Benson/Chedrese
23.	Smith, Rebecca	Lane	Chivers/McKellar
24.	Thapa, Himal	Ferrari	Lane/Carvalho

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Posters Presentations on April 8, 2019

Posters 1, 4, 7, 10, 13, 16, 19 and 22 will be presented from 11:30 am – 12:30pm

Posters 2, 5, 8, 11, 14, 17, 20 and 23 will be presented from 12:30pm – 1:30pm

Posters 3, 6, 9, 12, 15, 18, 21 and 24 will be presented from 1:30pm – 2:30pm

NOTE: Posters 1 to 8 – floor 1 lab area; Posters 9 to 16 – floor 2 lab area; Posters 17 – 24 – floor 3 lab area.

BIOL 990 POSTER PRESENTATION ABSTRACTS

#1. 11:30 am AARON J. BELL^{1,2}, DAVID A. WARDLE³, & IAIN D. PHILLIPS^{1,2,4}. Burning for biodiversity: testing the pyrodiversity-biodiversity hypothesis in a boreal island archipelago. ¹Department of Biology, University of Saskatchewan, #112 Science Place, Saskatoon, Saskatchewan, Canada, S7N 5E2; ²Troutreach Saskatchewan, Saskatchewan Wildlife Federation, #9 Lancaster Road, Moose Jaw, Saskatchewan, Canada, S7J 1M8; ³Asian School of the Environment, Nanyang Technological University, 50 Nanyang Avenue, Singapore, 639798, Singapore; ⁴Water Quality Services, Integrated Water Services, Water Security Agency of Saskatchewan, #101-108 Research Drive, Saskatoon, Saskatchewan, Canada, S7N 3R3.

Wildfires are diverse in their spatial extent, frequency, seasonality, and severity (conceptualized as ‘pyrodiversity’); however, climate warming and large-scale fire suppression activities over the past century have reduced overall variation in natural fire regimes. This loss in the spatio-temporal variation of fire reduces landscape pyrodiversity with accompanying losses in habitat heterogeneity and biodiversity. The ‘pyrodiversity begets biodiversity’ hypothesis posits that humans can promote landscape biodiversity in fire-prone ecosystems by restoring spatio-temporal aspects of natural fire regimes, but this concept has not been tested in the boreal forest. My thesis provides a rigorous test of the pyrodiversity-biodiversity hypothesis with a focus on saproxylic beetles; a hyperdiverse group of invertebrates that are important in the function of boreal ecosystems and the decomposition of decaying wood. Using a boreal lake island system, I will also consider the spatio-temporal patterns of fire in the context of other foundational principles in biogeography including isolation and landscape configuration. Understanding the relationship between pyrodiversity and biodiversity in a classic island experiment offers unique opportunities to test ecological theory while also providing timely recommendations pertinent to biodiversity conservation and fire management in Canada.

#2. 12:30 pm MOHAMMAD AMINI & JAMES D. BENSON. Rapid cooling-high pressure cryopreservation. Department of Biology, University of Saskatchewan, Saskatoon, SK.

The growing applications of tissue engineering and transplantation require cryopreservation to solve critical supply and shipping problems. In order to successfully cryopreserve tissues, it is necessary to use high concentrations of cryoprotective agents (CPA) which have toxic effects and may cause mechanical damage during equilibration. To reduce this problem, extremely high cooling rates may be used, but these have classically been limited by the Leidenfrost effect. Another alternative to high CPA concentrations is increased hydrostatic pressure, resulting in reducing melting point and ice crystal growth rate. In order to achieve rapid cooling-high pressure cryopreservation, a device has been designed, which achieves nearly theoretically maximal cooling rates at arbitrary pressures by using mechanically generated pressures and pre-cooled aluminum cooling blocks. Here we outline the theory and design of this device and discuss our planned experiments to document the cooling rates at different pressures, find the relationship between cooling rate and ice crystal formation as a function of CPA concentration and pressure, and investigate how cells and tissues can tolerate these high pressures.

#3. 1:30 pm MARYAM O. AJIBOYE¹, DOUGLAS P. CHIVERS¹ & MAUD C. O. FERRARI². The role of predator-related chemical cues and plastic pollution on *Limnephilus canadensis* (Trichoptera: Limnephilidae) larva case construction behaviour. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK. ²Department of Biomedical Sciences, WCVI, University of Saskatchewan, Saskatoon, SK. Defense against predation is essential for the survival of a prey. The portable case of an actively foraging caddisfly larva is generally agreed to have evolved as a defense against predators. Larvae of many caddisfly species use various materials present in their environment to construct transportable cases using self-secreted silk to bind them together. Aquatic prey use chemical cues to detect their predators. Caddisfly larvae inhabit most freshwater habitats, and it has been documented that caddisfly larvae are able produce and perceive chemical cues which affects their case construction behaviour. My research will investigate *Limnephilus canadensis* larvae case construction behaviour in response to predator-related chemical cues (predator odour, alarm cues and diet cues). I predict that larvae exposed to cues should construct longer, tougher and well cemented cases. I will also observe larvae case construction material selection when provided with either or both plastics and stones to construct their cases. Preliminary studies showed that larvae with plant material cases can reconstruct their cases using plastics only or both plastics and plant materials. Since larvae cases also serve as a camouflage, I will observe if plastic cases provide more protection against predators than cases built with native construction materials.

#4. 11:30 am JESS COSENTINO & CHRISTY MORRISSEY. Influence of winter origin on population structure, migration timing, and route selection in Sanderling (*Calidris alba*) during spring migration. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Many shorebird species undergo long distance migrations to travel between their breeding and wintering grounds. As a result of this lengthy journey, individuals are highly susceptible to a myriad of threats such as adverse environmental conditions and pollutant exposure. Sanderling (*Calidris alba*) are one of the most widely dispersed shorebird species throughout North America and challenges arise in accurately assessing overall population health due to their broad geographic dispersal throughout most of the year. Recent data suggests the possibility of three distinct wintering populations staging at Chaplin Lake, SK in large aggregations as a major interior fueling site during spring migration. This study aims to: 1) Identify distinct geographic wintering origins and migration routes of Sanderling populations staging at Chaplin Lake using feather stable isotopic signatures and automated radio telemetry of nanotagged individuals; 2) Estimate annual changes in the relative proportion of individuals from different wintering origins to identify changes in the Chaplin Lake population structure and migration timing over time. Sanderling, like many North American shorebird species, have displayed marked declines over the past 30 years and understanding how overwintering habitat use and migration timing are related is critical for implementing effective conservation strategies.

#5. 12:30 pm NICHOLAS A. BELLIVEAU & J. HUGO COTA-SÁNCHEZ. Form, function and evolution of floral polymorphism in the plains pricklypear cactus *Opuntia polyacantha* Haw. (Cactaceae). Department of Biology, University of Saskatchewan, Saskatoon, SK.

Many reproductive systems in flowering plants (angiosperms) exhibit floral polymorphism, where a population has two or more distinct floral morphs. This syndrome, which generally promotes cross-pollination, ranges from being morphologically and genetically simple to complex. The plains pricklypear cactus (*Opuntia polyacantha* Haw.), a species indigenous to the Canadian prairies, exhibits an unusual floral polymorphism not previously described in angiosperms. This study aims to compare the ploidy level, and morphological and ecological nature of the species' two morphs. Flowers, flower buds and stems will be collected from three populations south of Saskatoon, SK for morphometric analysis and chromosome counts. The populations will be censused for the frequency of each morph. Floral visitors (e.g. pollinators, nectar robbers) will be identified and their behaviour observed. Unaltered and emasculated flowers will be bagged to determine whether self-fertilization occurs. We predict that the morphs are isoplethic (i.e. occur in equal proportions within populations) and have distinct flower and pollen grain morphology, and floral visitor assemblages. We also expect that the morphs vary in ploidy level, and that self-fertilization occurs seldomly. Such findings would indicate a robust sexual breeding system, and therefore an evolutionary basis for the existence of floral polymorphism in *O. polyacantha*.

#6. 1:30 pm IQRA AZAM & JAMES D. BENSON. Cryoprotectant toxicity modeling in precision cut liver slices. Department of Biology, University of Saskatchewan, Saskatoon, SK

Cryopreservation is a widely used method for storage of cells and tissues at very low temperatures and is typically achieved using membrane permeable cryoprotective agents such as dimethyl sulfoxide or glycerol. Most of the currently used cryoprotective agents, however, are toxic to cells and tissues which compromises their use in cell therapies and tissue and organ transplant. To counter this problem, we will use thin liver tissue slices as a model as they are in high demand cells in the pharmaceutical and medical fields for toxicological testing, metabolism drugs, but also for transplants. Our first aim is to study CPA toxicity kinetics in hepatocytes by focusing on informing quantitative models of toxicity accumulation, mechanical and osmotic damage in individual hepatocytes. Next we will evaluate the diffusion and uptake of CPAs in precision cut liver slices. Finally, we will compare toxicity accumulation and mechanical damage due to CPA equilibration in precision cut liver slices and compare quantitative models of CPA induced toxicity kinetics. As a secondary objective, we aim to demonstrate that the use of small molecule ice-recrystallization inhibitors (IRIs) can modulate the osmotic response of hepatocytes and tissue model systems and reduce total CPA concentrations while adding minimally to toxicity.

#7. 11:30 am RUTH J. GREUEL & PHILIP D. MCLOUGHLIN. Patterns of nutrient distribution on Sable Island, NS. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Supply of macronutrients such as inorganic nitrogen (NH_4^+ , NO_3^-) in soil regulates primary productivity and plant community composition, and is thus critical for ecosystem function. Nutrient supply is affected by land use, soil texture and climate, among other factors. Sable Island is a small sand island (approximately $47 \text{ km} \times 1 \text{ km}$) located approximately 275 km southeast of Halifax in the Atlantic Ocean. Vegetation is dominated by marram grass (*Ammophila breviligulata*), but also consists of areas of heathland and mixed grassland with forbs. The island is subsidized by marine-derived nutrients with seals as the primary vector, and is home to a population of feral horses. Here, I present general growing season nitrogen supply rates across Sable Island and propose some hypotheses for nutrient distribution and flow, following previous research on sea-to-land nutrient transfer on the island. In the growing season of 2018, I measured NH_4^+ , NO_3^- and other macro- and micro-nutrients using Plant Root Simulators (PRS® probes, Western Ag Innovations). Plant-available nitrogen levels on Sable Island are generally low but are high towards the eastern and western ends of the island, and at sites where sandwort (*Honckenya peploides*) and the nitrogen-fixing beach pea (*Lathyrus maritimus*) occur.

#8. 12:30 pm BRYAN M. TYLER & MORRISSEY C. CHRISTY. Influence of Wetland Pesticide Pollution on Waterfowl Distribution, Abundance and Productivity in the Prairie Pothole Region. Department of Biology, University of Saskatchewan, Saskatoon, SK.

The Prairie Pothole Region (PPR) provides critical stop-over and nesting habitat for many migratory avian species, including waterfowl. However, the majority of the region has been converted to cropland, in-turn dramatically changing the landscape from its historic condition. Current conventional agricultural practices often rely heavily on pesticides to maintain crop health throughout the growing season. Recent studies have shown alarming rates of pesticide pollution in wetlands throughout the PPR. Many waterfowl are dependent on aquatic invertebrates and macrophytes as food sources which can be negatively impacted by current insecticides, fungicides and herbicides. Direct effects on waterfowl abundance and distribution such as water availability and habitat quality are well studied however, indirect effects of agrochemicals on waterfowl abundance, distribution and productivity, is lacking. For this study, I will examine the relationship between wetland pesticide pollution and the distribution and abundance of waterfowl across the PPR. In addition, I will conduct focal studies on selected wetlands spanning a gradient of pesticide pollution to assess brood productivity for specific species of diving and dabbling ducks.

#9. 1:30 pm Katherine Fedoroff¹, Mike Pollock², Doug Chivers³, and Maud Ferrari². The Impact of Boat Noise on Freshwater Fishes. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK. ² Department of Vet Biomedical Sciences, WCVU, U of S.

Noise pollution is rapidly becoming more prevalent on a global scale, yet it is one of the least studied anthropogenic disturbances. Due to its low attenuation in water, sound travels five times further than it does in air. Such effects, coupled with the wide spatial and temporal distribution of anthropogenic noise, make noise pollution a major concern for aquatic species. In this field experiment, yellow perch (*Perca flavescens*) will be randomly assigned to a treatment of 20 minutes of exposure to either ambient noise only (control) or ambient noise plus boat noise at a specific distance (100, 500, 750 or 1000 m) from the boat, which will be equipped with a 10 horse power engine. We will be recording pre-and-post treatment dissolved oxygen levels in the tube within which the fish is placed, and the changes in dissolved oxygen levels will help us understand the impact of boat noise upon fish metabolic rate. Our preliminary experiments showed that fish exposed to boat noise experienced an increased metabolic rate. This study provides more information regarding the impacts of boat noise on fish in their natural environment, particularly with regard to freshwater species where data are very limited.

#10. 11:30 am MD NOIM IMTIAZY & JEFF HUDSON. Do dissolved organic matter concentrations change along the length of Lake Diefenbaker in different flow conditions? Department of Biology, University of Saskatchewan, Saskatoon SK.

Lake Diefenbaker (LD) is a large multiple purpose reservoir on the Canadian Prairie that receives over 90% of its inflow from the South Saskatchewan River (SSR). The annual flow volume of the SSR varies with precipitation and temperature in the Rocky Mountains. Consequently, LD has experienced multiple years of high and low flows from the SSR. Such changes in hydrological condition may have a large influence on the export and storage of dissolved organic matter [DOM; i.e., dissolved organic carbon (DOC) and dissolved organic nitrogen (DON)] in LD. This proposed study will compare the DOC and DON concentrations during four high flow years (2011-2014) and four low flow years (2015-2018) across the length of LD. We anticipate that the DOC and DON concentrations would be significantly lower in low flow years as a result of a decrease in allochthonous DOM export from the SSR and an increase in degradation processes from prolonged water residence time. We also hypothesize that the DOC and DON concentrations would vary along the length of LD, with the highest concentration found in the riverine zone and the lowest in the lacustrine zone based on the longitudinal zonation concept by Kimmel and Groeger (1984).

#11. 12:30 pm CHRISTINA D. DESNOYERS¹, ANDRÉS LÓPEZ² & KIRSTY E. B. GURNEY³. Validations of an emerging genomics approach to dietary assessment. ¹Department of Biology, University of Saskatchewan, Saskatoon SK S7N 5E2; ²Department of Fisheries, University of Alaska, Fairbanks AK 99775; ³Environment and Climate Change Canada, Prairie and Northern Wildlife Research Centre, 115 Perimeter Road, Saskatoon SK S7N 0X4.

Despite recent advancements in genomics-based technologies, the relationship between the DNA of prey items consumed and the DNA recovered from the predator's feces is poorly understood. Conflicting evidence about factors that affect detection of prey DNA in fecal samples raise questions about whether DNA-based techniques can be used to make accurate inference about diet. The purpose of my research is to understand avian diet with greater resolution by validating a genomics-based approach to quantify invertebrate DNA that persists in avian feces. Specifically, I will target and amplify key DNA sequences in feces collected during a captive feeding trial to test hypotheses about prey-based factors (variation in mitochondrial DNA between taxa) and predator-based factors (time since consumption) that influence recovery of invertebrate DNA in avian feces. I expect to measure less DNA from hard-bodied than soft-bodied invertebrates, and that hard-bodied invertebrate DNA will be detectable in feces for a shorter period. I also expect that the relative proportion of prey DNA detected in feces will reflect the relative proportion of invertebrate species consumed by the predator. This research will contribute to improved understanding of DNA-based diet studies and will facilitate expanded use of these non-invasive molecular tools.

#12. 1:30 pm FARYAL HAMZA, JACK GRAY AND JAMES D. BENSON. EFFECT OF CRYOPROTECTANT EQUILIBRATION AND ICE PROPAGATION ON MOUSE OOCYTE TRANSMEMBRANE POTENTIAL AND TRANSCRIPTOMIS OF MOUSE OOCYTE BEFORE AND AFTER CRYOPRESERVATION. Department of Biology, University of Saskatchewan, Saskatoon. SK.

Oocyte cryopreservation plays an important role in reproductive technology offering fertility treatment to women who may lose ovarian function due to cancer treatment. The goal of this project is to identify and understand mechanisms of damage during cryopreservation. For example, the classic two factor hypotheses of damage suggest that too-fast cooling cause harmful intracellular ice formation and too-slow cooling cause damage due to not-well-understood mechanisms associated with solution concentration. We hypothesize that the latter phenomenon can be partially explained by the Workman-Reynolds effect, the generation of an electric field due to the separation of ions during ice solidification. The electric field may change a cell's transmembrane potential possibly altering cell protein function that can be identified via transcriptomics in oocytes. To evaluate this hypothesis, the objectives of this study are to examine the effect of cryoprotectant equilibration on mouse oocyte transmembrane potential at above zero temperature, to explore the effect of extracellular ice propagation on the transmembrane potential of mouse oocytes and to study potential impacts on the transcriptome of mouse oocytes during these processes. Electrophysiological and fluorescent microscopy techniques will be used to observe the changes in transmembrane potential.

#13. 11:30 am MORIAH S. TANGUAY¹ & KIRSTY E. B. GURNEY^{1,2}. Habitat selection of breeding scoters in the boreal forest of the Northwest Territories. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK; Environment and Climate Change Canada, Prairie and Northern Wildlife Research Centre, 115 Perimeter Road, Saskatoon, SK.

North American breeding populations of scoters (*Melanitta* spp.), which breed predominantly in the rapidly changing boreal forest have declined, yet habitat needs for these sea ducks remain poorly documented. To help predict impacts of ongoing environmental change in northern areas and prioritize key habitats for conservation of these species, the major objective of my research is to identify the pond-level and landscape-level predictors of breeding scoter presence and abundance on surveyed waterbodies by testing hypotheses about scale-dependent species-habitat relationships in wildlife. To achieve this goal, I will use a model-based approach to analyze aerial scoter survey data, remotely-sensed habitat characteristics extracted within two spatial extents, and pond attribute measurements. I predict that selection of waterbodies by scoters in the northern boreal forest is positively influenced by (i) the abundance of preferred invertebrate prey items within wetlands, (ii) wetland size, and (iii) wetland depth, as well as the amount of (iv) nesting habitat (dense coniferous forest cover) and (v) foraging habitat (number of ponds) on the landscape immediately surrounding study ponds.

#14. 12:30 pm DEBORAH M. HAWKSHAW & JEFFREY E. LANE. Effects of sex and body condition on hibernation in the northern most population of black-tailed prairie dogs (*Cynomys ludovicianus*). Department of Biology, University of Saskatchewan, Saskatoon, SK.

At northern latitudes, species can face prolonged periods of resource shortages. To cope with this challenge some species hibernate, an energy saving strategy. However, hibernation is associated with several costs which has led to predictions that individuals hibernate optimally according to their energy reserves. The Canadian black-tailed prairie dog (*Cynomys ludovicianus*) is one species that hibernates over winter. Through effects on hibernation, pre-hibernation body condition may be an influential factor in their survival and reproduction. Recent data suggests that female reproduction may be more dependent on spring body condition compared to males. Thus, sexual variation in hibernation patterns under varying body conditions could exist. Given this, I will investigate the effects of sex and body condition (both natural and manipulated via food supplementation) on prairie dog hibernation patterns and fitness. I will record male and female hibernation patterns with temperature sensitive data loggers and measure their pre- and post-hibernation body composition via quantitative magnetic resonance. In addition, select individuals will undergo pre-hibernation supplemental feeding to determine the effect of increased resources. Fitness consequences will be determined by measurement of survival and female reproductive success. This study

will provide insight into variation in energy allocation during hibernation and the consequences that has on fitness.

#15. 1:30 pm Jonathan Hsin¹ & Maud C.O. Ferrari². Cerebral lateralization: Development, maintenance, and cognitive abilities associated with perceived predatory risks of aquatic species. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK. ²Department of Biomedical Sciences, WCVU, University of Saskatchewan, Saskatoon, SK.

Cerebral lateralization is a common phenomenon, observed in various species across different taxa, such that some neurological functions or cognitive processes are emphasized on one hemisphere of the brain. It is thought to be manifested by behavioural tendencies including visual field preference and turning bias. While it may seem to be disadvantageous to exhibit behavioural tendency for prey animals in reaction to predatory attacks, studies have suggested that laterality may lead to enhanced cognitive abilities, offering higher survival rates through learning. In my research, I will first examine the development and plasticity of laterality overtime. Secondly, I will investigate cognitive abilities, with neophobia, latent inhibition, and habituation as parameters, of individuals showing different degrees of laterality. Lastly, I will attempt to observe inheritance of lateralization over generations. Subjects species will be wood frog tadpoles (*Lithobates sylvaticus*) for the first two experiments and zebrafish (*Danio rerio*) for the third. Our preliminary survival study performed in the summer of 2018 in University of Saskatchewan showed that tadpoles with higher degrees of laterality lived longer under direct predatory of diving water beetles compared to non-lateralized ones. Therefore, I hypothesize that cerebral lateralization confers evolutionary benefit through enhanced learning ability and is thus genetically heritable.

#16. 11:30 am SIMON P. TKACZYK, KAREN L. WIEBE, & DOUGLAS P. CHIVERS. Nest defence behaviour of male versus female Mountain Bluebirds (*Sialia currucoides*). Department of Biology, University of Saskatchewan, Saskatoon, SK.

In species of birds with biparental care, both parents often contribute to nest defence but the conflict and cooperation between the sexes is still poorly understood. It is likely that energy demands and re-nesting potential will cause the male to defend the nest more than the female. Alternatively, uncertainty of parentage predicts that the female will defend more. I will conduct an experimental study on Mountain Bluebirds (*Sialia currucoides*) breeding in nestboxes in central British Columbia. Using a taxidermy-mounted red squirrel (*Tamiasciurus hudsonica*) that I will place on the roof of nestboxes, I will quantify the defensive behaviour of males and females to simulated predation. The squirrel model will be displayed once during the incubation stage and again during the nestling stage. I will rank the defensive behaviours and compare them between the sexes. Incubation rhythms of the female (on and off-bouts) will also be measured using thermal data loggers to test the prediction that increased predation risk leads to fewer bouts. Brood size will be controlled for in models as will individual traits like age of the parent, its body condition, and plumage brightness as measures of individual quality.

#17. 12:30 pm GABRIELA P. HEYER & JEFFREY E. LANE. Intraspecific variation in the hibernation expression of Black-tailed Prairie Dogs (*Cynomys ludovicianus*). Department of Biology, University of Saskatchewan, Saskatoon, SK.

Hibernation is an adaptive strategy used by many mammalian species to survive harsh temperatures and declines in food availability. The black-tailed prairie dog (*Cynomys ludovicianus*) has been found to hibernate facultatively in northern parts of their range, although little is known about their hibernation expression in southern populations. Previous field studies have demonstrated intraspecific variation in hibernation expression in several species. However, it remains unknown whether this observed variation is due to an acclimatization effect, or genetic differences. I propose to take black-tailed prairie dogs near the northern and southern edges of their range and use a common garden experimental design to 1) determine intraspecific variation in the hibernation expression between populations, and 2) evaluate whether this variation is due to phenotypic plasticity or genetic variation. Throughout the course of the study, I will measure several phenotypes, including body composition, metabolic rate, heart rate, body temperature, and gene expression during hibernation. The proposed project will not only determine

hibernation ability and variation between understudied populations of black-tailed prairie dogs, but most importantly, it will elucidate the extent to which variation in hibernation expression is simply due to the phenotypic plasticity of a species, or genetic variation between populations.

#18. 1:30 pm BRANDEN T. NEUFELD¹, DR. DANIEL FORTIN², & DR. PHILIP McLOUGHLIN¹. Net primary productivity as fuel for the fire; macroecological drivers of boreal caribou recruitment and survival.

¹Department of Biology, University of Saskatchewan, Saskatoon, SK; ²Department of Biology, Université Laval, Québec, QC.

Threatened boreal caribou (*Rangifer tarandus caribou*), have received considerable attention due to local population declines and extirpations. Possibly the most important impact on caribou may involve a trophic cascade where anthropogenic landscape disturbance increases alternate prey (moose and white-tailed deer) abundance, in turn increasing predator (wolf) abundance, which acts to depress caribou recruitment. This ‘habitat-mediated apparent competition’ (HMAC) has been shown to apply in southern and western boreal and mountain caribou ranges. While not well demonstrated elsewhere, it has been widely accepted and underpins the nation-wide Recovery Strategy for Boreal Caribou in Canada. My project aims to test whether HMAC occurs in areas of lower species richness, like eastern boreal populations, and whether primary productivity is an important secondary factor, after landscape disturbance, in caribou-calf recruitment. Expanding upon Environment and Climate Change Canada’s enhanced analysis to support regional boreal caribou range and action planning, I also aim to test whether particular drivers of boreal caribou demography are scale-dependent, especially regarding primary productivity, species richness, and the effect of certain species’ presence. The project requires caribou data acquisition and constructing distribution maps for many Canadian megafauna. This macroecological approach has direct application to the federal recovery strategy for this threatened species.

#19. 11:30 am FRANKIE TU & JAMES D. BENSON. Real-time image segmentation of oocytes and follicles through an approximated level-set method. Department of Biology, University of Saskatchewan, Saskatoon, SK.

The ability to analyze cell or tissue volume response to solutes in real-time is important when seeking to classify cells based on mechanical, physiological, or morphological characteristics. Often, real-time image analysis is hindered by expensive computations such as calculating gradients. For example, a commonly implemented approach to identify cell boundaries in microscope images is to use a level-set method (LSM). Currently, the expense of an LSM stems from solving a partial differential equation (PDE). In the present study, we use an approach that replaces this PDE solver with element-switching routines and inexpensive integer-based computations to achieve faster segmentation that we refer to as the approximated level-set method. The approximated LSM reduces accuracy from a subpixel to pixel level, but accuracy can be regained by solving the PDE without integer constraints. Here we show how this reduction of computational expense has resulted in the ability to analyze images at a rate of approximately one frame per second, and we demonstrate the approach using test images of oocytes and immature ovarian follicles.

#20. 12:30 pm NICHOLAS G. SHEPHARD¹ & ANN E. MCKELLAR^{1,2}. Migration routes and wintering locations of Black Terns breeding in Western Canada. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK; ²Canadian Wildlife Service, Prairie and Northern Wildlife Research Centre, 115 Perimeter Road, Saskatoon, SK.

Despite conservation efforts, Black Tern (*Chlidonias niger*) populations are declining. Populations across the Black Tern breeding range have declined by up to 70% over the past century. As a result, Black Terns have become a priority species in the Canadian Prairie Pothole Region (PPR). A population objective of increase by 100% has been set in Saskatchewan. However, significant data gaps exist for Black Terns in the PPR and throughout their range. Virtually no band re-sighting data exist for the species. Little information exists on migration timing, routes, stop-over sites, or the range and conditions or over-wintering locations. An in-depth understanding of migratory

connectivity is imperative to the proper conservation of migratory species such as the Black Tern. There still remains a significant gap in knowledge of wintering grounds and stop-over sites for Black Terns in the PPR. I propose to deploy light-level geolocators to track Black Terns breeding in the core of their range. This technology has been successfully used to track Black Terns in Europe. Findings show that migration of populations are idiosyncratic with large variation in migration routes, staging sites, and timing. No such studies have occurred on North American Black Terns.

#21. 1:30 pm MUHAMMAD KALEEM SARWAR & JAMES D. BENSON. The Effects of Cryoprotocols on Bull Semen Lipidome and Proteome. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Cryopreservation of bull sperm has been 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 not perfect and thus there is considerable incentive to improve cryopreservation protocols. This project is founded on the hypothesis that bull sperm lipidome, proteome and membrane phase transition behavior are important indicators for rational media design leading to optimized cryopreservation. Moreover, the precise assessment of damage due to cold shock and CPA equilibration are also the major determinants for the cryosurvival of sperm. To test this hypothesis, we will evaluate biophysical and biochemical aspects of sperm involving membrane kinetics, phase transition behavior as well as the lipidome and proteome of the sperm from bulls who typically have high post thaw recovery and bulls who do not. This comparison of the lipidome and proteome and its connections to membrane phase transitions and membrane transport kinetics will help identify key lipids and transporter proteins critical to post-thaw recovery, leading to rational media design for bull sperm cryopreservation.

#22. 11:30 am SINAN ZHANG & JACK GRAY. Population coding of visual information and control of avoidance behaviours in flying locusts. Department of Biology, University of Saskatchewan, Saskatoon, SK, Canada.

In locusts, an identified neural pathway, including the lobula giant movement detector (LGMD) and the descending contralateral movement detector (DCMD) preferentially respond to objects approaching on a direct collision course and subsequently participate in generating proper behavioural outputs. In addition to this pathway, other motion-sensitive visual neurons have also been identified. However, their contribution to neural population coding of visual stimuli is unknown. I propose to use multichannel recordings to simultaneously record activity of multiple neurons in response to simple and complex object motion and simple or flow field backgrounds. Dimensionality reducing techniques, such as dynamic factor analysis, will group the individual functional units into neural ensembles, and provide insight into the neural encoding at a population level. Adding a flow field to simple looming stimuli will demonstrate the effect of visual background on ensemble activities. Performing the same recordings under various behavioural states will provide information on the link between the population coding and behaviour.

#23. 12:30 pm REBECCA E. SMITH. Saving for a rainy day: how climate affects intraspecific torpor variation in seasonal hibernators (*Urocitellus columbianus*). Department of Biology, University of Saskatchewan, SK.

Animal survival and reproductive success depend on a delicate balance between energy gain and energy expenditure. For seasonal hibernators, this balance is critical to maintaining sufficient body fat to sustain them through hibernation and still have stores remaining to reproduce in the spring. In the Rocky Mountains, increasing variation in climate patterns (i.e., precipitation and temperature) and more frequent late-season snowstorms are changing plant growing seasons and snowpack density. Using a single population of Columbian ground squirrels (*Urocitellus columbianus*) in Sheep River Provincial Park, Alberta, my study seeks to understand: (1) how climate, quality and availability of food resources (plants), and body fat stores are related; and (2) how hibernation conditions (snowpack density and pre-hibernation body fat) affect ground squirrel's torpor patterns during hibernation. To do this, I will use the Normalized Difference Vegetation Index to correlate intraannual plant growth (greenness) to historical climate data and records of ground squirrel weights. I will manipulate hibernation

conditions by building snow fences, supplementally feeding selected individuals, and recording their torpor patterns throughout hibernation. This project will provide insight into the abiotic and biotic influences on a seasonal hibernator, thereby providing an important mechanistic understanding of how climate change affects hibernator biology.

#24. 1:30 pm HIMAL THAPA¹, DOUGLAS P. CHIVERS¹, MIKE POLLOCK³, JACK GRAY¹ & MAUD C.O. FERRARI². Effect of background risks on associative learning performance of zebrafish (*Danio rerio*).

¹Department of Biology, University of Saskatchewan, Saskatoon, SK. ²Department of Biomedical Sciences, WCVN, University of Saskatchewan, Saskatoon, SK. ³Water Quality Services Unit, Water Security Agency of Saskatchewan, 101-108 Research Drive, Saskatoon, SK, Canada.

Prey show behavioural plasticity after repeated exposure to high levels of background predation risk. However, less is known about the effect of background risk on associative learning performance of fish with different types of rewards (food and social group). I predict that high-risk conditions might improve learned association with a social reward, as shoaling is a well-established antipredator response in shoaling fish. I will expose zebrafish (*Danio rerio*) to high (alarm cue) or low-risk (water control) environments for 4 days, to create high- and low-risk environments. Training trials will take place after the acclimation phase for 3 consecutive days, where high and low background risk fish will be trained as paired group (reward associated with a visual cue) or unpaired group (reward not associated with any specific visual cue). Probe trial will be done to evaluate the learning performance of the fish. I predict that fish in the paired group will learn to associate a visual cue with the reward. I also predict that the low background risk fish in the paired group will show greater learning performance in the food reward, compared to the high background risk group.

BIOL 990 ORAL PRESENTATIONS
APRIL 9, 2019 Room 106

8:30 am - Opening Remarks: Ken Wilson, Department Head

Session 1. Chair: Carmen Marquez Mellidez

	Student	Supervisor	Evaluators
8:45	#25. Salahinejad, Arash	Doug Chivers/Som Niyogi	Wilson/Morrissey
9:00	#26. Pecylak, Stephen	Maud Ferrari	Wiebe/McLoughlin
9:15	#27. Beadle, Joel	Jeff Hudson	McLoughlin/Wilson

BREAK 9:30 – 9:45 (CSRB room 206)

Session 2. Chair: Roy Vera

9:45	#28. Kodzhahinchev, Vladimir	Som Niyogi/Lynn Weber	Cota-Sanchez/Lane
10:00	#29. Espinoza-Ulloa, Sebastian	Neil Chilton/Jose Andres	Cota-Sanchez/Chivers
10:15	#30. Boyce, Paul	Phil McLoughlin	Morrissey/Chivers
10:30	#31. Elgin, Andrew	Christy Morrissey/Bob Clark	Wiebe/Gurney

BREAK 10:45 – 11:00 (CSRB room 206)

Session 3. Chair: Farshad Shafiei

11:00	#32. Wishart, Andrea	Jeffrey Lane	Marchant/Gurney
11:15	#33. Sadat, Mohammad	Doug Chivers/Maud Ferrari	Lane/Marchant
11:30	#35. Thoroughgood, Jessica	Neil Chilton	Ham/McLoughlin

LUNCH 11:45 – 1:00

Session 4. Chair: Rachel Parkinson

1:00	#36. Hendriks, Wilhelmina (Anouk)	Yangdou Wei	Ham/Carvalho
1:15	#37. de Albuquerque, Igor	Ken Wilson/Yangdou Wei	Carvalho/Ambrose
1:30	#38. Braun, Kelton	Art Davis	Cota-Sanchez/Ambrose
1:45	#39. Guerrero Chacon, Adriana	Jeffrey Lane	Angrini/Chilton

BREAK 2:00 -2:15 (CSRB room 206)

Session 5. Chair: Stephen Srayko

2:15	#40. Diyes, Chulantha	Neil Chilton	Gray/Clark
2:30	#41. Colpitts, Julie	Phil McLoughlin/Jocelyn Poissant	Benson/Clark
2:45	#42. Balzer, Zachary	Art Davis	Gray/Chilton
3:00	#43. Pusz-Bochenska, Karolina	Tyler Wist/Jack Gray	Wiebe/McKellar

Continues on next page....

BREAK 3:15 -3:30 (CSRB room 206)

Session 5. Chair: Denver Falconer

3:30	#44. Johnsen, Kirsten	Phil McLoughlin/Daniel Fortin	Wei/McKellar
3:45	#45. Zhang, Liyong	Chris Ambrose	Wilson/Wei
4:00	#46. Yunik, Matthew	Neil Chilton	Wilson/Chedrese
4:15	#47. Khorshidi, Hanie	Ken Wilson	Gray/Benson
4:30	#48. Rivet, Danielle	Douglas Clark/Ken Wilson	Chedrese/Marchant

BIOL 990 ORAL PRESENTATION ABSTRACTS

#25. 8:45 am ARASH SALAHINEJAD, SOM NIYOGI & DOUGLAS P. CHIVERS. Chronic exposure to bisphenol S causes abnormal social behaviours and disrupts isotocin signaling in the central nerve system of zebrafish (*Danio rerio*). Department of Biology, University of Saskatchewan, Saskatoon SK S7N 5E2.

Bisphenol S (BPS), an organic compound suggested as a safe alternative to Bisphenol A, is increasingly used throughout manufacturing processes, ranging from epoxy resins to polycarbonate containers. Hence, across ecosystems, organisms, including humans, are commonly exposed to this compound. Mounting evidence suggests that BPS acts as a harmful estrogenic and antiandrogenic compound. However, little is known about the impact of BPS on social behaviours and mechanisms underlying these behaviours. We exposed adult male and female zebrafish to 0, 0.25, 2.5, and 25 µg/L of BPS and 0.25 µg/L of 17-β-estradiol (E2) for 75 days. Afterwards, we tested the consequences on non-reproductive social behaviour by applying a novel tank test and by measuring shoal preferences as well as shoaling behaviour. All doses of BPS and E2 significantly decrease bottom-dwelling behaviour and the latency to reach the upper water column. Furthermore, both BPS and E2 exposure induced a significant decrease in shoal preferences. Our results also suggest that BPS disrupts important genes involved in the regulation of isotocin that may underly of the observed abnormal behaviours. Subsequently, we suggest that chronic exposure to environmentally relevant concentrations of BPS have adverse effects on non-reproductive social behaviours and thereby negatively impact ecosystems.

#26. 9:00 am STEPHEN PECYLAK, GABRIELLE ACHTYMICHUK, HUNTER STEVENS, DR. DOUGLAS CHIVERS, & DR. MAUD C.O. FERRARI: Effects of Ontogeny on the Generalization of Antipredator Recognition in Wood Frog Tadpoles (*Lithobates sylvaticus*). Department of Biology, University of Saskatchewan, Saskatoon, SK.

Generalization is the cognitive process whereby an individual will respond to one situation based on information it gathered from a similar situation that it has already experienced. The process of generalization will form a gradient based off of exactly how similar the two situations are. Wood frog (*Lithobates sylvaticus*) tadpoles are known to be able to generalize information pertaining to predation risk based off of olfactory cues. Wood frog tadpoles are also able to learn olfactory information as an embryo. The purpose of this study was to see whether or not predator information that was learned embryonically could be generalized, and how this generalization gradient compared to larval generalization gradient. Tadpoles were assigned either an embryonic or larval exposure crossed with brook trout as either a risk or control treatment. Tadpoles were tested for a learned risk response using either brook trout, splake, tiger trout, rainbow trout, or goldfish odour, which form a resolved phylogenetic gradient. This study was able to show that tadpoles that learn embryonically can generalize the information about brook trout to splake, tiger trout, and rainbow trout, while the tadpoles that were treated as larvae generalized to splake and tiger trout only.

#27. 9:15 am JOEL BEADLE¹, KRISTINE HUNTER¹, DAVID M. VANDERGUCHT², JEFF J. HUDSON¹. The relevance of aquaculture operations on water quality in Lake Diefenbaker. ¹Limnology Lab, University of Saskatchewan, Saskatoon, SK; ²Saskatchewan Water Security Agency, Regina, SK.

Lake Diefenbaker (LD) is a large reservoir located in southern Saskatchewan. The reservoir provides source drinking water for 45% of Saskatchewan. It also supplies water for industrial and agricultural purposes, generates hydroelectricity, provides flood control and recreation. Residents on the reservoir have complained of increased algal blooms indicative of decreased water quality. Some residents have attributed the perceived decrease in water quality to increased nutrient loading from the aquaculture operations. To address this concern, I have examined a set of water quality variables immediately in the embayment that contains the aquaculture farm and downstream of the embayment from June to October for five years (2011-2014 and 2018). To add further context to the potential impact of the fish farm, I will compare the nutrient loading from the fish farm with that from the South Saskatchewan River (SSR). I will also compare nutrient loading from the fish farm with that from the SSR during four high flow years (2011 to 2014) to a low flow year (2018). We anticipate that nutrient loads from the fish farm

will be more relevant during low flow periods, and may lead to water quality issues.

#28. 9:45 am VLADIMIR KODZHAHINCHEV¹, LYNN P. WEBER² AND SOUMYA NIYOGI¹. Acute aqueous co-exposure to sublethal doses of cadmium and benzo[a]pyrene cause greater-than-additive effects in adult zebrafish (*Danio rerio*). ¹Department of Biology, University of Saskatchewan, Saskatoon, SK; ²Department of Veterinary Biomedical Sciences, University of Saskatchewan, Saskatoon, SK.

Cadmium (Cd), a trace metal, and benzo-a-pyrene (BaP), a polycyclic aromatic hydrocarbon, are pollutants commonly found in water bodies in Canada. Cd is released as a by-product of mining, while BaP is found in petroleum products and released during incomplete combustion of organic matter. Both pollutants are toxic to aquatic organisms and can induce a variety of harmful effects at sublethal doses, primarily through the decimation of the anti-oxidant defences. Despite a wealth of literature on the toxic effects of either pollutant, relatively little is known about their interaction during aqueous exposures. This experiment assessed the effects of acute (72hr) co-exposures to sublethal, environmentally relevant doses (5.8-22 µg/L Cd; 1.5-15 µg/L BaP) on adult zebrafish (*Danio rerio*). Cadmium accumulation in muscle tissues was found to significantly increase during co-exposures, relative to single exposures of the same concentration. Additionally, co-exposures were found to have tissue-specific effects on transcript expression, with metallothionein2 and cyp450 expression increasing in the gills. Finally, lipid peroxidation content and physiological endpoints (body weight change, body condition and feeding rates) were assessed as markers of overall toxicity. Our findings suggest that Cd-BaP mixtures exert synergistic effects on zebrafish.

#29. 10:00 am ESPINOZA-ULLOA SEBASTIAN, CHILTON NEIL & ANDRES JOSE. Galapagos' Mockingbirds Genomics: New evolutionary and ecological approaches. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Galapagos' land birds have proven to be valuable model organisms to support evolutionary events (e.g. Darwin's finches). The Galapagos mockingbirds are a group of four endemic species, three of which are restricted to a single island each (*Mimus melanotis* of San Cristobal, *M. trifasciatus* of Floreana and *M. macdonaldi* of Española), while the fourth species (*M. parvulus*) is widely distributed occupying most area of the archipelago. Recent studies have shown that these four species come from a single common ancestor about 3 MYA, being the oldest known colonization for any land bird in the archipelago. The morphological and molecular analyses carried out to date on this system have been inconclusive and insufficient to determine different aspects of its evolution and population structures. For this study I propose a new approach based on genomics as a tool to unveil the evolutionary history and current species/populations status. As of today, this project has achieved to rebuild the complete genome of San Cristóbal mockingbird (our reference tool) and the derived analyses are giving rise to preliminary results in terms of the species demographic history and their relation between population sizes and levels of deleterious mutations.

#30. 10:15 am Paul Boyce and Philip McLoughlin. Spatial ecology and GPS tracking of feral horses (*Equus ferus caballus*) in the Alberta foothills. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Caballine equids were reintroduced to Alberta in the form of feral horses (*Equus ferus caballus*) with European colonization, after their extinction from the province in the Late Pleistocene. Their re-emergence after ~10,000 years is controversial however, due to the grazing strategy of horses which may impact resource use of native ungulates such as elk, and compete for forage on cattle grazing leases. Horse movements and resource use, at both large and small scales do not resemble that of other ungulates due to both social and physiological differences. Additionally, the Alberta population is unique among feral horse populations in that a suite of Pleistocene predators share the same mountainous habitat and are known to predate on horses. These factors are likely to influence both foraging and movement patterns and inference from other feral populations and ungulates grazers in general is difficult.

Over a three-year period we will use data from 20-30 GPS-tracked mares to document resource selection (proportional probability of occurrence) of horses in our study area within the foothills of Alberta. We will establish within band seasonal ranges and determine resource use as a function of horse population size, inferred from spatial heterogeneity in horse densities across the study area.

#31. 10:30 am ANDREW S. ELGIN¹, ROBERT G. CLARK^{1,2}, CHRISTY A. MORRISSEY^{1,3}. GPS-tracking Reveals Selection for Prairie Ponds by Tree Swallows in Cropland-Dominated Landscapes.

¹Department of Biology, University of Saskatchewan, Saskatoon, SK; ²Environment and Climate Change Canada, Prairie and Northern Wildlife Research Centre, Saskatoon, SK; ³School of Environment and Sustainability, University of Saskatchewan, Saskatoon, SK

Patches of non-crop habitat, such as perennial margins and wetlands, in agroecosystems may benefit bird and insect populations by serving as shelter, breeding areas, or foraging habitat. Aerial insectivorous birds, including Tree Swallows (*Tachycineta bicolor*), forage on the wing for flying insect prey. However, it was unclear to what degree prairie ponds might be selected relative to other habitat types in their home range. We hypothesized that prairie ponds act as insect reservoirs, harboring greater insect abundance than cropped areas, and hence, foraging Tree Swallows select for ponds, especially relative to cropland. Using miniature GPS tags, we tracked 24 adult female Tree Swallows to evaluate whether ponds were selected as foraging habitat at sites dominated by either tame grass, croplands, or mixed habitats in southcentral Saskatchewan. We used sweep-net transects to sample flying insects on each site. We confirmed that cropped uplands have the lowest insect abundance, while pond and grassy field margins had greater abundances. Consistent with prediction, GPS-tracked Tree Swallows primarily selected ponds as foraging areas, especially relative to cropland. This study underscores the importance of protecting and restoring prairie ponds in agricultural landscapes to mitigate aerial insectivore declines.

#32. 11:00 am ANDREA E. WISHART¹, STAN BOUTIN², ANDREW G. MCADAM³, BEN J. DANTZER^{4,5}, & JEFFREY E. LANE¹. Relationship between on- and off-body resources in a food hoarding mammal, the North American red squirrel (*Tamiasciurus hudsonicus*). ¹Department of Biology, University of Saskatchewan, Saskatoon, SK; ²Department of Biological Sciences, University of Alberta, Edmonton, AB; ³Department of Integrative Biology, University of Guelph, Guelph, ON; ⁴Department of Psychology, University of Michigan, Ann Arbor, MI; ⁵Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, MI.

The amount of energy accumulated by organisms that use stored energy, either endogenous (fat) or exogenous (cached), to fuel reproduction is often positively correlated with reproductive success (e.g., mass-dependent breeding). However, determinants of the amount of energy individuals store before breeding are not well understood. To determine how primarily food-caching animals balance endogenous resources while acquiring exogenous stores, we tracked individual North American red squirrels (*Tamiasciurus hudsonicus*), hereafter red squirrels, across the caching season at a site in southwest Yukon in a year of low food abundance. Squirrels defend individual territories centered around a larder hoard of white spruce (*Picea glauca*), typically at the same location for life. We estimated off-body resources at three time points throughout the food caching season (pre-caching, mid-caching, and post-caching) as amounts of hoarded spruce cones on individual territories. We also quantified on-body resources (percent fat and lean mass) for each individual using quantitative magnetic resonance (pre-caching and post-caching). Pre-caching, we found a negative correlation between percent body fat and cached resources. Post-caching, this trend was reversed, but was not significant. This work suggests the relationship between exogenous and endogenous energy stores is dynamic and may influence energy available for future breeding attempts.

#33. 11:15 am S. M. M. SADAT¹, ADAM L. CRANE², D. P. CHIVERS³ & M.C.O. FERRARI⁴, Predator life stage generalization, ¹Department of Biology, University of Saskatchewan, Saskatoon, SK, ²Department of Biomedical Sciences, WCVU, University of Saskatchewan, Saskatoon, SK

Prey could reduce the cost of learning, the identity of predators and nonpredators by making educated guesses about the identity of a new species based on their similarities to known predators and nonpredators. The phenomenon is called generalization. Here, we investigated whether, (1) wood frog, *Lithobates sylvaticus* learned to chemically recognize a specific life stage (either larval or adult stage) of predatory tiger salamander, *Ambystoma tigrinum* as a threat can generalize their recognition across the life stage of tiger salamander, (2) wood frog learned to chemically recognize a specific life stage (either larval or adult stage) of predatory diving beetle, *Dytiscus marginalis* as a threat can generalize their recognition across the life stage of diving beetle. We found that wood frog that are trained to recognize the odour of tiger salamander's life stages as a threat (the reference predator) did not generalize their response across the life stages but the wood frog that are trained to recognize the odour of diving beetle's life stages as threat generalized their response across the life stages. This is the first study showing that prey has the ability of generalization of predator odour recognition across the life stages.

#35. 11:30 am Jessica T. Thoroughgood & Neil B. Chilton. Molecular identification of fleas: Is the mitochondrial COI gene the true barcode of life? Department of Biology, University of Saskatchewan, Saskatoon, SK.

Genetic markers are commonly used as alternatives or adjuncts to morphological characters for the identification of organisms. The mitochondrial cytochrome oxidase I gene (COI) is often used for the identification of invertebrates. Fleas, some species of which are vectors of *Yersinia pestis* (the causative agent of plague), are identified based on their morphological characteristics. However, this requires the chemical clearing of specimens which prevents any subsequent molecular investigation of the fleas or their associated bacteria. In our molecular study, fleas parasitizing Richardson's ground squirrels (*Urocitellus richardsonii*) and black-tailed prairie dogs (*Cynomys ludovicianus*) from southern Saskatchewan were identified using sequences of the nuclear 28S rRNA gene and COI. Both genetic markers were reliable targets to distinguish between flea species. Variation in sequences of COI among individuals of the same species may be related to the geographical area from where they were collected.

#36. 1:00 pm WILHELMINA (ANOUK) G.H.M. HENDRIKS & DR. YANGDOU WEI. *Pythium cryptoirregulare*: a novel oomycete pathogen on hosts *Arabidopsis thaliana* and *Brassica napus*. Department of Biology, University of Saskatchewan, Saskatoon, SK

Phytopathogenic *Pythium* spp. cause seedling damping-off on a wide range of crop species worldwide and are traditionally thought to be necrotrophic. In this study, the oomycete *Pythium cryptoirregulare* was discovered to be pathogenic to the model plant *Arabidopsis thaliana* and the crop *Brassica napus*. To understand its pathogenesis, *A. thaliana* was inoculated with *P. cryptoirregulare* and examined by microscopy. *Pythium cryptoirregulare* exhibited a biotrophic phase as indicated by the ability of infected host cells to undergo cell plasmolysis. This observation differed from the previously reported necrotrophic lifestyle of *Pythium* spp. which kill hosts before colonization. Additionally, inhibition of root growth was observed prior to successful colonization by *P. cryptoirregulare* suggesting that *P. cryptoirregulare* may secrete growth inhibitors facilitating infection by delaying plant development. Notably, culture filtrates disturbed the transport and distribution of auxins indicated by altered pDR5::GFP and GFP-tagged PIN1 and PIN2 protein expressions in *A. thaliana*. This was then confirmed by a reduced inhibitory effect of the auxin-insensitive mutants *axr1-3*, *axr4-2* and *aux1-7*. These results suggest that *P. cryptoirregulare* secretes auxin-related metabolite(s) to reprogram plant growth. This characterization of *P. cryptoirregulare* as a novel pathogen of *A. thaliana* and *B. napus* gives new insights into understanding the pathogenic mechanisms as well as the interactions between oomycetes and plants.

#37. 1:15 pm IGOR D. ALBUQUERQUE, YANGDOU WEI & KENNETH WILSON. Potential role of naringenin chalcone in plant disease resistance. Department of Biology, University of Saskatchewan, Saskatoon, SK.

The flavonoid pathway is responsible for the production of many secondary metabolites that help plants protect themselves against adverse situations. In *Arabidopsis thaliana*, a specific flavonoid mutant, *tt5*, which accumulates naringenin chalcone (NC), exhibits reduced growth but enhanced resistance to anthracnose (*Colletotrichum higginsianum*) when grown under long days. We saw that this mutant exhibits not only resistance to pathogens but several abnormalities in its metabolism like callose deposition, ROS accumulation, programmed cell-death and the constitutive expression of pathogenesis-related proteins genes: PR-1 and PR-2. Growth under short days restores the wt characteristics to *tt5* plants and they lose resistance against the pathogen. Interestingly, *tt5* does not accumulate significant levels of NC when grown under short days. Although there is no report relating NC as an antifungal compound, we hypothesize that NC is playing a role in this scenario as a signaling molecule or as a gateway to another branch of the flavonoid pathway.

#38. 1:30 pm KELTON T. BRAUN & ARTHUR R. DAVIS. A Comparison of Nectary Morphology and Anatomy in North American Asters and Goldenrods (Tribe Astereae). Department of Biology, University of Saskatchewan, Saskatoon, SK.

The sunflower family (Asteraceae) is one of the largest families of plants, with over 25,000 species. Within this cosmopolitan family, the tribe Astereae has a clade formed by representatives found in North America, containing species such as the asters (*Symphyotrichum* spp. among others) and the goldenrods (*Solidago* spp.). The inflorescences of this group form structures known as capitula, which are visited by a large variety of insects, performing pollination services for the plants. When visiting the florets, insects often feed on nectar, a sweet substance produced by structures called nectaries. In Asteraceae, these floral organs are of an annular shape, surrounding the base of the style, and although ubiquitous in Astereae, they remain understudied. In this project, the morphology of floral nectaries within the North American clade of Astereae is being examined using scanning electron microscopy. Also, using resin and paraffin sectioning to examine nectary vascularization and anatomy, we seek to determine how sugars are brought into the nectary as a source for nectar production. The results of this work will contribute to a better phylogenetic understanding of the members within the largest clade of this extremely diverse dicot family.

#39. 1:45 pm ADRIANA L. GUERRERO-CHACÓN & JEFFREY E. LANE. Seasonal variation of body composition in Columbian ground squirrels. (*Urocitellus columbianus*). Department of Biology, University of Saskatchewan, Saskatoon, SK, S7N 5E2.

Hibernating mammals have a temporally limited active season which presents challenges to obtain the energy necessary for reproduction, growth and overwinter survival. In particular, Columbian ground squirrels (*Urocitellus columbianus*; hereafter, ground squirrels) have a short active season of 3-4 months, during which adults must meet the energetic requirements for breeding, moulting, survival and finally fattening before resuming hibernation. Females likely initiate reproduction with varying amounts of fat stores, which could influence their energy allocation strategies. Our main objective was to evaluate the seasonal and intraspecific variation in endogenous fat stores of female ground squirrels. To do so, we measured body composition (through quantitative-magnetic resonance) of females at standardized points throughout the active season in one population of ground squirrels located in Sheep River Provincial Park, Alberta. We found evidence of highly variable levels of body fat in adult females across the active season (0-39 g at hibernation emergence, 19-56 g at the peak of gestation, 0-12 g at the peak of lactation, and 86-170 g before hibernation), which likely have an effect in their energy allocation strategies.

#40. 2:15 pm Chulantha P. Diyes¹, Shaun J. Dergousoff², Neil B. Chilton¹. Reproductive capabilities and larval survival of American dog tick in Saskatchewan. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK, ²Lethbridge Research and Development Centre, Agriculture and Agri-Food Canada, Lethbridge, Alberta.

American dog ticks (*Dermacentor variabilis*) are obligate blood feeders, yet they spend a significant proportion of their life cycle off-host. The ability of these ticks to survive off-host depends on life cycle stage, the environmental conditions (temperature and relative humidity [RH]) experienced, and the exposure risk to predators and pathogens. The distributional range of *D. variabilis* in Saskatchewan has recently expanded northwards. This suggests that this tick species has the capacity to establish new populations in areas where environmental temperatures are more extreme (i.e. prolonged sub-zero temperatures) than in more southern parts of its distributional range. Key to this success will be the number of larvae produced by female ticks and the off-host survival of larvae. In this study, we determined the reproductive potential of *D. variabilis* females and examined the effect of temperature and RH on the survival of *D. variabilis* larvae. Our results revealed that larval production is related to the engorged weight of female ticks. Relative humidity had a greater effect than temperature on larval survival. The ability of overwintering larvae to survive sub-zero temperatures while in a snow-covered soil/litter layer is crucial for the northward expansion of *D. variabilis*.

#41. 2:30 pm JULIE A. COLPITTS¹, PHILIP MCLOUGHLIN¹ & JOCELYN POISSANT². Characterizing runs of homozygosity in an island population of feral horses (*Equus caballus*). ¹Department of Biology, University of Saskatchewan, Saskatoon, SK; ²Department of Veterinary Medicine, University of Calgary, Calgary, AB.

Inbreeding occurs when closely related individuals mate, often leading to negative fitness consequences. This results from an increase in the frequency of deleterious alleles and is of particular concern in small, isolated populations. Using genomic tools, inbreeding can be detected and characterized by runs of homozygosity (ROH). The frequency and length of these runs provide insight into the degree of inbreeding in a population, as well as the relative age of inbreeding with longer runs indicating more recent inbreeding events. ROH were assessed in 189 individuals from the feral horse population of Sable Island, Canada, to determine the severity and nature of inbreeding in this small, isolated and unmanaged population. Inbreeding was found to be high, with individuals having between 60 and 124 ROH with an average length of 5.7 Megabases. When compared to more than 30 domestic horse breeds, Sable Island horses had the highest average number of runs per individual, while the distribution of run length was comparable. This indicates elevated inbreeding in Sable Island horses, but that the timing of this inbreeding is similar to other breeds and may indicate population genetic structure or a founder effect.

#42. 2:45 pm ZACH S. BALZER & ARTHUR R. DAVIS. Examination of the host-seeking primary larvae of *Stylops advarians*. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Strepsiptera is an endoparasitic insect order best known for its unique life cycle, which arises from extreme sexual dimorphism. Adult males are free-living, whereas adult females are larviform and remain inside their host with only their cephalothorax protruding. Females release a sex pheromone to attract males to their location. The offspring emerge from the cephalothorax as highly mobile, host-seeking primary larvae, but only infect the immature stages of their host. The examined species, *Stylops advarians*, infects mining bees of *Andrena milwaukeensis* within Saskatoon. Thus, a phoretic host is first required in order to access immature bees, which are housed in subterranean nests. Primary larvae of *S. advarians* may travel on the outside of phoretic bee hosts as the bees travel to their nest to deposit pollen and nectar. The morphology of primary larvae was examined using scanning electron microscopy to identify the morphological adaptations that aid them in successfully travelling with a phoretic host. Mechanosensory and chemosensory structures are located on the head. Modifications of the pro- and mesothoracic tarsi and the caudal filaments suggest abilities to increase attachment. Finally, the thorax and abdomen are covered in spinulae that may help the primary larvae stay on their flying bee hosts.

#43. 3:00 pm KAROLINA PUSZ-BOCHENSKA^{1,2} & TYLER WIST² & JACK GRAY¹ & TIM DUMONCEAUX² & CHRYSTEL OLIVR² & ERL SVENDSEN². Development of methods for predicting aster yellows outbreaks in Western Canada. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK; ²Agriculture AgriFood Canada, 107 Science Place, Saskatoon, SK.

This project proposes several objectives. The first is to ascertain the origin of the migrant aster leafhoppers that arrive in Western Canada through molecular techniques, stable isotope analysis, and evaluation of the source of Southern winds over the project years, and evaluate if the Southern origin of aster leafhoppers influences their potential for causing AY outbreaks in Western Canada. The AY index, a measure of the severity of the AY risk, will be calculated for these arriving leafhoppers and for the leafhopper population that develops over the growing season in Western Canadian crops. Moreover, meteorological data and AY index will be analyzed to determine if disease incidence can be forecasted based on AY index and meteorological data recorded in spring. Subsequently, we will evaluate the best mode of action to disseminate the Aster Yellows index and warnings about potential outbreaks in the spring to alert growers to the movement of AY into Saskatchewan and potentially all of Western Canada. Given the cost of AY outbreaks, these results are of tremendous economic benefit to the Saskatchewan agriculture industry.

#44. 3:30 pm KIRSTEN JOHNSEN¹, DR. DANIEL FORTIN², & DR. PHILIP MCLOUGHLIN¹. Potential Differences in the Foraging Strategies of the Sable Island Horse. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK. ²Department of Biology, Université Laval, Québec, QC.

The Sable Island horse (*Equus ferus caballus*) provides a unique opportunity to study how constraints affect time budgets and foraging behaviors without the factors of predation and interspecific competition. On the western half of the island, where there are permanent ponds, the horses do not spend as much time acquiring water as do their eastern counterparts who dig wells in order to drink. I aim to test if there are different foraging strategies that stem from this main difference in their time budgets. There are also differences in parasite loads on the island and I will study how this constraint can affect foraging behaviors within the differences that may be caused by water source preference. I will test these ideas by estimating digestible energy intake with the assumption that a higher energy intake translates to greater success for individuals. Energy intake will be estimated by measuring vegetation intake rates as well as the average vegetation quality by community. Energy losses will be estimated by considering costs associated with performing different activities in the time budgets. Differences between groups will be tested using generalized linear models while accounting for variability between individuals as Sable Island has a long running census program.

#45. 3:45 pm LIYONG ZHANG & CHRIS AMBROSE. Microtubule organization and intercellular space formation in *Arabidopsis* spongy mesophyll tissue. Department of Biology, University of Saskatchewan, Saskatoon, SK.

Spongy mesophyll cells are large highly branched cells on the abaxial side separated by large intercellular spaces to maximize surface area for gas exchange for photosynthesis. In addition to their important role in photosynthesis, spongy mesophyll is an ideal system for complex cell shape and morphogenesis investigation, where cells exhibit in the extreme cell wall curved expansion (i.e. cell lobing) and local variations in cell wall thickness.

Microtubules (MTs) play an essential role in the determination of plant cell shape, as they control the deposition of cellulose microfibrils in the cell wall and induce local cell wall thickness, which will cause nonuniform expansion, thus creating cell shape. Previous research about the function of MTs during mesophyll morphogenesis were based on the immunofluorescence of microtubules through tubulin antibody, which makes it impossible to follow the same cell through live-cell imaging to observe the development process. Our transgenic lines, expressing MT markers or plasma membrane marker under the control of mesophyll-specific promoter, allow us to catch the whole process of mesophyll morphogenesis. Our results not only reveal a previously unknown dynamic feedback between microtubule organization and mesophyll cell shape, also lay the foundation for future studies of mesophyll.

#46. 4:00 pm Matt E.M. Yunik and Dr. Neil B. Chilton. Supercooling Saskatchewan's Ticks: Why Winter Won't Save Us. Department of Biology, University of Saskatchewan, Saskatoon SK.

The American Dog tick (*Dermacentor variabilis*) is a vector of veterinary and medically significant pathogens and a host to a suit of bacterial endosymbionts. These ticks are obligate semi-permanent ectoparasites that require at least three mammalian hosts on which to feed in order to complete their life cycle. Nonetheless, they spend a vast majority of their time off-host and their survival is determined by their responses to environmental conditions. In recent years, the geographical range of *D. variabilis* has expanded northward in Saskatchewan; however, extreme climatic conditions (relative humidity and temperature) may prevent further establishment in the north. The objectives of this study are to assess:

1) the off-host winter survivorship of adult ticks in the field at a site near their northern distribution limit in Saskatchewan, and 2) The tick's physiological response to sub zero temperatures. Preliminary results indicate that a small proportion of adult ticks collected the previous active season (spring & summer) can successfully overwinter. Implications of this finding with regards to their role as both host and vector of bacteria will be discussed.

#47. 4:15 pm HANIE KHORSHIDI & KENNETH WILSON. Does the *Chlamydomonas reinhardtii* homolog of Executer1 have a function in chloroplast retrograde signaling? Department of Biology, University of Saskatchewan, Saskatoon, SK.

The amount of the light energy plant and algae receive is often higher than their capacity for photosynthesis. Excess light energy causes formation of destructive compounds such as Reactive Oxygen Species (ROS) within the organism. ROS decrease the efficiency of photosynthesis by damaging lipid and protein components. Therefore, photosynthetic organisms have evolved various defense mechanisms to protect themselves from light stress. These include the production of physical and chemical ROS quenchers and the upregulation of defense genes via ROS-dependent signaling pathways. I am investigating a *C. reinhardtii* homolog of the *Arabidopsis thaliana* Executer1 protein which is involved in the cellular response to $1O_2$ stress. I am comparing photosynthetic efficiency and stress acclimation in *ex1* strains of *C. reinhardtii* exposed to high light or $1O_2$ stress. My initial results demonstrate that *ex1* cells are less capable of using light energy, making them more sensitive to high light than the wild type. Thus, I hypothesize *C. reinhardtii* EX1 participates in high light stress acclimation by activating cellular signaling pathways that can control stress resistance genes.

#48. 4:30 pm DANIELLE R. RIVET¹ & DOUGLAS CLARK². Using camera trap data to inform management and conservation decisions regarding polar bears (*Ursus maritimus*) to mitigate human-wildlife conflict. ¹Department of Biology, University of Saskatchewan, Saskatoon, SK.; ²School of Environment and Sustainability, University of Saskatchewan, Saskatoon, SK.

Current scientific knowledge of the causes and dynamics of conflicts between people and polar bears is insufficient for operational-level decision-making, a problem that has become increasingly pressing as changes in the Arctic climate accelerate. A better understanding of the biophysical drivers of polar bear-human conflict is urgently needed. Using a series of remote trail cameras installed at the Churchill Northern Studies Centre (CNSC), we were able to identify 55 unique polar bear visits to the Centre. We then were able to determine the duration of each visit, the direction from which the bears approached and left the Centre, the time of day or night bears were most likely to visit, whether bears arrived as individuals or as part of a family group, and whether there was human activity or presence in the Centre at the time of the visit. This kind of information is key for staff members of the CNSC, as well as wildlife managers and conservation officers, in terms of understanding drivers behind polar bear movement, polar bear approaches to infrastructure, and the likelihood of human-bear conflict, especially with regards to the safety of visitors and tourists during bear season.

5:00 PM AWARDS & ACKNOWLEDGEMENTS

Ken Wilson

BIOLOGY 990 SYMPOSIUM AWARDS:

Best Poster: A book prize will be awarded and the winning poster will be identified as such and remain on display throughout the year.

Best Field Research Presentation: A travel award to assist student attendance at a scientific conference, either nationally or internationally.

Best Lab-Based Research Presentation: A travel award to assist student attendance at a scientific conference, either nationally or internationally.

2018-19 GRADUATE STUDENT AWARDS:

Gary Bortolotti Graduate Award in Ecology or Animal Behaviour

Malcolm A. Ramsay Memorial Award

Hammer Limnology Scholarship

PRT Cell for Inc. Graduate Scholarship

R. Jan F. Smith Memorial Scholarship

Taylor A. Steeves Graduate Award in Botany

T.C. Vanterpool Memorial Travel Award

Vipen Sawhney Travel Award

Hugh Boyd Scholarship in Water Bird Ecology

5:30 PM BARBEQUE
NSM Atrium (Geology atrium)

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