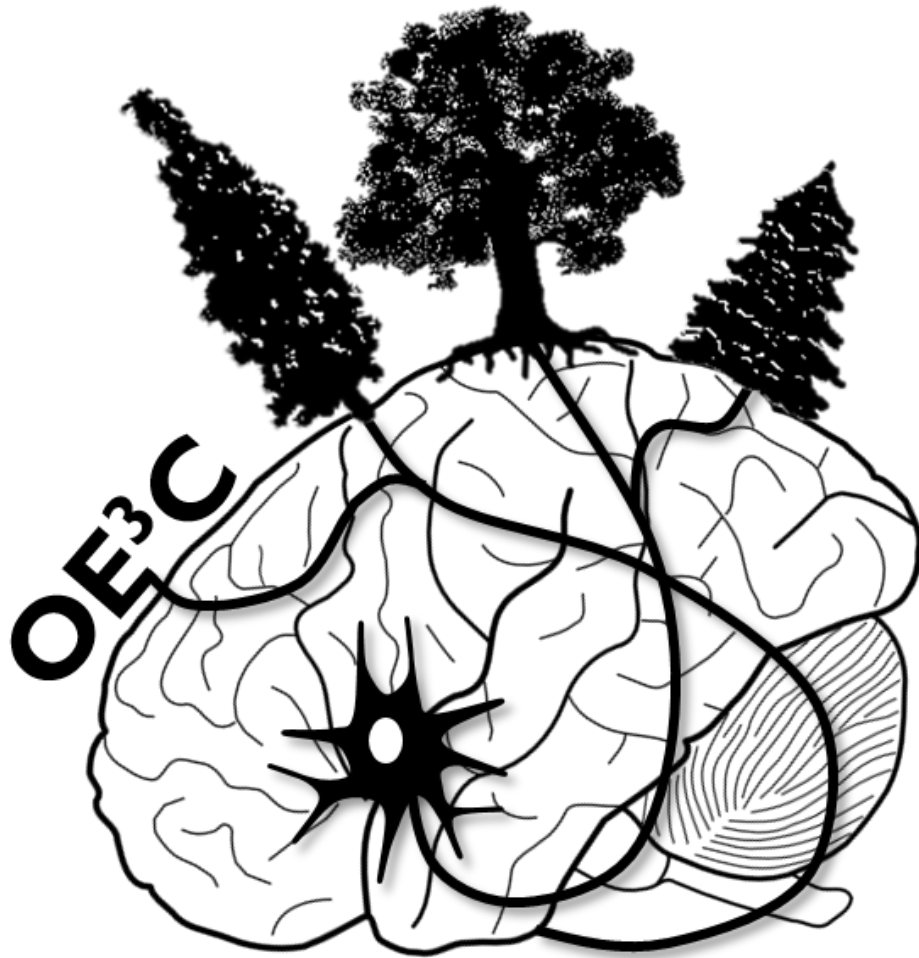


ONTARIO ECOLOGY, ETHOLOGY, AND EVOLUTION COLLOQUIUM



MAY 8-10, 2014

UNIVERSITY
of GUELPH

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INTRODUCTION AND WELCOME

Welcome to the 44th Ontario Ecology, Ethology, and Evolution Colloquium!

For decades, OE³C has brought together top researchers across Ontario to share findings in an intimate academic environment. Originally known as the Ontario Ecology and Ethology Colloquium, the recent addition of the third E – Evolution – significantly broadened the scope of this conference. This year, the Ontario Colloquium, with all of its three Es, is hosted by graduate students of the University of Guelph's Biology and Psychology departments.

We are happy to welcome over 120 top researchers to share their exciting findings. Presentation topics are highly diverse, ranging from animal welfare, climate change, and conservation biology, to evolutionary psychology and social behaviour. We are also proud to have four plenary speakers present the most recent and intriguing findings within the fields of ecology, ethology, and evolution.

OE³C is a great way for young researchers to receive constructive feedback about their research, and for faculty to recruit, and interact with, top prospective students. Like past OE³Cs, this conference was entirely organized by a subset of dedicated graduate students. Together, we strive to make this conference a friendly, collaborative, fun, and positive academic experience for all.

Please enjoy your stay at Guelph and welcome to OE³C 2014!

Sara Kafashan

OE³C 2014 Organizing Committee Member

2014 ORGANIZING COMMITTEE

OE³C 2014 would not be possible without the hard work and dedication of the following individuals:

Jamie Ahloy Dallaire

Kate Eisen

Kelsy Ervin

Sara Kafashan

Tony Kess

Heather Kinkaid

Richard Matta

Zachary Ramsay

IMPORTANT INFORMATION

Registration

On Thursday, registration will be open from 5:30pm-7pm in the Banquet hall. Finger foods and drinks will be served.

On Friday and Saturday, registration will be open from 7:30-8:30 am in the Thornborough Building.

Registration for OE³C 2014 includes a conference package, two dinnertime receptions, other meals, coffee breaks, and **three drink tickets.

Oral Presentations

Please report to your scheduled room in the Thornborough Building 15 minutes *before* your session begins so a moderator can help you load your presentation onto the audio-visual equipment.

All presentations will be loaded onto the room computer prior to the beginning of the session. To avoid compatibility issues, presentations should be saved as a **powerpoint file (.ppt)**.

Oral presentations are 15 minutes maximum (12 minutes, with 3 minutes for questions). Moderators in your session will signal to you at 10 minutes, and will ask you to wrap up at 14 minutes.

Please be prompt and respectful to help us stay on schedule!

Poster Presentations

Poster boards will be set up in the atrium of the Science Complex. Please feel free to hang your poster anytime after 1pm with the materials provided.

Please ensure your poster is no more than 4ft by 3ft.

Light snacks and drinks will be served during the poster session.

Be sure to remove your poster after the session is over. Unclaimed posters will be discarded by the end of the conference.

T-Shirts

Pre-ordered t-shirts will be handed out with your registration package.

Extra t-shirts will be available for purchase (\$15 each) at the registration desk.

Parking

Parking is available on campus (see parking availability on the campus map).

Meals

The opening reception will be held from 5:30-7:00 pm on Thursday evening (during registration), in XXXXX (see campus map). Finger foods and drinks will be served.

Breakfast with coffee, tea, or juice, will be served from 7:30-8:30 am on Friday and Saturday (during morning registration), in the Thornborough Building (see campus map).

Lunches will be held on Friday and Saturday in XXXX (see campus map).

The poster session reception will be held from 4:30-7:00 pm on Friday evening, in the Science Complex (see campus map). Finger foods and drinks will be served.

Accommodation

On-campus housing will be in the East side residence buildings (see campus map). Off-campus housing will be at the Delta Hotel (see campus map).

Check in is 3:00PM and check out is 11:00AM.

CAMPUS MAP



From Hanlon Pkwy (Hwy 6 N)
North from 401, exit 295
South from Hwy 7

From Hamilton (Hwy 6 S)
From 401, exit 299

CAMPUS MAP

Venues:

Science Complex Atrium



Thornborough Building



Richards Building



PLENARY SPEAKERS



Dr. Hafiz Maherali

Department of Integrative Biology,
University of Guelph

What maintains a 400 million year old trophic interaction? Exploring evolutionary causes and ecological consequences in the mycorrhizal symbiosis

The vast majority of plants form symbioses with soil fungi, which provide plants with nutrient uptake services in return for sugars from photosynthesis. Even though the symbiosis is widespread, several plant lineages have evolved the ability to exclude fungi from their roots, suggesting that the symbiosis is not always favoured by natural selection. To understand the causes of variation in the symbiosis, a ~3000 taxon database and a fossil calibrated molecular phylogeny were combined to reconstruct the evolutionary history of the symbiosis. Evolutionary associations between ecological climate niches and the Arbuscular Mycorrhizal (AM), Ecto Mycorrhizal (EM) and Non Mycorrhizal (NM) character states were also explored. Estimates of transition rates away from the ancestral AM state suggested that losses of the symbiosis (the NM state) are more frequent than transitions to the EM state. Nevertheless, transition rates back to the AM symbiosis from the NM state were five times more frequent than losses, suggesting that natural selection tends to favour the evolution of this symbiosis. Transitions from the AM to the NM state and from the AM to the EM state were also accompanied by a shift to colder climate niches. This pattern is consistent with previous reports of greater cold sensitivity in fungal lineages that form AM associations relative to fungal lineages that form EM associations. Cold climates may therefore restrict the evolution of the AM symbiosis, but not the EM symbiosis. Using these patterns as a foundation, I will also explore how we can test causal hypotheses about the origin, maintenance and consequences of the mycorrhizal symbiosis within populations, where evolution takes place, as well explore how the symbiosis influences community and ecosystem processes.

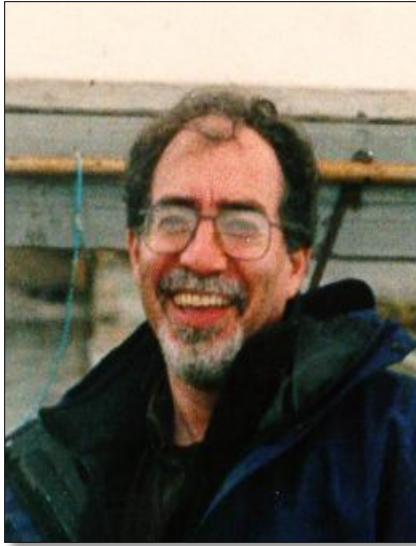


Dr. Nicole Mideo

Department of Ecology and Evolutionary
Biology, University of Toronto

Explaining the complex lives of malaria parasites

Despite a wealth of biomedical research into the pathogenesis of infectious diseases, little is known about the basic biology of their etiological agents. For many parasites, we lack satisfying answers to questions such as: what is it specifically about the interactions between hosts and parasites that results in disease symptoms? How do these interactions differ between closely related parasite strains or species? And, which factors have shaped parasite traits that determine harm to host and infectiousness? Using a combination of theoretical and experimental approaches, my work has revealed processes that underlie within-host dynamics of experimental rodent malaria infections and how differences in these processes give rise to the variation observed in patterns of disease. I will present results that demonstrate the importance of resource availability and competition and show that such 'bottom-up' mechanisms can explain phenomena that are often attributed to immune-mediated processes. Finally, I will describe some quirky traits of malaria parasites and explain how understanding the evolutionary factors that shape these traits may give us new insight into how to treat infections.



Dr. Bennett Galef

Department of Psychology, Neuroscience,
& Behaviour, McMaster University

Social influences on the food choices of Norway rats: Neuroanatomy, Molecular Biology and Behaviour

I intend to do four things during my talk: first, to review a series of behavioural experiments carried out in my laboratory over the last 30 years exploring one of several ways that my students and I have found animals can acquire information about food safety from others of their species. In particular, I shall be discussing evidence that after a naïve Norway rat (an observer) interacts with a recently fed conspecific (a demonstrator), the observer rat exhibits a long-lasting enhancement of its preference for whatever food its demonstrator ate.

Second, I shall describe a recent series of studies (Lesburgueres et al., 2011, *Science*, 331, 924-928) illustrating the potential utility of social learning about foods as an experimental paradigm for exploring the physical substrate of the processing and storage of memories. Third, I shall present a series of experiments that used our analyses of the behavioural mechanisms supporting social learning about foods to explore the function of a previously mysterious part of the mammalian olfactory system (Munger et al., 2010, *Current Biology*, 20, 1438-1444).

The Munger et al. (2010) and Lesburgueres et al. (2011) experiments not only contribute two more examples to the near endless list of instances of neuroscience providing techniques that deepen understanding of interesting behavioural phenomena, but also illustrate that students of behaviour have techniques with the potential to facilitate exploration of phenomena interesting to neuroscientists, molecular biologists, geneticists, etc..

Last, and perhaps most relevant to the concerns of ecologists and evolutionary biologists, I shall present evidence consistent with the view that social learning about foods has the potential to permit animals to thrive in environments that would otherwise be closed to them and can form the basis of traditions of food preference that last for many “generations.”

Studies of social learning have the potential to inform life sciences from anthropology to zoology.



Dr. Amy Newman

Department of Integrative Biology,
University of Guelph

Talk title

Talk abstract

CONFERENCE SCHEDULE

Thursday, May 8 <i>Science Complex Atrium</i>	
5:30-7:00	Registration and opening reception
7:00-8:00	Plenary speaker: Hafiz Maherali What maintains a 400 million year old trophic interaction? Exploring evolutionary causes and ecological consequences in the mycorrhizal symbiosis
Friday, May 9	
7:30-8:30	Registration and breakfast
8:30-9:30	Plenary speaker: Nicole Mideo Explaining the complex lives of malaria parasites <i>Room TBA</i>
9:30-10:00	Coffee break
10:00-12:00	Session 1A: Evolutionary Ecology <i>Room TBA</i>
	Session 1B: Aquatic Ecology <i>Room TBA</i>
12:00-1:15	Lunch
1:15-3:00	Session 2A: Conservation Biology and Biodiversity <i>Room TBA</i>
	Session 2B: Avian Ecology and Behaviour <i>Room TBA</i>
3:00-3:30	Coffee break
3:30-4:30	Plenary speaker: Bennett Galef Social influences on the food choices of Norway rats: Behaviour, Neuroscience, and Molecular Biology <i>Room TBA</i>
4:30-7:00	Poster Session and dinner reception <i>Science Complex Atrium</i>

CONFERENCE SCHEDULE

Saturday, May 10	
7:30-8:30	Registration and breakfast
8:30-9:45	Session 3A: Animal Welfare and Enrichment <i>Room TBA</i>
	Session 3B: Evolution of Behaviour <i>Room TBA</i>
9:45-10:15	Coffee break
10:15-12:15	Session 4A: Social Behaviour and Mate Selection <i>Room TBA</i>
	Session 4B: Climate Change and Invasion Biology <i>Room TBA</i>
12:15-1:30	Lunch
1:30-3:45	Session 5A: Community Ecology <i>Room TBA</i>
	Session 5B: Insect Ecology and Behaviour <i>Room TBA</i>
3:45-4:15	Coffee break
4:15-5:15	Plenary speaker: Amy Newman Title TBA <i>Room TBA</i>
5:15-5:30	Student awards

TALK SESSIONS

Session 1A: Evolutionary Ecology	
<i>Friday May 9, Room TBA</i>	
10:00	Kate Eisen, Andrea L. Case, and Christina M. Caruso <i>A phylogenetic analysis of gynodioecy and its correlates in the flowering plants</i>
10:15	L. Ruth Rivkin, Andrea L. Case, and Christina M. Caruso <i>The mechanisms of frequency-dependent selection in gynodioecious Lobelia siphilitica</i>
10:30	Harrish Nithianandan, Kemavijojana Rajkumar, Gausiha Rathitharan, Charmaine Condy, and Maydianne C. B. Andrade <i>Efficacy of DNA extractions across various developmental stages in black widow spiders</i>
10:45	Nathan S. Upham, Benjamin J. Evans, and Bruce D. Patterson <i>Testing for adaptive radiation and ecological constraint in a major lineage of rodents (Hystricomorpha, Caviomorpha)</i>
11:00	Joseph Anthony (Tony) Kess, Fiona Harper, and Elizabeth Boulding <i>Detecting genomic patterns of ecological adaptation in Galician Littorina saxatilis ecotypes through QTL mapping</i>
11:15	Jessica L. Zung, Jessica R. K. Forrest, Maria Clara Castellanos, James D. Thomson <i>Bee- to bird-pollination shifts in Penstemon: Effects of floral-lip removal and corolla constriction on bumble bee preference</i>
11:30	Dylan Sora and Brian Husband <i>Using flow cytometry to access the genetic and environmental factors influencing unreduced gamete production in Brassica</i>
11:45	Benjamin L. S. Furman and Ben Evans <i>Phylogenomics of African clawed frogs (Xenopus): Implications for evolutionary dynamics of sex chromosomes</i>
Session 1B: Aquatic Ecology	
<i>Friday May 9, Room TBA</i>	
10:00	Matthew Hryciyshyn, Jonathan Witt, and Teresa Crease <i>Molecular biogeography of the amphipod genus Hyalella in North America</i>
10:15	Jillian Moran, Natalie Jones, and Benjamin Gilbert <i>Are species larger at high latitudes? Testing latitude-body size relationships in ectotherms</i>
10:30	Viviana Astudillo-Clavijo and Hernan Lopez-Fernandez <i>Ecomorphological diversification of neotropical cichlids</i>
10:45	C. S. Mesher and J. D. Ackerman <i>Title TBA</i>
11:00	Rakesh Mistry and Josef Ackerman <i>The selective feeding behaviours of adult and juvenile freshwater mussels under flowing conditions</i>
11:15	István Imre, Grant E. Brown, and Nicholas S. Johnson <i>Ring the alarm: Behavioural manipulation of sea lamprey populations with damage-released alarm cues and predator cues</i>
11:30	S. Tuttle-Raycraft and J. D. Ackerman <i>The effects of suspended sediment on the suspension feeding of unionid mussels</i>
11:45	Dori Gao and Josef D. Ackerman <i>Including ecology to particle capture mechanisms: The effects of oscillation on particle capture</i>

Session 2A: Conservation Biology and Biodiversity	
<i>Friday May 9, Room TBA</i>	
1:15	S. Cotroneo U. G. Wortmann, and Marc Laflamme <i>A window into our evolutionary past: Mazon Creek Lagerstätten siderite concretions</i>
1:30	Sara J. Mason and Guy M. Narbonne <i>Small Ediacaran fronds of Mistaken Point</i>
1:45	M. Alex Smith, Winnie Hallwachs, and Daniel H. Janzen <i>Elevation and phylogenetic diversity on neotropical arthropods</i>
2:00	S. K. Monckton <i>Describing a group of Chilean bees, Chilicola (Heteroediscelis)</i>
2:15	Toby J. Thorne and M. Brock Fenton <i>The use of Great Lakes islands by migrating bats</i>
2:30	Kayla J. Gradil, Chris C. Wilson, Anthony P. Farrell, and Bryan D. Neff <i>The adaptive capacity of thermal tolerance: Reintroduction of Atlantic salmon into Lake Ontario</i>
2:45	J. Gibson, S. Shokralla, D. J. Baird, T.M. Porter, and M. Hajibabaei <i>Improving the power and efficiency of biodiversity assessment through the use of DNA metasytematics and next-generation sequencing</i>
Session 2B: Avian Ecology and Behaviour	
<i>Friday May 9, Room TBA</i>	
1:15	Tara M. Farrell, Alice Cui, and Scott A. MacDougall-Shackleton <i>Do stressful conditions in early-life affect song preferences in adult female European starlings (Sturnus vulgaris)?</i>
1:30	Pavlina Faltynek <i>The effects of corticosterone on birdsong in the adult zebra finch</i>
1:45	Adam Piraino, David Sherry, and Scott MacDougall-Shackleton <i>Sex differences in myelination of the song control system</i>
2:00	Shannon K. Mischler and Scott A. MacDougall-Shackleton <i>HVC is activated by the production of the gargle call in the black-capped chickadee (Poecile atricapillus)</i>
2:15	L. A. Grieves, D. M. Logue, and J. S. Quinn <i>Ready to fight: Reliable predictors of aggression in a joint-nesting nonpasserine bird</i>
2:30	Cody J. Dey and James S. Quinn <i>Self-organization and individual attributes influence the formation of dominance hierarchies in a group-living bird</i>
2:45	E. Bothwell, R. Montgomerie, S. C. Loughheed, and P. R. Martin <i>Body size divergence is greater among sympatric species of birds in warm, but not cool, environments</i>

Session 3A: Animal Welfare and Enrichment	
<i>Saturday May 10, Room TBA</i>	
8:30	Heather Y. McDonald Kinkaid, Yvonne van Zeeland, Nico J. Schoemaker, and Georgia J. Mason <i>Using comparative methods to investigate welfare in captive Psittaciformes: Are there ecological determinants?</i>
8:45	Jamie Ahloy Dallaire and Georgia J. Mason <i>Rough-and-tumble play prepares juvenile male mink for adult sexual behaviour by masculinizing them</i>
9:00	Georgia Mason and Rebecca Meagher <i>Having a ball: Mink given simple environmental enrichments are calmer and more fertile</i>
9:15	Tyler Pollock, Christian Moreno, Lida Sanchez, and Emanuel Mora <i>Wound healing in the wing membrane of the Cuban big fruit-eating bat (Artibeus jamaicensis)</i>
9:30	Cordellie C. N. DuBois, Emily M. Zakrajsek, Derek. B. Haley, and Katrina Merkies <i>Validation of triaxial accelerometers to measure the lying behaviour of adult domestic horses</i>
Session 3B: Evolution of Behaviour	
<i>Saturday May 10, Room TBA</i>	
8:30	Adam Sparks and Larry Fiddick <i>Strategic morality: Who condemns infidelity?</i>
8:45	Sara Kafashan <i>Biological markets: A paradigm for understanding human friendships</i>
9:00	Kevin R. Abbott and Thomas N. Sherratt <i>Predator decision-making and the evolution of imperfect Batesian mimicry</i>
9:15	Amanda M. Rotella <i>Skepticism of the predictive value of cooperative acts</i>
9:30	Joshua Gonzales and Sandeep Mishra <i>For the win: Risk-sensitivity theory in football decision-making</i>

Session 4A: Social Behaviour and Mate Selection	
<i>Saturday May 10, Room TBA</i>	
10:15	R. Matta, A. N. Tiessen, M. M. Kivlenieks, A. M. Meersseman, Y. O. Adjei-Afriyie, and E. Choleris <i>The effects of dorsal hippocampal dopamine D1-type receptor inhibition on social learning, food intake, and social interactions in male and female mice</i>
10:30	Carling M. Baxter and Reuven Dukas <i>Factors affecting male mate choosiness in fruit flies</i>
10:45	Trinh Nguyen and Amanda Moehring <i>Battle of the sexes: May the best fly win in reproduction</i>
11:00	Emily Martin and Tristan Long <i>More than kin and less than kind: Preferences and consequences of consanguineous matings</i>
11:15	Adam R. Reddon, Constance O'Connor, Susan Marsh-Rollo, Sigal Balshine, Magdalena Gozdowska, and Ewa Kulczykowska <i>Brain levels of isotocin and vasotocin are related to status and social behaviour in a cooperatively breeding cichlid fish</i>
11:30	Constance O'Connor, Susan Marsh-Rollo, Sergio Cortez Ghio, Kristina Hick, Joanne Tan, Marian Wong, Adam Reddon, Sigal Balshine, Nadia Aubin-Horth <i>The evolution of sociality: Differences in molecular pathways between social and non-social cichlids</i>
11:45	Humera Siddiqui, Luciana Baruffaldi, and Maydianne C. B. Andrade <i>Chemical confusion: Sex pheromones trigger mistaken identity by male widow spiders</i>
12:00	Patrick D. Moldowan, Ronald J. Brooks, and Jacqueline D. Litzgus <i>Turtles with teeth: Tomiodont morphology and functional significance in the painted turtle (Chrysemys picta)</i>
Session 4B: Climate Change and Invasion Biology	
<i>Saturday May 10, Room TBA</i>	
10:15	Nicola Day, Kari E. Dunfield, and Pedro M. Antunes <i>Plant soil feedbacks along an invasion chronosequence</i>
10:30	Miranda Chen and Sapna Sharma <i>Predicting the effects of climate change on lake trout (Salvelinus namaycush) distributions in Ontario</i>
10:45	Thomas Van Zuiden and Sapna Sharma <i>Predicting the effects of climate change on walleye (Sander vitreus) distributions in Ontario lakes</i>
11:00	Zachary Teitel and Lesley G. Campbell <i>Demographic consequences of soil moisture variation for an invasive, hybridizing weed</i>
11:15	Nao Ito, Laurence Packer, and Gail Fraser <i>Application of species distribution models for the management of the European fire ant</i>
11:30	Michael J. L. Peers, Morgan Wehtje, Daniel H. Thornton, and Dennis L. Murray <i>Effects of climate change on Canada lynx at their southern edge</i>
11:45	Cordero, L. <i>Can globally noxious species be controlled?: Some insights from southern Brazil</i>
12:00	Ken A. Thompson, Brian C. Husband, and Hafiz Maherali <i>The influence of physiological traits on climatic niche occupancy and competitive ability in the polyploid plant, Chamerion angustifolium (Onagraceae)</i>

Session 5A: Community Ecology	
<i>Saturday May 10, Room TBA</i>	
1:30	Eric Harvey and Andrew MacDougall <i>The interactive effect of nutrient enrichment and habitat destruction on consumer-resource alpha and beta-diversity across habitat sizes.</i>
1:45	Rebecca J. Parker, Lesley G. Campbell, and Eric De Noronha Vaz <i>The nettle in the hay stack: Tracking pollen abundance to locate small plant populations</i>
2:00	Christopher Blackford and Benjamin Gilbert <i>The effects of germination segregation on plant height between two native Californian grasses</i>
2:15	Deirdre E. Loughnan and Benjamin Gilbert <i>The effects of competition and soil moisture on variation in physiological traits in community assembly</i>
2:30	Susan Hensen <i>NO TITLE</i>
2:45	Paul B. L. George and Zoë Lindo <i>Wood ash and nematodes: Dishing the dirt on silvicultural community change</i>
3:00	Phil Rekret, Anna Simonsen, and John Stinchcombe <i>Rhizobial tolerance to fertilizer leads to modifications of the relationship dynamics in the Medicago lupulina-rhizobium mutualism</i>
3:15	K. Thompson, W. Deen, K. Dunfield <i>Effects of biomass cropping systems on soil denitrifier community abundance in Ontario soils</i>
3:30	Yi An Lin and Liette Vasseur <i>How do interactions drive productivity in diverse crop fields?</i>
Session 5B: Insect Ecology and Behaviour	
<i>Saturday May 10, Room TBA</i>	
1:30	M. M. Hamiduzzaman, E. Guzman-Novoa, B. Emsen, A. Sinia, G. Koleoglu, and P. H. Goodwin <i>Role of varroa mites to transfer honey bee viruses and their control strategies</i>
1:45	Caryn Dooner and Amanda Moehring <i>The effects of accessory proteins on sperm survivability in Drosophila pseudoobscura</i>
2:00	Blake Anderson and Reuven Dukas <i>Genetic influences on social behaviour in fruit fly larvae</i>
2:15	David Awde, Adonis Skandalis, and Miriam Richards <i>Foraging and vitellogenin gene expression patterns in eusocial sweat bees using qRT-PCR</i>
2:30	Kiera Newman and L. Vasseur <i>Food and oviposition preference of diamondback moth</i>
2:45	Shane Golden and Reuven Dukas <i>Do groups really make better foraging decisions than individuals?</i>
3:00	N. Tsvetkov and A. Zayed <i>Effects of social interactions of learning and memory in honey bees</i>
3:15	E. W. Service and C. M. S. Plowright <i>Both food restriction and risk of predation trigger social preferences by flower-naïve bumblebees</i>
3:30	Caroline Strang and David Sherry <i>Problem solving in bumblebees</i>

POSTERS

Poster Session	
<i>Friday May 9, Science Complex Atrium</i>	
1	Gina Capretta and Mehrdad Hajibabaei <i>Targeting the xenobiotic-responsive transcriptome: In silico identification and analysis of PCB-interacting genes conserved across taxa</i>
2	Farzeen Daruwalla and Nathan Lovejoy <i>Phylogentic analysis of weak electric knifefish of the family Apterontidae (Teleostei: Gymnotiformes: Apterontidae)</i>
3	Anastasia Savrova and Stephen C. Loughheed <i>Does habitat heterogeneity affect tadpole development?</i>
4	M. Miklavskaja and L. Packer <i>Fluctuating asymmetry of Chilean Xeromelissa rozeni mouthparts</i>
5	Michael Dobrovetsky, Matthew A. Kolmann, Devin D. Bloom, and Nathan R. Lovejoy <i>Body shape diversification in freshwater anchovies</i>
6	G. E. Fuss and H. Lopez-Fernandez <i>Ecomorphological diversification in the Lost World</i>
7	Lisa Ledger, Shadi Shokralla, Joel F. Gibson, and Mehrdad Hajibabaei <i>Assessing the potential of metabarcoding for measuring beta diversity using three plots of Costa Rican dry forest</i>
8	Nicole Fahner, Mehrdad Hajibabaei, and Donald Baird <i>Assessment of below-ground plant diversity in wetland soil through environmental DNA</i>
9	Meghan Krajchi, Lisa Derickx, and Pedro M. Antunes <i>Diversity of exotic and native plant species in urban forests of varying size</i>
10	Samantha Stefanoff and Sapna Sharma <i>Predicting the occurrence of a non-native warm water fish species, smallmouth bass (Micropterus dolomieu), in Ontario lakes under future climate change scenarios</i>
11	Narisha E. Ali <i>The European fire ant in Canada</i>
12	Shannon Meadley Dunphy, Kirsten Prior, and Megan Frederickson <i>Effects of an invasive slug on native ant-plant seed disperser mutualisms</i>
13	Sara Masood, Jonathan Ruppert, Arthur Rodgers, and Sapna Sharma <i>Impacts of altered landscapes and future climate on the distribution of woodland caribou (Rangifer tarandus caribou) in Ontario</i>
14	Guang Zhang, Jonathan Ruppert, Sapna Sharma, Bridget Stutchbury, and Emily McKinnon <i>The impacts of climate change, habitat alterations, human disturbance, and biotic interactions on wood thrush populations</i>
15	Emily Krutzmann, Erin McCallum, and Sigal Balshine <i>Effect of chronic wastewater exposure on aggression in the round goby</i>

16	Teresa J. Didiano and Tim P. Duval <i>Summer extreme precipitation events drive changes in soil moisture and growth traits in multiple southern Ontario wetland species</i>
17	Teresa Maddison and Spencer Barrett <i>Environmental influence on sexual dimorphism and sex ratio in a dioecious plant</i>
18	Andrea Boyer and Scott MacDougall-Shackleton <i>Effects of simulated recurrent inclement winter weather on the stress response and feeding behaviour of white-throated sparrows (Zonotrichia albicollis)</i>
19	Ahmed Elbassiouny, Tan Heok Hui, Devin D. Bloom, and Nathan R. Lovejoy <i>Molecular phylogenetics and the evolution of reproductive mode in halfbeak fishes from Southeast Asia</i>
20	J. W. MacLeod, S. P. Roach, and L. S. Phillmore <i>A longitudinal examination of hermit thrush (Catharus guttatus) singing behaviour</i>
21	Jennifer Foote, Adrianna Bruni, and Dan Mennill <i>The timing of the dawn chorus in a temperate bird community is related to both moonlight and meteorological conditions</i>
22	Ashley Hunter and Jennifer Foote <i>Circadian variation in ovenbird song rate for two song types</i>
23	Adriana Diez and Scott MacDougall-Shackleton <i>Cultural evolution of song: Do zebra finches go wild?</i>
24	Mandy Ehnes and Jennifer Foote <i>Can automated recording be used to discriminate among male ovenbird songs?</i>
25	Imane Meddah, Mukund Jha, and Reehan Mirza <i>Identification and characterization of Ostariophysan alarm cues</i>
26	Aderinsola Odetunde, Constance O'Connor, Adam Reddon, and Sigal Balshine <i>Safety in numbers? An investigation of anti-predator behaviour in a social fish</i>
27	Sara Pishdadian, Alex De Serrano, and Helen Rodd <i>The role of dopamine manipulation on the life history traits and colouration of male guppies</i>
28	Emily Xie <i>The effects of L-DOPA on exploratory behaviour in Poecilia reticulata (guppy)</i>
29	M. M. Kivlenieks, R. Matta, A. N. Tiessen, A. M. Meersseman, Y. O. Adjei-Afriyie, and E. Choleris <i>Influence of intrahippocampal D1-type antagonist, SCH23390, on olfactory discrimination abilities in male and female mice</i>
30	J. B. Thorpe, K. E. Gould, E. D. Borman, D. deCatanzaro <i>Circulating and urinary adrenal corticosterone, progesterone, and estradiol in response to acute stress in female mice (Mus musculus)</i>
31	Kelsy Ervin, Amy Moore, Kathryn Sinclair, and Elena Choleris <i>Does hippocampal estradiol play a role in the rapid estrogenic improvement of social learning?</i>
32	Jennifer Lymer, Christopher Gabor, Anna Phan, Fiona Young-MacDonald, Heather Morris, and Elena Choleris <i>Rapid effects of hippocampal G-protein coupled estrogen receptor on social and object recognition learning in the absence of spatial cues in female mice</i>
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ABSTRACTS: TALK SESSIONS

Session 1A: Evolutionary Ecology

10:00 **A phylogenetic analysis of gynodioecy and its correlates in the flowering plants**

Kate Eisen, Andrea L. Case, and Christina M. Caruso
University of Guelph

Gynodioecy, a breeding system where plants are female or hermaphroditic, has been hypothesized to facilitate the evolution of dioecy, a breeding system where plants are male or female. Despite the importance of gynodioecy, a database of gynodioecious species has not yet been assembled. This has limited our ability to test whether the evolution of gynodioecy and dioecy are correlated and to identify traits associated with gynodioecy. We assembled a database of gynodioecious species, and used it to determine the frequency and distribution of gynodioecy across the angiosperms. We also tested whether gynodioecy is associated with dioecy, or with traits previously associated with gynodioecy: an herbaceous growth form, and a temperate zone distribution. We found that fewer than 1% of species were gynodioecious, but gynodioecious species occur in 81 of 428 families. Compared to previous studies that surveyed breeding systems within local floras, we found fewer gynodioecious species, but more families that contained gynodioecious species. These 81 families were more likely to also contain dioecious species, herbaceous species, and species with a temperate zone distribution. Although our results supported the hypothesis that dioecy evolves via gynodioecy, we also found that gynodioecy was associated with different morphological and ecological traits than dioecy. This suggests that different conditions select for the evolution of gynodioecy versus dioecy.

10:15 **The mechanisms of frequency-dependent selection in gynodioecious *Lobelia siphilitica***

L. Ruth Rivkin¹, Andrea L. Case², and Christina M. Caruso¹

¹University of Guelph, Department of Integrative Biology, ²Kent State University, Department of Biological Sciences

Frequency-dependent selection occurs when the fitness of an individual depends on its phenotype and on the frequency of that phenotype within the population. Negative frequency-dependent selection is thought to be common in gynodioecious plants, where individuals are either female or hermaphroditic plants; if the fitness of female plants is limited by the availability of pollen to fertilize their ovules, then females should have higher fitness when they are rare relative to hermaphrodites. Although negative frequency-dependent selection is often invoked to explain how females persist in gynodioecious species, it is rarely experimentally tested. To test whether females have higher fitness when rare, we manipulated the frequency of female and hermaphrodite plants within artificial populations of the gynodioecious wildflower, *Lobelia siphilitica*. We also hand-pollinated half the female plants in each population to test whether the mechanism of frequency-dependent selection is variation in pollen availability. Females set 44% more fruits in populations where they were rare relative to hermaphrodites, as expected if frequency-dependent selection contributes to the persistence of females in gynodioecious species. However, the relationship between fruit set and female frequency was the same for hand- and open-pollinated plants, indicating that variation in pollen availability was not the

mechanism of frequency-dependent selection. Instead, both hand- and open-pollinated females produced 33% more flowers in populations where they were rare, suggesting that changes in flower production can also be a mechanism of frequency-dependent selection. This mechanism could explain how females persist in gynodioecious species even when reproduction is not limited by pollen availability.

10:30 Efficacy of DNA extractions across various developmental stages in black widow spiders

Harrish Nithianandan, Kemavijojana Rajkumar, Gausiha Rathitharan, Charmaine Condy, and Maydianne C. B. Andrade

Integrative Behaviour & Neuroscience Group, Department of Ecology & Evolutionary Biology, University of Toronto Scarborough

Molecular data have revolutionized the cataloguing of biodiversity and inference of phylogenetic relationships, but require extraction of high quality, ‘clean’ DNA from samples that may be hard to obtain. Protocols that minimize the cost and effort involved can increase the range of species from which such data can be collected. Among arachnologists, common wisdom suggests that clean DNA is best obtained from muscle tissue extracted from legs (destructive sampling). However, it is challenging to obtain sufficient tissue from spiderlings in this way, and rearing spiders to adulthood in research laboratories is time consuming and expensive. Here we extracted DNA from newly emerged spiderlings, six-week old juveniles and mature females of the Western black widow species (*Lactrodectus hesperus*, *Theridiidae*) from British Columbia and California and compared destructive versus non-destructive (whole-body) methods. We assessed DNA quality by comparing the caliber of gel electrophoretic results, the success of sequence contig assembly, the confirmation of species identity using DNA barcoding (sequence of cytochrome c oxidase subunit I, COI), and neighbor-joining methods to support clustering of our samples with other *L. hesperus* populations among other *Latrodectus* species. DNA from all specimens was successfully extracted, amplified and sequenced. Contig assembly was successful in most cases. A neighbor-joining analysis provided support for our samples clustering with other *L. hesperus* populations. These results show that high quality DNA can be extracted from the spiderlings using non-destructive methods. We discuss the utility of this reduced-effort method for analyzing genetic divergence among populations, which requires broad sampling.

10:45 Testing for adaptive radiation and ecological constraint in a major lineage of rodents (*Hystricomorpha*, *Caviomorpha*)

Nathan S. Upham^{1,2}, Benjamin J. Evans³, and Bruce D. Patterson²

¹University of Chicago, Committee on Evolutionary Biology, ²Field Museum of Natural History, Integrative Research Center, ³McMaster University, Department of Biology

Ecological diversification was investigated in the rodent suborder Hystricomorpha. The main component of this clade, Caviomorpha, has radiated to 244 modern species in the Americas and Caribbean, and spans three orders of magnitude in body size (~60 g to ~60 kg). A molecular timetree was constructed using 22 fossil calibrations and a 5-gene supermatrix for 68% of caviomorph species, including all 54 living genera, plus related rodents in Africa and Asia. Body masses and ecological life modes of species were mapped on the timetree. Two family dyads in Octodontoidea are sister to each other with crown radiations starting ~18 Ma, but show different histories. The southern, arid-adapted radiation of Octodontidae (degus, viscacha rats) and Ctenomyidae (tuco-tucos) shows

exponentially increasing rates of both species diversification and body-size disparification beginning ~5 Ma until the Recent. In contrast, the northern, mesic-adapted radiation of Echimyidae (spiny rats, tree rats) and Capromyidae (hutias) contains 18 lineages present since 10 Ma, with initially high evolutionary rates that then decline. Analyses within reconstructed life modes show that burrowers have smaller and less variable body sizes than tree-dwelling or terrestrial rodents. In the context of Simpson's adaptive zones, Ctenomyidae is confined to the single zone of burrowing while Echimyidae-Capromyidae occupies at least two (burrowing and tree-dwelling). Thus, the latter clade may constitute an old adaptive radiation that has persisted after saturating available niches.

11:00 Detecting genomic patterns of ecological adaptation in Galician *Littorina saxatilis* ecotypes through QTL mapping

Joseph Anthony (Tony) Kess¹, Fiona Harper², and Elizabeth Boulding¹

¹University of Guelph, ²Rollins College

Adaptation to different ecological selection regimes may be impeded by the presence of gene flow, as genetic exchange between populations is expected to break up combinations of adaptive genes and introduce ecologically disadvantageous alleles. The genomic architecture of genes involved in adaptive divergence may play a role in determining the rate and success of ecological adaptation with gene flow. Current sequencing technologies allow the development of high-resolution single nucleotide polymorphism (SNP) markers, enabling comparison of many genomic markers between many sampled individuals at once. These molecular tools can be used to "scan" the genomes of diverging populations to determine the organization and location of regions housing divergent loci, and to find associations between divergent phenotypes and genotypes. Identifying the location and organization of genes involved in divergence with gene flow is key to understanding the role of the genome in shaping adaptive trajectories. The marine snail *Littorina saxatilis* forms distinct ecotypes in different regions of the intertidal zone in the North Atlantic over very short distances, often connected by an intermediate hybrid zone. At sites on the Galician coast of northwestern Spain, two separate ecotypes have evolved different shell morphologies and body sizes to resist predation, UV exposure and dessication on the upper shore, and wave exposure on the lower shore. We are currently using an Illumina Miseq platform to develop SNP markers for QTL mapping F1 hybrid families to simultaneously identify the genes associated with these adaptations, and to better understand how their location and organization within the *L. saxatilis* genome may facilitate divergence despite gene flow.

11:15 Bee- to bird-pollination shifts in *Penstemon*: Effects of floral-lip removal and corolla constriction on bumble bee preference

Jessica L. Zung¹, Jessica R. K. Forrest², Maria Clara Castellanos³, James D. Thomson¹

¹University of Toronto, Rocky Mountain Biological Laboratory, ²University of Ottawa, Rocky Mountain Biological Laboratory, ³Centro de Investigaciones sobre Desertificación (CSIC-UV-GV)

Plants might be under selection for both attracting efficient pollinators and deterring wasteful visitors. Particular floral traits can act as exploitation barriers by discouraging the unwelcome visitors. In the genus *Penstemon*, evolutionary shifts from insect pollination to more efficient hummingbird pollination have occurred repeatedly, resulting in the convergent evolution of floral traits commonly present in hummingbird-pollinated flowers. Two of these traits, a reduced or reflexed lower petal lip and a narrow corolla, were found in

a previous flight-cage study to affect floral handling time by bumble bees, therefore potentially acting as “anti-bee” traits affecting preference. To test whether these traits do reduce bumble bee visitation in natural populations, we manipulated these two traits in flowers of bee-pollinated *Penstemon strictus* to resemble hummingbird-adapted close relatives and measured the preferences of free-foraging bees. Constricted corollas strongly deterred bee visitation in general, and particularly reduced visits by small bumble bees, resulting in immediate specialization to long-tongued bumble bees. On the contrary, we found little evidence that bees were deterred by lipless flowers or that lip removal and corolla constriction act in conjunction to affect bee preference. We conclude that narrow corolla tubes in hummingbird-pollinated penstemons function as “anti-bee” exploitation barriers that prevent bee access to nectaries, while the reduction of the corolla lip cannot be seen as a deterrent against bumble bees. Our results emphasize the importance of performing field trials with naturally foraging pollinators to fully understand the potential role of floral changes in pollinator shifts.

11:30 Using flow cytometry to access the genetic and environmental factors influencing unreduced gamete production in *Brassica*

Dylan Sora and Brian Husband

University of Guelph

Polyploidy, the possession of more than two complete sets of chromosomes, is widespread among angiosperms. The most common mechanism of polyploid formation is believed to be though the union of unreduced ($2n$) gametes produced through a meiotic non-reduction event during gametogenesis. Although the cytological mechanisms of unreduced gametes formation are well understood, the genetic and environmental conditions promoting unreduced gamete production are unclear.

Here we test the hypothesis that genetic (hybridity) and environmental (nutrient deficiency, leaf wounding) stressors will disrupt typical meiotic division in plant pollen cells increasing unreduced gamete production. We use flow cytometry to estimate unreduced gamete production on *Brassica napus*, *Sinapis arvensis* and backcrossed hybrids to compare the effects of hybridity, nutrient limitation and wounding treatments from pollen collected in two time intervals (blocks). Unreduced gamete formation ranged from 0-4.79% with a mean of 0.84%. Hybrids produced increased amounts of unreduced gametes in the first block only, indicating hybrids may increase polyploidization though unreduced gamete formation early in development, potentially explaining a high abundance of polyploid hybrids. Nutrient limitation and wounding did not affect unreduced gamete production. The second sampling block had increased percentages of unreduced gamete compared to the first, indicating unreduced gamete production may increase with plant age. This study is the first of its kind to measure unreduced pollen gamete production using flow cytometry in a manipulative experiment. These results increase understanding of unreduced gamete production and may further our knowledge of polyploidization events, providing a more comprehensive background in plant evolutionary biology.

11:45 **Phylogenomics of African clawed frogs (*Xenopus*): Implications for evolutionary dynamics of sex chromosomes**

Benjamin L. S. Furman and Ben Evans

I am working with high-throughput sequencing data (RNAseq) as a first step in understanding evolutionary transitions (“turnovers”) of sex chromosomes in amphibians, focusing on African clawed frogs (*Xenopus*). Amphibians represent an interesting model for studying sex chromosome evolution because, unlike mammals, the sex determining regions or genetic triggers have changed dozens of times, and sex chromosomes tend to be minimally diverged with genetic recombination occurring over most of their length. These ‘homomorphic’ sex chromosomes are thought to be the ancestral state of all sex chromosomes, including those of humans. The first step in this project is to resolve the phylogenetic relationships among the *Xenopus* genus. I have sequenced the transcriptomes of 5 individuals representing the major clades within the genus. One of the challenges of working with a polyploidy species is that it is necessary to sort out which sequences have an orthologous relationship (representing speciation events) and which sequences have a paralogous relationship (representing duplication events). We have designed a pipeline to ensure that only orthologous comparisons are made and I have conducted Bayesian phylogenetic analysis to resolve the phylogeny. Broader implications of this work include furthering our understanding of the evolutionary history of the only known master sex determining gene in Amphibians (DM-W). In addition, will be able to explore the evolution of polyploidy genomes, looking at rates of pseudogenization and the evolution of gene expression following a whole genome duplication event.

Session 1B: Aquatic Ecology

10:00 **Molecular biogeography of the amphipod genus *Hyaella* in North America**

Matthew Hryciushyn, Jonathan Witt¹, and Teresa Crease²

¹University of Guelph, ²University of Waterloo

Once thought to be one of the most broadly distributed North American freshwater invertebrates, the amphipod *Hyaella azteca* has since been characterized as a morphologically cryptic complex of over ninety species. Two primary ecotypes (a large and small-bodied morph) have been identified and their evolution is thought to have been mediated by size-biased fish predation. The present day distributions of these species have been shaped by their own unique evolutionary pasts in conjunction with the demographic consequences of the Pleistocene glaciations. Specifically, current patterns of variation result from the interplay of vicariance events caused by the advancing glaciers and the subsequent dispersal of hyalellids to post-glacial habitats. These processes had a profound effect on genomic markers, and through the application of phylogenetic and population genetics methodology, we can discern the biogeographic history of the *Hyaella azteca* species complex. To this aim, the diversity of the mitochondrial cytochrome c oxidase subunit I was analyzed, as well as structural and sequential variation within the first internal transcribed spacer (a component of the nuclear rRNA multigene family).

This presentation will compare the post-Pleistocene migration of hyalellid species. It will focus on those members of the *Hyaella azteca* species complex that have successfully recolonized glaciated regions and draw a line of comparison between dispersal patterns of large and small-bodied ecomorphs.

10:15 **Are species larger at high latitudes? Testing latitude-body size relationships in ectotherms**

Jillian Moran, Natalie Jones, and Benjamin Gilbert
University of Guelph

Ecological rules state that the mean body size of populations and species increase latitudinally. These rules have found support among endotherms; however, to date the data is very limited and much less conclusive for ectothermic organisms. This study responds to this gap, and examines how body size of crustacean zooplankton changes with latitude and temperature. I measured body size for 9 focal plankton species (both cladoceran and copepods) from 18 freshwater lakes which occur across a 1900 km gradient from southern British Columbia to the Yukon Territory. While latitude did not have a consistent impact on body size, there was a significant interaction between latitude and body size among species – within species, I found equal support for body size increasing and decreasing with latitude. These findings for individual species are confirmed at the community level, as I found no trend for community weighted mean body size with respect to latitude. My findings are consistent with studies on the body size variation of insects and suggest that latitude-body size relationships cannot be unanimously applied to ectothermic organisms. These results suggest that the effects of temperature change on zooplankton communities will be difficult to predict a priori because of these heterogeneous responses.

10:30 **Ecomorphological diversification of neotropical cichlids**

Viviana Astudillo-Clavijo and Hernan Lopez-Fernandez
University of Toronto

Neotropical (South and Central America) rivers harbor some of the most diverse families of freshwater fishes in the world. Of these, the Neotropical cichlids (*Cichlidae*) are the third most diverse family, with over 600 described species. What are the evolutionary processes responsible for generating such diversity? *Cichlidae* represents an ancient continent wide adaptive radiation in which the diversification of habitat use and associated phenotypes may have been important dimensions of diversification. We measured postcranial morphological traits with known implications for swimming performance (i.e. locomotor traits) and habitat variables for various *Cichlidae* species. We used multivariate ordination techniques and models of phenotypic evolution to investigate geophagine ecomorphological diversity and to test whether patterns of diversification conform to those of an adaptive radiation. Results show that the evolution of locomotor traits has indeed been an important dimension of phenotypic divergence during the geophagine adaptive radiation and that this is likely related to habitat divergence patterns.

10:45 **Title TBA**

C. S. Mesher and J. D. Ackerman
University of Guelph

Freshwater unionid mussels require a host fish to complete their lifecycle – they parasitize fish with their glochidia larvae. Some mussels are generalists, using many different species of fish, whereas others use one or two hosts. The evolution of host specificity has resulted in different methods for attracting hosts to increase the chance of successfully infesting the appropriate fish species. One method for attracting a host fish is modification of the mantle margins. *Lampsilis fasciola* (Wavyrayed Lampmussel), have complex mantle margin modifications or lures that look like fish, crayfish/red and hellgrammite larvae. The

frequency of this polymorphism differs and may be related to the fish host species. In order to examine this hypothesis, we tested the reproductive success of three different lure types of *L. fasciola* on a known host *Micropterus dolomieu* (Smallmouth Bass). The infestation (glochidia attached/glochidia exposed) and metamorphosis (juveniles produced/glochidia attached) rates as well as numbers of juveniles produced was analyzed over multiple years. There was considerable variation in the magnitude and direction across years. However, despite having the lowest frequency in the nature, the crayfish/red lure had comparable metamorphosis and infestation rates and juvenile production to the other lures in the laboratory. The maintenance of these polymorphic lures may be related in part to the role of different visual predators as hosts, prey recognition, and the confounding effects of turbidity in rivers.

11:00 The selective feeding behaviours of adult and juvenile freshwater mussels under flowing conditions

Rakesh Mistry and Josef Ackerman
University of Guelph

Freshwater unionid mussels play a vital role in aquatic ecosystems, in particular, clarification of lakes and rivers, nutrient cycling and benthic-pelagic coupling. It remains to be determined as to whether and how selective feeding in unionids occurs under ecologically relevant flow conditions. Flow chamber experiments using adult Fatmuckets (*Lampsilis siliquoidea*; shell length = 9 - 12 cm) indicate that seston flux using river water affects their clearance rates. Clearance rate (CR) increased with chamber velocity (0-18 cm s⁻¹) and CR at the highest flux were 5 time larger than under low or static flow conditions (i.e., 0.21 L h⁻¹). Preliminary data on juvenile Wavyrayed lampmussel (*Lampsilis fasciola*; shell length 430 - 580 µm) using a newly developed paddle-wheel flow chamber indicate that high seston flux reduce CR from 1.39 mL hr⁻¹ at 0 cm s⁻¹ to 0.39 mL hr⁻¹ at 8 cm s⁻¹). Data, obtained using flow cytometry techniques (FlowCam) are being analyzed to determine whether there is selectivity based on particle size and/or food quality. Results will provide information on habitat requirements of unionid mussels, their role in the great Lakes Ecosystem, and insight into their conservation.

11:15 Ring the alarm: Behavioural manipulation of sea lamprey populations with damage-released alarm cues and predator cues

István Imre, Grant E. Brown, and Nicholas S. Johnson
Algoma University, Concordia University, and United States Geological Survey Hammond Bay Biological Station

Sea lamprey (*Petromyzon marinus*) invaded the upper Great Lakes in the early 20th century and caused extensive economic damage to a variety of native fish populations. We investigated whether sea lamprey 1) show avoidance of injured conspecific, injured heterospecific, and predator cues, 2) respond to these cues during the day at different water temperatures, 3) show an avoidance response with repeated exposure to alarm cues, and 4) whether this response is found in juvenile sea lamprey. Mobile sea lamprey showed a significant avoidance response at night to migratory sea lamprey extract, white sucker (*Catostomus commersonii*) extract, 2-phenylethylamine (PEA), human saliva (predator cues) and a migratory sea lamprey extract and human saliva combination (injured conspecific and predator cue). Sea lamprey nighttime avoidance response was consistently induced after being exposed to the majority of the above stimuli 4x and 8x, respectively, the previous day. During the day, mobile sea lamprey showed an avoidance response only to PEA and human

saliva once water temperatures had risen to mean (\pm SD) = 13.7 (\pm 1.4) °C. Resting and hiding sea lampreys did not show an avoidance response to any of the stimuli. Sea lamprey larvae increased the rate of escape attempts and direction changes after exposure to larval lamprey extract, suggesting that larval sea lamprey respond to potential chemosensory risk assessment cues. Our findings support the continued investigation of natural damage-released alarm cue and predator-based repellents for the behavioural manipulation of sea lamprey populations in the Laurentian Great Lakes.

11:30 The effects of suspended sediment on the suspension feeding of unionid mussels
S. Tuttle-Raycraft and J. D. Ackerman

Discerning the role of suspended solids (SS) on aquatic organisms and biogeochemical processes is imperative and unionid mussels provide an excellent model system for investigation. Experimental results revealed that SS concentration > 8 mg/L significantly lowered the clearance rates (CR) of adult *Lampsilis siliquoidea* (shell length = 9-12 cm) by at least 28% compared to in no-sediment controls (CR = 0.87 ± 0.052 L hr⁻¹). This result was not consistent among SS of different grain size. Clearance rates were significantly lower when mussels were exposed to clay (0 - 5 μ m) or coarse silt (38 - 63 μ m) at 20 mg/L, but interestingly, the CR was not reduced using fine silt (5 - 38 μ m). Analogous experiments performed on newly transformed *Lampsilis fasciola* (shell length = 304.5 - 327.2 μ m) revealed similar CR vs. SS results (i.e., 32% decrease vs. no-sediment controls where CR = 0.24 ± 0.026 mL hr⁻¹) for juvenile mussels older than two weeks. In contrast, CR were positively related to SS concentration ($R^2 = 0.67$) for one week old animals where CR were 25% higher than control (CR = 0.17 ± 0.010 mL hr⁻¹) for SS >8 mg/L. Understanding how physical processes affect SS concentrations in lakes and rivers will provide valuable information on ecosystem function. Moreover, it will further our understanding of Unionid biology, the role they play in water quality, and assist in the management and conservation within the Great lakes Ecosystem.

11:45 Including ecology to particle capture mechanisms: The effects of oscillation on particle capture
Dori Gao and Josef D. Ackerman
University of Guelph

The capture of suspended particles is an important biological process in terrestrial and aquatic ecosystems and includes pollen capture, suspension feeding and larval settlement. The standard model for examining particle capture is to examine particle deposition on stationary and rigid cylindrical 'collectors'. This model does not, however, account for the dynamic movements that occur on collectors in natural systems, which are caused by winds and water currents. The oscillatory motion of these collectors may be characterized by their amplitude and frequency, which can vary in the longitudinal (parallel to the flow) and transverse (at right angles to the flow) directions. Previous computational fluid dynamic modeling in the lab suggests that the orientation of the oscillation may affect the capture efficiency of particles on moving collectors. Particle capture experiments were undertaken in a flow chamber at different velocities in which the magnitude, direction and frequency of the collector were controlled experimentally including the rigid condition for comparison to the standard model. The results of this experiment will be presented and discussed in the context of abiotic pollination and suspension feeding.

Session 2A: Conservation Biology and Biodiversity

1:15 **A window into our evolutionary past: Mazon Creek Lagerstätten siderite concretions**

S. Cotroneo¹, U. G. Wortmann¹, and Marc Laflamme²

¹University of Toronto, Department of Earth Sciences, ²University of Toronto Mississauga, Department of Chemical and Physical Sciences

Understanding the formation of fossils can shed light on taphonomic bias in the fossil record, and elucidate the processes by which new species emerge. Exceptional soft tissue preservation in Pennsylvanian-aged (280Ma) fossils of Mazon Creek, Illinois is accredited to the formation of siderite concretions, which encapsulate the remains of terrestrial and marine flora and fauna. The concretions display an evolution in the mineralogy radiating around the preserved organism, transitioning from carbonate-dominated to silicate-dominated, suggesting changes in the micro-paleoenvironment in which they formed. Cross-sectional analyses of the concretions reveal the evolution of processes involved in mineral formation and the conditions in which exceptional soft-tissue preservation occurred. Studies of similar fossils suggest that concretion formation is associated with the decaying organism they encapsulate, with the organism acting as a nucleation surface for the precipitation of minerals by sulfate reducing bacteria (SRB). Carbon and sulfur isotopic compositions may elucidate the potential role microbes played in the formation of the concretions, and if there was a transition from SRB to methanogen influence on the mineralogy. This work represents the first-ever detailed geochemical analysis of the Mazon Creek concretions, and represents an important step toward broadening our understanding of evolution and exceptional fossilization in deep time.

1:30 **Small Ediacaran fronds of Mistaken Point**

Sara J. Mason¹ and Guy M. Narbonne²

¹University of Toronto, ²Queen's University

The Mistaken Point fossil assemblage of Newfoundland is preserved in situ beneath layers of volcanic ash that smothered the deep marine biota. Dated at ~565 Ma, it is among the oldest known communities of macroscopic complex life. The biota, all soft-bodied, sessile, and epibenthic, are probable stem-group animals that fed by osmosis on dissolved nutrients supplied by bottom currents. Ecological tiering patterns of these fossil communities have previously been described, and are similar to those of recent filter feeding communities. The frond body plan, which generally consists of a bulbous holdfast, a stem and/or axial stalk, and a morphologically complex, foliate section called the *petalodium*, is common in this assemblage. Because the style of preservation favours larger organisms, the lowermost elevated tier of this ecosystem has previously received relatively little attention. These small fronds have been found to include juveniles of the larger fronds *Charnia*, *Charniodiscus*, and *Beothukia*; the small Ediacaran fronds described from other localities *Primocandelabrum* and *Avalofractus*; and two new monospecific genera. One has a distinctive three-dimensional, mop-like *petalodium* with secondary branching that defines it as a member of the clade Rangeomorpha. The other is unique in that it is the only Ediacaran frond with no clear evidence of discrete branches within its *petalodium*; it is characterized instead by a radiating lobate morphology. All of these morphologically disparate taxa follow the same frondose body plan, which shows that this tier of the paleoecosystem was a competitive one that promoted convergent evolution toward this first-order shape.

1:45 **Elevation and phylogenetic diversity on neotropical arthropods**

M. Alex Smith¹, Winnie Hallwachs², and Daniel H. Janzen²

¹University of Guelph, ²University of Pennsylvania

The diversity and phylogenetic community structure of many organisms is negatively affected by factors that covary with elevation. On the Pacific slope of the Cordillera Guanacaste within Area de Conservación Guanacaste (ACG) in northwestern Costa Rica we are engaged in a long-term test of the relationship between elevation and arthropod diversity on three volcanos. We test the strength of the diversity:elevation relationship using molecular operational taxonomic units (MOTU) or by phylogenetic diversity (PD) based on DNA barcodes, multi-gene phylogeny and morphometrics. In some groups, we have observed an asymmetrical mid-elevation peak at approximately 600–800 m and we found high species turnover between sites on the same mountain and among the three mountains. In most groups, at the highest elevation cloud forest sites we found evidence of significant phylogenetic clustering, the expected result of environmental filtering. Many groups are characterised by very narrow elevational range and high diversity at each sampling point. These results emphasise that climate change will bring strong changes in the location and composition of biodiversity on these mountains. Early results emphasise that the structure and composition of the hyperdiverse communities present at any one elevation are extremely vulnerable to a changing climate.

2:00 **Describing a group of Chilean bees, *Chilicola* (*Heteroediscelis*)**

S. K. Monckton

York University

Chilicola (*Heteroediscelis*) (Toro & Moldenke, 1979) is a diverse subgenus of colletid bees endemic to Chile. It includes ten described species and six more in the process of being described. As part of this work, I have conducted five months of field work in Chile, sampling diverse habitats, and collecting tens of thousands of specimens. Using this material, I have conducted a taxonomic revision and phylogenetic analysis of *Heteroediscelis*, using a combination of morphological and molecular (COI) data. The results of this work include a robust phylogeny (a first for this subgenus), a user friendly key incorporating clear photographs, and a series of revised descriptions for all species. I will discuss the process of taxonomic research as it led me to complete this work, and the potential for incorporating the results into a broader phylogenetic context, all in the context of Chile's great range of habitats and its diversity of endemic bee fauna.

2:15 **The use of Great Lakes islands by migrating bats**

Toby J. Thorne and M. Brock Fenton

Western University

Flight gives bats the potential to travel long distances, but relatively little is known about this phenomenon and few data are available on point-to-point movements. Three North American bat species appear to make large seasonal migrations and seven of the eight species of bats occurring in Ontario may show some type of migratory behaviour. It is thought that bats migrating across the Great Lakes select routes to minimise the distance travelled over open water, and Long Point (Lake Erie) is known to have high migratory activity of bats. I am testing this idea by examining activity of migratory bats at two islands in the Great Lakes, Amherst in Lake Ontario and Pelee in Lake Erie, which represent alternative crossing routes.

I deployed 11 detectors across the islands in 2013, to monitor bat presence and activity by recording their echolocation calls. This produced more than 700gb of audio data that I am currently analysing this data to test for the presence of migratory bats. In 2014 I am expanding data collection by adding bat detectors at mainland sites, to compare activity at sites that are not linked to the short crossing distance. This design also allows me to compare between islands to examine whether the characteristics of the two islands are relevant. Data are analysed using automated detection to identify calls, and a discriminant function analysis to distinguish different species. Identifying important migratory sites for bats is valuable for their conservation, particularly given identified conflicts between migratory bats and wind-power development.

2:30 **The adaptive capacity of thermal tolerance: Reintroduction of Atlantic salmon into Lake Ontario**

Kayla J. Gradil, Chris C. Wilson, Anthony P. Farrell, and Bryan D. Neff

Climate change is projected to have widespread effects that could threaten the viability of natural populations. The ability of a species to adjust to climate change is modulated by its adaptive capacity, some of which involves an evolutionary response. Here we examine the adaptive capacity of Atlantic salmon, an important aquatic ectotherm. In the face of impending climate change, conservation managers may be faced with augmenting or reintroducing individuals that have high thermal tolerance or those from a population with high thermal tolerance. Indeed, current restoration efforts to produce a self-sustaining Atlantic salmon (*Salmo salar*) population in Lake Ontario focus on three source populations as candidates for reintroduction. In this study, we evaluate the underlying genetic architecture and hence one component of adaptive capacity of thermal tolerance in the three populations. Optima for performance were determined using maximum heart rate measurements (thermal optimum T_{opt} , and critical temperature T_{crit}) as a proxy for aerobic scope. Furthermore, we investigated underlying cellular and molecular factors that may facilitate tissue oxygen supply and thereby thermal tolerance at individual and family levels. The results of this study provide insight into long-term survival for ongoing restoration efforts of Atlantic salmon as well as more broadly into the thermal adaptive capacity of freshwater fishes.

2:45 **Improving the power and efficiency of biodiversity assessment through the use of DNA metasytematics and next-generation sequencing**

J. Gibson¹, S. Shokralla¹, D. J. Baird^{2,3}, T.M. Porter⁴, and M. Hajibabaei¹

¹University of Guelph, ²Environment Canada, ³University of New Brunswick, ⁴McMaster University

Conventional biodiversity research via individual identification is costly and slow. To draw conclusions about changes in communities in response to natural and anthropogenic effects, biodiversity analysis needs to become more rapid, comprehensive, and cost-effective. High-throughput next-generation sequencing (NGS) technology (e.g. 454, Illumina MiSeq) allows the biodiversity of a given locale at a given time to be determined rapidly, accurately, and at a much lower cost per sample. We will present research that employs NGS and a metasytematic approach to better assess the biodiversity contained within mixed environmental samples. Samples include soil cores, water samples, benthic samples, and terrestrial Malaise trap samples. Each NGS sequencing run generates over a million DNA sequences from the organisms contained in each sample. Multiple target gene regions have been chosen for each kingdom of life, from bacteria, to plants, to fungi, to invertebrates, to

vertebrates. By facilitating greater biodiversity recovery in a shorter amount of time, DNA-based massively-parallel sequencing approaches will greatly multiply the force of human impact on assessing, and improving, the status of pristine and impacted ecosystems.

Session 2B: Avian Ecology and Behaviour

1:15 Do stressful conditions in early-life affect song preferences in adult female European starlings (*Sturnus vulgaris*)?

Tara M. Farrell¹, Alice Cui², and Scott A. MacDougall-Shackleton¹

¹Department of Psychology, University of Western Ontario, ²Department of Biology, University of Western Ontario

In songbirds, developmental stress adversely affects the song-control system (i.e., the neural regions that support song learning and production). To date, this phenomenon is well studied in males by assessing the quality of the song phenotype in adulthood. However, effects of developmental stress on the female song-control system and song preferences are less well studied. Here we subjected female European starlings (*Sturnus vulgaris*) to either an *ad libitum* or unpredictable food-supply from 35-115 days of age. In brief, we would remove access to food for 3-hours randomly between the hours of 0900-1800. Once birds were adults, we assessed song preferences using an operant conditioning task where birds actively chose to listen to a song by landing on a motion-activated perch in comparisons of (1) low- versus high-quality starling songs and (2) conspecific versus heterospecific (i.e., canary) songs. In addition, levels of neural activation in auditory forebrain regions (using expression of immediate early gene ZENK) were quantified following the presentation of either conspecific or heterospecific (i.e., canary) song. We found no significant effect of our developmental treatment on song preferences between low and high quality starling songs, but control females significantly preferred conspecific song to heterospecific song while the food-restricted females showed no preference. Currently, ZENK activation and volume measurements of the song-control system are being conducted and future results will be discussed. These studies aim to evaluate how developmental stress affects females' evaluation of potential mates using a sexually selected signal.

1:30 The effects of corticosterone on birdsong in the adult zebra finch

Pavlina Faltynek

The Advanced Facility for Avian Research

Stress represents an adaptive response to overcome external threats, yet stress can have adverse effects on the body and the brain. Previous research has shown that stress in juvenile songbirds can detrimentally affect song learning and production. However, little is known about the effects of stress hormones, such as corticosterone on adult birdsong. I used male zebra finches to conduct a within-subjects experiment to examine the effects of corticosterone administration on song stereotypy. I administered corticosterone and peanut oil (vehicle) both for a period of 24 hours and three weeks to each individual before recording and comparing their for similarity. I determined percent similarities between and within conditions. Results show a significant effect of experiment duration regardless of treatment and a significant linear trend in the decrease of percent similarity across treatments. Although stereotypy was seen to decrease as corticosterone and time increased, song latency and the number of songs per recording showed no trends. These results suggest that the primary neural structures responsible for aspects of song development and

maintenance (HVC) are vulnerable to the negative effects of stress and corticosterone, while other aspects of song production such as motivation to sing seem to be maintained. This study demonstrates that adult songbirds along with juveniles can be just as susceptible to the negative aspects of stress.

1:45 **Sex differences in myelination of the song control system**
Adam Piraino, David Sherry, and Scott MacDougall-Shackleton
Western University

The song control system (SCS) is an intensively studied network in the songbird brain, responsible for the learning, production, and maintenance of song. Extreme sex differences exist within the SCS and in singing behaviour, making songbirds an excellent model to study sex differences in the brain. Previous work has examined volume, neural number and density of SCS nuclei, while other important components of brain nuclei have been relatively unexamined. Myelination of the SCS, vital to the function of the nuclei and network, is relatively unexamined. In the current study, we used adult male and female zebra finches to examine sex differences in myelination of the SCS, specifically because males sing while females do not. To measure myelination in the SCS, we used immunohistochemical labeling of myelin basic protein (MBP). Regions examined included nucleus HVC, RA, and LMAN, in addition to tract HVC to RA, and HVC to Area X contained within lamina mesopallium ventralis (LMV). We found a significant male-biased sex difference in MBP immunoreactivity within HVC, RA, and the HVC to RA tract, but not within LMAN or LMV. This suggests myelination of HVC, RA, and the HVC to RA tract is important to functional adult song, as males sing and females do not. Furthermore, results for LMAN and LMV suggest they are functionally important for females, potentially for the perception of song, and/or the production of non-song vocalizations. Determining how sex differences in myelination of the SCS are regulated will provide an important advance in basic neurobiology.

2:00 **HVC is activated by the production of the gargle call in the black-capped chickadee (*Poecile atricapillus*)**

Shannon K. Mischler^{1,2} and Scott A. MacDougall-Shackleton^{1,2,3}

¹University of Western Ontario, Department of Psychology, ²University of Western Ontario, Department of Biology, ³Advanced Facility for Avian Research

Unlike many songbirds, black-capped chickadees are characterized by the production of highly complex vocalizations used in several contexts. One of these is the fee-bee song, which is produced by males during the breeding season in order to try and attract a mate. It has been shown that the song control system is instrumental for learning, production and maintenance of song (such as the *fee-bee*) in songbirds. These include brain regions such as the HVC, the robust nucleus of the arcopallium (RA) and area X. Previous studies have found that the volume of these brain nuclei increases during the breeding season. However the nuclei in the chickadee do not exhibit this change seasonally. This may be due to the production of complex learned vocalizations throughout the year (e.g. the *gargle* and the *chick-a-dee* call). In this study, wild black-capped chickadees were caught and subjected to behavioural manipulations in order to elicit the *fee-bee* song, *gargle*, *chick-a-dee* and *tseet* calls. The birds were then sacrificed and their brains were collected and processed by immunohistochemistry in order to examine ZENK expression (which is used to identify areas of the brain that are activated by specific stimulus or behaviour). The birds that produced the *gargle* call consistently showed significantly more ZENK activation of the HVC

than birds that had produced the *fee-bee* song, *chick-a-dee* and *tseet* calls, indicating that the song control system is not only involved in song learning and production, but in the production of learned vocalizations as well.

2:15 **Ready to fight: Reliable predictors of aggression in a joint-nesting nonpasserine bird**

L. A. Griesmer¹, D. M. Logue², and J. S. Quinn¹

¹McMaster University, ²University of Puerto Rico, Mayaguez

For a signal to be considered aggressive, it should increase in aggressive contexts, predict subsequent aggression, and elicit a response in receivers. Tests of the second, 'predictive', criterion with respect to aggressive signaling are most common for passerine bird songs, while passerine and nonpasserine calls and visual displays have received less attention. I tested the predictive criterion in free-living groups of the cooperatively breeding smooth-billed ani, a nonpasserine with a rare breeding system. I hypothesized that 1) males would be more likely to attack than females, 2) both hoots and throat inflation would predict attack and 3) hoot playback would elicit a stronger aggressive response than playback of the common ahnee call. All of the attacking birds were male, supporting my first hypothesis. Hoots and throat inflation were significant predictors of attack in male smooth-billed anis, supporting my second hypothesis. I found no difference in aggressive response for hoot compared to ahnee call playback; thus, my third hypothesis was not supported. I also found that the number of hoot calls and the proportion of time spent in the throat inflation posture increased in the period immediately prior to attack. Thus, throat inflation and hoot calls increase in aggressive contexts and appear to communicate intent to attack in this species. Receiver responses to hoots and throat displays remain to be investigated.

2:30 **Self-organization and individual attributes influence the formation of dominance hierarchies in a group-living bird**

Cody J. Dey and James S. Quinn

McMaster University

Dominance relationships are an important type of social relationship that can influence group dynamics and individual fitness. To date, most studies on dominance have been restricted to investigating the orderliness of dominance hierarchies, and how individual traits influence dominance rank. Here, we use a social network approach to investigate the patterns and quality of dominance interactions in the pukeko, a cooperatively breeding bird that lives in stable, mixed-sex social groups. By using a combination of modern statistical techniques, including the first application of exponential random graph models in behavioural ecology, we demonstrate that pukeko dominance networks emerge from both the attributes of individuals, as well as from endogenous, self-organization of dominance relationships (i.e. structural dependence). Pukeko dominance networks are influenced by sexual differences in dominance interactions, sexual homophily, complex effects of social rank and a tendency to form transitive triad motifs. These factors have differential effects on submissive and aggressive behaviours, but ultimately lead to the formation of orderly and highly asymmetrical dominance hierarchies that are temporally stable. This study demonstrates the utility of multivariate statistical tools for network analysis of animal societies, and provides a rich understanding of the factors that influence dominance interactions in this interesting species.

2:45 **Body size divergence is greater among sympatric species of birds in warm, but not cool, environments**

E. Bothwell, R. Montgomerie, S. C. Loughheed, and P. R. Martin

Differences in body size are widely thought to allow closely related species to coexist in sympatry; however, body size variation may also represent an important adaptation to climate. Here, we use a sister species approach to test the prediction that body size differences among closely related species are greater in sympatric compared with allopatric species of birds worldwide, and that these differences vary with geography, evolutionary distance, and environmental temperatures experienced across the range. We find greater differences in body size among sympatric compared with allopatric lineages, but only at temperatures above 25°C. These body size differences in warm environments declined with evolutionary distance between sister lineages, as allopatric lineages diverge over time. In regions with mean annual temperatures below 25°C, allopatric and sympatric species did not differ in body size, suggesting either that colder temperatures constrain the divergence of body size in sympatry, or that the biotic selective pressures favoring greater differences in size in sympatry are weaker in colder environments. Our results are consistent with suggestions by both Wallace and Darwin that climatic selective pressures are more important in cold environments, such as high elevations and latitudes, while biotic selective pressures dominate in warm environments, such as the lowland tropics.

Session 3A: Animal Welfare and Enrichment

8:30 **Using comparative methods to investigate welfare in captive *Psittaciformes*: Are there ecological determinants?**

Heather Y. McDonald Kinkaid¹, Yvonne van Zeeland², Nico J. Schoemaker², and Georgia J. Mason¹

¹University of Guelph, ²Utrecht University, Netherlands

Some wild species thrive in captivity, while others exhibit breeding or behaviour problems. Focusing on parrots, we completed a comparative study to identify ecological determinants of welfare among wild species in captivity. Our welfare measures were: species-typical rates of feather-damaging behaviour (FDB) and other stereotypic behaviours (SB), calculated from responses to a pet owner survey that yielded data for 53 species; captive reproductive rates (chicks/pair/year) published for 122 species (and corrected for natural annual fecundity); and ease of captive breeding (prolific/moderate/difficult) published for 141 species. We investigated four natural characteristics suggested to predict poor welfare: sociality, long foraging times, ecological specialism, endangeredness; and one, intelligence, suggested as either a risk or protective factor for poor welfare. For each species, we recorded from the literature data on several variables corresponding to these characteristics. We tested for predictive relationships between natural traits and welfare outcomes, controlling for phylogenetic non-independence with Mesquite software. Relatively long food search times predicted increased FDB rates ($P=0.039$) and greater breeding difficulty ($P=0.001$). Larger average relative brain volumes predicted increased SB rates (oral: $P=0.048$; whole-body: $P=0.018$), and, along with higher rates of reported innovative foraging behaviour, tended to predict decreased reproduction ($P=0.088$, $P=0.086$, respectively). Decreased reproduction ($P=0.042$) and greater breeding difficulty ($P=0.012$) were also predicted by increased endangeredness (IUCN) and narrower habitat breadths, respectively. Sociality was not a predictor. Thus, intelligent species with naturally

long foraging times were at increased risk for behavioural and reproductive problems in captivity, and captive breeding was additionally compromised in endangered ecological specialists.

8:45 **Rough-and-tumble play prepares juvenile male mink for adult sexual behaviour by masculinizing them**

Jamie Ahloy Dallaire and Georgia J. Mason
University of Guelph, Department of Animal and Poultry Sciences

9:00 **Having a ball: Mink given simple environmental enrichments are calmer and more fertile**

Georgia Mason¹ and Rebecca Meagher²
¹University of Guelph, Department of Animal and Poultry Sciences, ²University of British Columbia

We investigated whether simple enrichments could enhance mink wellbeing, aiming to improve welfare on fur farms (which house 70-80 million mink p.a.), and in captive breeding centres where endangered mustelids (e.g. black-footed ferrets) often reproduce poorly. Our starting population was 2032 mink, across three local farms. From each of 508 families, one juvenile male-female pair was enriched (E) with two balls and a moveable hanging plastic chain or length of hose, while a second male-female pair was a non-enriched (NE) control. In adulthood, elevated resting shelves (S) were given to sub-set of females with litters. Differential housing lasted 5-10 months (depending on whether mink were kept as breeding stock). Several signs of improved welfare emerged. E mink were calmer (less aggressive in temperament tests; quieter when handled; sometimes less fearful); less likely to chew their fur; E females had lower cortisol (inferred from faecal metabolites) on one farm; and E females weaned more offspring: about 10% more juveniles were produced per E female, due primarily to rates of barrenness being nearly halved, but also to E females giving birth to bigger litters on two farms. Furthermore, S females had less infant mortality: an additive effect such that ES females weaned c. 15% more juveniles than shelf-less NE females. Thus very simple enrichments were highly impactful. This work is changing how mink are housed, we hope will inspire improvements in conservation breeding centres, and raises fundamental questions about how such small changes to captive housing can alter personality and reproductive success.

9:15 **Wound healing in the wing membrane of the Cuban big fruit-eating bat (*Artibeus jamaicensis*)**

Tyler Pollock¹, Christian Moreno², Lida Sanchez², and Emanuel Mora²
¹McMaster University, Department of Psychology, Neuroscience, and Behaviour, ²University of Havana, Department of Animal and Human Biology

The flight membranes of bats are susceptible to holes and tears from a number of sources, including impact with natural and man-made objects, fighting between conspecifics, and predation. Furthermore, biologists commonly punch the wing membrane as a method of marking animals in the field for future identification. Previous research has shown that small holes in the wing membrane do not affect flight, as bats can compensate for asymmetries resulting from injury. Moreover, bats are able to rapidly and completely heal holes and tears in their flight membranes. Some evidence suggests that the presence of numerous blood vessels near the injury site accelerates healing; however, little is known regarding the extent to which delivery of blood to the injury site influences recovery. We

measured wound healing in the wing membrane of the Cuban big fruit-eating bat (*Artibeus jamaicensis*) following introduction of a circular, 4-mm-diameter punch. We compared wound healing rates in animals permitted to fly (active) with those restricted from flying (inactive). Given that tissue regeneration is a metabolically demanding process, we hypothesize that increased delivery of blood to the injury site resulting from flight activity will accelerate wound healing compared to sustained inactivity. These findings will not only be the first to characterize wound healing in *Artibeus jamaicensis*, they will also enhance our understanding of the influence of flight activity on the healing process of wing membranes following injury.

9:30 **Validation of triaxial accelerometers to measure the lying behaviour of adult domestic horses**

Cordellie C. N. DuBois, Emily M. Zakrajsek, Derek B. Haley, and Katrina Merkies
University of Guelph

Triaxial accelerometers have the advantage of being able to continuously monitor an animal's standing and lying behaviour without requiring live observations or video recordings. To date, no units have been validated for use in equines. Onset Pendant G data loggers were tested on two mature Standardbred horses for a period of five days. Data loggers were attached vertically to a single hind limb of each of horse and set to record position every twenty seconds. Horses were monitored by two independent observers via live observations (daytime) and video recordings (night-time). Data collected from the loggers was converted and edited using a macro program to calculate the time the animal spent lying down and the number of lying bouts. A paired t-test compared lying bout duration calculated from video observations and data loggers. There was no significant difference between the video observation recordings and the output from the data loggers ($t_{14} = -1.0732$, $p = 0.301$) and the macro was able to tabulate the correct number of lying bouts with predictability, sensitivity, and specificity all greater than 99%. This study validates Onset Pendant G data loggers in adult horses to determine the frequency and duration of standing and lying bouts when set to sample and register readings at twenty second intervals. The validation of automated data recording devices such as the Onset Pendant G data logger will assist in reducing the time expenditure of live observation and improve our understanding of equine time budgets with respect to standing and lying behaviours.

Session 3B: Evolution of Behaviour

8:30 **Strategic morality: Who condemns infidelity?**

Adam Sparks¹ and Larry Fiddick²

¹University of Guelph, ²Lakehead University

Moral condemnation of any specific behaviour increases the likelihood and/or severity of punishment for those who use that behaviour, including the condemner. Therefore we expect individual differences in moral judgements about 3rd party behaviour to reflect individual differences in use of – or victimization by – that behaviour. We tested this logic by examining the associations between condemnation of relationship infidelity and two sources of individual differences: (1) mate value and (2) relationship anxiety. All else being equal, higher mate value individuals are more capable of finding extra-pair partners and their primary partners are less likely to try to find an extra-pair partner; thus we expect

mate value and condemnation of infidelity to be negatively related. All else being equal, people who are more worried about abandonment or betrayal should be more willing to impose costs on cheaters; thus we expect those with more relationship anxiety to condemn infidelity more strongly. 342 Australians and Singaporeans rated the morality of a variety of infidelity-related acts. Age and sex were used as crude measures of mate value; relationship anxiety was assessed with an attachment style questionnaire. Mate value and anxious attachment significantly predicted condemnation as hypothesized for most acts. Reflecting sex differences in the relationship between age and mate value, men's condemnation of infidelity was unrelated to age, whereas older women condemned infidelity more severely. Supporting the argument that condemnation of 3rd party acts relates to one's own perceived vulnerability to infidelity, relationship anxiety was positively related to intensity of condemnation.

8:45 **Biological markets: A paradigm for understanding human friendships**

Sara Kafashan

University of Guelph

9:00 **Predator decision-making and the evolution of imperfect Batesian mimicry**

Kevin R. Abbott and Thomas N. Sherratt

Batesian mimicry is a fascinating anti-predator adaptation whereby palatable prey species (mimics) have a phenotype that resembles the phenotype of a defended species (models). Some examples of Batesian mimicry are notable because of how well the mimic's phenotype matches the model. Other examples are notable because the match is so poor that it is unclear why any predator would be fooled. This gullibility on the part of the predator is, however, critical to the initial evolution of mimicry and to the evolutionary persistence of imperfect mimicry. Understanding the evolution of mimicry requires an understanding of predator cognition and decision making. I will discuss recent theoretical and empirical work that explores the conditions that favours the evolution of gullible predators. Signal detection theory (SDT) has been the standard model of predator decision making in mimicry systems. SDT predicts that predators will avoid even poor mimics when the mimics are relatively rare or otherwise unprofitable and when the model is particularly aversive. Comparative data from hoverflies shows that mimetic fidelity is negatively related to mimic body size (i.e., profitability), which supports the SDT model. We have expanded the basic signal detection model to incorporate various ways that predators can increase their ability to discriminate between models and mimics. For example, predators can use multiple cues, spend more time inspecting potential prey, or allocate more attention to the task. These expanded models suggest various additional cognitive and ecological factors that would lead to the evolution of gullible predators.

9:15 **Skepticism of the predictive value of cooperative acts**

Amanda M. Rotella

University of Guelph

Why do we cooperate with non-kin? As humans, we are attentive to our reputation. In fact, minimal cues of observation such as eyespots and ambient noises increase cooperative behaviour in experimental economic games. Accordingly, reputation may have played an important role in the evolution of cooperative behaviours. To acquire a good reputation, people advertise their qualities through costly signalling, which can lead to better access to cooperative relationships and greater cooperation within those relationships. As such,

public generosity is a signal of cooperative intent. In fact, recent evidence suggests that people are more generous when competing over partners. These are circumstances where people have incentive to gain a good reputation and signal. The caveat is, however, that some individuals send false signals to gain access to these relationships and exploit cooperative individuals. Thus, it would be expected that when there is great potential to gain a good reputation, observers would become skeptical of the value of the signal to predict cooperative intent. Using cooperative economic games, I propose that people send stronger signals in situations where there is greater potential to gain a good reputation. Moreover, observers in these conditions may attune to reputation and increase their skepticism of the honesty of the signal accordingly. In this presentation, I propose several studies to empirically test these concepts.

9:30 **For the win: Risk-sensitivity theory in football decision-making**

Joshua Gonzales and Sandeep Mishra
University of Regina

Risk-sensitivity theory, derived from behavioural ecology, states that decision makers should prefer high-risk options in high need situations when low-risk options will not meet this need. Recent attempts to adopt risk-sensitivity as a framework for studying human decision-making have shown promising results. However, research on human risk-sensitive decision-making has lacked external validity due to strict adherence to experimental designs. Studies have also not extensively looked at multiple levels of need. The present study attempted to address both of these problems by looking at group-level risk-sensitive decision-making in National Football League (NFL) games. Offensive plays from the 2012 NFL regular season ($N = 33,944$) were analyzed in order to better understand how offensive teams make risk-sensitive decisions pertaining to two distinct needs: 1) attaining first downs and 2) scoring more points than the opposing team. Results indicate that decision-makers made risk-sensitive decisions correlated with attaining first downs at all points of the game. Risk-sensitive decisions were only made in regards to score disparity in the fourth quarter when the need to outscore the opponent was most salient. This is the first time risk-sensitivity theory has been examined in a naturalistic setting among humans. These results may help researchers better understand real world implications of the theory.

Session 4A: Social Behaviour and Mate Selection

10:15 **The effects of dorsal hippocampal dopamine D1-type receptor inhibition on social learning, food intake, and social interactions in male and female mice**

R. Matta, A. N. Tiessen, M. M. Kivlenieks, A. M. Meersseman, Y. O. Adjei-Afriyie, and E. Choleris
University of Guelph, Department of Psychology and Neuroscience Program

Dopamine is involved in addiction, feeding, and social learning. With systemic studies, our lab has previously found that dopamine D1-type receptors mediate social learning in the social transmission of food preferences paradigm (Choleris et al., 2011), however, the brain region(s) underlying this effect are unknown. The ventral tegmental area has dopaminergic projections to the hippocampus, a structure well known for its role in learning and memory processing, as well as social learning. We have microinfused the dopamine D1-type antagonist SCH23390 (at 1, 2, 4 and 6 $\mu\text{g}/\mu\text{L}$) into the Cornu Ammonis 1 (CA1) region of the dorsal hippocampus of adult male and female CD1 mice 15 minutes prior to a 30-minute

social interaction where mice had the opportunity to acquire a food preference from a same sex conspecific. Consistent with our previous work, we found that the highest dose of SCH23390 blocked social learning, however, feeding behavior remained unaffected in both males and females. Video analysis during the social interaction also showed that the learning impairment was not due to reduced exposure to the socially acquired food odor, as oronasal investigation was not influenced by SCH23390. An olfactory discrimination control task using the effectiveness of SCH23390 also showed that both male and female mice could distinguish between the two foods used in the social learning test. Thus, hippocampal dopamine D1-type receptors may be mediating social learning specifically. This study may help our understanding of the role that hippocampal dopamine plays in the 'social brain'.

10:30 Factors affecting male mate choosiness in fruit flies

Carling M. Baxter and Reuven Dukas
McMaster University

Male mate choosiness has been examined in many species, including fruit flies (*Drosophila melanogaster*). Traditionally, male fruit flies used in courtship experiments are isolated until they are four or five days old. However, inexperienced young (one-day-old) males also court and mate with females and are significantly choosier than inexperienced mature (four-day-old) males. We wished to determine what differences between young and mature males could contribute to this difference in choosiness. We specifically tested males' fertility, competitive courtship ability and attractiveness to females. We found that young and mature males were equally fertile in their first mating, but that mature males were more fertile in subsequent matings. When alone with a female, both young and mature males spent similar proportions of time courting, however, when in direct competition with another male, mature males spent significantly more time courting than young males. Finally, mating latencies for young males were longer than those for mature males, indicating females more readily mate with mature males and thus may be more attracted to mature than young males. Thus, mature males are more fertile, more competitive and are potentially more preferred by females. These results indicate that many age-related factors could affect a male's mate choosiness. Therefore, experiments that only use males of a specific age may miss crucial information about male mate choice and as a result may underestimate males' contributions to sexual selection and incipient speciation.

10:45 Battle of the sexes: May the best fly win in reproduction

Trinh Nguyen and Amanda Moehring
Western University

Males and females often have differing reproductive strategies to increase their individual fitness, which can result in sexual conflict. Males usually increase their fitness by mating multiply, while repeated mating comes at a high cost to females. Polyandrous females can receive indirect benefits of multiple mating by increasing the fitness of their offspring through additive and non-additive genetic effects, such as good genes or compatible genes. These benefits are acquired through mechanisms of sexual selection which can act at many levels: behavioural through female mate choice, or postmating through sperm competition and cryptic female choice. To tease apart the antagonistic relationship between males and females in sexual reproduction, males from *D. melanogaster* isolines were ranked for their quality using a variety of fitness traits. The performance of high and low quality males were then tested for their fertilization success independently (cryptic female choice), in the presence of competition (sperm competition), and via female mate choice. These different

aspects of sexual selection at both pre- and postmating levels were examined to determine how they contribute to overall male mating success, providing insight into how populations evolve in response to sexual selection.

11:00 More than kin and less than kind: Preferences and consequences of consanguineous matings

Emily Martin and Tristan Long
Wilfrid Laurier University

Females will often encounter different males of varying degrees of relation from which to pick a mate. It has generally suggested that mating with siblings or other close relatives is to be avoided in order to escape the potentially deleterious consequences of inbreeding depression. However, a number of recent studies have reported that in *Drosophila melanogaster* (a model organism for sexual selection), females are either indifferent to the degree of relation to their mate, or may even prefer closely related males. Motivated by these results, I have set out to independently test this phenomenon, and to examine further, expanding into the fitness consequences of incestuous matings, as this has not been done in the aforementioned studies. Using a series of assays to measure pre- and post-copulatory facets of *D. melanogaster* mating I set out to determine if mate choice outcomes are influenced by relatedness or potential familiarity due to a common developmental environment, and whether these results differ depending on potential intra-specific completion (so called choice or no-choice environments).

11:15 Brain levels of isotocin and vasotocin are related to status and social behaviour in a cooperatively breeding cichlid fish

Adam R. Reddon¹, Constance O'Connor², Susan Marsh-Rollo², Sigal Balshine², Magdalena Gozdowska³, and Ewa Kulczykowska³

¹McGill University, ²McMaster University, ³Institute of Oceanography of the Polish Academy of Sciences

The nonapeptide hormones oxytocin and vasopressin are potent regulators of social behaviour in mammals. In teleost fishes, the oxytocin and vasopressin homologues are isotocin (IT) and arginine vasotocin (AVT) respectively. The role of these nonapeptides in regulating social behaviour has received far less attention in fish than in mammals. However, the extraordinarily large number of extant teleost fish species, and the impressive diversity of their social systems provides a rich test-bed for investigating the role of nonapeptides in regulating social behaviour. Existing studies, mostly focused on AVT, have revealed relationships between the nonapeptides and both social behaviour and dominance status in fishes, although the direction of these relationships varies between species and experimental methodologies. To date, much of the work on endogenous nonapeptides in fish brains has measured genomic or neuroanatomical proxies of nonapeptide production rather than concentrations of these molecules in the brain. In the current study, we measure free biologically available AVT and IT in the brains of a highly social cichlid fish, *Neolamprologus pulcher* using high performance liquid chromatography with fluorescence detection. We found that brain AVT levels were higher in subordinate than in dominant animals, and levels of both AVT and IT correlated negatively with the level of social activity. We relate our results to previous data that have used other, indirect, proxies of nonapeptide levels in other species of fish.

11:30 **The evolution of sociality: Differences in molecular pathways between social and non-social cichlids**

Constance O'Connor¹, Susan Marsh-Rollo¹, Sergio Cortez Ghio², Kristina Hick^{1,now3}, Joanne Tan¹, Marian Wong^{1,now4}, Adam Reddon^{1,now5}, Sigal Balshine¹, Nadia Aubin-Horth²

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Uncovering the behavioural and mechanistic basis of sociality is crucial to understanding its evolution, but it is necessary to consider both the ecological and social context. Here, take advantage of the rapid and repeated radiation of African cichlid fishes to examine variation in molecular pathways that are proposed to underlie differences in social behavior. We compare molecular pathways among four species of social cichlids and four species of non-social cichlids. These fishes are all closely related, with similar mating behavior and ecological niches. Further, we compare specific social behaviors between one social and non-social species pair. Looking at expression of genes involved in the isotocin and vasotocin pathways (teleost homologues of oxytocin and vasopressin, respectively), we found that social species have higher brain gene expression of isotocin receptor 1, and lower expression of isotocin receptor 2. Social species also have higher brain gene expression of arginine vasotocin. At the behavioural level, we found individuals of a group-living species displayed higher social investment, higher social approach, and more frequent use of conflict resolution strategies than individuals of a non-grouping species. These results suggest that simple behaviors related to social motivation and conflict resolution are an important component of an overall group-living social system. Furthermore, we provide support for the notion that isotocin and vasotocin play a role in modulating social behavior in cichlid fishes. Together, the combination results contribute to our understanding of how social systems evolve at the level of both simple behaviors and the underlying molecular mechanisms.

11:45 **Chemical confusion: Sex pheromones trigger mistaken identity by male widow spiders**

Humera Siddiqui, Luciana Baruffaldi, and Maydianne C. B. Andrade
Integrative Neurobiology and Behaviour Group

Chemical communication is common among animal taxa and plays an important role in sexual selection, where pheromones can allow individuals to distinguish species, breeding condition and feeding history of potential mates at a distance. In many web-building spiders, chemicals released from females and their webs (pheromones) attract mate-searching males in the field and are critical to mate localization. We are studying evolutionary variation in the structure and function of these airborne pheromones across the genus *Latrodectus* (the 'widow' spiders), which includes over 30 species worldwide. Here we report the first evidence that species from two distinct biogeographical regions may have highly similar airborne pheromones. We tested the attraction of male redback spiders (*L. hasselti*, an Australian species) to airborne pheromones in a 2-choice olfactometer bioassay in which males walked a T-maze in an open-topped arena to one of two sources ventilated with a fan. We first show that our apparatus allowed males to make reasonable choices. Male redbacks reliably moved towards a conspecific female and her web over a control (a source with no web or spider present). However, when one source was a conspecific female and the other a heterospecific female (*L. mirabilis*, a species from Uruguay), male choosiness disappeared—males were equally likely to approach the heterospecific source. This suggests considerable conservation of sex pheromone structure

across relatively distantly related species. We discuss this result in light of contrary field studies suggesting males of other *Latrodectus* species do distinguish hetero- compared to con-specifics based only on sex pheromones.

12:00 Turtles with teeth: Tomiodont morphology and functional significance in the painted turtle (*Chrysemys picta*)

Patrick D. Moldowan¹, Ronald J. Brooks², and Jacqueline D. Litzgus¹

¹Laurentian University, Department of Biology, ²University of Guelph, Department of Integrative Biology

The Painted Turtle (*Chrysemys picta*) has an upper jaw notch bordered on each side by tooth-like cusps called tomiodonts. For 180 years, these tomiodonts have been used as a descriptor in anatomy, phylogenetics, and natural history; however, no quantitative study of these traits or their function has ever been completed. Observations of *C. picta* from a long-term study in

Algonquin Provincial Park (Ontario, Canada) have suggested that males have tomiodonts of more variable morphology and greater prominence than those of females. In addition, female *C. picta* in Algonquin Park have been regularly recorded with injuries on the nape indicative of bite wounds, possibly inflicted by the tomiodonts of males during mating. The putatively sexually dimorphic nature of the tomiodonts has raised a number of questions about their functional significance. We hypothesize that the tomiodonts confer a reproductive advantage to male *C. picta* owing to the use of these structures in securing mates. Discussion will focus on sexual dimorphism and *C. picta* tomiodont structure. Evidence for the functional significance of the tomiodonts, including the demography of bite wounds in an Algonquin Park *C. picta* population and experimental trials to assess courtship and pre-copulatory behaviours, will be introduced. In short, we propose a coercive mating strategy and test for sexual dimorphism and the functional significance of the tomiodonts in the reproduction of *C. picta*.

Session 4B: Climate Change and Invasion Biology

10:15 Plant soil feedbacks along an invasion chronosequence

Nicola Day, Kari E. Dunfield, and Pedro M. Antunes
Algoma University and the University of Guelph

Plants alter soil microbial communities and in turn these influence plant growth, termed plant-soil feedbacks. Positive/negative feedback occurs when a given plant species has greater/smaller fitness in home versus away soil (i.e., “trained” by another plant species). Positive/negative feedback can be due to a net balance between mutualists/pathogens. Exotic invasive plant species commonly show positive feedback in their invaded ranges and negative feedback in their native ranges, purportedly due to enemy release. However, broad scale studies have suggested negative feedback may increase in exotic invasive species over time, which is thought to be a result of the local enemies adapting to the novel plant. We collected soil across an invasion chronosequence to investigate temporal changes in plant-soil feedbacks and root-associated fungal communities in a highly invasive exotic plant in eastern North America, *Vincetoxicum rossicum* (*Apocynaceae*). We hypothesized that plants grown in soil from recently invaded sites (<12 years) would demonstrate positive feedback, but feedback would decrease with invasion time (50-100 years). *Vincetoxicum rossicum* was grown from seeds in a glasshouse study. Contrary to our hypothesis, plants grown in soil

from recently invaded sites had lower shoot biomass than those in soil from at least 100 year old invaded soil. Several known fungal pathogens were detected in the roots of *V. rossicum*. However, their degree of specialization on this plant species is unknown. Our data shows that more than 100 years of invasion does not appear to have been sufficient for root enemies to cause declines in this exotic invasive plant.

10:30 Predicting the effects of climate change on lake trout (*Salvelinus namaycush*) distributions in Ontario

Miranda Chen and Sapna Sharma

Increasing lake water temperatures in response to climate change are expected to alter the distribution, thermal habitat, and growth of many aquatic organisms, including an ecologically and economically important coldwater fish species, lake trout (*Salvelinus namaycush*). My project will examine the effects of climate change on the distribution of lake trout populations in Ontario. Using a historical dataset of 9885 Ontario inland lakes surveyed between 1957-1986 and a contemporary dataset of 700 lakes sampled between 2007-2012, I will identify the importance of environmental characteristics, such as lake chemistry, lake morphology and presence of predators and prey on lake trout occurrence in Ontario. Preliminary analysis using a classification tree indicated that maximum depth and mean August air temperatures explained the most variation in lake trout occurrence, suggesting the importance of lake morphology and climate on lake trout occurrence in Ontario. I will further compare a suite of statistical approaches (e.g. logistic regression, artificial neural networks, linear discriminate analyses) to identify which environmental characteristics are important predictors of lake trout presence and absence. Subsequently, I will predict future lake trout occurrence across Ontario for the years 2050 and 2070 by incorporating future climate change scenarios from twenty general circulation models and four greenhouse gas scenarios into our best predictive model of lake trout occurrence. Through understanding the main drivers that control lake trout populations and how future climate changes may impact them, we may further improve fisheries management decisions before lake trout become extirpated in Ontario lakes.

10:45 Predicting the effects of climate change on walleye (*Sander vitreus*) distributions in Ontario lakes

Thomas Van Zuiden and Sapna Sharma

Climate change is expected to alter suitable thermal habitat and distributions of Ontario freshwater fishes in response to increasing water temperatures, precipitation and decreasing levels of dissolved oxygen and water clarity. Distribution shifts of freshwater fishes could then lead to novel biotic interactions and potentially alter complex food web dynamics. The objective of this study is to understand the effects of climate change on populations of walleye (*Sander vitreus*), an ecologically and commercially important freshwater fish, and predict their future distributions in 9885 Ontario lakes. Environmental characteristics including lake morphology, chemistry, geography, and occurrence of predators and prey, will be used to predict the occurrence of walleye in Ontario. Preliminary analyses suggest lake size, climate, water clarity, and presence of smallmouth bass, a predatory fish, are the most important predictors of walleye occurrence. Subsequently, I will predict how climate change may alter walleye distributions in the future, using general circulation climate models for the years 2050 and 2070. It is hypothesized that walleye distributions will undergo a northward shift as climate warming continues. Next, the potential effects that northward expanding smallmouth bass (*Micropterus dolomieu*)

populations may have on walleye distributions under scenarios of climate change will be examined. Smallmouth bass are an invasive fish that predate on young walleye and compete with adult walleye. As such, I predict that smallmouth bass presence will exacerbate the northward shift of walleye. Predicting future walleye distributions under climate change and invasive species stress will allow for the development of conservation and management strategies.

11:00 Demographic consequences of soil moisture variation for an invasive, hybridizing weed

Zachary Teitel and Lesley G. Campbell

Cultivated plants are known to readily hybridize with their wild relatives, forming invasive populations that can become more weedy than their parental phenotypes. With global climate change, increasingly variable precipitation may create new advantages for weeds in agricultural habitats. To assess the relative ability of new populations to grow and invade a new location, we compared the demography of wild radish (*Raphanus raphanistrum*) and crop-wild hybrid radish (*Raphanus raphanistrum* x *Raphanus sativus*) populations across a soil moisture gradient. Field populations of wild radish and F1 hybrid radish were established in 2012 and received one of four watering treatments over the 2012-13 field seasons. Weekly population censuses assessed the number of seedlings emerging, their rate of survival and eventual fecundity. Hybrid populations had higher λ than wild populations but λ did not differ across precipitation treatments. Fecundity represented the greatest contributions to λ and was the most elastic demographic parameter relative to other life history stages. Predicting the likelihood that a weedy genotype will successfully invade requires an understanding of its λ and compositional demographic transition rates relative to its competitors. This study better informs selective weed control by isolating the most effective life-history stage 'choke point' to suppress population growth.

11:15 Application of species distribution models for the management of the European fire ant

Nao Ito, Laurence Packer, and Gail Fraser

Sightings of the non-native invasive European fire ant (*Myrmica rubra*) have been reported across North America in recent years as most North American records of this species date from the last ten years, implying that their populations in North America are fast expanding. Devoid of competitors and natural enemies in North America, *M. rubra* is expected to continue to expand its ranges from coast to coast. Once an invasive species is established in its introduced range, it is very costly if not impossible to eradicate. It is, therefore, vital to develop cost effective methods to prevent the spread of invasive species before populations reach peak levels and result in permanent damage to ecological systems. Ecological niche/species distribution models are often used in invasion biology to identify susceptible areas. They allow us to be vigilant and minimize and prevent possible future damage caused by invasion. Several different species distribution modelling algorithms were used to evaluate potential geographic distribution areas for *M. rubra* on 3 different scales (local/GTA, regional/southern Ontario, and continental/North America) for better prevention and mitigation of this non-native invasive ant and to determine areas that need to be vigilant for future invasions.

11:30 **Effects of climate change on Canada lynx at their southern edge**

Michael J. L. Peers¹, Morgan Wehtje¹, Daniel H. Thornton², and Dennis L. Murray¹

¹Trent University, ²Washington State University

Understanding the effects of climate change on species' persistence is a major research interest, however, most studies have focused on responses at the northern or expanding range edge. There is a pressing need to explain how species can persist at their southern range when changing biotic interactions will influence species occurrence. For predators, variation in distribution of primary prey owing to climate change will lead to mismatched distribution and local extinction, unless their diet is altered to more extensively include alternate prey. We assessed whether addition of prey information in climate projections restricted projected habitat of a specialist predator, Canada lynx (*Lynx canadensis*), and if switching from their primary prey (snowshoe hare; *Lepus americanus*) to an alternate prey (red squirrel; *Tamiasciurus hudsonicus*) mitigates range restriction along the southern range edge. Our models projected distributions of each species to 2050 and 2080 to then refine predictions for southern lynx on the basis of varying combinations of prey availability. We found that models that incorporated information on prey substantially reduced the total predicted southern range of lynx in both 2050 and 2080. However, models that emphasized red squirrel as the primary species had 7-24% lower southern range loss than the corresponding snowshoe hare model. These results illustrate that persistence at the southern range may require species to exploit higher portions of alternate food, and that climate projections based solely on abiotic data can underestimate the severity of future range restriction.

11:45 **Can globally noxious species be controlled?: Some insights from southern Brazil**

R. Leon Cordero

The current trends of human disturbances produce severe impacts on global ecosystems. Habitat degradation often elicits the invasion of exotic species that cause serious damage to local biodiversity and socioeconomic activities. The valuable and sensitive mosaic landscapes of Rio Grande do Sul, southern Brazil, with over 3000 species, are subjected to the invasion of a highly pervasive species. Gorse, *Ulex europaeus* L., is a shrub native to southwestern Europe, which out-competes native flora, alters habitat structure, reduces available native grasslands and generate important economic losses to local producers. Despite being one of the 100 worst global invasive species, little information still exists on habitat structure, ecological dynamics and invasiveness in most of its exotic range. This is especially true for the Brazilian case. We considered several approaches, which include studying landscape patterns of expansion, biotic interactions and performing controlled field tests of seed germination. Our preliminary results indicated that both light availability and grazing pressure exert an influence of gorse population structure. This study suggests a two-way mechanism to control gorse by promoting habitat heterogeneity and adequate grazing pressure. Lessons from this study could help to implement policies enhancing the conservation of frequently neglected ecosystems such as the forest-grassland mosaics.

12:00 The influence of physiological traits on climatic niche occupancy and competitive ability in the polyploid plant, *Chamerion angustifolium* (Onagraceae)

Ken A. Thompson, Brian C. Husband, and Hafiz Maherali
University of Guelph

Polyploidy—the possession of more than two copies of each chromosome in the nucleus—has significant physiological consequences, but little is known about how the altered physiology of polyploids influences their ecology. Here, we present results from two studies investigating how physiological traits influence (i) the climatic niche and (ii) competitive ability in *Chamerion angustifolium*, a polyploid plant. Tetraploid *C. angustifolium* have physiological adaptations to tolerate drought relative to diploids and are less tolerant of freezing. To investigate differences in the climatic niches of diploids and tetraploids, we compiled a dataset of 134 *C. angustifolium* populations of known ploidy across North America. We extracted climate data associated with these populations and found that tetraploids occupy a drier niche than diploids, while diploids occupy a colder niche than tetraploids. Using ecological niche models, we demonstrate that the climatic niches of diploid and tetraploid *C. angustifolium* are very similar to their geographic distributions. To investigate differences in the competitive abilities of diploid and tetraploid *C. angustifolium*, we conducted a competition experiment in the greenhouse where we grew both cytotypes together at different densities and relative proportions across a soil-moisture gradient. We found that cytotypes did not differ in their competitive abilities across the soil-moisture gradient. Collectively, our results suggest that physiology is at least partially responsible for differences in the realized climatic niches of diploid and tetraploid *C. angustifolium*, but do not enable tetraploid *C. angustifolium* to outcompete diploids when water is limited.

Session 5A: Community Ecology

1:30 The interactive effect of nutrient enrichment and habitat destruction on consumer-resource alpha and beta-diversity across habitat sizes.

Eric Harvey and Andrew MacDougall

Nutrient pollution, overharvesting, and habitat fragmentation are likely to affect consumers primarily via resource-based mechanisms, especially within terrestrial systems. An important issue when predicting the effect of multiple stressors is that their effect can interact in space and across trophic levels, leading to contrasting patterns of beta-diversity. We tested these interactions in a 13 ha large-scale plant-arthropod meta-community experiment. We found an interactive response to the multiple stressors with changes in consumer diversity mainly driven by plant response. We also found that the interactive effect of stressors can change across habitat sizes with bigger patches protecting communities against producer spatial homogenization thus supporting more consumers. Our results suggest an important context-dependence nature of the effect of environmental stressors and that, within grassland ecosystems, understanding the resource-based mechanisms by which global change affects producer communities at local and regional scales might be the key to predict future changes across the whole ecosystem.

1:45 **The nettle in the hay stack: Tracking pollen abundance to locate small plant populations**

Rebecca J. Parker, Lesley G. Campbell, and Eric De Noronha Vaz

There is a large degree of uncertainty surrounding small plant population estimates, both in presence/absence and quantitative parameters, most likely due to the difficulties associated with surveying a large landscape for few individuals. This is a problem for species management as it reduces our ability to, firstly, set goals for manipulating species and populations, and secondly, for enacting action plans to achieve those goal. To deal with this, we must firstly be using data collection techniques that minimize uncertainty from the beginning and also be using the most recent modeling and statistical methods for interpretation of data that inevitably comes with uncertainty. In this study I present a new survey tool that interpolates likely locations of an unknown plant population by tracking pollen captured from the surrounding landscape. This tool attempts to reduce the resources spent on plant surveys while maximizing confidence in population location. I show how my survey method is advantageous to current best practices in reducing the need for in-person sampling while simultaneously giving a numerical estimate of the confidence associated with the location of a population.

2:00 **The effects of germination segregation on plant height between two native Californian grasses**

Christopher Blackford and Benjamin Gilbert
University of Toronto

Germination is influenced by many factors, one of which is the presence of neighbouring seeds. Previous studies have observed species can alter their germination rate in the presence of interspecific seeds. Shifts in germination timing may increase temporal niche segregation between species which should increase fitness of both species and promote coexistence. However, other research has shown that early germinants tend to have a competitive advantage. This study tested the effects of germination segregation on plant height between two co-occurring California grasses: *Vulpia microstachys* and *Vulpia octoflora* (family: Poaceae). Pilot studies show these species germinate at different rates, with *Vulpia microstachys* (*V. microstachys*) germinating earlier than *Vulpia octoflora* (*V. octoflora*). A significant effect of temporal segregation on height was observed for both *V. microstachys* and *V. octoflora*. However, magnitude of temporal overlap did not predict height in either species. Germinating *V. octoflora* before *V. microstachys* occasionally led to greater height in *V. octoflora*, suggesting that early germination may increase fitness more than segregated germination for this species. Height of *V. microstachys* was constant across all treatments except one. *V. microstachys* height was not reduced when germinating after *V. octoflora*, suggesting that early germination in *V. microstachys* is not a strategy to avoid early life competition with *V. octoflora*. This experiment shows segregated germination and early germination does not necessarily lead to greater fitness. Future work should investigate germination segregation using metrics of fitness other than height and how germination segregation acts on coexistence at a community level.

2:15 **The effects of competition and soil moisture on variation in physiological traits in community assembly**

Deirdre E. Loughnan and Benjamin Gilbert
University of Toronto

Plant community assembly is the process by which abiotic conditions and competitive interactions influence the establishment and growth of plants within communities. Conflicting hypotheses predict an increased probability of species establishment as plant traits within the community converge to reduce competitive differences among species or diverge to limit negative interactions. Here we test these hypotheses using a manipulative approach, allowing the role of trait convergence and divergence from species differences or intraspecific differences to be isolated. Our current understanding of community assembly is mainly based on observational data, limiting our ability to draw causal relationships between community conditions and traits. Moreover, published studies predominately focus on interspecific variation, ignoring the potential for intraspecific variation to influence community patterns. We performed a transplant experiment to determine the effects of competition and soil moisture on intraspecific and interspecific variation of early-successional plants. Specific leaf area was significantly influenced by both competition and soil moisture; although, this trend was driven by a single species for which significant intraspecific variation was found. Analysis of the other traits revealed unique degrees of interaction between soil moisture and competition; however, these trends were generally due to species differences and not intraspecific variation. The effect of soil moisture and competition were therefore species- and trait-specific, likely reflecting interspecific differences in species growth strategies and plasticity. This research adds to our understanding of community assembly and functional ecology through a manipulative approach that allows us to further our understanding of the mechanisms underlying this process.

2:30 **Title TBA**

Susan Hensen and Hafiz Maherali

2:45 **Wood ash and nematodes: Dishing the dirt on silvicultural community change**

Paul B. L. George and Zoë Lindo
Western University

Wood ash produced from the burning of forestry refuse is commonly returned to silvicultural plantations as an added-value product. It is thought that this material can promote tree growth by increasing soil pH to help release previously inaccessible nitrogen in the soil, increasing soil nutrients, and promoting beneficial microorganisms. Although wood ash application is popular in Europe, soil amendment with wood ash is very uncommon in Canada. Furthermore, the effects of amendment on soil organisms are varied and poorly understood. In particular, the effects of wood ash on free living nematode communities are hard to discern; no studies of this type have been conducted in Canada's boreal forest. In conjunction with the Canadian Forest Service at Sault Ste. Marie, the Ontario Ministry of Natural Resources, and various forest interest groups, I will present my findings thus far, as well as discuss the implications of an altered nematode community. Our findings thus far indicate that approximately 1.5 years after disturbance, the communities of ash-amended plots have returned to control states in composition, diversity, and evenness.

3:00 **Rhizobial tolerance to fertilizer leads to modifications of the relationship dynamics in the *Medicago lupulina*-rhizobium mutualism**

Phil Rekret, Anna Simonsen, and John Stinchcombe
University of Toronto

The stability of mutualisms, such as those between nitrogen-fixing rhizobial bacteria and legumes, depends on a variable ratio of costs and benefits to both partners. Our objective was to determine how the addition of one of the exchanged resources, nitrogen, impacts rhizobial growth rates independent of the host plant. We compared in-culture growth rates of rhizobia at high, low and control fertilizer treatments isolated from the roots of *Medicago lupulina* plants that were harvested from experimentally fertilized and unfertilized plots at the Koffler Scientific Reserve. Rhizobial strains isolated from both fertilized and unfertilized plots had higher in-culture growth rates as concentration of fertilizer increased, with fertilized strains exhibiting the largest increase in growth. We suggest that the trend towards more competitive (higher growth rates) strains in fertilized soil was a result of one of two factors: the decreased dependence on rhizobia by *M. lupulina* for nitrogen, and therefore, minimal resource allocation (carbon) to the bacteria, or, the rhizobial tolerance to fertilizer induced a shift towards less cooperative and more competitive strains, independent of host response. Regardless, as selection for cooperative strains is relaxed in fertile soil, or an abiotic stressor such as fertilizer is present, there exists increased competition among strains or individuals. Preliminary data also suggests that there is a significant trade-off between the fitness of host plants (fruit number) and the competitive ability (growth rates) of strains isolated from those plots, with the relationship being more pronounced in strains isolated from fertilized plots.

3:15 **Effects of biomass cropping systems on soil denitrifier community abundance in Ontario soils**

K. Thompson¹, W. Deen², K. Dunfield¹

¹University of Guelph, School of Environmental Sciences, ²University of Guelph, Department of Plant Agriculture

Recently, interest in the use of plant based biomass energy has increased as a way to decrease dependence on fossil fuels. When introduced, switchgrass and miscanthus were proposed as sustainable alternatives to annual crops for biomass production. However, the effects of these perennial grasses (PGs) on soil quality indicators such as microbial abundance are largely unknown. Our objective was to assess changes in microbial and denitrifying community abundance as influenced by biomass production strategies that include PGs. Field trials were established in 2008 in a randomized complete design (n=3), comparing crop species (miscanthus, switchgrass, corn and soybean), fertilization rates (0 and 160 kg N ha⁻¹) and biomass harvest dates (fall and spring) in Ontario, Canada. Soil was collected (0-15cm depth) from Elora and Ridgetown from 2010-2012. Quantitative PCR was used to enumerate the total bacterial communities (16S), and communities of denitrifiers by targeting nitrite reductase (nirS) and nitrous oxide reductase (nosZ) genes. Comparing conventional crops with the proposed Best Management Practice (BMP) of spring-harvested PGs, PGs were found to have higher nirS, nosZ, and 16S abundances than the annual rotation over time at Elora only. These results indicate BMP PG plots may support larger denitrifying communities than annual rotations or fall-harvested PG plots, which signifies that BMP PG plots may have a lesser negative effect on microbial functioning and associated soil nitrogen-cycling processes than annual biomass crops. Our results suggest biomass production management influences soil microbial communities, this influence is dependent

on field site, and abundances respond to seasonal differences.

3:30 How do interactions drive productivity in diverse crop fields?

Yi An Lin and Liette Vasseur

Crop fields are plant communities where in general diversity is artificially kept very low in order to increase productivity of a target species. However, as plants grow, intraspecific competition becomes increasingly intensive, limiting the growth of the target species. On the other hand, crop diversification, by growing two or more target crop species at the same field, can potentially reduce the intensity of intraspecific competition and lead to facilitation among crops. However, in such systems, interspecific competition among crops and weeds also occur. Additionally, in organic fields, weeds may differ in the aggressiveness in comparison with weeds continually exposed to conventional controls. The purpose of this research was to investigate the role of competition and facilitation among onion and yellow wax bean and how diversification could influence the species productivity. In addition, we investigated crop-weed interactions under monocrop and intercrop microcosms as well as the adaptive responses of two weed species, *C. album* and *A. hybridus*, from a conventional and an organic farm. Using a full factorial experimental design (mono and intercrop, presence or absence of a weed species), crop and weed fresh and dry weight were measured and land equivalent ratio was calculated. We found that growth of onion under intercropping is significantly higher than its growth in monoculture. Weeds had significantly lower biomass and height under intercropping. Intercropping onion with wax bean may reduce the net effect of competition with weeds by using resources more efficiently compared with monoculture, thus increasing crop productivity and suppressing weed growth.

Session 5B: Insect Ecology and Behaviour

1:30 Role of varroa mites to transfer honey bee viruses and their control strategies

M. M. Hamiduzzaman, E. Guzman-Novoa, B. Emsen, A. Sinia, G. Koleoglu, and P. H. Goodwin

Deformed wing virus (DWV), Israeli acute paralysis virus, black queen cell virus and Kashmir bee virus were detected in bee and Varroa. Viruses were common in high-mite-populated colonies. Multiplication of DWV increased in bees over time. Entomopathogenic fungi as biocontrol agents of varroa mites were used to investigate the interaction between DWV and fungal-inoculated mite. Level of DWV was higher in brood infested with mites as well as varroa-macerate injected brood, but negative in control brood suggesting that varroa mite could vector and transmit virus in honey bee. Grooming behavior showed some effects on the expression of immune-related genes in bees.

1:45 The effects of accessory proteins on sperm survivability in *Drosophila pseudoobscura*

Caryn Dooner and Amanda Moehring
Western University

Antagonistic co-evolution between males and females to control reproductive success may give rise to a variety of reproductive strategies, such as female spermicides and male accessory proteins. The interplay between male sperm morphology (fertilizing eusperm versus non-fertilizing parasperm), male accessory gland proteins (ACPs), and female reproductive tract proteins (FRPs) has not been assessed. Three aspects of these

reproductive traits within *Drosophila pseudoobscura* will be discussed: (1) the effect of ACPs and parasperm proportion on sperm survivability when in the presence of FRPs; (2) the effect of ACPs and parasperm proportion on sperm survivability when not in the presence of FRPs; and (3) the effect of conspecific vs heterospecific ACPs on sperm survivability when in the presence of conspecific FRPs.

2:00 **Genetic influences on social behaviour in fruit fly larvae**

Blake Anderson and Reuven Dukas
McMaster University

Group living is associated with a number of costs and benefits, all of which must be taken into account when deciding to join others. Fruit flies (*Drosophila melanogaster*) provide an excellent model system for studying both the proximate and ultimate mechanisms underlying social behaviour. Like their adult counterparts, fruit fly larvae exhibit robust social behaviour, which includes both attraction to conspecifics and learning from social experience. Furthermore, the propensity for larvae to form groups changes throughout development, and varies across environmental conditions. We assessed how genetic factors influenced larval aggregation behaviour, specifically how it varied amongst natural populations, and in larvae carrying different alleles of the foraging gene. The two foraging morphs showed differences in how aggregation behaviour changed throughout development. We also found that there were distinct patterns of aggregation between different wild caught isofemale lines. The differences between these lines were consistent across several consecutive generations. Our results suggest that larval social behaviour, specifically aggregation, shows heritable variation that extends beyond a single gene. Differences between spatially distinct natural populations may reflect adaptation to ecological conditions that favour either solitary or group living.

2:15 **Foraging and vitellogenin gene expression patterns in eusocial sweat bees using qRT-PCR**

David Awde, Adonis Skandalis, and Miriam Richards
Brock University

Both the foraging (for) and vitellogenin (vg) genes are associated with differences in behaviours between castes of social insects. These two genes are involved in foraging and egg-laying behaviour, which is one of the major hallmarks of caste differentiation in primitively eusocial sweat bees, such as *Lasioglossum laevisimum*. We hypothesize that in *L. laevisimum*, actively foraging individuals have high expression levels of for, while non-foragers have low levels, and that individuals with ovary development will have high expression of vg, while individuals with no developed ovaries will have low levels. To investigate this hypothesis, we designed a quantitative RT-PCR (qRT-PCR) study aimed at comparing expression patterns in queens and workers. As a baseline we evaluated for and vg expression in newly eclosed males with respect to eight control genes (actin, arginine kinase, EF-1alpha, GAPDH, RpL13, Rpl32, RpP2, and RpS5); for and vg gene expression levels were similar in heads, thoraces, and abdomens. We then analysed summer workers (females) caught on the wing; for expression levels were highest in thoraces and lowest in abdomens, while vg expression was similar across tissues. Comparisons between queens and workers will likely reveal caste-specific patterns in for and vg gene expression.

2:30 **Food and oviposition preference of diamondback moth**

Kiera Newman and L. Vasseur

Brock University

Plutella xylostella (Diamondback moth ((DBM)) is a Lepidoptera that feeds and oviposits almost exclusively on Brassicaceae plants. Host plants include many crops, landscape ornamentals, and weeds. Our objective was to determine food and oviposition preferences of individuals coming from different regions of Canada (Saskatchewan, Alberta, and three Ontario environments) and how larval age may also influence this choice. To do so, we simultaneously exposed a larva of instar III or IV (n=18 for each instar and population) to leaf discs of garden cress, wintercress, black mustard, aubretia, broccoli and ornamental kale, and observed its selection over a period of one hour. The rate of herbivory and weight gain were measured. Adult females were exposed to the same species and their oviposition preferences examined. Results show that garden cress (*Lepidium sativum*) is the most preferred species for both food and oviposition sources. No studies have yet reported DBM preference for garden cress. Oddly, previous studies have reported that garden cress contains saponins, chemicals proposed to be toxic to DBM larvae. The ultimate goal of our study was to understand host plant preferences and their potential to act as reservoirs to sustain, limit and promote population growth and whether these preferences differ among populations of diverse geographic origins. Our results suggest that DBM might be able to survive and grow on species previously thought to be toxic, questioning the ability of using such plants as trap crops and the capacity of DBM to adapt to novel hosts.

2:45 **Do groups really make better foraging decisions than individuals?**

Shane Golden and Reuven Dukas

McMaster University

There are a number of advantages and disadvantages to group living. One obvious disadvantage is competition. You require the same resources as those around you and there is usually a limited pool to obtain them from. Fruit fly larvae raised with others actually show a slower development time and lower survival to adulthood. However, there are a number of advantages to living in a group. Groups of larvae can regulate beneficial yeast densities, and suppress the growth of harmful molds.

Aside from regulation of their environment, groups can also more accurately assess and react to their environment. Groups tend to make fewer false positives, with larger groups making fewer errors. Collective decision-making is found in eusocial hymenopterans. Additionally, it is found in non-eusocial insects such as tent caterpillars and cockroaches. Groups are able to locate optimal food sources by individual differences in exploration followed by exploitation by the group. However, groups may become stuck on suboptimal food sources as once the group starts feeding on a suboptimal source, it is harder for a group to abandon it than an individual. We investigated the accuracy of groups of fruit fly larvae attempting to find high quality foraging spots compared to individuals. We found that overall, groups were more likely to find better foraging spots but only after they were given enough time to sample the environment extensively.

3:00 **Effects of social interactions of learning and memory in honey bees**

N. Tsvetkov and A. Zayed

York University, Department of Biology

Honey bees are a highly eusocial organism, where one colony is made up from about 20,000 individuals. Social interactions are crucial for proper development in many organisms. Social isolation from birth impairs memory recall in rats and reduces the number of mushroom body (brain area central for learning and memory in insects) fibers in *Drosophila*. We hypothesized that reducing the number of social interactions available to a honey bee from emergence will impair learning and memory. To test this hypothesis, we placed honey bees from emergence in three different social groups: 1 bee, 8 bees, and 32 bees. When the honey bees were 6 days old, they were individually tested for sucrose sensitivity, discrimination learning, and short and long term memory. The honey bees raised in isolation were most sensitive to sucrose, where those raised in groups of 8 were intermediate, and those from groups of 32 were the least sensitive. There was a significant linear effect of sucrose sensitivity on learning and memory, where the most sensitive honey bees learned the discrimination task the best and had the best memory. Taking both effects into account, those raised in isolation, should have the highest learning and memory scores, since they are the most sensitive. There was, however, no effect of group size on learning and memory. One explanation is that honey bees raised in smaller groups had impaired learning and memory, but it was compensated by higher sucrose sensitivity.

3:15 **Both food restriction and risk of predation trigger social preferences by flower-naïve bumblebees**

E. W. Service and C. M. S. Plowright

Prior to any functional experience with flowers, bumblebees show an unlearned preference for flowers occupied by other bees, at least when the occupied flowers are rare and the occupiers are conspicuous. The preference may possibly facilitate the discovery of food sources. In view of reports of aggressive behaviours directed towards occupiers, another possibility is that the preference may be interpreted as a competitive or defensive response. Here, compared to a baseline condition where access to sugar solution was restricted, we undertook two experimental manipulations: increasing food shortage by depriving colonies of pollen and simulating predation by exposing workers to CO₂. From each of two colonies, 48 workers entered a 12-arm radial maze. Nine corridors were empty, while three corridors were furnished with a stimulus pinned to the back wall: either a coin, or a Styrofoam circle, or a dead bumblebee. Each worker made 20 unrewarded choices. In the baseline condition, the proportion of choices of the corridor occupied by the bee did not differ from chance. Both manipulations, however, lead to a significant increase in that proportion. The preference for the occupied corridor was specific: no preference for the corridors occupied by other objects was detected. Approach of other individuals is triggered by both foraging and non-foraging contexts.

3:30 **Problem solving in bumblebees**

Caroline Strang and David Sherry

Western University

Behavioural flexibility, the ability to recognize change in the environment and respond appropriately, has long been considered a measure of animal intelligence. Animals' ability to solve ecologically relevant problems is increasingly used as a measure of behavioural

flexibility. Foraging bumblebees engage in two behaviours that fall under the broad definition of problem solving: complex flower handling requires petals to be lifted and moved to reach nectar rewards and nectar robbing requires chewing through the bottom of a flower to get nectar without having to enter the flower. Both of these behaviours are learned and there are individual differences in how successful bees are at each task. We developed two laboratory problem solving tasks comparable to flower handling and nectar robbing. We gave bees repeated trials with each task and compared their performance to a typical laboratory measure of behavioural flexibility, discrimination reversal learning. Discrimination reversal learning requires an animal to learn to discriminate between rewarded and unrewarded choices and then reverse their responding when the reward contingencies are changed. We found that bees' performance on the problem solving tasks improved with experience, indicating that the tasks involved learning. We also found that persistence, the length of time that bees attempted to solve the problems, and variability in behavioural output, the number of different ways the bees tried to solve the problems, were correlated with success.

ABSTRACTS: POSTERS

1 **Targeting the xenobiotic-responsive transcriptome: *In silico* identification and analysis of PCB-interacting genes conserved across taxa**

Gina Capretta and Mehrdad Hajibabaei

Biodiversity Institute of Ontario and University of Guelph, Department of Integrative Biology

Biomarker genes conventionally investigated in ecotoxicogenomic studies are often vertebrate specific and, consequently, cannot be used to assess the functional genomic response of many invertebrate bioindicator species or standard toxicological organisms. Whole transcriptome analysis is also not a feasible option due to the associated computational challenges of large data sets. As such, a targeted approach, one that identifies a suite of xenobiotic-interacting genes conserved across taxa would benefit environmental biomonitoring efforts. PCBs are ubiquitous legacy contaminants toxic among metazoans. Using publically available online databases, a local library of PCB-interacting genes with known homologues across multiple taxa was generated. Using the sequence information available on GenBank for each PCB-interacting gene, seven complementary DNA (cDNA) sequences from six different taxonomic groups were downloaded and aligned. A conserved domain was identified for each PCB-interacting gene. With this method, a key set of evolutionarily conserved PCB-interacting genes (N=64) was determined. Of these genes, 20% involve cellular processes, 16% involve genetic information and processing, 28% involve environmental information processing, and 36% involve metabolism. For each conserved domain per gene, overall nucleotide conservation ranged from 49.50 to 72.76%, (average = $56.02 \pm 5.21\%$) with similar nucleotide conservation profiles across each KEGG pathway.

2 **Phylogentic analysis of weak electric knifefish of the family *Apteronotidae* (Teleostei: *Gymnotiformes*: *Apteronotidae*)**

Farzeen Daruwalla and Nathan Lovejoy

University of Toronto

The South American rivers and streams are home to a number of endemic electric fishes. These fishes have developed various morphological and genetic adaptations that allow them to thrive in the murky waters of the Amazon river. A family of weak electric fish known as *Apteronotidae* consists of 25 species from 12 genera of the order *Gymnotiformes*. These fish have developed a primary sensory mechanism such as an electric organ that aids them to survey their environment. Previous morphological and electric organ studies have restricted the taxonomic classification of the family by generating a phylogeny with a small sample size. This study aims to generate a phylogenetic tree of the family *Apteronotidae* using mitochondrial cytochrome b (CytB) and nucleus recombination-activating (RAG2) genes. CytB is a good indicator of interspecific variation between species due to its high evolutionary rate. In contrast RAG2 a nuclear gene has a slower evolutionary rate and is highly conserved. Using basic PCR and DNA extraction techniques the gene for CytB and RAG2 were amplified and phylogentic trees were constructed using PAUP analysis, after sequences were edited. Our results indicated differences in phylogenetic patterns using CytB and RAG2 genes as criteria. Our study adds to the lack of molecular data for the family *Apteronotidae* and addresses the limitations of using just morphological data. In conclusion,

genetic analysis and morphological analysis would allow for an explicit phylogeny of Apterodontidae.

3 **Does habitat heterogeneity affect tadpole development?**

Anastasia Savrova and Stephen C. Loughheed

Tadpoles exhibit phenotypic plasticity when placed in unpredictable environments. To survive inhospitable wetlands many tadpoles will accelerate their developmental rate and in consequence to this, metamorphose at a smaller size to ensure survival. However this may decrease fecundity and survivorship in adult stages of anurans. We investigated developmental responses to differing habitats in 3 focal frog species at the Queen's University Biology Field Station: *Pseudacris crucifer*, *Lithobates sylvaticus*, and *Hyla versicolor*. From May-July 2014 daily sweeps were conducted in 9 marshes, tadpole length measured and stage of development (Gosner Stage) was identified. Marshes were classified by hydroperiod into 4 types. *H. versicolor* showed a significant difference in size at metamorphosis among wetlands ($P < 0.05$). Developmental rate also differed significantly in wetland type for *H. versicolor* ($P < 0.05$). Developmental rate among individual wetlands differed for *H. versicolor* ($P < 0.01$) and *P. crucifer* ($P < 0.05$). There may be several environmental factors that can account for these differences in developmental rate and size at metamorphosis including hydroperiod, predator and population density, food quality and availability, temperature of the wetland, inter/intra-specific competition, and microhabitats within a wetland. Future studies may consider looking at these factors individually and see how significant their effect is on tadpole development.

4 **Fluctuating asymmetry of Chilean *Xeromelissa rozeni* mouthparts**

M. Miklasevskaja and L. Packer

Fluctuating asymmetry (FA), random deviations from perfect symmetry in bilateral traits, is a common measure of developmental stability (DS), which is defined as one's ability to buffer against environmental and genetic perturbation. There is a widespread hypothesis that heterozygosity grants an increased ability to compensate for genetic variation caused by genetic and environmental factors, rendering homozygous individuals less symmetric. This hypothesis is especially well tested in haplodiploid organisms, which present a clear distinction between "homo"zygosity (males) and heterozygosity (females). Relatively few FA studies looked at this relationship in Hymenopterans or in haplodiploid organisms in general and the results are rather inconsistent. In addition to this, if natural selection on FA is common, non-essential traits should exhibit higher asymmetry than functionally essential traits. This study compares FA measurements of seven maxillary palp segments (taken to the nearest 0.1 μm) between males and females of the Chilean bee, *Xeromelissa rozeni*. The results showed no sign of FA difference between sexes for any of the traits ($P > 0.05$). Although a significant difference in FA variation among traits was noted with an exceptionally high levels of FA in membranous and apical (non-functional) parts ($P < 0.01$). The results of this study suggest that there is an equally strong selection force for maxillary palp symmetry in both males and females leading to a relatively low FA in both sexes, and that less functional traits exhibit higher FA due to relaxation of selection.

- 5 **Body shape diversification in freshwater anchovies**
Michael Dobrovetsky, Matthew A. Kolmann, Devin D. Bloom, and Nathan R. Lovejoy

Freshwater and marine habitats differ in a variety of selective pressures and ecological circumstances. These differences are likely to have affected the evolution of marine and freshwater lineages. Here, we test whether marine and freshwater lineages of anchovies (*Engraulidae*) exhibit differences in the evolution of body shape. We examine the body, jaw, and gill shape along with weight of 36 closely related marine and freshwater species. We predicted that freshwater species would be more diverse in body shape compared to their marine relatives, and our data supports this hypothesis. This suggests that fishes living in freshwater may evolve at higher rates than their marine counterparts.

- 6 **Ecomorphological diversification in the Lost World**
G. E. Fuss and H. Lopez-Fernandez
University of Toronto, Department of Ecology and Evolutionary Biology

The selection factors determining niche specialization and community assembly evolution have long been contemplated by community ecologists. While competition appears to be a driving force, many other alternative forces can also impact community assembly. Examples range from resource availability to resource distribution, niche availability, and total geographic area. More specifically, it has been shown that smaller environments with less resources select for generalized niches, as does less interspecies competition. In contrast, it has been suggested that niche specialization is foremost limited by evolutionary time, however this is masked by immigration in most communities. The Mazaruni River in Guyana offers an excellent opportunity to determine the impact of such selection factors on community ecology, as the upper portion has been geographically isolated by rapids for many years. This has resulted in an absence of immigration and emigration in the river, creating a different population structure than the nearby rivers, and presumably much less competition. To determine the impact of this isolation on community assembly and niche evolution, a Principal Component Analysis (PCA) was performed on ecologically relevant morphological traits to reduce the data to fewer axes that represent the majority of morphological variation. This was used to determine the distribution of the community within morphospace, and subsequently the ecological niches occupied by different species by comparison with habitat data. The resulting distribution was compared with a PCA previously performed on a nearby non-isolated community to determine the difference in occupied niches and niche size, and subsequently the impact of isolation on these factors.

- 7 **Assessing the potential of metabarcoding for measuring beta diversity using three plots of Costa Rican dry forest**
Lisa Ledger, Shadi Shokralla, Joel F. Gibson, and Mehrdad Hajibabaei
University of Guelph

Can environmental metabarcoding find a place in the ecologist's toolkit for measuring beta diversity? Using Illumina MiSeq sequencing technology and the trap contents from a total of nine Malaise traps distributed across three plots of Costa Rican dry forest of varying successional age, we set out to answer this question. Through the use of multiple marker regions (COI and 16S) and multiple primer sets for each, we generated distribution patterns both within and between sites for terrestrial arthropods and their associated prokaryotes and concluded that metabarcoding on its own was both able to differentiate between sites and that observed beta diversity varied between the markers, and by extension the

taxonomic groups they target. The addition of further marker regions (18S, rbcL) in future is anticipated to further support these conclusions.

8 **Assessment of below-ground plant diversity in wetland soil through environmental DNA**

Nicole Fahner^{1,2}, Mehrdad Hajibabaei^{1,2}, and Donald Baird^{3,4}

¹Biodiversity Institute of Ontario¹, ²University of Guelph, Department of Integrative Biology,

³Environment Canada at Canadian Rivers Institute, ⁴University of New Brunswick,
Department of Biology

Plant communities are essential to ecosystem function thus plant diversity is an informative aspect of ecosystem health that can be assessed for biomonitoring initiatives. This can especially be critical in wetlands as they go through changes in hydrological regimes. Biodiversity analysis from environmental DNA through DNA barcoding in combination with next-generation sequencing techniques offers a solution to past vegetation survey impediments. Due to the relative stability of DNA and the below-ground accumulation of plant tissues - from actively growing roots and rhizomes to dormant seeds and non-living plant detritus - this method is expected to capture plant diversity from broad spatial and temporal scales in a single sample. This research will examine variance in below-ground vegetation diversity relative to past above-ground vegetation surveys in the hydrologically variable Peace-Athabasca Delta wetlands of Wood Buffalo National Park while also addressing the challenging trade-offs between size of DNA marker region and taxonomic resolution inherent with degraded environmental DNA.

9 **Diversity of exotic and native plant species in urban forests of varying size**

Meghan Krajchi, Lisa Derickx, and Pedro M. Antunes

Algoma University and Invasive Species Research Institute

Invasive exotic plant species can alter ecosystem composition and threaten biodiversity. Little is known about the effect of exotic plant diversity on native plant diversity in urban forests and whether the size of these forests determines their susceptibility to exotic plant species introduction and establishment. We examined the relative abundance and identity of exotic plant species across the urban forests of Sault Ste. Marie, Ontario. These data were used to determine if there is a relationship between exotic plant species diversity and native plant species diversity in urban forests and if forest size plays a role in this relationship. We hypothesized that there would be a greater abundance of exotic species than native species in urban forests. Of the species recorded in urban forests, only one quarter were exotics. There was a positive relationship between native plant diversity and exotic plant diversity. As forest size increased, native plant diversity remained stable, while exotic plant diversity decreased. This indicates exotic plant species found in these forests are not invasive. Smaller urban forests have both greater exotic plant diversity and overall plant diversity than larger urban forests. Further study is needed to compare forests across different cities and over time.

10 **Predicting the occurrence of a non-native warm water fish species, smallmouth bass (*Micropterus dolomieu*), in Ontario lakes under future climate change scenarios**

Samantha Stefanoff and Sapna Sharma
York University

Climate change is predicted to increase the surface water temperatures of Ontario lakes, and subsequently increase the number of thermally-suitable lakes for warm water fish species, such as smallmouth bass. The northward shift of smallmouth bass (SMB) populations is proposed to have profound implications on native fish populations through predation and competition pressure. This study aims to investigate the lake morphometry, water chemistry, climatic and biotic factors that are important in determining the current and potential future distribution of smallmouth bass under scenarios of climate change. We used data collected by the Ministry of Natural Resources on 9885 lakes in Ontario to develop a logistic regression model to predict the occurrence of smallmouth bass. Preliminary analysis suggests that mean July air temperature is an important predictor of smallmouth bass occurrence in Ontario lakes, suggesting that smallmouth bass prefer regions with higher July air temperatures. With additional suitable habitat becoming available for this warm water fish species under scenarios of climate change, smallmouth bass are predicted to shift their range northward and potentially competing with greater numbers of native coolwater and coldwater fish populations. It is important to study where smallmouth bass may occur in the future to help protect these regions from possible invasion.

11 **The European fire ant in Canada**

Narisha E. Ali

Despite conventional geo-climatic barriers, forces such as global warming, globalization of trade, and urbanization, are driving the introduction of Invasive Alien Species (IAS) in greater frequency and range. The U.S. history is characterized by successive non-native ant establishment (e.g. Argentine Ant (1891), black imported fire ant (1918), red imported fire ant (1930), tawny crazy ant (2002)). Colonization by the European Fire Ant *Myrmica Rubra* through eastern coast U.S. is well documented, and is now present in QU (1957), ON (1975), NS (1998), NB/PEI (2008), and NL/BC (2010). Based on the US experience, Canada may be facing similar social and ecological challenges with the spread of *M. rubra*.

Outside its native range *M. rubra* causes significant impacts to humans, non-human species, and ecosystems. BC estimates \$100M annually over 20 years in combined health and property impacts. Municipalities in the GTA see the issue as cross-boundary, therefore, not their responsibility; while provincial and federal governments view it as a private property issue. Since an effective control of *M. Rubra* is nonexistent, control and mitigation can only occur with early detection, rapid response, and cooperation. Rapid wide-scale spread due to contaminated soil movement is clearly linked to issues around land use planning due to ongoing infill, new developments, and large infrastructure projects in the GTA that generate significant soil surplus.

In my research I hope to answer critical questions that can contribute towards the development of a more complete understanding and effective approach to addressing the spread of *M. rubra* in the GTA.

12 **Effects of an invasive slug on native ant-plant seed disperser mutualisms**

Shannon Meadley Dunphy¹, Kirsten Prior², and Megan Frederickson¹

¹University of Toronto, ²University of Florida, Gainesville

In eastern North America up to 30% of herbaceous plant species in forests are specially adapted with ant-dispersed seeds (myrmecochory). In myrmecochorous systems plants offer ants an ant-attractant food reward (elaiosomes) in exchange for seed dispersal. However, ants may not be the only organisms attracted to the elaiosomes; here I show that the invasive slug, *Arion subfuscus*, eats the ant-attractant food reward, reducing the attractiveness of the seeds to ants preventing them from dispersing the seeds. Through seed removal/predation experiments and video monitoring I offered seeds of Canadian wild ginger (*Asarum canadense*) to forest communities, allowing access to different combinations of ants, slugs, and rodents to assess the effect of each group on seed fate. Ants visiting the seed depots were the primary seed dispersers, while slugs consumed only the elaiosomes. Lab trials confirmed that elaiosome consumption by slugs prevents ants from dispersing the seeds; thus possibly removing a valuable food supply for the ants and preventing new seedlings from establishing. Disruption of native seed dispersal mutualisms by invasive slugs has potential large negative consequences for ants, myrmecochorous plants, and the forest community as a whole.

13 **Impacts of altered landscapes and future climate on the distribution of woodland caribou (*Rangifer tarandus caribou*) in Ontario**

Sara Masood, Jonathan Ruppert, Arthur Rodgers, and Sapna Sharma

Habitat alteration and climate change are two important environmental stressors posing increasing threats to the threatened forest-dwelling woodland caribou, *Rangifer tarandus caribou*, in Ontario. The first objective of this study was to identify important linear features, climatic variables, and habitat characteristics that influenced the distribution of woodland caribou in Ontario between 1980 and 2012. The second objective of this study was to predict how climate change will affect woodland caribou distribution in Ontario in the mid-century (2050) and late-century (2070). Caribou occurrence, linear features, and habitat data were obtained from Ontario Ministry of Natural Resources, and historical climate data (1950-2000) was obtained from Intergovernmental Panel on Climate Change (IPCC). Projected climate data was used from 2 greenhouse gas scenarios (RCP 2.6 and RCP 8.5) of Canadian General Circulation Model for 2050 (2041-2060) and 2070 (2061-2080), obtained from IPCC. Logistic regression model indicated that linear features, climatic variables, and habitat characteristics were all significant predictors of current woodland caribou distribution. Moreover, it was found that woodland caribou avoid roads and extreme weather, and prefer coniferous forests. Future climate projections indicated a reduction along the edges of woodland caribou distribution by 2050 and 2070. These results highlight the negative consequences of altered landscapes and climate change and can be integrated in management decisions to avoid woodland caribou extirpation in Ontario.

14 **The impacts of climate change, habitat alterations, human disturbance, and biotic interactions on wood thrush populations**

Guang Zhang, Jonathan Ruppert, Sapna Sharma, Bridget Stutchbury, and Emily McKinnon
York University

Climate change (temperature, precipitation, acid rain), habitat alterations (forest fragmentation, fire), human disturbance (road, urban density), and biotic interactions (nest predation and brood parasitism) influence the distribution of wood thrush, but their relative influences are not fully understood. We have 2764 study sites in total based on the Breeding Bird Survey (BBS). Our research questions are which climatic, environmental, and biotic variables influence the presence/absence, abundance, and trends of wood thrush. We analyzed wood thrush occurrence, abundance, and trends using logistic and linear regression models, classification and regression trees, and boosted regression trees. Geography explained 59% of the variation in the occurrence of wood thrush, such that wood thrush is found in eastern United States and southeastern Canada. The important predictor variables on explaining the abundance of wood thrush are vegetation, acid rain, and spring temperature, reflecting wood thrush as forest-dwelling Neotropical migrant and impacted by the acid rain in late 19th century. The model describing trends of wood thrush explained very little variation (19%) by abiotic, biotic, and climatic variables in the breeding region. This suggests that the declines in wood thrush may be attributed to environmental stressors in their wintering range, such as tropical deforestation. Our findings suggest the abundance of wood thrush within the BBS range is largely dependent on the vegetation in the breeding region, but their trends may be mainly determined by variables in their wintering grounds. The results of our study can also be applied to other Neotropical migrants for conservation purposes.

15 **Effect of chronic wastewater exposure on aggression in the round goby**

Emily Krutzelmann, Erin McCallum, and Sigal Balshine
McMaster University

Municipal wastewater often contains a complex mixture of contaminants, many of which are not removed by conventional treatment methods. Physiological impacts have been observed in fish downstream from wastewater treatment plants but little is known about how wastewater exposure affects behaviour. We assessed the effect of chronic wastewater effluent exposure on aggression and resource contests in the invasive round goby (*Neogobius melanostomus*), a highly aggressive species. We exposed 57 round goby (24 males, 33 females) for 4 weeks to one of three concentrations of effluent: 100% (high dose), 50% (intermediate dose), and 0% (control dose). Fish were then tested using a resident-intruder paradigm. Our results show that males decreased submissive behaviours at higher doses, while females did not. However, exposure did not influence the total number of aggressive acts or contest duration. Interestingly, females had significantly longer contests with more aggressive bouts than did males across all doses. Our study suggests that effluent exposure may be affecting contest behaviour in subtle ways; exposed fish appear unable to effectively assess when to submit to a larger intruding fish. Additionally, our findings show sex differences in aggression in the round goby, a novel result as female aggression has not been studied before.

16 **Summer extreme precipitation events drive changes in soil moisture and growth traits in multiple southern Ontario wetland species**

Teresa J. Didiano and Tim P. Duval

University of Toronto Mississauga, Department of Geography,

Forecasted precipitation regimes are characterized by changes in the magnitude and frequency of rainfall, which will impact plant-water interactions in wetland plant communities. While the response of wetland plants to changes in precipitation regimes are typically documented under static precipitation-water table conditions (constant water table), fewer studies have examined the impacts of transient precipitation-water table conditions (fluctuating water table). Here we seek to understand the response of wetland plants to transient conditions by answering two questions: i) Do transient conditions modify soil water availability? ii) Do wetland species exhibit varying growth rates induced by transient conditions? To do this, we established a greenhouse common garden using multiple species (four forbs, two rushes, one grass, and one sedge), applied three watering treatments (control, transient condition, and intense transient condition), and measured soil moisture and growth traits. We found repackaging precipitation into fewer, larger events caused an increase in soil moisture variability and plant growth for five of the eight species; however, this change depended on the magnitude of the event. Transient conditions reduced total biomass in one rush species by 51% and all forb species by 38-50% relative to the control, whereas intense transient conditions had no effect. This decrease was driven by changes in aboveground biomass, belowground biomass, and/or leaf production. Our study shows that summer extreme precipitation events of lower magnitude have negative impacts on plants, while plants grown in larger magnitude events perform similar to natural conditions.

17 **Environmental influence on sexual dimorphism and sex ratio in a dioecious plant**

Teresa Maddison and Spencer Barrett

University of Toronto, Department of Ecology and Evolutionary Biology

Species with separate sexes provide a special opportunity to study features such as sex ratio and sexual dimorphism. Environmental condition plays a critical role in determining the phenotype of an individual, and may influence the expression of sexually dimorphic traits. When resources are limiting, organisms are expected to invest in a trait that maximizes reproductive ability only after they are able to survive. Moreover, stressful conditions may cause sex-biased mortality, influencing the population sex ratio. I investigated the environmental influence on sex ratio and the expression of sexually dimorphic traits in *Rumex rothschildianus*, an annual wind-pollinated flowering plant. Environmental stress affected the expression of vegetative traits, but did not reveal any sexual dimorphism. As environmental conditions became less stressful, flower production became more sexually dimorphic: males increased flower production, while females showed no change. I postulate increasing sexual dimorphism of flower production is due to differential costs of reproduction of the sexes. Females must invest in both flower and seed production, and so do not modify allocation to flowers across environments, but later invest heavily in seed production. An increase in seed production was seen in the low-stress environment, supporting this proposition. In more stressful conditions, the sex ratio became more female-biased, potentially due to male Y-chromosome degeneration increasing male mortality in such environments. Most, if not all, of the literature regarding the influence of environment on sexually dimorphic traits has focused on animals, and such studies will help unify

perspectives on sexual dimorphism in plants and animals.

18 **Effects of simulated recurrent inclement winter weather on the stress response and feeding behaviour of white-throated sparrows (*Zonotrichia albicollis*)**

Andrea Boyer¹ and Scott MacDougall-Shackleton²

¹Western University, Department of Biology, ²Western University, Department of Psychology

Climate change has been linked to increasing frequency and severity of violent, unpredictable winter storms and other extreme weather events at nearly all latitudes. As climate change becomes a more prominent issue in the present, it is important to study and understand the effects that climate change, particularly inclement winter storms, will have on species in future years. There has been prior research regarding how birds cope with winter weather and their ability to predict oncoming inclement weather, but limited research surrounding how birds respond, both physiologically and behaviourally, to recurrent inclement winter storms over a long-term period. The primary objective of my study is to determine the long-term effects that inclement winter weather has on white-throated sparrows' (*Zonotrichia albicollis*) stress response system and feeding behaviour. I used a hypobaric climatic wind tunnel to simulate storms approaching, residing, and subsiding in the area by altering barometric pressure and temperature once per week for 10 weeks, and measured behavioural responses, body composition, and baseline corticosterone levels in birds exposed, or not exposed, to weekly simulated storms. This novel research is important for determining the effects of future environmental conditions with respect to physiology and behaviour in a migrating songbird. Understanding how species will respond to predicted environmental changes will give an insight into future conservation and management strategies surrounding climate change.

19 **Molecular phylogenetics and the evolution of reproductive mode in halfbeak fishes from Southeast Asia**

Ahmed Elbassiouny¹, Tan Heok Hui², Devin D. Bloom^{1,3}, and Nathan R. Lovejoy¹

¹National University of Singapore, Department of Biological Sciences, ²Raffles Museum of Biodiversity Research, ³Biodiversity Institute, University of Kansas, Division of Entomology

Hemirhamphodon is a genus of Southeast Asian halfbeak fishes that is mostly endemic to the island of Borneo. The genus includes nine species; one of which is egg laying (oviparous) and the rest are live bearing (viviparous). However, the sequence of evolution of these reproduction modes is poorly understood. Here, we use molecular phylogenetics to determine the directionality of evolution of reproductive mode. We amplified and sequenced five genes from eight species of *Hemirhamphodon*, including one egg-laying species and seven live-bearing species. Our molecular phylogeny suggests that *Hemirhamphodon tengah*, the egg-laying species, evolved from live bearing ancestors. Our study provides insight into diversification events and biogeography in continental Southeast Asia.

20 **A longitudinal examination of hermit thrush (*Catharus guttatus*) singing behaviour**

J. W. MacLeod, S. P. Roach, and L. S. Phillimore
Dalhousie University

Passerine songbirds can be divided into closed learners, which acquire their song repertoires during a critical period early in life and don't add to that repertoire thereafter,

and open learners, which can continue to learn new songs after that early period (Beecher & Brenowitz, 2005). The default assumption has been that most songbirds are closed learners, yet actual evidence of this exists for relatively few species. Indeed, recent research suggesting that some birds traditionally thought to be closed learners may in fact have open learning abilities (e.g., Great Tit; McGregor & Krebs, 1989) highlights the need for this issue to be examined in additional species. The current study looked for between-season song repertoire changes in adult male hermit thrush (*Catharus guttatus*) individuals. Eighteen males (13 colour-banded) were recorded spontaneously singing on territory during consecutive breeding seasons, and their singing bouts were analyzed to generate song type repertoires. No season-to-season changes were detected in any of the individuals' song repertoires. The only changes detected related to song type variants, which are characterized by how they combine the introductory and post-introductory portions of different song types, as well as their extremely rare occurrence. These variants differed between season with respect to their structure and frequency. The use of colour banding in this study also generated information regarding breeding site fidelity, which was 50%, and partially addressed the utility of song type repertoire composition for accurately identifying individual males by song.

21 **The timing of the dawn chorus in a temperate bird community is related to both moonlight and meteorological conditions**

Jennifer Foote¹, Adrianna Bruni², and Dan Mennill²

¹Algoma University, ²University of Windsor

Male songbirds of many species sing at high rates before sunrise resulting in a pronounced dawn chorus. The time that males begin to sing varies both within and among species. The extrinsic factors that may influence the timing of the dawn chorus for North American bird species have received little attention. In this study, we consider relationships between the start time of the dawn chorus and ambient temperature, precipitation, cloud cover, lunar phase, and Julian date. We used automated recorders to record the dawn chorus at twelve locations near Echo Bay, ON. We focused on six common bird species in this northern temperate agricultural community. There was a clear temporal order in dawn chorus start time among species; Alder Flycatchers begin singing earliest in this group of birds, followed by Song Sparrows, White-throated Sparrows, American Robins, Eastern Phoebe, and Black-capped Chickadees. Our results indicate that a different suite of environmental factors influenced the chorus start times of different species and to different degrees. In general, we found that males began singing earlier with full or third quarter moon (when moonlight is present at dawn) and with increasing temperature at nautical twilight. Males began singing later with presence of cloud cover and precipitation. Males started to sing later as the season progressed or showed a mid-season peak of early singing. This investigation reveals that extrinsic abiotic factors have a significant effect on the timing of the dawn in north temperate birds.

22 **Circadian variation in ovenbird song rate for two song types**

Ashley Hunter and Jennifer Foote

Algoma University

In many bird songbirds, males sing different types of songs and these songs often have distinct functional roles. Male ovenbirds (*Seiurus aurocapilla*) sing a loud regular song that sounds like 'teacher-teacher'. This regular song type is sung at a high rate and likely functions in territory defense and mate attraction. Male ovenbirds also sporadically sing a

flight song that may or may not be accompanied by flight. The timing and functions of this song type are not well understood. We used automated recorders to record 22 male ovenbirds continuously for 24 hours. We determined the song rate for regular and flight songs across eight time periods: afternoon, evening, dusk (sunset-civil twilight), night (divided into two equal periods), dawn (civil twilight-sunrise), and morning (divided into two equal periods). We found that regular songs were sung significantly more often at dawn and during the morning than they were from afternoon to dusk. Regular songs were not sung at night. We found that flight songs were sung only from afternoon until just prior to the dawn chorus. However, flight songs were least common during the afternoon period and increased significantly in the evening. Our results show that the two song types of ovenbirds have distinct peaks during the daily cycle. Our results suggest that the two song types could have distinct functional roles. In addition, the peaks in song rate for each type may correspond to the highest period of song transmission.

23 **Cultural evolution of song: Do zebra finches go wild?**

Adriana Diez and Scott MacDougall-Shackleton

In both songbirds and humans exposure to conspecific vocalizations is required in order to produce effective communication signals. Birds reared in isolation produce an abnormal isolate song. However, birds tutored with isolate songs progressed toward a more species-typical version over generations (Feher et al. 2009 *Nature* 459:564-568). Thus zebra finches (ZF) may have a biased predisposition to sing their conspecific song, but tutoring is required in order to transform the isolate song toward a wild type (WT) song. Here, I explore if this effect is associated with the fact that the first tutor was an isolate ZF that sang a song with ZF characteristics, or if the social interaction with a tutor is what matters. I raised birds over multiple generations starting with WT song, isolate song, and song of ZF tutored by heterospecific Bengalese finches (BF). The tutee of each generation served as the tutor for the next over 3-4 generations. Preliminary results show phonological and syntactic changes occur over generations from a BF-like song and isolate-like song toward more WT song. Thus in both cases it appears that the birds have an inherent bias to use song features from their tutor that most closely match their species-typical songs.

24 **Can automated recording be used to discriminate among male ovenbird songs?**

Mandy Ehnes and Jennifer Foote

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Many species of birds produce individually distinctive vocalizations. Birds can recognize other individuals based on the distinctive features of their songs and researchers can use bioacoustics tools to discriminate among individuals. Typically, bioacoustics analyses use recordings made with highly directional microphones that are free of background noise and spectral overlap. However, recent technological advances in automated recording have made it possible to record remotely and cover larger areas simultaneously. However, whether individually distinctive features of songs can be used to discriminate among individuals from automated recordings has not been tested. We test whether spectrogram cross-correlation can be used to discriminate among songs of 19 ovenbirds (*Seiurus aurocapilla*). We used two microphone types: directional microphones and omni-directional microphones of automated recorders. Because birds may vary in their distance from the recorder, we selected songs that were either loud (close to the recorder) or quiet (further from the recorder). We found that all recording types could be used to discriminate the songs of individual male ovenbirds from other males in the population. We found that the

discrimination among directional recordings was significantly better than among omnidirectional recordings. Additionally, we show that louder recordings from song meters can be used to discriminate among individuals significantly better than quiet recordings. Our results suggest that automated omnidirectional could be valuable for future behavioural research allowing individuals to be followed over an entire breeding season. In addition, our results suggest that acoustic surveys of communities could provide information about abundance as well as presence/absence of species.

25 **Identification and characterization of *Ostariophysan* alarm cues**
Imane Meddah, Mukund Jha, and Reehan Mirza

Ostariophysan fishes, which make up about 74% of freshwater organisms, rely on their ability to sense specific chemical information in order to assess and avoid risk predation. Alarm cues, which are released when fish epidermis sustains mechanical damage that occurs during a predation event, enhance prey's ability to detect and respond appropriately with an antipredator response. While a tremendous amount of work surrounding predator-prey interactions within the Ostariophysi Superorder has been performed, the chemical identification of alarm cues has received relatively little attention. The objective of this research is to develop a methodology to identify the chemical structure and characteristics of Ostariophysan alarm cues via analytical methods and subtractive-combination bioassays. Fish skins will be subjected to different processes of extraction and separation in order to produce several molecular fractions which will be subsequently used as stimuli in behavioural assays. Once the active fraction(s) is isolated, gas chromatography – mass spectrometry (GC-MS) and nuclear magnetic resonance (NMR) will be used to identify the chemical structure of the active compound in alarm cues. Upon effective identification and characterization of these cues, further studies can be performed to understand the anti-parasitic and UVB radiation defence roles, thus consolidating the present knowledge on their ecological role and evolution across the Ostariophysi Superorder.

26 **Safety in numbers? An investigation of anti-predator behaviour in a social fish**
Aderinsola Odetunde, Constance O'Connor, Adam Reddon, and Sigal Balshine
McMaster University

Group living is associated with both benefits, such as more efficient defence of a shared territory, as well as costs, such as increased competition for food and mates. Therefore, the degree to which individuals are expected to prefer to group and preferred group size will depend on the ecological conditions. For example, previous studies have shown that many fish species form larger groups when exposed to predators, but tend to disperse when exposed to food odours. In the current study, we investigated how group size preference changed in the presence of olfactory and visual cues of predation, using a full-factorial design, in a cooperatively breeding cichlid fish, *Neolamprologus pulcher*. We presented focal *N. pulcher* with the choice between joining a small or large group, when exposed to different combinations of cues of predation. We found that these social fish had a baseline preference for the larger group when not exposed to predation cues. However, this preference disappeared when the focal fish were exposed to cues of predation. This somewhat counter-intuitive result suggests that *N. pulcher* do not use a simple 'safety in number' grouping response as an anti-predator behaviour. Thus, more complex factors, such as the superior ability to maintain or defend a territory or offspring in a group, are likely important factors in driving the evolution of group living in this highly social fish.

27 **The role of dopamine manipulation on the life history traits and colouration of male guppies**

Sara Pishdadian, Alex De Serrano, and Helen Rodd

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The Guppy (*Poecilia reticulata*) has a long history of being studied for sexual selection because of males' conspicuous colour patterns and courtship of females. In this experiment, guppies were treated with Ritalin™, which is known to decrease dopamine levels. This treatment has the potential to affect the guppy's behaviour, physical appearance and attractiveness to mates. I examined the guppies' size at maturity and carotenoid-based colouration. Ritalin is known to affect growth patterns in humans. Experiments with other species have shown a relationship between dopamine and melanin, however little research has been done on this pathway in vertebrates. I measured body length, the area of the orange (carotenoid-based) spots, as well as saturation of their carotenoid spots using digital photographs of control and experimental fish. Analyses showed that Ritalin did have a significant effect on carotenoid saturation in addition to body size. Also observed was a significant interaction effect among the fish lineages on orange spot size. This suggests there is a link between carotenoid colouration and dopamine in vertebrates as well as elaborating on the complex effects of Ritalin.

28 **The effects of L-DOPA on exploratory behaviour in *Poecilia reticulata* (guppy)**

Emily Xie

University of Toronto

Exploratory behaviour allows an animal to gather information about novel aspects of its surroundings. Combined with dispersal behaviour, high exploration rates can allow individuals to find areas with higher quality of food, better breeding spaces, fewer competitors, more mates, and reduce the risk of inbreeding. Disadvantages to exploration include the energy spent on travelling, and a high risk of predation for prey species, as exploring novel environments would mean leaving areas known to be safe. This trade-off results in a multitude of factors that influence the rates of exploratory behaviour within and between species. We studied exploratory behaviour in a fish, *Poecilia reticulata* from a natural population using the open-field test. *P. reticulata* is an excellent candidate for research in exploratory behaviour because they are known to disperse to new habitats and show considerable variation within and between populations. Studies in lab organisms suggests that the neurotransmitter dopamine is correlated with exploration, and we were interested in asking whether altering dopamine levels in *P. reticulata* affects their exploratory behaviour. This was done by administering L-DOPA, which is naturally converted to dopamine in the brain by aromatic amino acid decarboxylase (AADC). We will discuss differences in exploratory behaviour between L-DOPA treated and control individuals. This study will provide insights into the reward mechanisms involved in exploratory behaviour, allowing for greater understanding of motivation guiding the behaviour in natural populations. Future studies will include assays of dopamine levels in individuals from populations known to show high versus low levels of exploratory behaviour.

- 29 **Influence of intrahippocampal D1-type antagonist, SCH23390, on olfactory discrimination abilities in male and female mice**
M. M. Kivlenieks, R. Matta, A. N. Tiessen, A. M. Meersseman, Y. O. Adjei-Afriyie, and E. Choleris
University of Guelph, Department of Psychology and Neuroscience Program

The neurotransmitter dopamine has been implicated in various behaviours, including reward and motivational learning, social interactions (e.g. affiliation, aggression), and feeding. In 2011, Choleris et al. showed that dopamine plays a role in the social transmission of food preferences. Systemic injections of the D1-type dopamine receptor antagonist, SCH23390, blocked social learning in mice without affecting their feeding behaviour. Dopaminergic neurons in the ventral tegmental area project to various brain structures within the limbic system, such as nucleus accumbens, the amygdala, and the hippocampus. The latter plays a crucial role in various types of learning and memory, including social learning. Recently, we found that infusing SCH23390 (6 µg/µL) directly into the CA1 region of the hippocampus also blocked social learning without affecting feeding behaviour, suggesting an involvement of the hippocampus in dopaminergic mediation of social learning. However, an alternative explanation of these results is that influence of dopamine on social learning may be indirect, via effects on orosensory processing. Thus, we examined the effect of 6 µg/µL intrahippocampal infusions of SCH23390 in male (n=23) and female (n=21) mice on flavour recognition abilities. Using a discrimination task where SCH23390- and control-treated mice received a 5 min choice between two flavoured diets, we found that all mice were able to effectively discriminate between the two, and preferentially investigated a novel over a familiar flavour. The flavoured diets used were the same employed in the social transmission of food preferences test. Hence, the results of the present study allow us to rule out indirect effects of SCH23390 and support the notion that the DA1-type dopamine receptor in the hippocampus is directly involved in the mediation of social learning.

- 30 **Circulating and urinary adrenal corticosterone, progesterone, and estradiol in response to acute stress in female mice (*Mus musculus*)**
J. B. Thorpe, K. E. Gould, E. D. Borman, D. deCatanzaro
McMaster University, Department of Psychology, Neuroscience & Behaviour

In studies of stress, it can be difficult to obtain blood rapidly enough to avoid confounding steroid measures. Noninvasive urinary steroid measures may provide an alternative insofar as they reflect systemic steroids. In Experiment 1, we profiled urinary corticosterone, progesterone, and estradiol in ovariectomized female mice following one hour on an elevated platform. This increased urinary corticosterone for 3 hours and progesterone for 4 hours. In Experiment 2, blood and urine samples were obtained at 0–6-hour stressor offset. Females showed increased serum corticosterone and progesterone immediately after stressor offset. Urinary corticosterone was increased at both 0 and 2 hours post-stress, while an increase in progesterone 2–6 hours after stressor offset was not significant. Estradiol was not influenced by this mild stressor. In Experiment 3, mice were exposed to a more severe one-hour stressor, a rat across a wire-mesh grid. In serum, both corticosterone and progesterone were elevated immediately after stressor offset and returned to baseline within 2 hours. In urine, this severe stressor elevated corticosterone immediately and 2 hours after stressor offset, and in progesterone 2 hours after stressor offset. Estradiol in serum was not dynamic, but it was significantly elevated in urine 4 hours after stressor offset. Urinary measures generally reflected systemic measures; however, with a different

time course resulting in a longer return to baseline. We suggest that the relative value of serum or urinary steroid measures in mice depends upon the experimental design, and that estradiol may only respond when the stressor is severe.

31 **Does hippocampal estradiol play a role in the rapid estrogenic improvement of social learning?**

Kelsy Ervin, Amy Moore, Kathryn Sinclair, and Elena Choleris

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Social learning is an adaptive learning strategy in which animals acquire information from conspecifics, rather than through risky trial-and-error learning. In the social transmission of food preferences (STFP), an observer mouse interacts with a demonstrator mouse that has eaten a novel-flavoured food. When subsequently offered two novel foods, the observer prefers the food it smelled previously on the demonstrator's breath. We found systemic administration of 17 β -estradiol to improve social learning on the STFP within 45min, when behavioural effects are likely due to estrogens acting through rapid cell signaling mechanisms rather than gene transcription. However, where estrogens exert these effects in the brain is currently unknown. The hippocampus is a possible candidate; systemic estradiol increases dendritic spine density in the CA1 hippocampus, intrahippocampal estradiol rapidly facilitates learning in nonsocial learning tasks, and hippocampal lesions impair the STFP. Hence, we implanted female ovariectomized mice with bilateral guide cannulae aimed at the CA1 hippocampus. We infused observer mice with 0.5 μ L (per side) of vehicle, 25nM, 50nM, or 100nM 17 β -estradiol 15min prior to a brief social interaction with the demonstrator. We measured food preference during the choice test at intervals of 30min and 2, 4, 6 and 8h; the first measurement was therefore 45min after treatment to focus on the rapid effects of estradiol. We also used an STFP paradigm that was difficult, in which control-treated observers showed no social learning, in order to better see any enhancing effects of estradiol. Preliminary results show that the hippocampus may not mediate estrogenic rapid regulation of social learning, suggesting that the brain regions involved in estrogens' rapid effects on the STFP are different from those involved in non-social learning. We are therefore now assessing other regions of the "social brain", such as the amygdala, that may be involved in the rapid estrogenic enhancements of social learning.

32 **Rapid effects of hippocampal G-protein coupled estrogen receptor on social and object recognition learning in the absence of spatial cues in female mice**

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Estrogens can rapidly affect learning and memory tasks such as social recognition, object recognition, and object placement in female mice (Phan et al., 2011, 2012). Improvements in these tasks can be seen within 40 minutes of systemic and intrahippocampal administration of 17 β -estradiol, the estrogen receptor (ER) α agonist, PPT, and the recently discovered G-protein coupled estrogen receptor (GPER) agonist, G-1. These paradigms were performed in the test mouse home cage, thus providing a number of spatial cues the mouse can use to assist in recognition learning. The Y-maze was designed to eliminate most of these cues. Intrahippocampal administration of 17 β -estradiol improved object but not social recognition in the Y-maze within 40 minutes. However, systemic administration of 17 β -estradiol did improve social recognition. This means that brain regions other than the hippocampus are involved in mediating social recognition in the absence of spatial cues.

Intrahippocampal ER α and GPER agonists improve, while the ER β agonist impairs social recognition. This study investigates the role of hippocampal GPER on social and object recognition in the Y-maze. We infused 50, 100, or 200nM G-1 (0.5 μ L per side, 0.2 μ L/min) into the CA1 region of the hippocampus of ovariectomized female mice and evaluated their performance on object or social recognition in the Y-maze. The social recognition experiment is currently underway. 50nM and 200nM G-1 improved object recognition learning in the Y-maze. Thus, the estrogenic improvements on object recognition in the absence of spatial cues are mediated, at least in part, through hippocampal GPER.

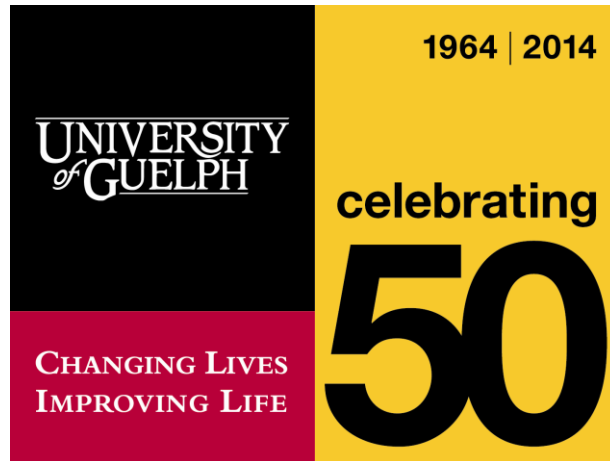
33 **Community Engaged Research**

Amanda Caskenette
University of Guelph

As a researcher that performs research in public spaces, it is beneficial to empower citizens that use these places with knowledge about our projects. When there is transparency in research, among other benefits, there is increased public awareness, acceptance, and reduced unintentional vandalism. This is why we started Inquisitive Citizen. Inquisitive Citizen will provide a way to inform the public that may be using the area near our sites as to the purpose of our research and equipment so they can be better informed. Using tags, the study site will be linked to a map that allows citizens to participate in your research or avoid sensitive areas. This map will also connect you to other studies that are occurring in your area, allowing for collaboration across fields of study. Beyond this, you will be able to use this tool to get a measure of pedestrian traffic to your sites, and can be included on your grant applications to fulfill community engagement requirements. The overall goal of Inquisitive Citizen is to break down barriers in research, and we need you to help us get started. We are looking for researchers to be test subjects for this field season. Come stop by our poster during the poster session to discuss possibilities.

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