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**Friday, May 11**

Plenary Speaker #1 Dr. Julie Morand-Ferron

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Friday, May 11th

Plenary Speaker #1

Dr. Julie Morand-Ferron
Associate Professor
University Research Chair in Cognitive Ecology,
Department of Biology, University of Ottawa
8:45 – 9:45 am in NCB 113

Intraspecific variation in cognitive performance in songbirds from contrasting habitats

The study of learning and memory has traditionally been dominated by the proximate approach, with ultimate questions on the evolution of cognition having been addressed rather recently. Models on the evolution of learning underline the importance of environmental variability and predictability in determining the value of information, but the impact of habitat characteristics on cognitive biases and abilities is not yet well understood. Here I present a series of experiments investigating individual variation in reversal learning in great tits (*Parus major*) inhabiting sites differing in elevation and climate harshness along the Pyrénées, France. We also examined the relationship between habitat and cognitive performance in food-hoarding black-capped chickadees (*Poecile atricapillus*). Spatial memory, exploration and social information use were compared in individuals living along an urbanization gradient in and around Ottawa, where more urbanized environments should be characterized by less intense winter food shortage due to the availability of artificial food sources. I discuss these results in the context of the ‘harsh environment’ and the ‘cognitive buffer’ hypotheses, and suggest approaches to examine sources of variation in cognitive phenotypes in natural populations.
Session #1 Effects of Predation and Fear

Friday May 11th in NCB 113.
Moderated by Lauren Witterick.

10:15 AM  Fear of predators has long-lasting effects on the brain and behaviour in wild animals
Authors: Lauren Witterick¹, Julia Hryniewicz¹, Scott MacDougall-Shackleton¹, Craig Bailey², Michael Clinchy¹, Liana Zanette¹
Author Affiliations: ¹University of Western Ontario; ²University of Guelph

Predators affect prey populations not only through direct killing, but also through perceived predation risk – the ‘fear’ of predators. Responding to predation risk is critical for prey survival, however perceived predation risk can have lasting effects ranging from individual changes in neurobiology up to population level effects. To experimentally test the lasting effects of predator ‘fear’ on the brain and behaviour, we manipulated perceived predation risk using auditory playbacks of predators or non-predators in wild caught brown-headed cowbirds (Molothrus ater) in large outdoor aviaries. We found differences in escape behaviour during the predation risk manipulation and lasting changes in neurogenesis and dendritic morphology one week after exposure to increased predation risk. Our research aims to integrate results from biomedical research showing long-lasting fear effects on the brain in lab animals (rats) with fear-induced behavioural changes documented by ecologists in the field.

10:30 AM  Dynamics of Herring Gull Predation of Chimney Swifts at a Migratory Roost
Authors: Fera, B. R.¹,³, Pearce, J.², Foote, J. R.³
Author Affiliations: ¹Department of Psychiatry and Behavioural Neuroscience, McMaster University, Hamilton, Ontario, Canada; ²Pearce & Associates Ecological Research, Sault Ste. Marie, Ontario, Canada; ³Department of Biology, Algoma University, Sault Ste. Marie, Ontario, Canada.

Many aerial insectivores, including chimney swifts (Chaetura pelagica), have experienced large-scale population declines. We know very little about how predators may impact chimney swift populations. We examined novel predatory behaviours of herring gulls (Larus argentatus) on chimney swifts at a migratory roost in Sault Ste. Marie, Ontario. We used a video surveillance system combined with behavioural observations in the field to study gull predation at and around the roosting chimney during the 2016 breeding season. In total, we documented 47 predation events with 17 resulting from aerial pursuits and 30 resulting from captures by gulls perched on the roost. We found a significant positive correlation between the number of swifts captured and the total number of swifts roosting for both aerial and perched captures. Perched herring gulls were significantly more successful at capturing swifts as they exited the chimney in the morning compared to when entering at night. Captures at night were significantly more likely to result from aerial hunts. We show that approximately 2% of the local population was lost to predation, which combined with other potential changes to habitat and prey abundance could become a significant threat in the future.
Predators kill, but the fear of being killed has recently been demonstrated to be a powerful force in its own right. Perceived predation risk is critical in affecting prey populations in addition to maintaining ecosystem structure and function. Large carnivores in particular have been identified as key drivers of fear effects on prey that can result in cascading effects through the food chain. Facing growing extinction rates worldwide, experimentally testing the fear reactions of prey to large carnivores in a multiple-species system is essential to understanding the full scope of their role in a given ecosystem. Using a new Automated Behavioural Response system that combines audio playbacks with automated camera traps, we offer the first large-scale assessment of the anti-predator reactive responses of South African wildlife to large carnivore cues at the Klaserie Private Game Reserve. We contrasted the behavioural responses of 27 species of prey and competitors to three predator vocalizations (lion, cheetah and wild dog) at 18 different sites, using non-predator calls as a negative control. We experimentally demonstrated the existence of a clear hierarchy of fear in which lions overshadow both wild dogs and cheetahs. Our findings corroborate the hypothesis that prey use rules of thumb in choosing appropriate reactive anti-predator strategies. Our research provides new means for investigating the differential roles that large carnivores exert in multi-predator systems and for elucidating how incomplete predator guilds arising from growing extinction rates, can alter prey demographics and lead to potential cascading effects on ecosystem function.
Soil systems are biodiverse and responsible for important ecosystem processes such as decomposition, recycling of nutrients, and carbon storage. Understanding how global change factors and cascading effects of global change affect soil biodiversity and soil food web structure will allow us to link these changes to potential outcomes in ecosystems processes. We tested whether top-down (predator) and bottom-up (nutrient) processes are moderated or altered by warming using a novel experimental soil system comprising 80 mesocosms, simultaneously examining the impacts of temperature (12°C, 16°C), nutrients (control, nutrient addition) and predator addition (control, addition of Mesostigmata mites). Results indicate a peak in Mesostigmata (predator) abundance after 3 months followed by a decrease at the end of the experiment (6 months), and an increase in Collembola (prey) abundance throughout time. Top-down control by predators was negatively affected by warming as a single factor with consequent reduction in Mesostigmata abundance, whereas adding nutrients benefited their abundance, reinforcing nutrients as bottom-up players in the food chain. The interaction between predator addition and warming decreased Collembola abundance significantly, likely because warming induced mortality of predators was counteracted by the experimental predator additions, leading to no net change in predation pressure. P: P ratios showed no significant difference across all treatments and interactions. In fact, they were driven by changes in collembolan abundance rather than changes in mesostigmats. Taken together, these results suggest that warming alters top-down and bottom-up trophic cascades in soil systems by affecting predator and prey abundances with potential consequences for ecosystem processes.
The environment presents many stressors, and stress impacts the behaviour and
cognitive functioning of animals. Predators are common environmental stressors for
birds, and just the perception of a predator is enough to elicit a stress response. Part
one of this study examined the stress responses of songbirds to acute predator threats
that are perceived through one of three sensory modalities. Multiple species of songbird
were tested: wild-caught black-capped chickadees (*Poecile atricapillus*) and house
sparrows (*Passer domesticus*), as well as lab-bred zebra finches (*Taeniopygia guttata*).
Subjects were assigned to one of three experimental conditions in which they are
exposed to visual, auditory, or olfactory stimuli. Each group was exposed to a predator,
a non-predator, and a control stimulus in randomized order across three acute
exposure events lasting 30 minutes. Video recordings were taken during the exposure to
observe subjects’ behaviour. Blood samples were obtained immediately following
exposure and will undergo corticosterone analysis. Part two of this study investigates the
effect of exposure to chronic acoustic predator cues on spatial memory retention in
black-capped chickadees. Chickadees were first trained to retrieve seeds from artificial
trees. Spatial memory retention was tested after 14 consecutive once-daily exposures
(30 min) to a predator or non-predator call. Searching performance during training and
testing was monitored in real time from behind a one-way mirror. Analysis of data
collected for these experiments is currently underway. Insight gained from this research
will contribute towards understanding how the perception of predators influences
behaviour and memory.
Fear of predators halves recruitment rates and permanently handicaps survivors
Authors: Marek C. Allen¹, Michael Clinchy¹, and Liana Y. Zanette¹
Author Affiliations: ¹Western University, Department of Biology

Predators not only kill prey, but through the ‘fear’ of predation, predators induce costly anti-predatory responses in prey. Anti-predatory costs may scale up to effects on prey populations, through effects on prey reproduction and survival of juveniles and adults. My thesis focused on assessing how the perceived risk of predation affected prey population dynamics through effects on juveniles. I monitored the fate of juvenile song sparrows (Melospiza melodia) reared in study sites manipulated to be perceived as either a high or low predation risk environments using audio playbacks. Juveniles in my high predation risk treatments had lower survival, which effectively led to halving the recruitment rates compared to my low risk treatments. Furthermore, scared juvenile survivors were in poorer condition which appeared to have adverse, lifelong effects in males. Thus, predation risk costs can extend past early offspring reproductive output, all the way to recruitment, suggesting that the fear of predators can have a greater, negative effect on wildlife populations than previously demonstrated in terrestrial vertebrates.

The effect of nectar robbing on selection on floral traits of the native wildflower Impatiens capensis
Authors: McDonald, S.¹, Caruso, C.¹
Author Affiliations: ¹Department of Integrative Biology, University of Guelph, Guelph, Ontario, Canada

Floral traits commonly evolve in response to pollinators; however, these traits can also evolve in response to non-pollinator agents of selection. One example of potential non-pollinator agents of selection are nectar robbers, which damage the corolla and remove nectar from flowers without pollinating. This nectar robbing may not affect pollinator visitation rates, but can affect the duration of pollinator visits. Consequently, I predicted that nectar robbing would intensify selection on pollination efficiency traits, but not on pollinator attraction traits. To test if nectar robbers cause selection on floral traits, I experimentally robbed Impatiens capensis flowers. I measured one pollinator attraction trait (landing pad size), four pollination efficiency traits (opening size, corolla length, spur length, and spur angle), and two fitness components (seeds/fruit and conspecific pollen grains deposited/flower). Although the nectar robbing treatment did not affect the number of seeds/fruit or pollen grains/flower, selection on one pollination efficiency trait did differ between treatments. Specifically, robbed flowers experienced significant selection for greater spur angle via pollen deposition, while un-robbed flowers experienced selection for smaller spur angles. Furthermore, selection on a pollinator attraction trait (landing pad size) was not different between robbed and un-robbed flowers. Therefore, I did find evidence that nectar robbers can act as agents of natural selection on floral traits supporting the importance of non-pollinator agents of selection.
Chemical communication in birds has historically been understudied due to the long-held misconception that olfaction was unimportant or even non-existent in this group. Recently, however, a growing body of research suggests that avian chemical communication is more widespread than previously believed and that olfaction plays an important role in avian mate choice and reproduction, as it does in other taxa. Preen oil secretions from the uropygial gland contain volatile, odour-producing compounds and are considered the main source of avian body odour. Thus, preen oil may be involved in olfactory communication, particularly if the chemical composition of this substance differs between the sexes or varies seasonally. Using gas chromatography, we compared the preen oil chemical profiles of male and female song sparrows (Melospiza melodia) at different times of year (breeding versus post-breeding). We then tested song sparrows’ preferences for same- versus opposite-sex preen oil, using a two-choice behavioural trial. We also tested whether song sparrows attend to chemical cues of brood parasites. Brood parasitic brown-headed cowbirds (Molothrus ater) frequently parasitize song sparrow nests, and song sparrows react aggressively to the presence of female cowbirds. Thus, we tested song sparrows’ responses to female cowbird preen oil versus carrier solvent (control) using the same two-choice design. These experiments are a key step in determining whether songbirds are capable of using the information available in preen oil. Generally, our results suggest that chemical communication in songbirds may be more widespread than previously thought.
10:30 AM  **Drosophila melanogaster** stress Odorant (dSO) displays the characteristics of an alarm pheromone  
**Authors:** Ryley T. Yost, Emerald Liang, Megan Stewart, Selwyn Chui, Andrew F. Greco, Shirley Q. Long, Ian S. McDonald, Jeremy N. McNeil, and Anne F. Simon  
**Author Affiliations:** 1Department of Biology, University of Western Ontario, London, ON, Canada; 2Department of Physiology and Pharmacology, University of Western Ontario, London, ON, Canada; 3Department of Pathology and Laboratory Medicine, Schulich Medicine & Dentistry, Western University, London, ON, Canada

Social interactions are crucial for the reproduction and survival of organisms. One type of social information exchanged between organisms are danger signals, that can occur in the form of alarm pheromones. Generally, alarm pheromones are fast acting, highly volatile, and their avoidance is often contextual. In response to mechanical agitation or electric shock, *Drosophila melanogaster* emits a chemical compound termed the *Drosophila* stress odorant (dSO). Upon perception of dSO, flies avoid areas previously occupied by stressed conspecifics. However, it is not clear whether dSO is an alarm pheromone. The contextual, genetic and neural underpinnings of the response to dSO has received little attention, and the emission has received even less. Using a binary choice assay, we investigated the conditions affecting the emission of and response to dSO. We identified other stress mechanisms inducing an avoidance response, including simple transfer and occupation of an empty dry vial for twelve hours. Flies emit dSO regardless of the time of day, and for up to 2 hours after being stressed. However, dSO itself is highly volatile. We found that the emission of dSO was not age specific, when the response to dSO depends on age, sex, and mating status. Finally, dSO does not appear to be species specific. Taken together, these results support the notion that dSO is indeed an alarm pheromone.

10:45 AM  **Understanding the function of nocturnal song in ovenbirds: males do not countersinging at night**  
**Authors:** Kristen L. D. Marini, Homam AL-Ani, and Jennifer R. Foote  
**Author Affiliations:** Department of Biology, Algoma University, Sault Ste. Marie, Ontario

Contrary to popular belief, many diurnal birds do not spend all night sleeping; there is increasing evidence showing that many diurnal birds vocalize at night, often at low rates. While diurnal singing is extremely well studied, for most species, the function of nocturnal song remains poorly understood. The ovenbird (*Seiurus aurocapilla*) is one such diurnal species that sings occasionally at night, and previous research suggests that nocturnal song is influenced by environmental factors and may serve a social function. Here, we experimentally exposed male ovenbirds to nocturnal flight songs to test whether they attend to the nocturnal songs of conspecifics. We compared vocal output and latency to song both during the night and during the following dawn chorus to determine if males altered their vocal output in response to the nocturnal song of an unknown male. After playback exposure, we found no evidence of countersinging or change in the rate of nocturnal singing, nor any changes in vocal output during the dawn chorus. Our results suggest that nocturnal song does not serve as an intraspecific social function in ovenbirds, but instead may be used as a signal to females. Though nocturnal song is often infrequent, it may serve a function in the mating system of some diurnal bird species, including the ovenbird.
The neural basis of sexual selection, a driving force of speciation and evolution, remains poorly understood and rarely studied. More specifically, the neural distinction between receptivity of conspecific and heterospecific mates remains a mystery. *Drosophila melanogaster* females vary in their receptivity, depending on the quality and species of the courting male. The mushroom body is an area of the *Drosophila* brain that has been proposed as an area of sensory integration and higher order behavioural functions. Using the split-GAL4-UAS system, a spatially refined advancement of the well-established GAL4-UAS system, specific lobes of the mushroom body will be individually hyper-activated or silenced in *D. melanogaster* females. These females will then be paired with wildtype *D. melanogaster* males, or wildtype males of a closely-related sibling species, *D. simulans*, and assessed for differences in receptivity. These experiments will further our understanding of the mushroom body’s function, as well as provide insight into how conspecific and heterospecific receptivity are distinguished in the *Drosophila* brain.
Investigating effects of the social environment on variation in territorial vocalizations of red squirrels (*Tamiasciurus hudsonicus*)

**Authors:** Bain, M.¹, Wilson, D.R.², Boutin, S.³, Humphries, M. H.⁴, Dantzer, B.⁵,⁶, Lane, J. E.⁷, McAdam, A. G.¹

**Author Affiliations:** ¹Department of Integrative Biology, University of Guelph, Guelph, ON, Canada; ²Department of Psychology, Memorial University of Newfoundland, St John's, NL, Canada; ³Department of Biological Sciences, University of Alberta, Edmonton, AB, Canada; ⁴Department of Natural Resource Sciences, MacDonald Campus, McGill University, Ste-Anne-de-Bellevue, QC, Canada; ⁵Department of Psychology, University of Michigan, Ann Arbor, MI, U.S.A.; ⁶Department of Ecology & Evolutionary Biology, University of Michigan, Ann Arbor, MI, U.S.A.; ⁷Department of Biology, University of Saskatchewan, Saskatoon, SK, Canada

In vocal animals, acoustic signalling plays an important role in communication among conspecifics. Information about the social environment can be gathered from information contained within acoustic signals. In red squirrels, territorial vocalizations are used as the main form of defense to protect food caches from pilfering by conspecifics. These vocalizations signal the territory owner's presence to its surrounding conspecifics and are used to deter potential intruders. Previous studies suggest that red squirrels have vocal signatures that are individually unique from one another, and we want to explore why variation exists at the individual-level in territorial vocalizations. The acoustic niche hypothesis suggests that variation in vocalizations is beneficial when there is potential risk of acoustic interference from the immediate environment. From this, we hypothesized that squirrels risk signal interference from conspecifics when traits of the signal are structurally similar. We predicted that if vocalizations are more important to the immediate social environment, then individuals' call properties are more variable at closer spatial scales, decreasing the chance of territorial vocalizations experiencing interference. Results from this will contribute to the body of literature that investigates contexts under which the social environment should be considered an important factor in variation in acoustic communication, even in territorial animals where social interactions are antagonistic.
Many bird species have multiple song types which serve distinct functions. Ovenbirds sing two song types, a short primary song consisting of a single repeated syllable and a more complex flight song consisting of many note types. While the primary song is sung frequently and is understood to be used for mate attraction and territory defense, the flight song is sung sporadically and its functional significance is not well understood. We investigated the daily and seasonal pattern of both song types in a breeding season. We recorded 24 male ovenbirds using autonomous recorders that recorded for 24 hours once per week. We annotated and identified all songs of both song types for individual males using the individually distinctive characteristics of the primary notes. We found that for both song types, there was significant variation at both daily and temporal scales. Primary songs were sung most often from the dawn chorus through the morning and were less common later in the day. Flight songs were sung in late afternoon, early evening, and throughout the night, terminating just before the start of the dawn chorus. The pattern of song type use was stable across the season. Song rate for both songs showed a similar seasonal pattern with the highest rates in late May-early June. Our results suggest that flight and primary songs may convey different information thus serving distinct functions.
Discrimination of familiarity in red squirrel (Tamiasciurus hudsonicus) territorial vocalizations

Authors: Robertson, J.G.¹, Boutin, S.², Humphries, M. H.³, Dantzer, B.⁴,⁵, Lane, J. E.⁶, McAdam, A. G.

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Territoriality arises when the benefits of exclusive access to resources exceed the costs of defending them. Behavioural plasticity increases the net benefits of territoriality by reducing defensive effort when unnecessary. The dear enemy phenomenon, where familiar territorial neighbours refrain from intruding on one another and reduce their defensive efforts, has been demonstrated in red squirrels (Tamiasciurus hudsonicus). The mechanism by which squirrels discriminate between conspecifics, which is necessary for this territorial plasticity, is unknown. Territorial vocalizations in this species are individually unique; we hypothesized that these calls are the mode of discrimination, and that squirrels would adjust their behaviour in response to the acoustic information in their environment. Our prediction was that familiar calls would deter neighbours from intruding on a territory, compared to the call of an unfamiliar individual. To test this, we performed a speaker replacement experiment where red squirrels (n = 42) were temporarily removed from their territories and replaced with a speaker broadcasting their own call or an unfamiliar call. Contrary to our prediction, broadcasting an unfamiliar call did not increase the risk of intrusion at a territory compared to the owner’s call. However, the identity of intruders did vary: familiar neighbours refrained from intruding on the owner’s call, but these individuals were more likely to intrude on the unfamiliar playback. Further studies of the dear enemy phenomenon would benefit from considering existing variation in familiarity within territorial neighbourhoods, rather than classifying conspecifics as a binary of familiar or stranger.
Evaluation of mercury and stress exposure impacts on songbirds health and migratory capacity

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In their natural habitat, wildlife has to face multiple stressors (i.e. predation, food unpredictability, climate change) in addition to pollutants burden. While growing evidences suggest that stress worsen the impact of contamination, toxicant exposure might alter the ability to cope with stressful situations. Such impairment brings high risks for animals, especially during energetic life stages such as migration. Effectively, as both mercury and stress reaction pathway involve effects on the neural, endocrine system, immunity, and oxidative homeostasis, the possible cumulative interactions may disrupt animals’ behaviour and physical ability, more than expected, ultimately impairing their ability to migrate and their fitness. This project aims to determine the relationship between stress and mercury exposure and the effects on Song Sparrow (Melospiza melodia). Therefore adults will be captured and dispatched in four environmentally relevant treatments: control, stressed only, mercury exposed only, and both stress with mercury exposition. A behavioural approach associated with immune, hormonal, neurologic, and metabolic health measurements will be applied to monitor the birds’ conditions. I expect the group exposed to both stress and Hg to show stronger health biomarkers response and a lower cognitive and migration capacity than the other groups. In conclusion, mercury pollution is still an actual concern for wildlife populations to whom the impacts in real life situation still requires more investigations. That is why this study will inform on mercury toxicological pathway and help to evaluate if the tolerated contaminant levels in the wild are relevant or more harmful than initially thought.
Soil homogenization modifies productivity, nitrogen retention and decomposition during grassland restoration

Authors: Holly Stover, Hugh Henry
Author Affiliations: University of Western Ontario

In former agricultural systems, soil heterogeneity can be low as a legacy of tillage, and this homogenization of soil may have important implications for ecosystem function following the ecological restoration of former cropland. We investigated the relationship between soil homogenization and three ecosystem functional response variables – aboveground productivity, nitrogen retention (via $^{15}$N tracer addition) and plant litter decomposition (litter bags) – during the first two years of a tallgrass prairie restoration in a former agricultural field. We compared plots with topographic heterogeneity (pits and mounds) with flat plots, and we also compared plots with substrate heterogeneity (topsoil patches enriched with sand or woodchips) with homogeneous plots that contained the same overall ratios of component materials. Soil homogenization reduced aboveground productivity by 50% for the woodchip treatment, but it had the opposite effect for the topography treatment (more than 50% increase relative to pits and 30% increase relative to mounds). Homogenization also reduced plant $^{15}$N retention for the woodchip treatment by 50%, but the rate of litter decomposition increased by 8%. Overall, variation in nitrogen retention and decomposition were associated with the treatment effects on aboveground productivity and the relative abundance of forbs and grasses. The latter results suggest that the influence of soil homogenization on ecosystem function may occur indirectly as a result of effects on plant community assembly.

Climate warming and plant community shifts in boreal peatlands

Authors: Lyons, C.L. and Lindo, Z.
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Boreal peatlands are important global carbon sequesters due to the accumulation of peat (partially decomposed plant material). Therefore, the aboveground plants are important determinants for carbon storage potential. Boreal peatlands are mainly dominated by three different plant functional groups: Sphagnum mosses, Carex sedges, and shrubs. Sphagnum mosses comprise a vast majority of peat, meaning Sphagnum spp. contribute the most to carbon storage potential of Boreal peatlands. Under climate warming there is evidence towards a shift from Sphagnum mosses to Carex sedge-dominated peatlands. I am performing a field experiment in northern Ontario looking at the effects of passive warming on peatland plant communities in two different types of peatlands, a Sphagnum dominated and Carex dominated peatland. I have one field season of plant community composition data collected using the point intercept method under passive warming and control treatments. I have also measured leaf area index (LAI) as an indicator of aboveground biomass. After only one growing season I observed trends towards increasing aboveground biomass under passive warming in the Carex dominated peatland, and plant community shifts throughout the growing season in Sphagnum dominated peatland. Specifically, there were detectable changes in LAI under passive warming where the Carex dominated peatlands demonstrated greater LAI in the warming treatment. Climate warming has the potential to impact the plant community composition at these two Boreal peatland sites and this could indicate a shift from a carbon sink to a carbon source, exacerbating climate warming effects.
The effect of urbanization on reproductive traits of the wildflower *Linaria vulgaris*

**Authors:** Ariana Longley & Christina Caruso  
**Author Affiliations:** University of Guelph

Urbanization has led to changes in the abiotic and biotic environment. These changes can cause the strength and direction of natural selection to differ between rural and urban populations. Two environmental changes that may affect reproductive trait evolution in urban plant populations are pollinator declines and mate limitation. Pollinator declines may increase competition for pollinators and select for traits that make flowers more attractive to pollinators. Mate limitation, through decreased genotypic diversity, may result in selection for more clonal growth to ensure population persistence. I will use three approaches to test if pollinator declines and mate limitation in urban environments are imposing selection on populations of the self-incompatible species *Linaria vulgaris*. First, I will use a common garden to test my prediction that urban plants produce more attractive flowers and more clones. Second, I will use hand pollination to test my prediction that plants from urban populations produce fewer seeds/fruit when mated with plants from their own population than when mated with plants from rural populations. Third, I will measure selection differentials on floral traits of plants in urban and rural populations to test my prediction that pollinators exert stronger selection on floral traits in urban populations. My results can be used to make predictions on how urbanization affects the evolution of plant reproduction in urban populations, and thus whether these populations will adapt and persist, or go extinct.

Using reversible brain deactivation to understand the function of the avian hippocampus

**Authors:** Brodbeck, M.I.R.\(^1,2\), Lomber, S.G.\(^2\), MacDougall-Shackleton S.A.\(^1,2\), Sherry, D.F.\(^1,2\)  
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The hippocampus participates in a variety of cognitive functions in humans, non-human primates, rodents, and birds. Previous research on the avian hippocampus has examined its role in spatial memory and orientation. The avian hippocampus is homologous to the mammalian hippocampus but has a very different cellular organization and anatomical location on the dorsal surface of the brain. Reversible inactivation of the hippocampus can be used to determine the function of the hippocampus during memory acquisition, retention, and retrieval. Reversible inactivation offers many advantages. Animals can serve as their own controls making the technique more powerful and more ethical. Additionally, recovery of function by other brain areas is less likely to affect the interpretation of behavioural results compared to lesion methods. Cryoloops have been used to inactivate cortex, but not hippocampus, in mammals. Cooling the hippocampus in birds provides a unique opportunity for studying hippocampal function in memory, especially spatial memory. We use implanted cryoloops placed over the hippocampus to reversibly inactivate the hippocampus of brown-headed cowbirds and observe behavior on spatial tasks. I will describe the cryoloop technique for reversibly inactivating the hippocampus, and preliminary results obtained with cowbirds using this technique.
Drosophila stress odorant is not species specific

Authors: Emerald Y. Liang1, Ryley T. Yost2, and Anne F. Simon

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Some flies of the Drosophila species are known to be pests in Ontario. D. suzukii, the spotted-wing fly, punctures the skin of ripening fruits during egg laying1,2. D. suzukii are currently found on multiple fruit farms across southern Ontario and their presence leads to decrease in crop production varying from 25-50%3,4. D. melanogaster, or the vinegar fly, is one of the major pests in bars, restaurants, vineyards and kitchens, due to its attraction to overripe fruits. D. melanogaster displays an innate avoidance of an odorant emitted by stressed flies (dSO)2. Our study sought to determine whether D. suzukii and D. simulans showed the same avoidance towards dSO, despite a lack of avoidance for CO2, the only known component in dSO5. From cross testing the dSO avoidance using a T-maze apparatus with D. melanogaster, D. simulans, and D. suzukii, we found that D. simulans and D. melanogaster avoid dSO are as efficient in avoiding dSO emitted by either of the 3 species, but D. suzukii, although avoiding dSO, displays a more limited avoidance. We will discuss the possible reasons for that discrepancy. The results of this experiment might give rise to natural repellants for D. Suzukii to be used in agricultural practices.

4 Anon, Spotted Wing Drosophila. Teagasc.

Acute oral toxicity of four systemic insecticides to the common eastern bumblebee (Bombus impatiens)

Authors: Kayla Mundy1, Ryan Prosser1, Nigel Raine1

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Bumblebees are present in agricultural systems and provide pollination services for many crops. However there is a dearth of acute oral toxicity values for insecticides. Those values that are available focus on the European bumblebee, Bombus terrestris and the European honeybee, Apis mellifera. Attempts have been made to extrapolate from the honeybee onto other bee species, but this may not be adequate. This talk will report the acute oral toxicity of four systemic insecticides; thiamethoxam, sulfoxaflor, flupyradifurone and cyantraniliprole to the Common Eastern Bumblebee (Bombus impatiens) and compare these values to those reported for A. mellifera. The results support the conclusion that not every insecticide's toxicity can be estimated accurately from A. mellifera data.
2:22 PM Alternative reproductive strategies in white-throated sparrows are associated with differences in malarial infection intensity

Authors: R. J. Boyd¹, T. R. Kelly¹, S. A. MacDougall-Shackleton¹,² and E. A. MacDougall-Shackleton¹

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Immune defenses often trade off with other life history components. Even within species, optimal allocation to immunity may differ between the sexes or between alternative life history strategies. White-throated sparrows (Zonotrichia albicollis) are unusual in having two discrete plumage morphs, white-striped and tan-striped. Within each sex, white-striped individuals are more aggressive, provide less parental care, and have higher circulating androgens than tan-striped individuals. We extended immunocompetence handicap models, which predict sex differences in immunity and parasitism, to hypothesize that infection susceptibility should be greater in white-striped than tan-striped birds. We inoculated birds of both morphs with malaria parasites (Plasmodium) as they approached breeding condition. Morphs did not differ in infection risk, but among birds that became infected, parasite loads were higher in tan-striped than white-striped individuals. Our findings are not consistent with immunocompetence handicap models; instead, morph differences in immunity could reflect differences in risk of injury, or other social or genetic factors. We conclude that white-throated sparrow morphs may differ in immune investment, but that these differences are distinct, and presumably under separate control, from sex differences in disease resistance often observed in vertebrate animals.

2:30 PM Negative Selection in Social Insects

Authors: Imrit, M.A.¹, Dogantzis, K.A.¹, Zayed, A.¹

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Eusociality, characterized in part by complex social behaviours, cooperative brood care, and reproductive division of labor, evolved independently several times in insects. The evolution of eusociality has been hypothesized to lead to differences in the extent of both positive and negative selection. While population genomics studies of eusocial insects have so far focused on positive selection, there has been no study of the extent of negative selection in social insects, and its relationship to the evolution of caste-biased genes. To address this gap in knowledge, my research will estimate the extent of negative selection in honey bees, bumble bees, and wasps, through analysis of published population genomic datasets. My study will compare the relationship between the strength of negative selection and caste-specific patterns of gene expression, and examine if the strength of negative selection correlates with the level of social complexity in this species triad.
Nonvascular plant vulnerability to fire activity in the Northwest Territories: Interactive effects of fire severity and soil moisture

Authors: Kristen E. Bill1, Merritt R. Turetsky1, & Jennifer Baltzer2

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In northern boreal ecosystems, wildfire is the most important natural disturbance as it controls ecosystem structure and function. With both the extend and severity increasing in recent years, plant assemblages are predicted to shift from conifer dominated to deciduous dominated forest cover. Further, plant community responses to wildfire are important for understanding the consequences of climate warming and future carbon storage capabilities. This study uses variations in time-since-fire and moisture gradients to examine the controls of vegetation composition in the Northwest Territories, Canada. We use a chronosequence approach (space for time substitution) with 346 burned and unburned sites that burned between 1940-2014 that is dominated by black spruce (Picea mariana) or jack pine (Pinus banksiana). The objectives of this study were to assess how fire activity affects the dynamic boreal forest floor vegetation communities and compare it to the response of boreal forests in Alaska to wildfire. While stands in Alaska are showing a strong shift to deciduous stands, preliminary results from this study suggest that Northwestern Canada may be responding differently to fire activity. By quantifying plot level moisture, soil organic layer thickness, non-vascular and forest type we aim to determine the dominant controls on successional patterns. A change in ecosystem stable state in response to changes in the fire regime has important implications for carbon storage, nutrient cycling, and wildlife habitat.

Do birds that tweet also feel beat? Perception of temporal patterns in a songbird.

Authors: Brendon Samuels1,2, Scott MacDougall-Shackleton3, Jessica Grahn2,3

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In music humans experience a regular beat, yet how the brain perceives beat remains unclear. Sensitivity to beat is rare in the animal kingdom and has been theoretically linked to vocal learning ability; it has been shown in parrots but not in passerines. We conducted a series of behavioural experiments to investigate the perception of rhythmic auditory patterns by a vocal learning songbird, the common starling (Sturnus vulgaris) using operant conditioning methods. Both human and songbird subjects were trained to categorize acoustic tone patterns that produce a strong or weak sense of beat. Results indicate that humans learned this task while songbirds mostly failed to transfer to a simple training discrimination between only two patterns. An additional operant experiment aimed to identify features of acoustic patterns that starlings attend towards, revealing they discriminate primarily on the basis of overall tempo. Studying the perception of timing and rhythm in other species may contribute to understanding the mechanisms and evolution of beat perception as an integral component of musicality.
Asynchronies between fertilizer application and crop nutrient demand have led to over-fertilization and increased soil nitrogen leaching from agricultural fields. The use of stimuli-responsive polymers for the coating of fertilizers offers a more targeted delivery mechanism, which could increase nutrient use efficiency and reduce soil nutrient losses. However, despite reducing the amount of leaching many current controlled release fertilizers degrade based upon environmental conditions. I have been working with a redefined class of triggerable biodegradable polymers (poly(ethyl glyoxylate)) that are designed to go through end-end depolymerization after the protective end cap on the polymer is cleaved off by a specific stimulus. I aim to develop a fertilizer coating that will degrade based on specific plant-root stimuli, which would allow for controlled and targeted release of fertilizer pellets.
**Session #4 Organism Distributions & Movement**

Friday May 11th in NCB 114.
Moderated by Tosha Kelly.

1:30 pm  **Track me if you can: long-term wintering site fidelity in song sparrows**

**Authors:** Kelly, T. R.¹, K. A. Hobson¹, S. A. MacDougall-Shackleton¹,², and E. A. MacDougall-Shackleton¹

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Philopatry to wintering and stopover sites can have significant consequences for individual fitness and population dynamics but long-term evaluations of winter philopatry within a population are rare, likely due to the limited ability of researchers to track the migratory movements of small animals. Stable hydrogen isotope (δ²H) values in feathers have been effective in determining geographic origins of molt but claw isotope values (δ²Hc) can be used effectively to infer origins over several months prior to sampling. We collected claw tissue from 443 song sparrows breeding near Newboro, Ontario, Canada over seven breeding seasons and released 32 geolocators over two summers. We are the first to demonstrate that geolocator-derived wintering positions correlated well with latitudes derived from δ²Hc values. Male song sparrows migrated shorter distances than females, but the difference in distance travelled between sexes varied among years. Values of δ²Hc were repeatable for males but not females suggesting males are the philopatric sex in our population.
North American aerial insectivores have experienced serious population declines over the last 50 years. Approximately 91% of the Canadian Chimney Swift (Chaetura pelagica) population was lost between 1969 and 2014. Monitoring and research in Ontario have primarily focused in the southern portion of the province and little is known about northern swift populations. We counted swifts video-recorded entering a roost at two large chimneys in Sault Ste. Marie, Ontario, a city at the center of the Great Lakes in Northern Ontario, from 2006-2016. Roost attendance was highly variable during spring migration with the highest observed peaks reaching over 2000 swifts each year. In 2014 and 2016, two peaks in swift numbers were observed, however, in 2015, despite clear fluctuations in numbers, no distinct peaks emerged. Seasonal monitoring revealed that counting swifts on the four or five provincial SwiftWatch dates fails to capture peak numbers of swifts. Swift counts were negatively correlated with temperature during spring migration. Following migration, the number of swifts was less variable and few swifts roosted during the post-breeding season. The Sault Ste. Marie roost may be one of the largest in Canada and should be of special concern and may lead to new insights into this threatened species at the edge of it range.

Differential migration is commonly observed in songbirds, however, the underlying behavioural mechanisms are still uncertain for most, if not all, species. My research evaluated how traits including sex, age, body condition, and morphotype affect the migration schedule in White-throated Sparrows (Zonotrichia albicollis). Sparrows were studied during migratory stopover at Long Point, Ontario. Migration timing was determined using capture data; plasma metabolite analysis and quantitative magnetic resonance were used to examine stopover refuelling rate and body condition; radio telemetry was used to determine stopover duration; wintering latitude was determined using isotopic analysis of head feathers; and sex and plumage morph were confirmed genetically. Males migrated earlier than females (protandry), with males arriving at stopover 10 days before females. Contrary to previous songbird studies, stopover refuelling rate did not differ between ages, sexes, or sparrow morphotype. Stopover duration was influenced only by fat stores and air temperature. Stable isotope analysis suggests that wintering latitude is influence by body size, with larger birds wintering further north. These early results suggest that sex-specific stopover behaviour does not contribute to protandry.
Ants fill many ecological roles and can heavily influence communities. In the tropics, arboreal ants have been relatively well studied and found to be super-abundant in the forest canopy. However, little is known about arboreal ant communities in temperate regions. We sampled trees in a temperate forest nearby Toms Brook (Virginia) to determine the prevalence of arboreal ants and which trees and nesting sites they prefer. Trees were felled and examined for ant nests. Nests were found under bark, within hollow twigs, branches, and trunks, with the majority of nests in dead twigs (60%). Previous studies found more nests in larger trees, with a higher diameter at breast height (DBH). This pattern was also supported for Toms Brook, but was less strong than in tropical regions. A relatively smaller DBH here might have contributed to a lower overall density of ants. Together with previous studies in New Guinea (tropical) and the Czech Republic (temperate), this study allows for a rigorous comparison of arboreal ant communities between regions. Linking arboreal ant communities with host trees can help us to better understand their functional roles within the forest ecosystem, which habitats they prefer, and how that differs in temperate versus tropical habitats.
Shifts in Collembola communities under top-down and bottom-up effects are mediated by warming

Authors: Jordan Kustec, Carlos Barreto, and Zoë Lindo
Author Affiliations: University of Western Ontario

Top-down and bottom-up effects are the processes that structure food webs and ecological communities. Among these effects, warming has been proposed both as a bottom-up (enrichment) effect as well as a factor that mediates top-down and other bottom-up effects within a food web. Shifts in aboveground terrestrial and aquatic communities due to top-down and bottom-up control are well studied, yet soil detrital systems are understudied despite their importance in carbon storage, decomposition, and nutrient cycling. Here we tested the community-level response of a mid-trophic group of soil-dwelling invertebrates (Collembola (a.k.a. springtails)) to experimental bottom-up effects of nutrient addition and warming, and top-down effects of predator addition. Collembola communities were destructively sampled after three and six months from a full factorial experimental mesocosm system. Predator addition and warming were significant in reducing Collembola abundance and structuring communities, while bottom-up nutrient addition had no effect. We found that Collembola community structure was homogenized under both predator addition and warming. However, this homogenization in community structure was due to different mechanisms related to shifts in community body size under these treatments. Specifically, warming increased the prevalence of small-bodied individuals, while predators reduced the abundance of large-bodied species; a combination of these two treatments further homogenized community structure. Our results demonstrate that body size is a community level response variable, and that warming can mediate top-down control on community structure as well as additionally acting as a bottom-up effect.
Fungal populations on the move

Fungi are an integrative component of all ecosystems on Earth. They play important roles in nutrient cycling, environmental protection, food security, and plant, animal, and human healths. However, our understanding of fungal populations is very limited. In this talk, I will present our research efforts in using genetic and genomic tools to understand fungal populations at local, regional, and global scales. Our analyses suggest that contemporary forces related to human activities are accelerating gene flows among fungal populations at all geographic scales. Furthermore, such gene flows create abundant opportunities for mixing and hybridization among genetically differentiated strains and populations. I will briefly discuss the impacts of fungal gene flow and hybridization on the environment and human welfare."
Poster Session

Friday May 11th in NCB Atrium.
4:30 – 6:30 PM

Poster 1 Change happens from the ground up: Measuring the success of the multifunctional solution using agriculturally marginally restored prairie grasslands for soil carbon storage

Authors: Annalisa Mazzorato
Author Affiliations: University of Guelph

Soils are necessary for global food production and security and contribute to a large range of ecological and economic ecosystem services. Soils are known to have degraded for various reasons, the focus of this research project being the intensification of agriculture, poor soil management practices and the movement of food production into poor quality marginal lands. The increasing demand on soils to provide higher function at lower cost demonstrates the need for sustainable solutions and proper resource management. The current shift in agriculture is towards sustainable intensification and resiliency, where inputs are minimized, and production is sustained to ensure lower risk as extreme climatic events intensify. Sustainable intensification on cropping systems depends on proper management, restoration and enhancement of soil quality. A new solution to create resiliency in agricultural systems is to remediate low producing areas to construct highly productive perennial ecosystems, such as native prairie grasslands, that provide multiple services with little input. In collaboration with Alternative Land Use Services Canada (ALUS Canada) I am exploring the broad core question: to what extent does age, depth and cover type affect the soil carbon potential of marginally restored prairie grasslands compared to adjacent conventionally farmed cropping systems and woodlots? To answer these questions, soils on farms across Southern Ontario with varying degrees of management intensity were sampled in the summer of 2017. Management of these grasslands presents a unique win-win strategy, in which agricultural intensification can grow sustainably without the loss of environmental resiliency.
The Antarctic harbours a variety of algae that can withstand extreme cold but falter at warmer temperatures (psychrophiles), including the unicellular green alga Chlamydomonas sp. UWO241. Little is known, however, about the origins and evolution of psychrophilic algae, and their nuclear genomes remain largely unexplored. For my PhD, I propose to sequence and assemble the entire nuclear DNA of UWO241 using a next-generation sequencing (NGS) approach, and then employ these data to better understand the evolution of photopsychrophyliy. DNA sequencing technologies have undergone tremendous advancements in recent years, but assembling, annotating, and analyzing a nuclear genome is still a huge undertaking, especially for small laboratory groups, partly because many eukaryotic genomes are repeat rich and contain thousands of genes and introns. To characterize the UWO241 genome I will, firstly, develop an assembly pipeline for processing high-throughput DNA sequencing reads into genomic contigs. These contigs, alongside RNA-sequencing data, will then be fed into an annotation pipeline, which I will design based on the most up-to-date eukaryotic bioinformatics gene-profiling software. Computational analyses will be carried out on an in-house computer, which I have constructed for the Smith Lab, as well as on Western’s supercomputing network SHARCNET. Lastly, I will perform a wide range comparative genomic analyses of the UWO241 genome with those of other model green algae, including Chlamydomonas reinhardtii. Preliminary data already suggest that the UWO241 genome is exceptional in many ways—including its size (>230 Mb) and gene copy number—and at least some of these features appear to have a fundamental role in surviving in the extreme cold.
Fire blight is a serious disease affecting important fruit plants such as apple and pear. This disease is caused by the bacterium *Erwinia amylovora*. The economic impact of fire blight is difficult to manage; it could suppress an orchard from growing and producing for many years. Southern Ontario has a high risk of severe fire blight outbreaks due to its moderate weather. The current treatment of fire blight using antibiotics comes with harmful effects on both humans and the environment. The recent emerging of antibiotic-resistant *E. amylovora* generated the need for the adaptation of safer and environmentally friendly pesticides to replace antibiotics. Due to their antibacterial activities, phages (viruses which only infect and lyse bacteria) are very attractive tools for use to control the *E. amylovora*. Among the advantages of using phages as a biopesticide are less toxic to the environment and affect only the target bacteria. The development of phage-based biopesticides is currently in progress in our lab. The possibility of development of phage-resistant bacterial hosts continue to prevent the widespread acceptant of phage to treat bacterial diseases. The selection of the right phage that can infect a wide range of *E. amylovora* and escape the pathogen resistance mechanisms is a significant step during the developing of phage-based biopesticide. In previous studies, four different phages were purified to use in the control of *E. amylovora*. This project is an attempt to purify more unique phages with a wide host range to generate a basket of phages that can be used as a mixture or individually to control the pathogenic bacteria.
Poster 4  
**Video-monitoring of Chimney Swift (Chaetura pelagica) behaviour at a migratory roost**

**Authors:** O'Brien, S.¹, Pearce, J.² and Foote, J.¹  
**Author Affiliations:** ¹Department of Biology, Algoma University, Sault Ste. Marie, Ontario; ²Great Lakes Wildlife Research, Sault Ste. Marie, Ontario

The Chimney Swift (Chaetura pelagica) is a cavity-nesting, communal roosting specialist, and the Canadian population has undergone a population decline of approximately 91.2% from over the last 50 years. It is therefore important to understand swift roosting behaviour in order to make informed decisions about conservation and habitat management. We conducted a two season long behavioural study on the roosting behaviour of Chimney Swifts, in Sault Ste. Marie, Ontario. Using infrared surveillance cameras, we recorded their in-chimney behaviour for 24 hours a day. Our goal was to examine how the swifts utilize the chimney as a communal roost. We made observations of roosting depth and wall preference every 30 minutes and compared these observations to weather conditions. We found that swifts roosted most often at a depth of 1-5 meters, and rarely utilized the deepest portion of the chimney. Swifts were more likely to roost deeper in the chimney when temperature was colder, in the early morning, and when roosting in the post office chimney compared to the courthouse chimney. We found that swifts were primarily perched on the South and East walls of the chimney. We did not find any significant relationship between prevailing wind direction and wall preference, however, there was a trend toward roosting on the opposite wall compared to wind direction. Our results suggest the deeper portion of the chimney likely provided a warmer microclimate during cold nights, although further research is still needed to fully explore factors influencing roosting wall preference.

Poster 5  
**Effect of Gut Microbiome on Modulating Social Spacing in Drosophila melanogaster**

**Authors:** Yen Chan, Yanira J. Padilla, Marc-André Lachance, Anne F. Simon  
**Author Affiliations:** Department of Biology, Western University, London, Ontario, Canada

The gut microbiome has been found to modulate many essential functions including metabolism, immunity, and behaviour. Specifically within behaviour, social behaviours such as aggregation, mating preference, avoidance, oviposition, and aggression are known to be regulated in part by this host-microbiome relationship. However, there has yet to be research done on elucidating the microbiome effect on social space, another aspect of social behaviour. In that context, I hypothesize that the gut microbiome also contributes to normal social spacing, and I am using Drosophila melanogaster to study this relationship. The experimental design is centered on comparing the social space between axenic (microbe-free) and control flies. Several strains were utilized to characterize the microbiome effect on social space. Data that we gathered supports the microbiome’s role in normal social spacing but only to a certain degree, where the effect is mediated by the sex of the flies, the strain genotype, as well as its history in terms of how recently it was caught. Future work can be done on characterizing the microbiome in each of these fly strains to identify both the species of microbes present as well as its abundance.
**Poster 6**  
Happy Families? Co-operative foraging in *Drosophila melanogaster* larvae is mediated by kinship.  
**Authors:** Khodaei, L., Long, T.A.F.  
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The decision when individuals should engage in co-operative behaviour rather than competing with conspecifics is central to understanding the evolution of social behaviour. One potentially important factor in this decision is the degree of relatedness between interacting individuals, as kin gain indirect fitness benefits from helping each other out. Recently it has been observed that fruit fly, *Drosophila melanogaster*, larvae in environments with depleted resources sometimes work collaboratively, by aligning themselves and coordinating their movements to dig an enlarged air cavity or feeding cluster. This co-operative behaviour allows them to reach otherwise inaccessible food beneath the surface. In this experiment we set out to examine whether this phenomenon varied in its magnitude and/or frequency depending on larval consanguinity. We found that as relatedness among individuals in a vial increased, the frequency and size of air cavities increased, and more individuals participated in this co-operative behaviour. There is evidence depth of the cavities is correlated by the width, which does vary across the different degrees of relatedness; meaning that depth and width of the feeding cluster may be covariates, however more evidence is needed to support this finding. These results suggest that larvae are capable of determining whether conspecifics are relatives and adjust their social behaviour accordingly.

**Poster 7**  
Determination of Bacterial 16S rRNA Termini using RNA-seq  
**Authors:** Silke, J. R., Wei, Y., Xia, X.  
**Author Affiliations:** 1 Department of Biology, University of Ottawa, Ottawa, Ontario, Canada; 2 Ottawa Institute of Systems Biology, Ottawa, Ontario, Canada  

The interaction between the Shine-Dalgarno (SD) sequence in the 5' UTR of the messenger RNA and the anti-Shine-Dalgarno (aSD) sequence in the free 3' end of the 16S rRNA (3' TAIL) of the ribosome is vital to ensure efficient translation initiation. Despite this, many dubious annotations of 3' TAILs associated with curated genomes in NCBI’s non-redundant database have been discontinued. If the downstream terminus of the 3' TAIL is unknown in a given species, the full extent of the SD:aSD interaction remains unclear. Growing repositories of high-throughput RNA sequencing (RNA-seq) data present an opportunity for mapping the precise termini of 3' TAILs. Using our RNA-seq based strategy to map the 3' TAILs of 21 bacterial species has revealed appreciable heterogeneity that may contribute to species-specific differences in protein production. Our method successfully recovers the known 3' TAIL in *Escherichia coli* and reveals the mature 3' TAIL in species lacking current annotations for the 3' terminus. Furthermore, we identify the core aSD motif using the 5' untranslated regions (5' UTRs) of all known protein-coding genes for each of the 21 species studied and conclude that an intermediate binding affinity between the SD and aSD favours efficient translation more than overly strong or weak interactions. This information will facilitate future translational studies, particularly for species that have been less frequently studied, and our findings may be of interest to those in the pharmaceutical industry seeking to optimize protein production.
Naked mole-rats are eusocial mammals native to sub-Saharan Africa. Their hierarchy consists of one breeding female, 1-3 male consorts, and their reproductively suppressed offspring, called subordinates. Subordinates are divided into two subcastes: soldiers and workers. A third “disperser morph” subcaste has been suggested with a subset of subordinates exhibiting motivation to leave their natal colony and mate with unfamiliar conspecifics. To determine whether colony variables (e.g., population density, sex ratio, queen temperament) influence the incidence of dispersal, we evaluated dispersal behavior in 17 colonies. Queen aggression significantly predicted the presence of female but not male dispersers though dispersers were not themselves recipients of queen aggression. We also compared in-colony and out-pairing behavior between putative dispersers and their sibling workers. Most in-colony behaviors did not differ between dispersers and workers though dispersers were more aggressive towards familiar subordinates; both sexes were targets of female disperser aggression. Following out-pairing, dispersers and workers produced litters at similar rates demonstrating that motivation to leave the colony and not reproductive maturation per se, is the key to successful dispersal. Collectively, these data suggest that dispersal in naked mole-rats is driven by aggressive queens and that putative dispersers show traits consistent with successful breeders (e.g., aggression).
Poster 9  
Stream biogeochemical resilience in the age of Anthropocene

Authors: Dong, R.¹, Creed, I.F.², and Scheuerell, M.³

Author Affiliations: ¹Department of Geography, Western University, London, Ontario, Canada; ²Department of Biology, Western University, London, Ontario, Canada; ³Northwest Fisheries Science Center, NOAA, Seattle, Washington, U.S.

Recent evidence indicates that biogeochemical cycles are being pushed beyond the tolerance limits of aquatic ecosystems. In streams, the consequences of passing this tolerance threshold may lead to cascading effects downstream. Here, we explore the question: Is there empirical evidence that global atmospheric changes are increasing the risk of biogeochemical resilience loss and are thus moving towards a new condition of ecosystem function? This project uses three metrics to measure resilience which are reactivity (the highest initial response after a disturbance), return rate (the rate of return to equilibrium condition after reactive changes), and variance of the stationary distribution (the signal to noise ratio). Multivariate autoregressive models were used to derive these metrics for streams in the Turkey Lakes Watershed of Central Ontario. We observed increasing risks of biogeochemical resilience loss and identified the constituent(s) that may be increasing risk from time series analysis. Non-stationary trends and stationary cycles were removed, and the standard deviation (SD) of remaining residuals were analyzed to determine if there is an increase in SD over time that would indicate a pending shift towards a new normal. We observed that ammonia-nitrogen and dissolved organic carbon are increasing in SD which is indicative of a pending shift in forest stream systems. This study provides empirical support that biogeochemical cycles in streams are showing signs of exceeding tolerance levels and shifting towards a “new normal”, which can create more favorable conditions for destruction of current ecosystem function.

Poster 10  
Evaluating wetland restoration success by tracking recovery of plant functional traits.

Authors: Howard, R.¹, Salaria, S.², Creed, I.¹,²

Author Affiliations: ¹Department of Biology, Western University, London, Ontario, Canada; ²Department of Geography, Western University, London, Ontario

Wetland ecosystem services are at risk in many areas of North America due to changes in land use and the consequential wetland loss. Restoration efforts have increased in response to recognition of the ecological role of wetlands in flood mitigation, water purification, biodiversity, and carbon sequestration. Vegetation diversity and community composition have typically been used to assess restoration success; however functional traits may be better indicators of wetland recovery. Our research aims to analyze plant functional traits to understand how ecosystem functions change with time since restoration. We studied nearly 40 seasonal prairie pothole wetlands that ranged in age from newly restored through 24 years restored. Vegetation community composition, functional traits, and functional diversity were evaluated from field-based measurements in combination with information from plant functionaltrait databases. We compare results of plant functional trait analysis with traditional community composition metrics to show that functional traits are an effective approach for assessing ecosystem function. In addition, our results demonstrate that restored prairie wetlands show incomplete recovery of plant diversity, highlighting the need for improved wetland restoration policy and management efforts.
Poster 11  Wren you hear me now: assessing vocal variety in the winter wren (Troglodytes hiemalis)
Authors: Clarke, T. † & Foote, J. †
Author Affiliations: †Department of Biology, Algoma University, Sault Ste. Marie, Ontario

Songbirds vary in the complexity of their songs and the size of their song repertoires. Within many species, song variation correlates with the quality of males. The winter wren (Troglodytes hiemalis) sings a complex song that is 5-10 seconds long. Each male sings 2-3 song types that include a variety of elements made up or repeated syllables. In this study, we recorded five male winter wrens using autonomous recorders in Hiawatha Highlands Conservation Area in Sault Ste. Marie, Ontario. In order to determine if winter wren songs vary in complexity, we extracted clear songs from recordings and assigned song elements to categories in one song type for each male (N = 16 to 20 songs per male). Within each each male we identified the number of repeated syllables. On average, male winter wren songs included 34.8 ± 0.71 syllables combined into 15.4± 0.31 elements of which 10.6 ± 0.22 were unique. We found that there was a significant variation among males in the number of unique elements used per song, the total number of elements used per song, and the total number of syllables per song. The complex song of the winter wren, which varies in complexity among males, may convey information about male quality to both mates and rivals.

Poster 12  Applications of RNA Sequencing data to characterize mature RNA transcripts
Authors: Wei, Y. †, Silke, J.R. †, Xia, X. †, Xia, X. †
Author Affiliations: †Department of Biology, University of Ottawa, Ottawa, Ontario, Canada; †Ottawa Institute of Systems Biology, Ottawa, Ontario, Canada.

Microorganisms require efficient transcription and translation to grow and replicate rapidly. Understanding factors contributing to these processes not only advances our knowledge of molecular biology and evolution to gain insights in the battle against pathogens, but also improves efficiency of biosynthesis in biopharmaceutical industry. Efficient biosynthesis depends much on efficient transcription of rRNA, tRNA, and mRNA components of the translation machinery. Protein-coding genes may often be transcribed in intron-containing pre-mRNAs in Eukaryotes, or co-transcribed in operons in Prokaryotes. Acting on Prokaryotic protein-coding genes, the anti-Shine-Dalgarno sequence embedded in the 16S rRNA 3' end influences translation initiation efficiency, whereas tRNA abundance and specificity impacts translation elongation efficiency. To uncover post-modification processes on primary transcripts, and trace how variations in rRNAs and tRNAs influence the evolution of protein-coding genes, the challenge lies in accurate characterization and quantification of these RNA components. In this study, we explore the applications of high-throughput RNA Sequencing (RNA-Seq) data. We devised strategies to characterize the 5' and 3' UTR of mRNA transcripts and reveal the major 3' terminus of the 16S rRNA, and reduce processing time of quantifying rRNA and mRNA transcription through RNA mapping. These applications have not only revealed sequence mis-annotations, but are also applied to 1) identify introns and exons in Saccharomyces cerevisiae, and 2) annotate operons in Escherichia coli.
**Poster 13**  
**Differential Vulnerability to Window Collision Mortality Among Songbird Species**

**Authors:** Olivia Colling¹, Yolanda Morbey¹,², Christopher Guglielmo¹,²  
**Author Affiliations:** ¹Department of Biology, University of Western Ontario, London, ON, Canada; ²Advanced Facility for Avian Research, University of Western Ontario, London, ON, Canada

It is estimated that billions of birds worldwide die each year from window collisions. Birds appear to behave as if windows are invisible, suggesting they cannot distinguish between glass and open space. The objective of my MSc research is to determine if some bird species are more vulnerable to dying from window collisions than others. Using a combination of citizen science and bird monitoring data from the Fatal Light Awareness Program (FLAP) and regional bird banding stations, I will determine if the mortality seen in downtown Toronto is simply a function of species abundance or if it is unequal among species. In addition to among species differences in mortality, I will compare individuals within species to address if age is a factor in collision mortality vulnerability. To determine this, I will use the FLAP 2017 and 2018 bird collections to identify individuals by species and age. This information will be used to compare age ratios.

**Poster 14**  
**Sexual Selection Through Machiavellian Intelligence: Social Species Signal Traits may not be the Key Determinant of Reproductive Success**

**Authors:** Hann, J., White, D. J., & Davies, H.  
**Author Affiliations:** Department of Psychology, Wilfrid Laurier University, Waterloo, Ontario, Canada

Birdsong has historically been thought to serve as an honest indicator of male genetic quality. Here we examine whether, in brown-headed cowbirds (Molothrus ater) song serves this function, or alternatively, whether reproductive success is better explained by the effective use of a set of social skills (the Machiavellian intelligence hypothesis). Results indicated that song attractiveness, as measured by females’ preferences in sound attenuation chambers showed no significant relationship to reproductive success. Social measures of the males (directed songs, countersinging, pursuits, fights) taken in the breeding season explained 75% of the variance in copulation success and 58% of the variance in offspring production. These findings demonstrate males require more than just an attractive song to breed successfully; they require a suite of skills that allow them to track others, engage in courtship and in competition. This suggests that evolution favours the development of a repertoire of Machiavellian skills to breed successfully.
Many animals form social groups, but the adaptive value of being gregarious often differs between individuals. If an individual’s benefits are small they may associate only loosely with the group, perhaps strongly with a few preferred individuals while avoiding despotic individuals. Alternatively individuals may associate relatively equally with all group members due to the advantages gained from cohesion, despite alternative food patches available nearby. We tested this by analysing the social networks of winter flocks of black-capped chickadees (Poecile atricapillus) in relation to experimental treatments; three feeders 5m, 40m or 130m apart. As distance between resources increases, so does the risk of losing contact with the group and the costs of doing so. If preferential associations are more important than general cohesion, we expected changes in measured network structure when resources are close, as individuals can easily maintain contact with the group whilst also following their own social preferences. We found similar network structure at all resources distributions, though stability of individual positions decreased when resources were close together. This suggests that while preferential association is strong enough to maintain the network structures, it does not override the need for cohesion even when alternative foraging choices are available nearby.
What happens in the brain of nocturnally migrating birds?

Authors: Madeleine I.R. Brodbeck¹, Verner P. Bingman², Songyi Yuan¹, and Scott A. MacDougall-Shackleton¹

Author Affiliations:¹Department of Psychology, Western University, London, ON; ²Department of Psychology and J.P. Scott Center for Neuroscience, Mind and Behavior, Bowling Green State University, Bowling Green, USA

Every year, thousands of bird species make long and costly trips migrating. One of the ways birds orient and navigate for these costly trips is by using the earth’s magnetic field. The mechanism for how birds integrate and perceive this information still remains in question. Cluster N, a forebrain region, is active, expressing immediate-early genes, at night in night-migrating birds. Migrating and non-migrating bird species have been compared for their levels of activation in cluster N, and comparisons have been made within night-migrating species for levels of activation during the day and night. Cluster N is consistently active during the night in night-migrating birds. However, no comparisons of activation within the same species of a night-migrant have been made between birds exhibiting nocturnal migratory restlessness (zugunruhe) or not exhibiting migratory restlessness. We housed 18 white-throated sparrows in outdoor aviaries. Brains were collected during the day, or at night. In the night, brains were both collected in birds that were exhibiting migratory restlessness, and in those that were inactive. Thus, we had birds in three different groups: day (n=5), night migratory active (n=7), and night migratory inactive (n=6). We are currently using immunohistochemistry to quantify immediate-early gene expression in the Cluster N of these birds. This study will allow us to determine if Cluster N activity has a circadian cycle during migration season, regardless of migration behaviour, or if it is more facultatively regulated on a night-to-night basis.
Poster 17  Sex differences in cell proliferation in the vocal control system of the zebra finch developing brain
Authors: Adriana Diez 1, Scott MacDougall-Shackleton 1,2,3
Author Affiliations: 1University of Western Ontario Graduate Program in Neuroscience; 2University of Western Ontario Department of Psychology; 3University of Western Ontario Department of Biology.

Song development in songbirds implies learning and production of complex vocalizations. Typically, song development happens early in life, and it entails exposure to an adult song. This protracted process requires that an internal representation of the adult song is formed (sensory phase), followed by a succession of “singing practice” phases (sensorimotor, motor and crystallization) until the vocal output matches the adult memorized song. Behaviorally, song development has been well studied. However, the neural changes that occur at the cellular level, in the underlying structures of the “vocal control system”, the brain circuitry that allows song learning and production, are not well understood. The aim of this research is to examine these cellular changes in the “vocal control system”. Specifically, describing the cell proliferation processes that occur during early development until sexual maturity in male and female zebra finches.

For this purpose, the brains of 76 zebra finches of both sexes were randomly collected for one of four brain collection schedules corresponding to the different song developmental phases. Brain tissue was stained against proliferating cell nuclear antigen (PCNA) to visualize brain proliferation. Preliminary results suggest that the immuno reactivity for PCNA in male and female zebra finches in the underlying areas related to vocal learning extends beyond the sexual maturation where song crystallization typically occurs.
Saturday, May 12\textsuperscript{th}

**Plenary Speaker #3**

Dr. Jeremy McNeil  
Helen I Battle Professor  
Department of Biology, Western University  
8:45 – 9:45 am in NCB 113

**The behavioural and chemical ecology of migratory lepidopterans**

Insects exhibit two general strategies to cope with habitat deterioration: “here later” where they enter into a state of dormancy until local conditions improve, or “there now” where they emigrate in search of new habitats suitable for reproduction. I will present the results of several interdisciplinary studies examining aspects of the migration in several important agricultural pests and the monarch butterfly. I will also consider how climate change could, directly or indirectly, impact the migration of these species.
Session #5 Reproduction: Tactics & Selection
Saturday May 12th in NCB 113.
Moderated by Chloe Montreuil-Spencer.

10:15 AM  
Links across seasons: Winter physiology and summer breeding in a non-migratory bird
Authors: Montreuil-Spencer, C.¹, Schoenemann, K.¹, Bonier, F.¹
Author Affiliations: ¹Department of Biology, Queen’s University, Kingston, Ontario, Canada

Reproduction is an energetically demanding life history stage that comprises costly physiological and behavioural changes. Despite these costs, some individuals invest more in reproduction, and breed more successfully than others. To understand variation in reproductive investment, studies often evaluate factors during breeding, but conditions outside of the breeding season may also play a role. These linkages across life history stages remain poorly understood, particularly at the mechanistic level. Using wild populations of Black-capped Chickadees (Poecile atricapillus), we evaluated whether traits relating to energetic condition (i.e., circulating corticosterone concentrations, and metrics of body condition) during the non-breeding season predicted reproductive investment in the subsequent breeding season. We found that females with high winter fat scores laid eggs sooner and fed their offspring more often, and females with high winter corticosterone concentrations produced lighter eggs. We also found that males with high winter fat fed their offspring more often and had nestlings with lower baseline corticosterone, and that males with high winter corticosterone concentrations had lighter eggs and smaller nestlings in the brood produced by their mate. These winter energetic traits may relate to reproductive investment via carry-over effects across seasons, and/or because they reflect an individual’s phenotypic quality. Altogether, our findings suggest that in wild populations, conditions experienced outside of the breeding season may be important factors explaining variation in reproductive investment, even in a non-migratory species. These linkages between life history stages could have important implications for the study of population dynamics, particularly in declining populations.
Determining the Voltinism and Sociality of the Sweat bee *Lasioglossum zonulum* in the Niagara Region

**Authors:** Proulx, A. N. M.¹, Richards, M. H.¹

**Author Affiliations:** ¹Department of Biological Sciences, Brock University, St. Catharines, Ontario, Canada

Of the ~20,000 species of extant bees, sweat bees (family Halictidae) exhibit substantial diversity in social behaviour, making them prime candidates for research on social evolution. Previous studies indicate that *Lasioglossum zonulum* exhibits solitary behaviour in Europe, however pan trap collections in the Niagara region over the last 15 years suggest that *L. zonulum* displays two periods of foraging activity, a trait consistent with eusocial species. I plan to identify both the number of *L. zonulum* broods and generations produced per year (demographic and genetic voltinism respectively) to test the following three hypotheses: 1. If *L. zonulum* is demographically univoltine, then it must be solitary. 2. If *L. zonulum* is demographically bivoltine, and females from the first brood possess a similar degree of ovarian development to foundresses (i.e. are reproductive), then *L. zonulum* is solitary. 3. If *L. zonulum* is demographically bivoltine, and females from the first brood possess a significantly lower degree of ovarian development than foundresses (i.e. are workers), then *L. zonulum* is eusocial. New specimens will be collected using pan traps and will be used alongside specimens collected over the previous 15 years to determine demographic voltinism via foraging activity periods, and will be dissected to determine genetic voltinism via ovarian development. Phylogenetically, *L. zonulum* exists in a clade of primarily solitary sweat bees, therefore if *L. zonulum* is eusocial or exhibits eusocial behaviours, it could represent an evolutionary transition and independent origin of eusociality in sweat bees.
Genetic Basis of Hybrid Sterility in *Drosophila pseudoobscura* and *D. persimilis*.

**Authors:** Alannah Mattice

**Author Affiliations:** 1Department of Biology, Western University, London, Ontario, Canada

Hybrid sterility is a reproductive barrier that can prevent gene flow between species. The genetic basis of this common reproductive barrier, however, remains poorly understood. *Drosophila pseudoobscura* and *D. persimilis* are able to form sterile male and fertile female hybrids. These two species also produce heteromorphic sperm: sperm which can vary in shape and size within one ejaculate. F1 hybrids of these species produce needle-eye shaped sperm that appears to have failed to separate during spermatogenesis. This sterile needle-eye phenotype can be tracked during an introgression analysis between these species. Using ten generations of backcrossing, I will be selecting for the sterile needle-eye phenotype in order to genetically map regions of the genome linked to hybrid sterility. The presence of the needle-eye sterility phenotype in some sperm morphs but not others will allow me to simultaneously identify genomic regions affecting sperm heteromorphism. Whole genome sequencing will be performed on males of the tenth-generation backcross for specific sperm sterility phenotypes and their fertile brothers. Loci of interest for sterility will be identified as genomic introgressions present in sterile males but not their fertile brothers. Loci for sperm heteromorphism will be identified by comparing males that have sterility in only one sperm morph to those that have sterility in only the other morph. Identifying candidate loci for sterility will help elucidate the mechanisms behind hybrid sterility. Of even greater interest, this study may be the first to identify candidate loci for the production of different sperm morphs.
11:00 AM  Using gene knock-down to test mechanisms of reproductive regulation in honey bees (*Apis mellifera*)

**Authors:** Gallo, A. J., Guzmán-Novoa, E.², Thompson, G. J.¹

**Author Affiliations:** ¹Department of Biology, Western University; ²Department of Environmental Science, University of Guelph.

Honey bee (*Apis mellifera*) workers are well known for their selfless tendency to forego reproduction in favour of directing help towards their queen mother. This altruistic tendency results in both behavioural and physiological changes; however, the underlying genetic mechanism of these changes has yet to be completely understood. In this study, we use RNA-interference to knock-down single genes previously identified as important to regulating this altruistic response to queen pheromone. We have initiated cage experiments in an attempt to knock-down the gene *fruitless* and monitor changes to worker behaviour, gene expression and physiological changes. Our results are unfolding but initial results suggest that workers do respond to the RNAi treatment at this and potentially other loci, as evidenced by small differences in survivorship and target gene expression. Moreover, we are currently dissecting worker ovaries to test if the knock-down affect is correlated to worker reproductive physiology. If so, our study may reveal a causal link between single genes and the phenotypic expression of reproductive altruism along with providing greater understanding of the underlying genetic mechanism. We present our study and initial results within this broader context of insect sociobiology.

11:15 AM  Mating competition and cooperation: Restricted mating strategies are associated with prosocial preferences and personality

**Authors:** Amanda Rotella & Pat Barclay

**Author Affiliations:** Department of Psychology, University of Guelph, ON

Why are some people more prosocial than others? To address this question we conducted one exploratory study (N = 144) and two confirmatory studies (Ns = 1,040 & 830), investigating if prosocial preferences, as measured by social value orientation (SVO) and HEXACO Honesty-Humility (HH), are related to scales associated with life-history theory, such as socio-sexual orientation (SOI) and risk-taking. SVO and HH were related to SOI with prosocials reporting a more restricted mating strategy, while less prosocial individuals engage in a less restrictive mating strategy, with the effect only being present in males for SVO ($R^2 = .05$ & .04), and both genders for HH($R^2 = .17$ & .12). Both measures were associated with risk-taking for ethical and social risks, but not for non-social risks. We propose that prosocial preferences and personality reflect extended mating strategies, such that one's optimal prosocial strategy may be dependent on the amount of mating competition on individual faces. In other words, the more investment one puts into mating, the less one invests in cooperation. We will also present a mathematical model based on game theory as proof of concept for this theory, which demonstrates that as the amount of mating competition increases, the payoff for cooperation decreases.
11:30 AM  Can You Have it All? Assessing Links between Plastic Growth and Reproductive Traits in *Latrodectus hasselti* Males  
**Authors:** Yousef Safar, Vighnesh Sukhu, Laini Taylor, Luciana Baruffaldi and Maydianne C.B. Andrade  
**Author Affiliations:** University of Toronto Scarborough, Department of Biological Sciences, 1265 Military Trail, Scarborough, ON, M1C 1A4, Canada

Adaptive developmental plasticity allows an organism to shift life history allocation in response to conditions experienced during ontogeny. Variable factors such as mate presence or diet may change the trajectory of individual development. If adaptive, the result is the production of adult phenotypes that are well suited to the competitive context indicated by those cues. We examined the effect of diet and the presence of adult females on males’ developmental time, mass, and sexually selected traits (running performance and sperm production) in *Latrodectus hasselti*, a scramble-competing widow spider. Final-instar males were divided into four treatment groups in a 2x2 design in which female presence (No females, Females present) was crossed with diet (High or Low). Body size and mass were measured before and after maturity, then running performance and sperm load quantified in adult males. High diet males developed faster and gained more mass regardless of whether females were present. Nevertheless, all males showed similar sperm counts, and running endurance (time), suggesting differential allocation to maintain these functions. Surprisingly, males on a low diet performed similarly to males that were on a high diet in terms of distance travelled, but only if they had been exposed to females as juveniles. Our results indicate that diet affects the resources available to development and mass, with low diets imposing costs on males. However, males maintain investment in some traits (sperm production, endurance) at the expense of development time and body size, and this is affected by cues of scramble competition (female presence).

11:45 AM  RNAi knockdown of fruitless transcripts to investigate reproductive isolation between *Drosophila melanogaster* and *Drosophila simulans*  
**Authors:** Werry, N.A., Moehring, A.J.  
**Author Affiliations:** 1Department of Biology, Western University, London, Ontario, Canada

Reproductive isolation reduces gene flow between populations and drives speciation. In *Drosophila melanogaster* and *Drosophila simulans*, the fruitless gene influences sexual development and female rejection of copulation attempts from heterospecific males. The gene has four potential first exons (P1 - P4), the first of which is sex-specifically spliced. How fruitless influences female receptivity is challenging to study as genetic disruptions can affect multiple transcripts and pre-developmental knockout of most fruitless transcripts is lethal. To bypass these limitations, RNAi specific to the melanogaster and simulans sequence for each exon will be expressed through the Gal4/UAS expression system, paired with a heat-shock inducible promoter. This will allow for localized, temporally controlled silencing of three specific fruitless transcripts (fru-Fem, fru-P3 and fru-P4) which circumvents developmental lethality. Selectively silencing expression of one species’ alleles of these transcripts in melanogaster/simulans hybrids will allow for assessment of their role, if any, in female rejection behaviour.
10:15 AM  **Effect of shelter availability on foraging in Atlantic salmon (Salmo salar)**

Authors: Therrien, C. A.\(^1\), Morbey, Y. E.\(^1\), Neff, B. D.\(^1\)

Author Affiliations: \(^1\)Department of Biology, Western University, London, Ontario, Canada

Juvenile Atlantic salmon (Salmo salar) use several anti-predator behaviours to reduce their vulnerability to predation, such as utilizing shelters and changing the timing of foraging behaviour to avoid predators. However, the consequences of shelter availability on the foraging behavior and growth of important native species such as Atlantic salmon (Salmo salar) are not well-understood. Moreover, little is known about how different populations of the same species might differ in their response to shelter availability. Atlantic salmon were extirpated from Lake Ontario due to human activity and since their extirpation, restoration attempts have focused on evaluating the suitability of two candidate populations (LaHave and Sebago). How these two candidate strains respond to an increase in shelter availability in Lake Ontario’s tributaries may be an important factor that can influence their juvenile performance during restoration attempts. To address these knowledge gaps, I measured the feeding and activity of juvenile Atlantic salmon from the two populations while they were held in net pens erected in a Lake Ontario tributary that differed in their level of shelter. Fish from both populations foraged more and had greater activity when shelter was abundant. However, these differences in foraging behavior did not have a noticeable effect on growth rate or the amount of food consumed. Overall, the results suggest that high shelter availability is beneficial for Atlantic salmon with no differences between populations. I will discuss how our data might help direct recovery efforts for Atlantic salmon.
10:30 AM  
**Landscape ecology of *Falco sparverius* (American kestrel)**

**Authors:** Hughes, M.¹, Vasseur, L. ¹, ², Willwerth, J.³

**Author Affiliations:** ¹Department of Biological Sciences, Brock University, St. Catharines, Ontario, Canada; ²UNESCO Chair in Community Sustainability: From Local to Global, Environmental Sustainability Research Centre, Brock University, St. Catharines, Ontario, Canada; ³Cool Climate Oenology and Viticulture Institute, Brock University, St. Catharines, Ontario, Canada.

The American kestrel (*Falco sparverius*) is a predatory bird, the smallest member of the falcon family. This native North American bird nests in cavities, are ambush hunters, and prey predominantly on insects, small rodents and birds. Agricultural fields create the perfect habitats for kestrels due to the availability of perches and open fields for hunting. Through the use of nest boxes in ideal areas, kestrels may support various ecosystem services such as pest control and control of invasive European starling (*Sturnus vulgaris*) populations through competition for nesting sites. Over the past three years, nesting boxes have been employed and monitored in various agricultural fields across the Niagara region. Successful nest sites were monitored for average clutch size, as well as sex ratios. Starting in year one with one successful nest site, we have observed steady increases in the occurrences of successful nest boxes in adjacent fields. Modeling and mapping the landscape ecology surrounding successful nesting sites can help to better understand habitat quality and selection of kestrels, and ultimately the potential use of American kestrels for the provision of ecosystem services.

10:45 AM  
**Selling Success: Portrayals of invasive species management and the potential to underestimate risk**

**Authors:** Noelle Stratton¹, Nicholas Mandrak¹, Nicole Klenk¹

**Author Affiliations:** ¹University of Toronto Scarborough

The Great Lakes are of enormous ecological and economic importance to Canada and the United States. Unfortunately, the region is currently threatened by at least 188 non-native species. The Sea Lamprey, is an ectoparasite that has been long established throughout the Great Lakes and had tremendous negative impacts. Sea Lamprey management is currently estimated to cost $20 million per year, and this is only one of the 188 non-native species. Despite the inability to date to eradicate the Sea Lamprey threat, the Great Lakes Fishery Commission has declared these efforts to be a “remarkable success”. Their goal was clearly to demonstrate to stakeholders that management efforts are having clear impacts on Sea Lamprey abundance and movement in the interest of continuing this highly effective management program. However, does this type of phrasing give a false sense of our ability to control the impacts of other invaders? Do we risk implying that the threat is over? Are we giving the impression that if we simply had the resources, we could manage anything? And, how might this influence the sense of urgency toward future invaders? Given the importance of early detection and rapid response to efficient and cost-effective invasive species management, any minimization of the threat of invasive species in the minds of stakeholders could be disastrous. By overselling our successes, are we underselling the risks? In this talk, I will explore these questions in order to frame my current PhD research objectives, and the questions I intend to explore going forward.
Agricultural intensity and diet of Barn Swallow (*Hirundo rustica*) nestlings: Insights from fecal DNA and stable isotope analyses

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For aerial insectivorous birds, low insect availability can directly influence reproductive success through reduced nestling body condition and fledgling survival. By decreasing prey insect abundance through homogenization of habitats and the use of insecticides, agricultural intensification may have contributed to recent widespread declines in North American aerial insectivores. We investigated the effects of agricultural intensification on nestling Barn Swallows at 20 colonies in southern Ontario by examining the effects of row crop density on diet and body condition in 2575 nestlings from 618 nests across two years. Nestling diet was investigated using stable isotopic analysis ($\delta^{13}$C, $\delta^{15}$N) of nestling feathers and insect DNA barcoding of fecal sacs. Contrary to predictions, nestling body condition was positively correlated with amount of row cropping surrounding a barn. This effect was consistent between years, indicating that nestlings were in better condition when raised in more agriculturally intensified sites, possibly because adult birds can better forage in open habitats. However, composition of prey items showed high variability and no effect of agricultural intensity. Stable-nitrogen isotope values of nestling feathers ($\delta^{15}$N) were positively correlated with the proportion of row cropping, which might result from increased use of nitrogenous fertilizers and ammonification in more heavily cropped landscapes. Our results suggest the proportion of row cropping does not negatively affect nestling condition or diet as barn swallows may be able to take advantage of a relatively robust regional aerial plankton community, despite possible landscape effects on insect productivity.
How does environmental complexity facilitate adaptive evolution?
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Sexual selection is an important agent of evolutionary change, but the strength and direction of selection often varies over space and time. One potential source of heterogeneity may lie in the opportunity for male-male and/or male-female interactions which is often mediated by the spatial complexity of the environment. It has been suggested that increased spatial complexity permits sexual selection to act in a complementary fashion with natural selection (hastening the loss of deleterious alleles and/or promoting the spread of beneficial alleles) via two (not mutually exclusive) pathways. In the first scenario, sexual selection acts more strongly on males in complex environments, providing increased difficulty in locating potential mates; this allows males of greater genetic ‘quality’ a greater chance of outcompeting rivals, with benefits manifested indirectly in higher quality offspring. In the second scenario, increased spatial complexity reduces opportunities for males to antagonistically harm females, allowing females (especially those of greater potential fecundities) to achieve greater reproductive success resulting in direct fitness benefits. Here, using Drosophila melanogaster, we explore the importance of these mechanisms by measuring direct and indirect fitness of females housed in simple or complex spatial environments. We find strong evidence in favour of the female mediated and conflict mediated pathways as individuals in complex environments remated less frequently and produced more offspring than those housed in a simpler spatial environment, while environmental complexity had no indirect effects on offspring fitness.
11:30 AM  Invasive earthworms and tallgrass prairie: an investigation of the earthworm community in restored and remnant tallgrass prairie across Southern Ontario

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Since only 1-3% of tallgrass prairie habitat remains in North America, dedicated citizens, scientists, and government officials are working to restore and protect prairie in Southern Ontario. While there is increasing evidence that invasive earthworms are important ecosystem engineers, surprisingly little is known about them. For example, we are missing key information about their presence/absence, community structure, and population density. Given their role as granivores and their habit of burying seeds, the objective of this study is to quantify invasive earthworm communities in 22 restored and remnant tallgrass prairie sites across southern Ontario.

To represent the variation of tallgrass prairies in southern Ontario, the sites selected include 5 remnants, 2 restored-remnants, and 15 restored sites of various ages, including the rare Charitable Research Reserve. Site management history also varies, as does time since restoration, adjacent land use, soil characteristics, and parcel size (0.3 ha to 36 ha). In October 2015 and 2016, ten 20 cm x 20 cm plots per site were sampled using a standard mustard extraction method, soil samples were collected, and the density and size of earthworm middens were recorded.

The key finding of this study is that invasive earthworms were found in all remnant and restored tallgrass prairie sites across southern Ontario. By characterizing the earthworm community of restored and remnant tallgrass sites, this research sheds light on these key soil fauna and can become a jumping off point for investigating the ecosystem interactions between our restored ecosystem at risk and our new underground residents.
White-tailed deer (*Odocoileus virginianus*) populations have been increasing in urban areas. Their influence on urban environments as a keystone species and as a carrier for communicable diseases has been well-studied. However, the influence of urbanized environments - via phenomena such as artificial light, noise pollution, and human activity - on deer has received less attention. White-tailed deer in rural environments are crepuscular, showing greatest activity at dusk and dawn. Here, we examine the effects of anthropogenic influences on the daily activity patterns of deer. We used four motion-sensor camera traps to monitor deer activity on a 24-hour basis at an urban park (the Riverwood Conservancy park in Mississauga, ON). We speculated that urban white-tailed deer experience disturbance in their crepuscular activity patterns due to anthropogenic influences found in suburban areas. We predicted that urban deer are non-crepuscular, showing peaks in activity at different periods of the day, thus deviating from their typical dusk-dawn cycle. A two-way ANOVA indicated that urban deer maintain a crepuscular behaviour. The greatest observed difference in daily activity was observed in the Winter. This finding suggests a possible extension of the duration of the dusk and dawn periods via artificial light reflected on a nearby bridge. However, we have not analyzed all photos taken over the course of the study, but we will have them completed by the time of the conference.
Response thresholds of recurrent winter storm cues in white-throated sparrows (Zonotrichia albicollis)

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Climate change has been linked to an increasing frequency of inclement weather and winter storms. As such, it is important to understand the effects changing weather patterns have on birds. We investigated the effects of experimental recurrent inclement winter weather cues on body composition, glucocorticoid hormones, and behaviour of white-throated sparrows (Zonotrichia albicollis). We used a hypobaric climatic wind tunnel to simulate storms by altering barometric pressure and temperature accordingly, and measured behavioural responses, body composition, and baseline corticosterone levels in birds exposed, or not exposed, to two simulated storms per week over a three-month period. This project was compared to a previous study wherein birds were exposed to only one simulated storm per week. Surprisingly, control birds not exposed to two simulated storms per week had higher fat mass and baseline corticosterone levels compared to experimental birds. There were no detectable effects on lean mass or testosterone levels, however, birds only exposed to one storm per week had vastly different results. Experimental birds developed significantly higher fat and lean masses at one storm per week, and baseline corticosterone levels decreased over time in both groups, however there was no effect of experimental treatment. Thus, these findings suggest that birds may hold a metabolic threshold of being able to respond to only one additional storm per week. This research provides novel experimental evidence that birds detect changing weather patterns and respond appropriately, and indicates that repeated exposure to inclement weather cues directly affects birds’ energy reserves.
Freezing can enhance the drought tolerance of plants because these stresses elicit similar physiological responses. Few studies have examined the effects of freeze-drought interactions on plant growth and the mechanism(s) behind this interaction. Furthermore, majority of these studies have exposed plants to stresses at times that are not ecologically relevant. We examined how spring freezing influences the summer drought tolerance of 6 graminoid (Agrostis stolonifera, Arrhenatherum elatius, Bromus inermis, Festuca rubra, Lolium perenne, Poa compressa) and 2 forb species (Plantago lanceolata, Securigera varia), with the goal of examining the generality of cross-acclimation responses. We exposed individual plants to 5 °C or -5 °C for 3 days in the spring, then subjected the plants to a 3-week summer drought, and harvested the plants after a 3-week recovery period. In addition, we measured soluble proteins and sugars in leaves prior to the drought and at the onset of drought symptoms. In terms of total dry biomass, we found that there was a significant interaction between freezing and drought stress for Agrostis stolonifera, Bromus inermis and Poa compressa and a marginally significant interaction for Plantago lanceolata. The decline in biomass for plants exposed to drought stress was lower for plants previously exposed to freezing when compared to non-frozen plants. These interactions did not appear to be correlated with changes in both soluble protein and sugars in leaves. Our results indicate that there is variation in cross-acclimation responses among species, and we should be cautious when generalizing stress interactions.
Heat shock proteins (HSPs) are highly conserved molecular chaperones. The accumulation of HSPs is a key component of the functional heat shock response that occurs when organisms are exposed to supra-optimal temperatures, where higher HSP levels prevent heat-induced protein aggregation and misfolding. *Chlamydomonas* sp. UWO241 is a photosynthetic alga isolated seventeen meters below the surface of the Antarctic Lake Bonney. This extremophile has evolved at permanently low temperatures (4°-6°C), and is unable to grow >18°C. This work aims to answer the questions: Does UWO241 have HSPs? What is the relationship between HSPs and the ability of UWO241 to respond to non-permissive growth temperatures?

We screened the UWO241 genome and detected at least 60 genes encoding potential HSPs. In contrast, the genome of the model mesophilic alga *Chlamydomonas reinhardtii* encodes 47 HSP genes. This expansion in UWO241 is due to multiple gene duplications; however, many duplicates have lost functionality and are present as pseudogenes. Several duplicated genes (HSP20, HSP70, ClpB3) show highly conserved identity (>90%) at the level of exons, suggesting that they are under strong evolutionary pressure that favors sequence conservation. UWO241 constitutively accumulates high protein levels of major HSPs under steady-state growth conditions (4-15°C); however, their accumulation is not heat-responsive and does not increase upon exposure to non-permissive growth temperature (24°C). We conclude that despite its evolution at constant cold, UWO241 has retained a HSP gene family; however, the heat shock response in UWO241 is not dependent on HSP accumulation. The functional roles of HSPs in UWO241 are discussed.
Overwintering physiology of the Brown Marmorated Stink Bug 
(*Halyomorpha halys*)

**Authors:** John Ciancio¹,², Brent J. Sinclair¹, and Tara D. Gariepy¹,²

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In temperate North America, insects spend a significant portion of their life overwintering, where they encounter various environmental stressors including low temperatures, desiccation, and energy drain. The Brown Marmorated Stink Bug (*Halyomorpha halys*) is an invasive pest that damages several economically important crops - such as corn, soy, and apples - thus threatening the Canadian agricultural landscape. Here, we aim to determine the relative importance of low temperatures, desiccation, and energy drain in determining *H. halys* overwintering success, and to determine if *H. halys* stress tolerance changes seasonally. We placed groups of *H. halys* in a residential overwintering habitat, and conducted measurements of their tolerance of low temperatures, desiccation, and energy drain at three sampling points throughout the winter. *Halyomorpha halys* are chill-susceptible, and die at temperatures above their supercooling point (SCP; temperature at which internal ice formation begins). Their SCP does not change throughout winter, nor does water content or lipid and protein content; this suggests that desiccation stress and energy drain do not limit *H. halys* survival, while low temperatures may be a limiting factor. Female *H. halys* have significantly higher water content and lipid stores compared to males; however, this does not appear to enhance overwintering success because only 39.7% of the surviving individuals were female. Overall, our study identifies potential strategies that aid in *H. halys* overwintering success, which may inform future pest managements strategies, and thus control future invasions of *H. halys*.

Benefits and costs of frost avoidance in herbaceous plants

**Authors:** F. C. Lubbe and H. A. L. Henry

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Frost is a major stress that greatly impacts the distribution of plant species. Non-woody plant species can survive in cold regions only if they can avoid or tolerate freezing stress. Many plants avoid freezing stress by placing buds at or below ground level where they are insulated by snow, litter or soil. Although it can protect, increased bud depth may have a cost when frost stress is absent. Shallow bud placement may facilitate early season growth and provide a competitive advantage over neighbouring plants. I subjected six bulbous, herbaceous, plant species to a suite of experiments to decouple the effects of bud depth on frost tolerance and competitive ability in the spring. In the field, I buried plants in the fall at one of three depths, and half of the plants experienced snow removal to allow greater frost penetration into the soil. In a second experiment, I exposed plants to one of six freezing temperatures under controlled conditions. Emergence (when possible), height, and biomass were measured and data were analyzed through linear regressions. Species response varied, but the results indicated a trend of greater growth with depth, probably as a result of frost stress avoidance. *Muscari armeniacum* offset these costs through a decrease in storage allocation. Controlled freezing temperature exposure yielded a trend toward increased mortality and decreased growth with greater frost severity. Two exceptions were *Apios americana*, which exhibited increased mortality with frost severity, but no sublethal effects, and *Helianthus tuberosus*, which largely avoided mortality and sublethal effects.
Cold Comforts: Long term cold exposure prolongs memory in common pond snail, *Lymnaea stagnalis*

**Authors:** Brynne M. Duffy¹, Susan E. Anthony¹, Ken Lukowiak², and Brent J. Sinclair¹

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*Lymnaea stagnalis* is a species of pond snail that experiences cold winters, but its ability to form and retain memory through these experiences remains uncertain. Cold has been shown to block formation and promote retention of long-term memory (LTM) in ectotherms, likely by slowing the gene activation and protein synthesis necessary for memory consolidation and forgetting. *L. stagnalis* is a model system for studying memory because they are easily conditioned to reduce aerial respiration. By testing their ability to learn and remember this operantly-conditioned response in either a one-hour 4 °C cold-shock or two-week 4 °C acclimation conditions, we assessed the nature of *L. stagnalis* memory processes in ecologically relevant, simulated winter temperatures. We hypothesized that the shorter cold-shock would block LTM formation but allow retention of consolidated LTM by reducing enzymatic activity needed for consolidation and forgetting. In contrast, we hypothesized that through the novel equilibria established in cold-acclimated snails LTM formation in low temperatures would occur, while also allowing the processes involved in forgetting. Cold-shocked snails, as predicted, were unable to form LTM of the conditioned response in the cold. However, the retention of previously acquired LTM’s was preserved. Further, acclimated snails both formed and retained LTM at low temperatures. Based on the differential results obtained for cold-shocked and cold-acclimated snails, we conclude that the effect of cold exposure on memory formation and retention in *L. stagnalis* is dependent on the duration of cold exposure.
Can coarse taxonomy detect disturbance in the Boreal forest in northern Alberta? A case study with soil mites

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Ecosystems are continually disrupted by disturbance events, which threaten their stability, and may lead to an altered state. To detect changes caused by disturbance, researchers use ecological indicators. Ecological indicators can be physical, chemical or biological in nature. Biological indicators (bioindicators) have been used for decades to monitor ecosystems, with organisms ranging in body size from large (birds and amphibians) to small (mites and nematodes). Small-bodied organisms are typically highly diverse and abundant; however, some have argued that their diversity makes them unfeasible to be used as bioindicators. Due to this concern, researchers have tested whether coarse taxonomy (genus- and family-level) can be used to sufficiently delineate environments, to quicken identification time of specimens. In my MSc., I tested this premise by determining whether two different feeding groups of soil mites could indicate forest fire, forest harvest and linear disturbance. This study was conducted in the Boreal forest of northern Alberta, with samples being collected by the Alberta Biodiversity Monitoring Institute (ABMI). Disturbed sites were paired with undisturbed sites for analysis, for a total of 13 pairs for forest fire, 11 pairs for forest harvest, and 7 pairs for linear disturbance. The two feeding group of mites consisted of predators and detritivores, and were identified to the species-, genus-, and family-level. We found that predatory mites indicated disturbance better than detritivorous mites at species-level. However, both groups could indicate disturbance at genus- and family-level, suggesting that coarse taxonomy can be used in bioindicator studies, which will ease the identification process for researchers.
1:30 PM  Investigating the social dynamics of winter flocks of Black-capped chickadees by use of an automated radiotelemetry array
Authors: Course, C.J. & Sherry, D.F.
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Seasonality of social behavior is widespread in birds which makes this group an excellent model to study social group dynamics such as: fusion-fission, and cohesion. Since our understanding of these processes is mostly theoretical, studies that examine social dynamics in an ecological context are needed. I constructed a network of automated radio-towers in a 60 hectare forest to track individual and flock behaviour of radio-tagged Black-capped chickadees through the winters of 2016-2018. Seasonal “radioprofiles” indicate that: flocks can be identified from telemetry data alone, flocks of birds have differing activity schedules, and individual movement between flocks (fission) can be studied. This research shows that automated telemetry can effectively study social behavior on the level of the individual and flock directly in the field. This method provides for a deeper understanding of social evolution by examining real-time social dynamics simultaneously across multiple groups in a natural setting.

1:45 PM  Analysis of Living Social Networks: Insights from a Drosophila Model
Authors: Christine T Scharf, Anne F Simon, Kristin Ransome, and Graham J Thompson
Author Affiliations: Western University, Department of Biology, London, ON, N6A 3K7, Canada

Shoals of fish, herds of elk, plagues of locusts – sometimes, animals form conspicuous aggregations in which individuality appears to be subsumed within a larger social group. Here we use social space and network analysis to study how individuals position, orient and respond to each other within a living social context. Specifically, we test how living populations of fruit flies vary the number and nature of their interactions as a function of genetic and environmental circumstance. Using social space analysis and a social network assay that scores all individual interactions in real time, we find that density and genotype can alter the number and directions of interactions, as well as higher-order features that help to identify the most social individuals or the tendency to form sub-groups. We are currently expanding our network analysis of flies and other types of insects to test how age, sex-ratio, and individual mating status within populations affect insect aggregate behaviour.
Towards an identification of the neural circuitry necessary for proper social spacing in *D. melanogaster*

**Authors:** Robinson, J. W., Yost, R. T., de Belle, J., Simon, A. F.

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The social environment can affect behaviour by altering molecular processes and neuronal functioning. In *Drosophila melanogaster*, an individual’s social experience can change its expression of genes, as well as modify signaling through its brain. Furthermore, social experience can affect behaviours including aggression, mating, learning and memory, as well as social spacing. Integration of the environment, social experience, genetics, and the neural circuitry all contribute to the fly’s preferred spacing distance to another individual. Social isolation alters gene expression and can affect levels of dopamine, a signaling molecule in the brain. In addition, dopaminergic signaling has been identified as a modulator of spacing and mutations to a protein that regulates neuronal signaling, Neuroligin 3 (*nlg3*), also affects fly social spacing. We want to assess the effect of social isolation as well as map the relevant neural circuitry of the fly brain to better understand the factors affecting social spacing behaviour. Using genetic and molecular techniques we have identified specific brain regions rich in *nlg3* protein which may facilitate the decision making of the fly. While we determined that the abundance of Neuroligin 3 does not change with isolation, we want to determine if there is an upstream modulation of dopamine that is altering the fly’s response to social experience. Our results will provide insights into a genetic and molecular basis of how social spacing behaviour is affected by social experience.

Molecular signatures of kin selection: are caste-associated genes nearly neutral?

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Social insects are characterized by sub-fertile castes that evolve via indirect selection, yet little is known about how this type of selection affects rates of molecular evolution. On the one hand, genes indirectly selected for subfertility may experience relaxed adaptive molecular evolution, relative to genes directly selected for reproduction. On the other hand, genes associated with sub-fertile castes may be less constrained and thus, free to evolve rapidly. These potential yet contrasting ‘signatures of kin selection’ remain unresolved. In this study, I test for the differences in the rate of adaptive molecular evolution across caste-biased and un-biased genes from a subterranean termite. Specifically, I exploit allelic diversity captured in a newly available RNA sequence data set to reveal the differences in patterns of nucleotide substitution that are associated with sub-fertile castes.
The evolution of male harm depends on the environment in which polygamy occurs

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The current accepted paradigm in sexual conflict theory states males harm evolves as a byproduct of adaptation under polygamy but not under enforced monogamy. However, not all polygamous conditions should necessarily create sexual conflict. Although Drosophila melanogaster has been a flagship species for the study of sexual conflict, recent work shows that the scope for male harm is much reduced when adults interact in lower density and more structurally complex environments compared to the simple environments used in most past studies (i.e. standard fly vials/bottles). Here we present the results of a large D. melanogaster evolution experiment involving 63 replicate populations and the two traditional mating regimes—enforced monogamy (EM) and polygamy in a simple environment (PS)—as well as a third mating regime, polygamy in a complex environment (PC). Evolved differences among females from different regimes are relatively small, whereas males diverge dramatically. Consistent with past studies, we find that EM males outperform PS males under monogamy assay conditions, and that the reverse occurs under polygamy assay conditions. However, this apparent trade-off does not exist for PC males which instead outperform PS males under all assay conditions. Moreover, PC males often do as well as or better than EM males, even under monogamous conditions. This suggests that PC males are able to evolve to achieve high fitness under polygamy without evolving to be harmful to their mates. These results highlight the importance of the environment delimiting the opportunity for sexual conflict and the evolution of male harm.

Can losers still be winners? The evolutionary biology of winner-loser effects

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In many animals, the outcomes of competitive interactions can have lasting effects that influence an individual’s future reproductive success and have important consequences for the strength and direction of evolution via sexual selection. In the fruit fly, Drosophila melanogaster, males who have won previous contests are more likely to win in subsequent conflicts, while losers are more likely to repetitively lose (winner-loser effects), but the direct fitness consequences and genetic underpinnings of this plasticity are poorly understood. Here, we tested how male genotype and the outcomes of previous male-male conflicts influence male precopulatory success in intrasexual (male-male competition) and intersexual (female choice) contexts. We found that winners have increased reproductive success compared to losers in both scenarios, and identified genetic variation in this plasticity. However, losers consistently mated for a longer duration, indicating greater investment into postcopulatory mechanisms. We discuss the importance of these results in the context of sexual conflict and trade-offs between male reproductive strategies.
Determining if Ntu affect female receptivity towards males from other species

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During courtship, it is extremely important for organisms to be able to recognize conspecifics because of the heavy costs associated with forming interspecies hybrids. Many organisms use species-specific cues to recognize potential mates. These cues are then perceived and evaluated via neural pathways. The underlying genetic basis of how species-specific cues are evaluated and subsequently processed into either receptive or rejectionary behaviour remains almost entirely unknown. This project aims to determine whether the gene Ntu, which is involved in neuron development in Drosophila species, is involved in species identification during courtship. I will use the CRISPR/Cas9 system to knock out either the Drosophila melanogaster or D. simulans allele of Ntu in interspecies hybrids and see if this results in melanogaster-like or simulans-like female mating behaviour. Complementary to this, I will silence each species' Ntu allele using allele-specific RNAi that is expressed in particular subsets of neurons via the Gal4/UAS system in hybrids. Differences in behaviour would indicate that Ntu is involved in species recognition during courtship via the particular subset of neurons. If successful, this would be the first time that a gene has been linked to interspecies mate rejection and provide the first insight into which neurons contribute to that behaviour.
Acknowledgements

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