Abstracts – 2020 TEA Student symposium

Libesha Anparasan, University of Western Ontario

Identifying critical nutrient sites for migrating monarch butterflies: New promise from stable isotopes and fatty acids

The fall migration of the monarch butterfly (*Danaus plexippus*) requires frequent stopovers at which monarchs can rest and refuel. At overwintering sites, individuals must have enough stored lipids to last through the winter and fuel part of the northward return and reproduction. Despite the recognized importance of safe nectaring sites, little is known about which areas are most important for this purpose. The fatty acids used to fuel migratory flight and overwintering periods may also play a role in northward reproduction and thus sources of these vital lipids are important sites of migratory and reproductive resources. Stored fatty acids are synthesized almost exclusively from plant nectar carbohydrates en route, but larval diet may provide a large proportion of essential fatty acids. Knowing where both essential and non-essential fatty acids originate for the critical overwintering, migratory, and reproductive periods of the monarch butterfly is important for their conservation. In this study, compound specific stable isotope mass spectrometry will be used as a means of tracing origins of fatty acids in monarchs as well as the allocation and use of specific fatty acids within the body during different life history events. Preliminary data on bulk lipid isotopic fidelity to dietary sources are presented. This study will provide the basis for using this technique to potentially estimate spatial origins and allocation patterns of fatty acids in migrating monarchs and define the areas needed for conservation during migration.

Julia Boyle, University of Toronto

Plasticity and habitat choice match colour to function in an ambush bug

Ambush bugs, *Phymata americana*, are found on the tops of flowers waiting to attack insect visitors with their large raptorial forearms; and their success may depend largely on how much they blend into the flower they're perched on. Ambush bugs vary in color from greenish white to rich yellow, which is similar to the most common flower habitats available in their environment. However, it was unknown if the color variation existing in ambush bugs affected what kind of flower they chose to perch on, and whether they could alter their own color to better match their background. In our study, we surveyed whether ambush bugs found in the wild tended to match the flower color they were found on, and if this was correlated with how often they had prey. In lab experiments, we followed up by providing ambush bugs a choice between yellow and white flowers, as well as keeping individuals on white and yellow backgrounds to see if they would change colour over time. The results demonstrated that ambush bugs use a combination of color change and habitat choice to optimize their ability to catch unsuspecting prey.

Jesse deHaan, Brock University

The effect of temperature on metabolic rate and gas exchange pattern in developing *Ceratina calcarata*

Ceratina calcarata (Hymenoptera: Apidae) is a small twig-nesting, mass-provisioning bee native to eastern North America. They construct their nests by tunneling into the pithy centre of Teasel, Raspberry or Sumac twigs. Teasel grows in sunny fields, while raspberry and sumac often grow along wood-margins in the shade. As a result, developing brood can experience different microclimates based on the nesting site chosen by their mother; higher temperatures are observed at sunny nesting sites, while the temperature at shady nesting sites remains relatively cooler. *C. calcarata* are ectotherms, meaning they cannot regulate their body temperature, so their physiological processes are influenced by their environmental temperature; at warm temperatures, metabolic rate is increased. Metabolic rate can be estimated by measuring the volume of CO_2 an organism produces (i.e., exhales) over time. Research has suggested that gas exchange patterns, the forms of respiration that an insect uses to breathe, can be life stage-, temperature-, and metabolic rate-dependant. Three types of respiratory gas exchange patterns exist in insects; discontinuous, cyclical, and continuous. Cyclical gas exchange and discontinuous gas exchange typically occur at normal temperatures or when metabolic demands are low, while continuous gas exchange occurs during periods of increased metabolic demands. Which gas exchange patterns are used by *C. calcarata*? Can the life history of *C. calcarata* influence their metabolic rate? In this study we aim to characterize the different gas exchange patterns utilized by the developing brood and adult brood of *C. calcarata* from sun and shade nests.

Sydney Gram, University of Toronto

Diversity and host preferences of insects that develop inside mushrooms

Fungi and insects are among the most diverse organisms on Earth, and they have been interacting with each other in complex ways for over 400 million years. In temperate forests, a variety of different beetle and fly species complete their larval development inside of mushrooms and other fungal fruiting bodies. However, identification of these larvae is often impossible by morphology alone, and therefore much of the diversity and ecology of these insect-fungus interactions remains to be uncovered. This study is the first survey of fungivorous insect larvae to employ DNA-based techniques to identify juvenile insects collected from wild mushrooms. The host preferences of identified insect larvae are discussed, taking into account the morphology, freshness, taxonomy, and seasonality of the fungi fruiting bodies in which different insects were found. We find that host preference data support the general trend of flies laying eggs in soft, fresh mushrooms, and beetles laying eggs in tougher, often decayed fungi. However, there is variation in preference and degree of specialization within these groups. We also note that while most beetles were able to be identified to the species level from DNA barcodes, reference barcode databases for species-level identification of fungivorous flies are largely incomplete.

Kate Lindsay, University of Guelph
A revision of the genus *Scipopus*: Solving the *Scipopus* problem

Scipopus Enderlein is a large group of Neotropical flies often recognized by their orange heads and black bodies. Despite their seemingly conspicuously appearance, the genus lacks a proper generic definition and diagnosis. The goal of my research is to identify synapomorphies to define the genus and to differentiate *Scipopus* from the other three closely related genera in the *Scipopus* group: *Pseudeurybata* Hennig, *Phaeopterina* Frey and one undescribed genus. Preliminary DNA barcode data shows these four genera as distinct clades. The *Scipopus* group, along with several other Micropezid genera are relatively easily separated on the species level but on the generic level show high occurrences of homoplasy and character overlap, making them an evolutionarily interesting group to study.

YeongGyun Ryu, Ryerson University
Studies on Flapping Micro Aerial Vehicles (FMAVs) development: the insect-inspired flying robots

Flying insects with flapping wings have inspired many researchers to develop small-sized aerial vehicles, called "Micro Aerial Vehicles (MAVs)," because they provide insights into overcoming the limitation of fixed or rotary wings that conventional aircrafts and helicopters have. The flying insects also can execute complex maneuvers and attain high aerodynamic efficiency at low flight speeds. Accordingly, it is important for researchers to investigate the principles of insect flights and to apply them to the robotic models. In this presentation, I will briefly explain history and development process of flapping MAVs (FMAVs), as well as introduce the recent flying robots. I also will present how to demonstrate the aerodynamic performances of flying insects. Among the insects, hawkmoth, Manduca sexta, was my main research target because of its hovering/forward flight capacities and similar size to that of MAVs specifications. To study the principles of its flapping flights, a dynamically scaled-up robotic model was developed, and force/torque and flow visualizations were measured during flapping motions. These studies elucidated the aerodynamic mechanisms of the hawkmoth and suggested the important mechanisms to obtain higher aerodynamic force in FMAVs development. This presentation will improve the understanding of how to study flying insects in engineering field.

Posters

Alvaro De la Mora-Pena, E. Guzman-Novoa, J.L. Uribe-Rubio, L.G. Espinosa-Montano, C.A. Medina-Flores
***Varroa destructor* mites irritate honey bees and make them sting faster**

Honey bees (*Apis mellifera*) protect their nests and food stores from intruders by stinging. The stinging behavior of honey bees could be affected by a number of stressors, which could reduce or increase their ability to defend their nests. However, there are no studies on how particular stressors, like parasites, affect this behavior. Among the parasites affecting honey bees, the most damaging is the mite *Varroa destructor*. *V. destructor* is an external parasite that feeds on honey bee hemolymph and fat body tissue, causes serious health problems and increases bee mortality. This study was conducted to determine if *V. destructor* could affect the stinging responses of

individual honey bees in a controlled environment. Groups of 30 bees of the same age were subjected to one of the following treatments: 1) control bees that were fed sugar syrup and kept in cages in an incubator until tested, 2) bees artificially infested with two mites/bee, kept under the same conditions as the control bees. When the bees were seven days old, they were exposed to an electric stimulus of 0.5 mA, and the time they took to sting a leather patch was recorded under laboratory conditions. The experiment was repeated three times. Bees exposed to *Varroa* parasitism stung significantly faster (2.58±0.29 s) than the control bees (3.63±0.52 s; $P<0.005$). It is concluded that *Varroa* increases the irritability of the bees and reduces their stinging response time. The implications of these results on nest defense will be discussed.

Alexandra Sauk, Caleb C. Ryan, and Hugh G. Broders, University of Waterloo
Unwelcome guests: understanding ectoparasite assemblages of bats in Atlantic Canada.

Bats can be parasitized by a variety of ectoparasites, including mites, ticks, and fleas. Bat ectoparasites can be host specific, feeding on a limited group of closely related bat species, while others are generalist parasites. Ectoparasites may adversely affect body condition, increase roost switching and grooming behaviours, and reduce fitness. Given recent dramatic declines in many bat species in Atlantic Canada and across eastern North America, more research is needed to determine the diversity and number of ectoparasite species to understand what bat species are affected by ectoparasites and whether bat ectoparasites are transmissible between bat colonies. Ectoparasite diversity and transmissibility likely varies between bat species based on roosting strategies of the bats and by the life history strategies of the ectoparasites themselves. Previously collected ectoparasites from throughout Atlantic Canada were identified using morphological characteristics and confirmed with DNA barcoding for the mitochondrial cytochrome oxidase I gene. Currently identified specimens include the mites *Spinturnix americanus, Androlaelaps casalis,* and *Macronyssus crosbyi;* the chigger *Leptotrombidium myotis;* and the flea *Myodopsylla insignis*. The specimens were assigned to five operational taxonomic units (OTUs), one per morphologically identified species, except for *Macronyssus crosbyi* specimens which were assigned to two OTUs. Nine haplotypes were identified for *Spinturnix americanus* and three haplotypes were identified for *Macronyssus crosbyi.* Additional specimens are being processed and will be included in diversity analyses including Faith's phylogenetic diversity and estimates of species richness. The combination of morphological and DNA barcoding identifications of bat ectoparasites are effective in determining ectoparasite assemblages to accurately estimate species richness and for determining geographic population structure and divergence within species.

Tanushree Tiwari, Rodney Richardson, Clement Kent, Stephen Rose, Harshil Patel, Alivia Dey, Ida Conflitti, Amro Zayed and BeeOMICs consortium York University
Identifying the genetic markers for pathogen loads in the honey bee (*Apis mellifera*)

The honey bee, Apis mellifera is a model organism for sociogenomics and is one of the most important managed pollinators. As such, recent threats to honey bee health are particularly alarming. The social honey bees live in highly crowded nests providing favorable conditions for the spread of infectious diseases. But honey bees have several social and individuals mechanisms for protecting themselves against disease. The BeeOMICS consortium has sequenced the genomes of approximately 1,000 honey bee colonies in Canada, which were

evaluated for a number of traits, including the abundance of several pathogens within each colony. I plan to carry out genome-wide association studies (GWAS) on colony pathogen loads to gain a deeper insight of the genetics of immunity in honey bees. This research will set the groundwork for breeding disease resistant honey bees using marker assisted selection.

Albert Tomchyshyn, University of Toronto

Effects of Urbanization on Milkweed Pollinator Richness and Abundance

Pollinator populations are critical to agriculture because they provide ecosystem services that are crucial for crop pollination. With current declines in pollinator richness and abundance, several studies have looked at the effects urbanization has on pollinator communities. In this study, I observed the richness and abundance of pollinators by visiting pollinator communities on *Asclepias syriaca* along a rural to urban gradient. Though pollinator richness did not differ from urban to rural sites, pollinators were more abundant within rural areas. Future research should elaborate on the relationship between *A. syriaca* abundance and pollinator abundance since this relationship is still relatively unknown.