TEA Student Symposium Abstracts 2019

Talks

A review of Canadian Pachygastrinae (Diptera, Stratiomyidae) with illustrated key
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The Pachygastrinae are a mostly tropical subfamily of Stratiomyidae (soldier flies). These flies are often poorly represented in collections and little is known of their natural history. Using specimens housed in five collections, the Canadian fauna is reviewed, and an illustrated key is provided for 9 species and 1 genus. *C. pallidipennis* (Williston)*, G. punctifera* (Malloch)*, N. vitrea* Hull*,* and *P. pulchra* Loew are recorded from Canada for the first time. Numerous new provincial records are also documented.

Hot models: projecting future climate-driven distributions of two ambush bug species, *Phymata americana* and *Phymata pennsylvanica*
Vicki M. Zhang. Supervisors: Locke Rowe, David Punzalan. University of Toronto

Climate change can have a variable number of effects on different species, even closely-related species. In the present study, I use Maxent, a machine-learning species distribution software, to predict the future ranges of two closely-related ambush bug species found in overlapping distributions, *P. americana* and *P. pennsylvanica*. Four Representative Concentration Pathways (RCP) were used, which project four different trajectories of greenhouse gas emissions affecting temperature and precipitation; a lower RCP indicates a better-case scenario, in which greenhouse gas emissions is predicted to peak earlier, followed by an earlier decline in greenhouse gas emissions. An increase in *P. americana* and *P. pennsylvanica* ranges was observed at lower RCPs, but these distributions narrow in latitude and longitude at higher RCPs. This suggests that slightly warmer temperatures and slightly more variable precipitation may not affect ambush bug distributions greatly. *P. pennsylvanica* was predicted to be less sensitive to changes attributed to RCP projections, as their projected ranges did not undergo major latitudinal or longitudinal, relative to *P. americana*. These results provide evidence for species-specific environmental requirements for *P. americana* and *P. pennsylvanica* and highlight the effects of climate change on range shifts. The use of species distribution models (SDM) in ecology is growing as it provides the ability to identify the effect of environmental variables on species distributions and to forecast future environmentally-driven changes. Understanding how these abiotic factors affect ambush bug distributions will be fundamental for future research on their taxonomy and conservation.

Laphria (Diptera: Asilidae) of Ontario, with a key to the eastern Canadian species of Laphriini and *Dasylechia*
Kate G. Lindsay and Stephen A. Marshall. University of Guelph

The 24 described and two undescribed species of *Laphria* Meigen (Diptera: Asilidae) currently known from eastern Canada (defined here as Manitoba eastward) and the adjacent United States are reviewed and keyed, with an emphasis on the Ontario fauna. Species in the related genera *Dasylechia* Williston and *Lampria* Macquart found in the same region are also keyed. *Laphria cinerea* (Back) and *Laphria canis disparella* Banks are recorded from Ontario for the first time. The female of *Laphria sicula* McAtee is included in a key for the first time.

Social organisation of the sweat bee *Lasioglossum zonulum* in the Niagara region.
Proulx, A. N. M., Richards, M. H. Brock University

Sweat bees (Halictidae) exhibit substantial social diversity, making them prime candidates for comparative research on social evolution. The halictid *Lasioglossum zonulum* exists in a primarily solitary clade and exhibits solitary behavior in Europe; however, recent analyses of pan trap collections in the Niagara region demonstrate *L. zonulum* exhibiting a flight phenology more typical of eusocial sweat bees and rarely found in solitary species. To clarify this discrepancy, I plan to determine the social behavior of *L. zonulum* in the Niagara region by examining the flight phenologies, size, wear, and ovarian development of preserved specimens collected from the Niagara region over the last 15 years. Preliminary results show that *L. zonulum* does not exhibit the flight phenology typical of solitary sweat bees. Comparisons of size dimorphisms and ovarian development between spring and summer females could not effectively distinguish the behaviours of Niagara populations as either solitary with two broods or eusocial. Further analyses of the females captured in summer is needed to evaluate whether *L. zonulum* is weakly eusocial or if it is solitary with two broods. If it is solitary with two broods, *L. zonulum* could represent an evolutionary transition state between solitary and eusocial behavior.

How does the lightness of a species assemblage change across elevation? Testing the thermal melanism hypothesis with two abundant and diverse insect families
Lauren Janke, Sarah Dolson, Dan Janzen, Winnia Hallwachs, Shoshanah Jacobs, M. Alex Smith. University of Guelph

According to the thermal melanism hypothesis, ectotherms ought to be darker in colder environments to obtain more heat, and lighter in warmer environments to avoid overheating. We predicted that insect assemblages in the cloud forest at the top of a neotropical mountain would be darker than those at the bottom. To test this hypothesis, we used insects from two families (Formicidae and Staphylinidae) from a decade of collections across a 1500m elevation gradient in northwestern Costa Rica (all imaged, tissue sampled, and DNA barcoded). We found that these two insect assemblages followed a trend that supported the thermal melanism hypothesis.

Mass-Provisioning Bees: An Exception to the Temperature Size Rule in Insects.
Jessica deHaan. Brock University

Insects are generally unable to thermoregulate, so their body temperature and physiological processes are therefore influenced by their environmental temperature. In insects, the relationship between temperature, developmental rate, and body size is known as the Temperature Size Rule. Insects that develop more slowly at lower temperatures consume more food and reach larger adult body sizes than those that develop quickly at high temperatures and consume less food. Insects often develop in extreme thermal conditions, which may prove fatal unless compensation through the heat shock response occurs (i.e. Heat shock proteins). The heat shock response causes the insect to incur a metabolic cost whereby a portion of the total energy it consumes must be diverted from growth and development to cellular maintenance. Hymenoptera adult body size is also positively correlated with the amount of food consumed during development. In mass provisioning bees, the mother controls the size of her offspring by varying the amount of pollen in their provision masses, as each pollen mass contains all the nutrients each offspring requires to develop from larva to adult. There is also a strong correlation between maternal foraging time and weather conditions. I suggest that mass-provisioning bee offspring body size is constrained by ecological and physiological factors, and that these factors are influenced by environmental/thermal conditions. Thermal compensation is responsible for body size variation in bees experiencing thermal stress. Offspring body size is limited by maternal input, which is itself influenced by environmental conditions during provisioning.

Posters

Floral resource competition between honeybees and native bees in Toronto
Sarah MacKell. York University

Bees are the most efficient pollinators for many crops and wildflowers, and their pollination services are estimated to increase annual global crop production by $235-577 billion USD. Alarmingly, many bee species abundances are in steep decline globally, including in Canada. There are many proposed reasons why bee species populations are declining including climate change, pesticides, habitat loss, lack of forage, diseases and pests, and even the increase in non-native pollinators. Multiple studies have shown that the introduction of non-native honeybees can have negative impacts on native bee species; some of these effects are decreased: visitation rates, diversity, thorax widths, and fecundity of native bees. With the increase of urban beekeeping in cities that have high native bee diversity, for example Toronto, it is important to investigate whether these introductions of non-native bees might be harming our native bee populations. My study will investigate whether native bees are competing with honeybees for floral resources in Toronto by performing a field study at 10 sites across the city. The objectives of this study are: 1) measure abundance and diversity of all bee species, 2) measure body sizes of native bees as an indicator of larval nutrition, 3) measure pollen and nectar abundances, and which bees are using these resources, 4) observe floral

resource competition between honeybees and native bees (i.e. displacement interactions), and 5) identify whether honeybees and native bees are collecting pollen from similar plant species. This study may help inform future bee conservation management plans in Toronto and other urban landscapes.

Studies on the utility of using a parasitoid to control cotton bollworm, *Helicoverpa armigera* (Hübner)
Yogita Jaybhay-Sanap. Royal Ontario Museum/Pune University, India

Biological control agents are vital components of an integrated pest management strategy, and this is frequently referred to as natural control. Natural enemies of insect pests include predators, parasitoids, and pathogens. The parasitoid, *Chelonus blackburni* (Cameron), was found to be the best biological control agent for the polyphagous pest, *Helicoverpa armigera* (Hübner).

In laboratory conditions, mass production of *C. blackburni* is an important aspect to control *H. armigera* pest. *Phthormaea opercullela* was a most suitable alternative host for rearing of parasitoids in the laboratory in optimum conditions. *C. blackburni* alters the feeding performance of *H. armigera* larvae upon parasitism and as a result severely affects growth and development. Moreover, it shortens the feeding period of *H. armigera* and increases mortality. Furthermore, damage of a plant as a result of insect feeding or establishment of a pathogen triggers certain biosynthetic pathways which result in the release of volatiles different from a mechanically damaged or undamaged plant. The antennae of *C. blackburni* has many sensilla which play a vital role during host-finding and acceptance behaviors for oviposition.

This study provides an insight to changes involved in *H. armigera* due to parasitism by *C. blackburni,* a parasite that could be used as an effective biocontrol agent to manage *H. armigera.*

Negative Selection in Social Insects
Arshad Imrit. York University, Amro Zayed's lab

Eusociality, characterized in part by 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 knowledge gap, 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.

The coast to coast ant: a continental assessment of *Tapinoma sessile* (Hymenoptera: Formicidae)

Daniel McIsaac, Paulson Des Brisay, Gary Umphrey and M. Alex Smith. University of Guelph

Allopatric speciation can occur when a species is separated due to physical barriers such as mountains or rivers. Arthropods tend to have small distributions due to their dependence on abiotic factors such as temperature. However, some species deviate from this pattern, including one species of ant, *Tapinoma sessile* whose range covers most of North America. While common, this species is also taxonomically understudied in the literature due to its lack of defining morphological characteristics. Previous genetic research has uncovered multiple genetic clusters within *T. sessile*. I am interested using morphometrics to help elucidate if these genetic clusters represent cryptic species within a species complex (genetic distance correlated with morphometric distance) or are intraspecific phylogeography (no morphometric distances that correspond with genetic distance). Using a collection of 314 specimens from across North America, I measured 19 morphological characters to compare specimens to the recently described neotype locality (Indiana) using multivariate statistics. I expect to see that populations have diverged along the cardinal directions across the continent (coincident with major barriers such as mountains) and morphological and genetic variation will differentiate populations from the neotype locality.

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

Anna M Chernyshova, Graham J Thompson. Western University

In termite societies, sexual kings and queens are highly specialized for reproduction, while more-or-less sterile workers and soldiers perform non-reproductive roles that are associated with colony growth, colony maintenance and defence. Workers and soldiers can therefore be considered reproductively altruistic because they labour to help produce large numbers of non-descendent kin (i.e., siblings, half-siblings, etc.) at the expense of their own direct fitness. The evolution of altruism, in any taxon, is therefore intriguing because in theory it requires 'genes for altruism' to evolve indirectly via selection on reproducing relatives, who carry, but do not express these genes. Therefore, the notion of indirect selection is fundamental to our understanding of social evolution, yet surprisingly, we know little about how real genes might respond to this type of selection within living populations. The 'nearly neutral' hypothesis predicts that genes indirectly selected for subfertility may experience relaxed adaptive molecular evolution, relative to genes directly selected for reproduction. If so, we expect that the ratio of non-synonymous to synonymous substitutions will tend towards a neutral value of '1', relative to loci under direct selection for which this ratio will deviate from neutrality in either a purifying or positive direction. Here, we exploit newly available RNA sequence data for the eastern subterranean termite to test key predictions from the nearly neutral hypothesis.