156th Annual General Meeting

of the

Entomological Society of Ontario

November 1-3, 2019
Bark Lake Leadership and Conference Centre
Irondale, ON

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The venue is set amidst spectacular forests and lakes, well off the main road. It is the perfect place to balance learning and contemplation.

Conference activities will take place in the Dining Hall, and we will be in Oak Centre and Tamarack area for sleep.

Wi-Fi can be accessed from the Pavilion and Dining Hall. The password will be provided at check-in.

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Schedule at a Glance

Friday, November 1st

4:30 – 6:30pm	ESO Governing Board Meeting
5:30 – 6:30pm	Registration – Main Office
6:30 – 7:30pm	Supper (cash bar open 6:30 – 10:30)
7:30 – 10:30	Mixer Trivia Hosted by Martin Parker of the Peterborough Field Naturalists
9:00 - late	Bonfire Social

Saturday, November 2nd

7:30-8:20am	Breakfast and Registration
8:20-8:30am	Welcome message and announcements
8:30-9:10am	Plenary talk: David LeGros Sponsored by BASF Canada
9:15-10:30am	Early morning session
10:30-10:45 am	Break
10:45am-12:00pm	Late morning session
12:00-1:00pm	Lunch and viewing posters
1:00-2:30pm	Early afternoon session
2:30-2:45pm	Coffee break
2:45-4:15pm	Late afternoon session
4:15 -5:00pm	Break and student hike
6:00-7:00pm	Pre-banquet mingle and Poster Session (cash bar open 6:30-10:30)
7:00-9:30pm	Banquet
8:00-9:00pm	Banquet talk: Yves Alarie

Sunday, November 3rd

8:00-9:00am	Breakfast
9:00– 10:15am	Early Morning Session
10:15 – 10:30am	Break
10:30 – 11:15am	ESO Annual General Business Meeting
11:15 – 11:30pm	Awards Ceremony and wrap up
12:00 – 1:00pm	Lunch
1:00 – 5:00pm	Free Time
2:00pm	Check-out
5:00pm	Time to go

Organizing Committee

Kaitlyn Fleming, Sarah Langer, Ayden Ricker-Held, Kathryn Vezsenyi and David Beresford

We thank the wonderful staff at the Bark Lake Leadership and Conference Centre

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Plenary Speaker

David LeGros

Is Natural History history?

Abstract: In the face of the modern biodiversity crisis, it has never been more important to connect people with Nature. As the Senior Park Naturalist in Algonquin Provincial Park, I have many opportunities to do so, but there are still challenges. Ontarians often do not have a grasp of the biodiversity in their own backyards, let alone the wilderness. Natural history has fallen out of fashion within educational institutions and has short-changed students - what was commonly taught is now rare. You have to know what you are looking at to know when you are seeing something out of the ordinary. By observation and experiment, we must continue to develop our awareness of Nature, because whether we like it or not, we have a front row seat to the changes on the horizon.

Bio: I am currently the Senior Park Naturalist for Algonquin Provincial Park, where I have been for 6 years. In the past I held a variety of positions, primarily where the intersections of nature and education meet, in both the public and private sector. Today, I am responsible for educational and interpretive programming, collaborating on park publications, hiring and training naturalists and gathering natural history records in Algonquin. Among my favorite parts of the job is working with enthusiastic staff, learning from them and watching them develop their skills. Sharing Algonquin with the public is truly a dream job; I get to pull back the curtain on this amazing place and give visitors a better look and understanding of it. As a student I completed a diploma in Fish and Wildlife Technician at Fleming College, an undergraduate biology degree at Trent University, including a very formative honours thesis on Nicrophorus beetles in Algonquin with Dr. Dave Beresford, and a MSc at Laurentian University that investigated techniques to mitigate the negative impacts of forest roads on amphibians. I have published a number of peer-reviewed articles on Nicrophorus beetles, amphibians and reptiles, based on academic research and natural history observations. I am also the primary author and editor of the popular Algonquin Park publication, The Raven. I am passionate about protecting natural places and biodiversity and connecting people to Nature in a sustainable way. I live in Huntsville with my wife, Cortney, and in my time off I enjoy camping, birding, herping, looking at insects, plants - everything is interesting. Never stop flipping rocks!

Banquet Speaker

Yves Alarie

Dealing with Hairy Beasts: How larval chaetotaxy impacting the understanding of evolutionary history of Hydradephaga (Coleoptera)

Abstract: Although the Hydradephaga are among the most common insect inhabitants of freshwaters, knowledge of their larval morphology is scant throughout the world. The identification of larvae is a continuing problem because the literature available to accomplish this is scattered, limited to certain groups, outdated, difficult to use, or non-existent. In regard of systematic studies, data about larval stages, particularly in holometabolous insects, are likely to improve adult classifications. Because larvae of Holometabola share little in common with adult anatomically, they offer a rich, parallel source of information about phylogenetic relationships. A more rigorous and stable classification will result from combining characters from both adult, molecules, and larvae. Recent studies have demonstrated the taxonomic and phylogenetic value of chaetotaxy in studying larval Hydradephaga. Study of body sensilla (setae and pores) were shown to be useful and important both for diagnosis and study of phylogenetic relationships among taxa. Use of such a character set has led to a reconsideration of the phylogenetic relationships among several lineages. This presentation synthesizes these studies into a more comprehensive approach. A corollary objective of this presentation is to exemplify how knowledge of insect larvae and an ability to identify them has the potential to make the wealth of characters present in the larval stage available for ecological study.

Bio: Yves Alarie is full professor in the Department of Biology at Laurentian University, Sudbury, Ontario, Canada. He holds a Ph.D. in systematics from the Université de Montréal, Québec, Canada and spent two years as NSERC Postdoctoral Fellow in the Department of Entomology at the University of Manitoba, Canada. His research involves Hydradephaga systematics with a strong emphasis on larval morphology.

Full Schedule

Friday, November 1st	
4:30 – 6:30	**ESO Governing Board Meeting** Main Office
5:00 – 6:30	**Registration** Main Office It is the first building on the right as you arrive (watch for the sign). Oral presenters should submit their presentation material at registration
6:30 – 7:30	**Supper** Dining Hall (cash bar 6:30 – 10:30)
7:30 – 10:30	**ESO Mixer** Dining Hall (cash bar 6:30 – 10:30) Trivia with Martin Parker (Secretary for the Peterborough Field Naturalists)
9:00 - late	**Bonfire Social**

Saturday, November 2nd	
7:30 – 8:20	**Breakfast and Registration** Dining Hall
8:20 – 8:30	**Welcome message and announcements** Dining Hall David Beresford
8:30 – 9:10	**Plenary Talk – Dave Legros** Dining Hall
9:15 – 10:30	**Early Morning Session -** Dining Hall *** indicates student talk for Presidents Prize for Best Oral Presentation ***
9:15	**Meghan E. Duell**, Amanda D. Rowe, Christian J. K. MacQuarrie, & Brent J. Sinclair Surviving the polar vortex: extreme cold tolerance of the emerald ash borer
9:30	**Thomas J. Hossie** Using pastry caterpillars to address questions in ecology and evolution through experiential learning
9:45	**Stephanie A. Rivest***, & Heather M. Kharouba Dispersal abilities and habitat suitability of a newly introduced butterfly in Canada, *Polyommatus icarus*
10:00	**Shelby D. Gibson***, Amanda L. Liczner, & Sheila R. Colla At-risk bumble bees (Bombus spp.) show preference for invasive tufted vetch in protected areas
10:15	**Rebecca Rizzato**, Diana Catalina Fernández, Dana Gagnier, & Roselyne Labbe. Using parasitoid wasp *Jaliscoa hunteri* to target a major pepper crop pest in Canada

10:30 – 10:45	**Break** Dining Hall
10:45 – 12:00	**Late Morning Session -** Dining Hall *** indicates student talk for Presidents Prize for Best Oral Presentation ***
10:45	**C. J. K. MacQuarrie**, M. Gray, G. Jones, & K. Ryall Biological control of the emerald ash borer
11:00	**Bandele Morrison***, & Amro Zayed (Lightning Talk) Gene Expression Profiles in Honeybee Brains using the Food Search Box Protocol
11:05	**Claire Baragar***, Brent Sinclair, Jacqueline Lebenzon, & Meghan Duell (Lightning Talk) Mitochondrial physiology of the freeze-tolerant cricket, *Gryllus veletis*
11:15	**Cassandra Russell***, Brent Short, & Rebecca Hallett Utilizing semiochemicals for reliable detection and monitoring of pepper weevil (*Anthonomus eugenii*) in Ontario greenhouses.
11:30	**K.C. Galang***, J.R. Croft, G.J. Thompson, & A. Percival-Smith Analysis of the Drosophila melanogaster anti-ovarian response to honey bee queen mandibular pheromone
11:45	**David Beresford** How to correct for irregular trapping times, and why you need to
12:00 – 1:00	**Lunch and viewing of posters**
1:00 – 2:15	**Early Afternoon Session -** Dining Hall *** indicates student talk for Presidents Prize for Best Oral Presentation ***
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1:05	**Nasim Amiresmaeili**, Tara Gariepy, & Brent Sinclair (Lightning talk) Using thermal biology to choose a climate-matched biological control agent for an emerging agricultural pest
1:15	**Carol McLennan***, Angela Gradish, Andrew Frewin, & Rebecca H. Hallett Susceptibility of the swede midge parasitoid, Synopeas myles (Hymenoptera: Platygastridae) to foliar applied insecticides
1:30	**Dillon Brian Muldoon***, Alexandra Stinson, Mary Ruth McDonald, & Cynthia Scott-Dupree The enhancement of non-crop habitat to support natural enemy populations at the Holland Marsh, ON.

1:45	**Rodney T. Richardson**, Clement F. Kent, Tanushree Tiwari, & Ida M. Conflitti, Amro Zayed and the BeeOMICs Consortium Local landscape composition and colony-wide genetic diversity predict honey bee colony size
2:00	**Jacqueline E. Lebenzon***, Alex S. Torson, & Brent J. Sinclair Beetle, it's cold outside: The metabolomic and transcriptomic changes that drive cold tolerance in the Colorado potato beetle (Leptinotarsa decemlineata)
2:15	**Kenneth W. Dearborn***, Sandy M. Smith, Chris J. K. MacQuarrie, & Daegan J. G. Inward Developmental rates of emerald ash borer eggs can be used to improve its management in global maritime regions
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3:00	**Nadia Tsvetkov***, A. Khalili, I. Conflitti, & A. Zayed Heritability of Neonicotinoid Detoxification in Honey Bees
3:15	**Amanda Semenuk***, Patrick Moldowan, & M. Alex Smith Carnivorous plants and bog arthropods: diversity and trophic level
3:30	**Yasin Kahya**, H. Vasfi Gencer, & Amro Zayed Sperm competition during sperm storage process in honey bee (*Apis mellifera* L.) queens
3:45	**Mohamed Elmankabady***, Alexandre Loureiro, Daniel H. Janzen, Winnie Hallwachs, & M. Alex Smith Functional morphological differences in beetle elytral structures along a neotropical elevation gradient.
4:00	**Tiffany Yau***, & Stephen A. Marshall *Stipulosina*, a new genus of Limosininae (Diptera: Sphaeroceridae) associated with bamboo stipules in Ecuador
4:15 – 5:00	**Break** Student Hike Fishing demonstration with Ayden Ricker-Held
6:00 – 7:00	**Pre-Banquet Mingle and Poster Session** Dining Hall (cash bar 6:00 – 10:30)
7:00 – 9:30	**Banquet**
8:00	**Banquet Speaker: Yves Alarie**
9:30	**Bonfire! Weather permitting**

Sunday, November 3rd	
8:00 – 9:00	**Breakfast** Dining Hall
9:00 – 10:15	**Oral Presentations** Dining Hall *** indicates student talk for Presidents Prize for Best Oral Presentation ***
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9:15	**L. Corbin***, M. Richards, & D. Awde Behavioural variation among sweat bee species from the Niagara region
9:30	**M. Alex Smith**, Alexandre Loureiro, Brent Sinclair, Daniel Janzen & Winnie Hallwachs Thermal tolerance of a hyperdiverse insect group along a neotropical elevational gradient
9:45	**Yanira Jimenez-Padilla***, Marc-Andre Lachance, & Brent J. Sinclair Gut yeasts accelerate development in *Drosophila melanogaster* larvae
10:00	**Alex S. Torson**, Ayman Al Baz, Amanda D. Roe, & Brent J. Sinclair Transcriptomic changes during diapause in the Asian longhorned beetle
10:15 – 10:30	**Break**
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11:15 – 11:30	**Awards Ceremony and wrap-up**
12:00 – 1:00	**Lunch**
1:00 – 5:00	**Free Time**
2:00	**Check-out**
5:00	**Time to go**

Presentation Abstracts

Student Talks

* indicates student talk for Presidents Prize for Best Oral Presentation *

Mitochondrial physiology of the freeze-tolerant cricket, *Gryllus veletis* – Lightning Talk

Authors: **Claire Baragar***, Brent Sinclair, Jacqueline Lebenzon , Meghan Duell
Affiliation: University of Western Ontario Email: cbaragar@uwo.ca

Abstract: Freeze-tolerant insects can withstand internal ice formation. During freezing, cells osmotically dehydrate and shrink, and whether this impairs mitochondrial function is unknown. The spring field cricket (*Gryllus veletis*) becomes freeze-tolerant through cold acclimation, which results in a decreased whole-animal metabolic rate. During recovery from freezing, whole-animal metabolic rate in *G. veletis* increases. I propose to assess whether changes in whole-animal metabolic rate during acclimation and recovery from freezing are mirrored in mitochondrial respiration rates. I hypothesize that during acclimation, *G. veletis* suppresses mitochondrial respiration rates to protect its mitochondria from future freezing, or it repairs mitochondrial damage accrued during freezing.

Behavioural variation among sweat bee species from the Niagara region

Authors: **L. Corbin***
Affiliation: Brock University Email: lc15kl@brocku.ca

Abstract: Sweat bees are key models in understanding the evolutionary transitions to eusociality due to their social diversity. Many sweat bee species' behaviours remain unknown, limiting our knowledge on the behavioural variation among taxa and social patterns within genera. Thus, describing social traits in sweat bees provides further insight on their behaviour and the mechanisms underlying social evolution. The objective of this study was to describe the social behaviour of two *Lasioglossum* (*Dialictus*) species, *L. hitchensi* and *L. ellisiae*, from pan trapped specimens. Comparative analyses between these species demonstrates social variation in closely related taxa from a local region.

Developmental rates of emerald ash borer eggs can be used to improve its management in global maritime regions

Authors: **Kenneth W. Dearborn***, Sandy M. Smith, Chris J. K. MacQuarrie, & Daegan J. G. Inward
Affiliation: University of Toronto Email: Kenneth.w.dearborn@gmail.com

Abstract: The emerald ash borer, *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae), is an invasive Asian beetle that has killed millions of North American ash trees. Stage-specific growth rates are needed to better manage and reduce long-term impacts. Here, we quantify the development rate of the initial life stage across biologically-relevant temperatures (7-35°C) to predict egg phenology. Developmental time was shorter as temperatures increased from 15-35 °C. Establishing the approximate duration eggs take to develop and are present on trees will improve forest management by refining biological control release timing. Quantification will be particularly important when applied to cooler summer maritime regions.

Functional morphological differences in beetle elytral structures along a neotropical elevation gradient.

Authors: **Mohamed Elmankabady***, Alexandre Loureiro, Daniel H. Janzen, Winnie Hallwachs & M. Alex Smith
Affiliation: University of Guelph Email: melmanka@uoguelph.ca

Abstract: Insect cuticle micro-structures are responsible for multiple adaptations to abiotic conditions. We used Staphylinidae (rove beetles) collected along a neotropical elevation gradient to test whether this structural diversity matched prior estimates of taxonomic and genetic diversity. We used scanning electron microscopy (SEM) to measure if elytral structures corresponded with functions expected to be favoured within forests found along that gradient (low elevation dry forest, mid-elevation rain forest and high elevation cloud forest). Preliminary analyses suggest an association between elytral structural morphology and forest type, suggesting a relationship between elytral type and functional diversity.

Analysis of the *Drosophila melanogaster* anti-ovarian response to honey bee queen mandibular pheromone

Authors: **KC Galang***, JR Croft, GJ Thompson, A Percival-Smith
Affiliation: York University Email: bandem95@my.yorku.ca

Abstract: In *Apis mellifera*, the anti-ovarian effect of queen mandibular pheromone (QMP) on workers can, surprisingly, be induced in other insects, including fruit flies; females exposed to synthetic QMP develop smaller ovaries with fewer eggs. We use the *Drosophila melanogaster* model to identify 9-oxo-2-decenoic acid and 10-hydroxy-2-decenoic acid (10HDA) as the components of QMP that are essential for the anti-ovarian response. In addition, we used olfactory receptor GAL4 drivers and a neuronal activator to test whether candidate neurones are potential labelled lines for a decenoic acid response. We identified Or-49b as a potential candidate receiver of the 10HDA signal.

At-risk bumble bees (*Bombus* spp.) show preference for invasive tufted vetch in protected areas
Authors: **Shelby D Gibson***, Amanda L Liczner, Sheila R Colla
Affiliation: York University Email: shelbydgibson@gmail.com
Abstract: Declines have been reported in certain species of bumble bees historically present in southern Ontario, including: Yellow bumble bee (*B. fervidus*) (Fabricus, 1798), American bumble bee (*B. pensylvanicus*) (DeGeer, 1773), and Yellow-banded bumble bee (*B. terricola*) (Kirby, 1837). Threats to bumble bee populations include: land-use changes, habitat loss, climate change, pathogen spillover, and pesticide use. A solution has been to encourage "bee-friendly" planting. Our question is whether there is a difference in co-occurring at-risk bumble bee floral use in protected areas. The results of a redundancy analysis show a difference in foraging between common and at-risk bumblebee species.

Gut yeasts accelerate development in *Drosophila melanogaster* larvae
Authors: **Yanira Jimenez-Padilla***, Marc-Andre Lachance, & Brent J. Sinclair
Affiliation: University of Western Ontario Email: yjimenez@uwo.ca
Abstract: The gut of *Drosophila melanogaster* houses a diverse community of microbes, including bacteria, yeasts, protozoa, and viruses. Yeasts are often provided to flies as nutrients, but their role in the gut microbiota is poorly understood. I studied the effects of *Saccharomyces cerevisiae* (the yeast commonly used in lab settings) and *Lachancea kluyveri* (a yeast originally isolated from the gut of some *Drosophila* spp.) on fly development. I reared *D. melanogaster* either as axenic (free of microbes), or gnotobiotic (with a known yeast species in their gut), and recorded the pupation and eclosion times. Both yeasts reduce larval development time by c. 23 %, and the effect is not purely dietary.

Beetle, it's cold outside: The metabolomic and transcriptomic changes that drive cold tolerance in the Colorado potato beetle (*Leptinotarsa decemlineata*)
Authors: **Jacqueline E. Lebenzon***, Alex S. Torson, and Brent J. Sinclair
Affiliation: University of Western Ontario Email: jlebenzo@uwo.ca
Abstract: The Colorado potato beetle overwinters in diapause as an adult, where it is likely to encounter sub-zero temperatures and risk freezing of its body fluids. Beetles have evolved strategies to avoid freezing altogether and become cold-tolerant during winter, but we still do not understand the physiological mechanisms that drive survival at these low temperatures, and the extent to which their diapause programme confers cold tolerance. We used an 'omics approach to uncover the metabolomic and transcriptomic differences between diapause and cold tolerance in the Colorado potato beetle, and identified several metabolic pathways that could drive differences in sub-zero temperature survival.

Susceptibility of the swede midge parasitoid, *Synopeas myles* (Hymenoptera: Platygastridae) to foliar applied insecticides
Authors: **Carol McLennan***, Angela Gradish, Andrew Frewin, & Rebecca H Hallett
Affiliation: University of Guelph Email: cmclen01@uoguelph.ca
Abstract: Swede midge *Contarinia nasturtii* (Keiffer) (Diptera: Cecidomyiidae) is a major pest to cruciferous vegetable and canola production in North America. Native to Eurasia, the swede midge is now distributed from the east coast of North America to Minnesota. In 2016 a swede midge parasitoid, *Synopeas myles* (Walker) (Hymenoptera: Platygastridae), was discovered in Ontario. Establishment of this natural enemy, also native to Europe, has developed an interest in conservation biological control efforts. Foliar insecticides containing the active ingredients chlorantraniliprole and lambda-cyhalothrin are currently registered in Canada for swede midge management in canola. Determining susceptibility of *S. myles* to these insecticides is important for determining the compatibility of insecticide use and conservation biological control efforts.

Gene Expression Profiles in Honeybee Brains using the Food Search Box Protocol – Lightning Talk
Authors: **Bandele Morrison***, & Amro Zayed
Affiliation: York University Email: bandem95@my.yorku.ca
Abstract: Honeybees are central place foragers. Part of what allows the bees to improve their foraging skills is their ability to learn where food patches are relative to the hive, avoid predation risk and navigate new locations. The molecular mechanisms underlying this learning ability have been investigated by using Proboscis Extension Reflex (PER) and free-flight learning protocols. We know that during learning, gene expression in the brain changes in the short-term and long-term. Here, we utilize a newly developed learning protocol called the Food Search Box (FSB) paradigm to study spatial learning in the honeybee. By conducting time-course experiments in the context of FSB, we are investigating how gene expression changes over time in response to spatial learning.

The enhancement of non-crop habitat to support natural enemy populations at the Holland Marsh, ON.
Authors: **Dillon Brian Muldoon***, Alexandra Stinson, Mary Ruth McDonald, Cynthia Scott-Dupree
Affiliation: University of Guelph Email: dmuldoon@uoguelph.ca
Abstract: The Holland Marsh (HM), Ontario, is an agroecosystem with a primary focus on carrot and onion production. It contains negligible uncultivated habitat to support natural enemies (NE) of insect pests of carrots and onions. Recent upgrades to the HM drainage system have provided an opportunity to investigate how enhancements to canal berms can affect NE populations. Five berm plots were established, each with three treatments: (1) Control; (2) Floral Enhancement, and (3) Floral + Shrub Enhancement. Active and passive trapping was used to determine the abundance and richness of NE and insect pests at these berm plots.

Dispersal abilities and habitat suitability of a newly introduced butterfly in Canada*, Polyommatus icarus*
Authors: **Stephanie A. Rivest***, & Heather M. Kharouba
Affiliation: University of Ottawa Email: srive046@uottawa.ca
Abstract: The frequency of species introductions is on the rise globally. One newly introduced butterfly, the European Common Blue (*Polyommatus icarus*), is expanding its range around Montréal, QC. To understand its potential for range expansion in the future, we assessed the dispersal capacity of *P. icarus* adults. We also characterized its habitat suitability at two scales: local and landscape-level. We found that *P. icarus* adults only rarely fly long distances (~900m) and that they are most abundant where there is more floral cover, where there is an intermediate amount of habitat disturbance and where their preferred larval foodplant is found.

Utilizing semiochemicals for reliable detection and monitoring of pepper weevil (*Anthonomus eugenii*) in Ontario greenhouses.
Authors: **Cassandra Russell***, Brent Short and Rebecca Hallett
Affiliation: University of Guelph Email: rcassie@uoguelph.ca
Abstract: The pepper weevil, *Anthonomus eugenii* Cano (Coleoptera: Curculionidae) is the most important pest of pepper (*Capsicum* spp) in the southern United States, Mexico, Central America and most recently, Ontario. In 2016, Ontario pepper growers estimated yield losses of over $83 million CAD and this value continues to grow due to constant reintroduction of the pest to greenhouses from infested pepper shipments. Early detection is key to preventing economic losses, however pheromone-based monitoring kits have proven unreliable for early detection of *A. eugenii* in the presence of fruiting plants. Pheromone lures are being out competed by naturally produced male aggregation pheromones and plant produced volatiles. Investigation into the addition of plant volatiles to synergize weevil response to the pheromone lure is underway. Improved attraction to these monitoring tools will ideally see higher adoption of monitoring traps and aid in detecting *A. eugenii* early before economic damage occurs in greenhouse peppers.

Carnivorous plants and bog arthropods: diversity and trophic level
Authors: **Amanda Semenuk***, Patrick Moldowan, M. Alex Smith
Affiliation: University of Guelph Email: asemenuk@uoguelph.ca
Abstract: Carnivory in plants has evolved independently nine times as a method of acquiring nitrogen in nutrient-poor ecosystems. Prey-capturing mechanisms may differ between carnivorous plant species, such as the pitfall trap of the pitcher plant (*Sarracenia purpurea*) and the sticky-trap of the sundew (*Drosera rotundifolia*). Does this difference in trapping-mechanism result in differences in captured prey? We conducted DNA barcoding and stable isotope analysis of insects collected from carnivorous plants in Algonquin Park to identify the diversity and trophic level of carnivorous plant prey. We will present findings regarding how unique the prey assemblages are for two neighbouring carnivorous plant species.

Heritability of Neonicotinoid Detoxification in Honey Bees
Authors: **N. Tsvetkov***, A. Khalili, I. Conflitti, & A Zayed.
Affiliation: York University Email: nadiats@yorku.ca
Abstract: The toxicity of neonicotinoids (NNIs) varies greatly between honey bee sub species. In order to investigate the potential genetic factors influencing the different tolerances to NNIs, we exposed honey bee workers to an NNI and recorded their 24 hour survival rate. We then genotyped the bees using microsatellites and found a statistically significant effect of patrilines on mortality. Afterwards, we sequenced three detoxification genes from 100 bees in order to determine the allelic variation between the patrilines with the most extreme survival rates. The effects of NNIs on honey bees is still a hotly debated topic, understanding the genetic mechanisms behind the natural variation of NNI detoxification could help reconcile seemingly contradicting results in the scientific literature.

***Stipulosina,* a new genus of Limosininae (Diptera: Sphaeroceridae) associated with bamboo stipules in Ecuador**
Authors: **Tiffany Yau*** & Stephen A. Marshall
Affiliation: University of Guelph Email: tyau@alumni.uoguelph.ca
Abstract: Thirty specimens of Sphaeroceridae collected from bamboo stipules in the Ecuadorian Andes in 2002 included four new species of an undescribed genus. The publication of *Stipulosina* was held back pending further recordings of the unusual habitat restriction. In May 2019 we visited a site near the original collection locality of *Stipulisina*. There we collected more specimens, tested the hypothesis that they are stipule inhabitants, and learned more about their biology and natural history. We examined eight bamboo species from two different elevations, finding *Stipulosina* only on *Chusquea scandens* with high specificity on the stage and condition of the bamboo.

Non-Student Talks

Using thermal biology to choose a climate-matched biological control agent for an emerging agricultural pest - Lightning Talk
Authors: **Nasim Amiresmaeili**, Tara Gariepy, Brent Sinclair
Affiliation: University of Western Ontario & AAFC Email: n.amiresmaili@gmail.com
Abstract: Biological control is an important component of agricultural insect pest control but not all introductions of biocontrol agents are successful. This is possibly because the source populations for the biocontrol agents are adapted to climates significantly different from the release locality. We are using thermal biology to choose a climate-matched population of *Trissulcus japonicus* (Hymenoptera: Scelionidae), a parasitoid wasp that is a natural enemy of invasive Brown Marmorated Stink Bug [BMSB; *Halyomorpha halys* (Hemiptera: Pentatomidae)] in Canada. There is a very high likelihood that our results will be directly used to inform decisions about strains of parasitoid chosen for release.

How to correct for irregular trapping times, and why you need to
Authors: **David V. Beresford**
Affiliation: Trent University Email: davidberesford@trentu.ca
Abstract: Sampling insect populations often requires setting traps for set periods of time such as hourly, daily, or weekly. Because insects are poikilotherms, any temperature changes during the trapping periods will cause insect activity to vary accordingly. Using a stable fly sticky trap example, I demonstrate that this effectively means that such trapping takes place on irregular time intervals in terms of physiologically relevant time. I argue this requires correcting trap catch numbers by converting them into catch per unit sample period, where sample period is measured in degree days.

Surviving the polar vortex: extreme cold tolerance of the emerald ash borer
Authors: **Meghan E. Duell**, Amanda D. Rowe, Christian J. K. MacQuarrie, Brent J. Sinclair
Affiliation: University of Western Ontario Email: mduell@uwo.ca
Abstract: The emerald ash borer (*Agrilus planipennis*, EAB) is a lethal pest to ash trees throughout North America. In 2018, EAB was confirmed in Winnipeg, which is much colder than areas where it was previously established. Cold tolerance models suggest the 2019 Polar Vortex should have killed all overwintering Winnipeg EAB with air temperatures in of-34°C. However, some Winnipeg EAB survived exposure to -50°C. Supercooling points ranged from -25°C to -52°C, much lower than those from southern Ontario. This increased cold tolerance suggests that EAB could expand its range in Canada and is driven by high hemolymph osmolality with glycerol accumulation.

Using pastry caterpillars to address questions in ecology and evolution through experiential learning
Authors: **Thomas J. Hossie**
Affiliation: Trent University Email: thossie@trentu.ca
Abstract: Using artificial prey to examine patterns of predation by wild predators has proven to be an important research tool for biologists, but is also an effective way for educators to teach ecology and evolution by observation and experiment. Pastry caterpillars in particular have been employed to investigate questions about the efficacy of specific adaptations (e.g., countershading, eyespots, polymorphism), however the questions that can be addressed by this technique is limited only by the investigator's own creativity. In this talk I outline this approach and how it can be used to teach ecology and evolution across a range of grade levels.

Negative Selection in Social Insects – Lightning Talk

Authors: **Arshad Imrit*,** B.A. Harpur, K.A. Dogantzis, & A. Zayed
Affiliation: York University Email: imarshad@my.yorku.ca

Abstract: 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.

Building *Culicoides* (Diptera: Ceratopogonidae) DNA barcode reference libraries to support molecular biosurveillance protocols

Authors: **L. Janke***, R. Young, Y. Millian-Garcia, I. Thompson, T. Quintana-Loeza, & R. Hanner.
Affiliation: University of Guelph Email: jankel@uoguelph.ca

Abstract: *Culicoides* (Diptera: Ceratopogonidae) midges are known vectors of various animal diseases that are of concern to the agricultural industry. A better understanding of the phylogeographic distribution of these species and the infectious agents they may carry could help inform disease management and prevention decisions. Emerging molecular biosurveillance protocols have the potential to support these objectives in a timely, cost-effective manner and at a scale not possible using conventional methods. However, a well-curated reference sequence library derived from properly identified specimens of known provenance together with an accessible information system to host this information is required to undertake such programs. To achieve this objective, the Canadian Food Inspection Agency is collaborating with the University of Guelph to populate the Barcode of Life Data System with additional information on expert-identified *Culicoides* specimens destined for multi-gene barcoding. Together, we have populated specimen records for more than 220 individuals with high-resolution composite images that reveal key diagnostic characters used to support their identifications. This work will expand our molecular and morphological knowledge of *Culicoides* and help support a Canadian molecular metabarcoding biosurveillance protocol.

Sperm competition during sperm storage process in honey bee (*Apis mellifera* L.) queens

Authors: **Yasin Kahya**, H. Vasfi Gencer, Amro Zayed
Affiliation: York University Email: kahyasin@gmail.com

Abstract: Sperm competition is expected to occur in honey bees during migration of sperm from several drones into the spermatheca of the queen shortly after mating and/or during sperm use by the queen for fertilizing the eggs. The first aim of the study was to develop a pyrosequencing based method enabling the genotypic identity of the heterospermic contents in the spermathecae of instrumentally inseminated queens (IIQs) to detect sperm competition during sperm migration process. The second aim was to disclose whether injection order of semen and queen genotype (cryptic female choice) affect the proportions of two drone genotypes in spermathecal contents of these IIQs or not.

Biological control of the emerald ash borer

Authors: **C J K MacQuarrie**, M Gray, G Jones, K Ryall
Affiliation: Natural Resources Canada Canadian Forest Service Email: christian.macquarrie@canada.ca

Abstract: The emerald ash borer is the most significant forest pest in Ontario, killing hundreds of thousands of trees since the time it was discovered in Windsor, Ontario in 2002. In 2013, a biological control program was established to introduce some natural regulation of the insect in Ontario, and throughout Canada. This program has resulted in the successful introduction of two larval parasitoids *Tetrastichus planipennisi* and *Spathius galinae*, and an egg parasitoid *Oobius agrili* at multiple sites in the province. Ongoing work has been examining the impact and spread of these species from the initial release sites.

Natural history observations of leaf mining insect-*Astereae* associations

Authors: **Julia J. Mlynarek**
Affiliation: AAFC Email: julia.mlynarek@canada.ca

Abstract: Leaf mining insects are intimately associated with host plants during their larval stage. Leaf miner-plant interactions should therefore be a perfect system to test eco-evolutionary hypotheses. But the patterns of host ranges remain unclear because of rearing and identification challenges. I set out to have a clearer picture of the leaf mining insects (Diptera, Coleoptera and Lepidoptera) feeding on plants in the *Astereae* (Asteraceae) tribe in Eastern Canada. I will highlight the interesting host range patterns and try to explain them through taxonomic, ecological and evolutionary lenses.

Morphometric analyses from zones of sympatry and ocellar structures confirm species status of *Apis laboriosa*
Authors: **Gard W. Otis**, Nyaton Kitnya, Jharna Chakravorty, & Axel Brockmann
Affiliation: University of Guelph Email: gotis@uoguelph.ca
Abstract: *Apis laboriosa*, the cliff-nesting honeybee of the Himalayan region, is accepted as a valid species by most researchers. However, due to the lack of a comprehensive taxomonic analysis, a few continue to consider it to be a larger, blacker, hairier subspecies of the widespread *Apis dorsata*. We sampled foragers of two colour morphs of [Megapis] from 3 zones of sympatry in NE India. Morphometric analyses separated the bees into two non-overlapping clusters. Characters of the ocellar region on the heads of both workers and drones allow for unequivocal identification, thus further confirming the species status of *Apis laboriosa*.

Local landscape composition and colony-wide genetic diversity predict honey bee colony size
Authors: **Rodney T. Richardson**, Clement F. Kent, Tanushree Tiwari, Ida M. Conflitti, Amro Zayed, & the BeeOMICs Consortium
Affiliation: York University Email: rtr87@yorku.ca
Abstract: Few studies have examined how intracolonial genetic diversity and local landscape composition impact honey bee colony health and productivity. Further, such studies have been limited in sample size or experimental design. In the BeeOmics project, approximately 1,300 colonies situated across five Canadian provinces were phenotyped and genotyped for an associational study. Here, we used linear mixed effects modelling to investigate these data for associations between intracolonial genetic diversity, local landscape composition and measures of fall colony size. Results show that both intracolonial genetic diversity and local landscape composition predict measures of fall colony size.

Using parasitoid wasp *Jaliscoa hunteri* to target a major pepper crop pest in Canada
Authors: **Rebecca Rizzato**, Diana Catalina Fernández, Dana Gagnier, & Roselyne Labbe.
Affiliation: AAFC Email: rebecca.rizzato@Canada.ca
Abstract: The pepper weevil, *Anthonomus eugenii* (Coleoptera: Curculionidae) is an important pest of pepper crops in Canada. One possible means of reducing its populations is through targeting immature life stages through parasitism by parasitoid *Jaliscoa hunteri* (Hymenoptera: Pteromalidae). However until now, the mechanism employed by this wasp has been poorly understood. In this study, results of laboratory and greenhouse trials are presented which better elucidates the conditions required for *J. hunteri* to affect pepper weevil in greenhouse or field pepper crops. The implications of our findings on the development of best practices for pepper weevil biological control in Canada are discussed.

Thermal tolerance of a hyperdiverse insect group along a neotropical elevational gradient
Authors: **M. Alex Smith**, Alexandre Loureiro, Brent Sinclair, Daniel Janzen, & Winnie Hallwachs
Affiliation: University of Guelph Email: salex@uoguelph.ca
Abstract: The fine-scale distribution of neotropical species across elevation is thought to be prescribed by low variability in abiotic factors such as temperature and precipitation. We asked whether the thermal tolerance (CTmax) of a hyperdiverse insect family (Staphylinidae) would correspond with this prediction (namely a negative relationship between CTmax and elevation). In a preliminary study, we analysed the CTmax for 30 species across 1500m in Costa Rica. Our results suggest that even small differences in elevation correspond with community-level differences in thermal tolerance. Diverse, abundant, high-elevation staphylinid assemblages may be un-prepared for coming increases in temperature associated with the climate crisis.

Transcriptomic changes during diapause in the Asian longhorned beetle
Authors: **Alex S. Torson**, Ayman Al Baz, Amanda D. Roe, & Brent J. Sinclair
Affiliation: University of Western Ontario Email: atorson@uwo.ca
Abstract: To cope with harsh winter conditions, many insects enter a state of developmental arrest known as diapause – a phenotype characterized by decreased metabolic rate and increased stress tolerance. The Asian longhorned beetle, *Anoplophora glabripennis*, is an invasive species whose invasion risk to Canadian forests is likely correlated with its overwintering capacity. The objectives of this study were to 1) test the hypothesis that *A. glabripennis* overwinter in diapause and 2) determine transcriptomic signatures of the diapause phenotype using machine learning. We observed tissue-specific changes in diapausing larvae and identified suites of transcripts that correlated with physiological changes during diapause.

Poster Abstracts

Student Posters
* indicates student talk for Presidents Prize for Best Poster*

***Scipopus*: Finding a satisflying generic concept**
Authors: **Kate G. Lindsay***, & Stephen A. Marshall
Affiliation: University of Guelph Email: lindsay.kate6@gmail.com
Abstract: *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.

Insect diversity, thermal tolerance, and thermal regulating behaviours along a neotropical elevational gradient
Authors: **Alexandre Loureiro***, Brent J. Sinclair, Karl Cottenie, Daniel H. Janzen, Winnie Hallwachs, & M. Alex Smith
Affiliation: University of Guelph Email: a.loureiro@uoguelph.ca
Abstract: The biodiversity living on tropical mountains (the environment with the greatest biodiversity per unit area in the world) is under threat from the climate crisis. Furthermore, many tropical species remain undescribed, which puts us in a race against time to document both them and their ecology. Understanding how patterns of insect community structure and diversity are generated in tropical mountains, and how insect thermal tolerance influences behaviour, will lead to a better understanding of the evolution and maintenance of tropical diversity. This may also lead to better conservation practices and the prevention of their extinction.

Can the parasitoid wasp, *Trissolcus japonicus*, be used control the brown marmorated stink bug (*Halymorpha halys*, Stål) in Ontario?
Authors: **Caitlin M. MacDonald***, Tara D. Gariepy, Hannah Fraser, & Cynthia Scott-Dupree
Affiliation: University of Guelph Email: cmacdo14@uoguelph.ca
Abstract: The parasitoid wasp, *Trissolcus japonicus*, parasitizes the eggs of the brown marmorated stink bug (BMSB). BMSB poses a significant threat to the agri-food industry in North America and no registered insecticides exist for its management in Canada. Therefore, *Trissolcus japonicus* is being considered as a candidate biological control agent. Before releasing *T. japonicus* in Ontario, its physiological host range is being assessed by testing its impact on native stink bugs. Additionally, after the discovery of *T. japonicus* in Maryland, USA and London, Ontario, its distribution is being investigated in Ontario. Preliminary data suggests that populations continue to persist in London.

Thermal tolerance of rove beetles (Staphylinidae) across a forest/field ecotone.
Authors: **Ida Ostovar***, M. Alex Smith
Affiliation: University of Guelph Email: iostovar@uoguelph.ca
Abstract: The climate crisis and habitat fragmentation are exposing many animals to new thermal regimes, and so we need to better understand the thermal tolerance of the most diverse and abundant animals - the insects. For example, although they are amongst the most diverse animal families, there is limited information regarding the thermal tolerance of the Staphylinidae. We are estimating the thermal tolerance (CTmax) for staphylinids found across a forest/field ecotone on the University of Guelph campus. We expect that the assemblage of forest species will have lower CTmax than the assemblage in the field.

Tissue-specific Transcriptome Atlas of the Asian Longhorned Beetle
Authors: **Kevin Ong***, A.S. Torson, A.D. Roe, & B.J. Sinclair
Affiliation: University of Western Ontario Email: kong7@uwo.ca
Abstract: The Asian long-horned beetle (ALB; *Anoplophora glabripennis*) is an invasive wood-boring pest in North America and Europe. But, there are limited tools available for the functional characterization of the species. In this study, we characterize the transcriptomic profiles of developing larvae in five tissues; the subesophageal ganglion, midgut, hindgut, Malpighian tubules, and fat body. We assessed differences among tissues using principal component analysis, DESeq2, and fuzzy clustering. The differences were characterized into functional classes using gene ontology enrichment, and KEGG pathway analysis.

Understanding Contributions of Invertebrates to the Seasonal Diet of Walleyes on Lake St. Joseph
Authors: **Ayden Ricker-Held***, David Beresford, Dak de Kerckhove and Chris Wilson
Affiliation: Trent University Email: aydenrickerheld@trentu.ca
Abstract: Walleye (*Sanxder vitreus*) are ecologically and economically significant for recreational and commercial fisheries across Ontario. Walleye are effective piscivores, but their foraging behaviour on alternative prey is largely unknown. Angler anecdotal evidence suggests that walleye target insects such as Mayflies (Ephemeroptera). My research examines the diets of walleye from May to September on Lake St. Joseph in northern Ontario, to determine the role insectivory plays in seasonal foraging. I will identify stomach contents of mature fish through morphologically analysis and eDNA methods. These results will inform long-term management strategies.

Unearthing the adaptive significance of soil chambers built by insects
Authors: **Kurtis F. Turnbull***, Jeremy N. McNeil and Brent J. Sinclair
Affiliation: University of Western Ontario Email: kturnbu9@uwo.ca
Abstract: Many insects construct chambers in soil prior to winter dormancy or metamorphosis. However, the adaptive value of these structures is unclear. We use prepupae of the western bean cutworm, *Striacosta albicosta* (Lepidoptera: Noctuidae) to test three potential roles for soil chambers: that they confer space for metamorphosis, trap air during soil inundation, or exclude pathogens. By experimentally manipulating the integrity of chambers, our initial results show that these structures are necessary for prepupae to survive prolonged soil flooding. We will discuss possible mechanisms by which chambers might reduce the severity of hypoxia (i.e. low oxygen) in flooded soils.

Identifying genetic markers for deformed wing virus (DWV) levels in Honey Bees
Authors: **Tanushree Tiwari***, Rodney Richardson, Clement Kent, Alivia Dey, Ida Conflitti, Stephen Rose, Harshil Patel, Kathleen Dogantzis, Amro Zayed and BeeOmics Consortium
Affiliation: York University Email: tiwari.tanushree@gmail.com
Abstract: 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.

Non-Student Posters

Can honeybees detoxify neonicotinoids?
Authors: **Simran Bahia**, Nadia Tsevtkov, Avideh Khalil, Amro Zayed
Affiliation: York University Email: sbahi035@yorku.ca
Abstract: Canadian honeybees have experienced high colony mortality in recent years with neonicotinoid usage on crops being a major contributing factor. Honey bees tend to be more sensitive to N-nitro neonicotinoids (imadocloprid, clothianidin, thiamethoxam) compared to the N-cyano class (thiacloprid) due to the latter being more easily metabolized by the honeybee. Here we examine if honey bees that survive exposure to the N-nitro neonicotinoid clothianidin have different levels of expression of specific detoxification enzymes (e.g. CYP9Q1-3, a family of cytochrome p450 monooxygenases responsible for metabolizing neonicotinoids) relative to honey bees that die after exposure to clothanidin.

Where did the honey bee come from?
Authors: **Kathleen Dogantzis**, Tanushree Tiwari, Ida Conflitti, Alivia Dey, Amro Zayed
Affiliation: York University Email: kdogantzis@gmail.com
Abstract: The honey bee, *Apis mellifera*, is natively distributed through Africa, Europe, and parts of Asia. Though it is commonly agreed that subspecies can be divided into at least five genetically distinct evolutionary lineages, there remains considerable contention regarding the species ancestral origin and subsequent expansion across its native range. Addressing this question is important for understanding how the honey bee genome diverged to facilitate adaptation across its distribution. Here, we used an extensive population genomic dataset consisting of over 200 individual genomes from at least 14 subspecies to disentangle the out-of-Africa and out-of-Asia debate.

Predatory capacity and life histories of two native North American nabids

Authors: Julia J. Mlynarek, Andrew Laflair, Kai Zhang, Paula Vilcu, Kathrin Sim, Rebecca Rizzato, **Dana Gagnier**, and Roselyne M. Labbe
Affiliation: AAFC Email: Dana.Gagnier@canada.ca

Abstract: Cultivated tomato, Solanum lycopersicon is an important crop grown in greenhouses and fields throughout Canada. Yet, managing pests on this crop continues to represent a major challenge, particularly in light of new invasive pests species for which few to no native natural enemies have been well investigated. The objective of this study was to better understand the biological control potential of *Nabis americoferus* and *Nabis roseipennis* through conducting life history and predatory functional response trials. Our study shows that *N. americoferus* develops faster than *N. roseipennis* and they consume a lot prey but they eat more aphids than whiteflies. These findings contribute to improving our overall understanding of damsel bug natural history. This research can directly assist in the development of best practices for the application of nabids for the biological control of pests in greenhouse and field crops in Canada.

Effects of Urbanization on Milkweed Pollinator Richness and Abundance

Authors: **Albert Tomchyshyn**, Lindsay Miles, Marc Johnson, Sophie Breitbart
Affiliation: University of Toronto Email: albert.tomchyshyn@mail.utoronto.ca

Abstract: 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.

Activity and thermal tolerance of five sympatric species of Ontario ants

Authors: **Taya Venart-Johnson**, Brittany Cote, Laura Rocha-Sersanti, Noor Taji, Al Loureiro, M. Alex Smith
Affiliation: University of Guelph Email: tvenartj@uoguelph.ca

Abstract: Range limits and foraging behaviours of arthropod species are affected by abiotic factures (temperature and precipitation) and competitive interactions. For example, one species of ant, (*Prenolepis imparis*) is known to be more active at cooler temperatures (and less active during the heat of the summer) than other co-occurring ant species. This pattern is thought to be due to competition avoidance, but what is unknown is whether these differences correspond with differences in the critical thermal maximum (CTmax) for these species. To determine this, we measured CTmax and activity for five sympatric ant species across 38 degrees of temperature.

NOTES

NOTES


Bark Lake
MN
Aspen Beach
Maple Point
Flagpole Point
Point Cabin
Poplar
Bark Lodge
SW
Maple Section
Pine Section
Maple Cottage
Hemlock
Aspen Section
AC
Hilton
Birch
Balsam Centre
EC
Water Plant
Oak Staff
Dining Hall
Willow
Oak Section
Oak Centre
Tamarack Section
To 1st & 2nd Beaches (see Inset)
Tamarack Lodge
Tamarack Cottage
Tamarack Dorm
Oak Lodge
OF
CC
P
Pine Lodge
Elm Section
Pavilion
T
AF
A
Administration
Maintenance/ Housekeeping
Sewage Plant
1st & 2nd Beach
2nd Beach
Bark Lake
1st Beach
Tamarack Lodge
Oak Centre
Parking
Chrismar Mapping Services Inc., v.150408.2bCol
To Hwy. 503
BARK LAKE
LEADERSHIP AND CONFERENCE CENTRE
A Archery
AC Arts & Crafts
AF Aspen Field
CC Challenge Course
EC Equipment Centre
OF Oak Field
SW Swimming
T Trails
First Aid
Public Phone
P Parking
Public Washroom
Open Area
Wetland
metres 0
100 metres