

ESC/ESAB JAM 2012 PRESENTATION ABSTRACTS, listed alphabetically by first author

1. **Abdelghany, A., D. Suthisut, and P.G. Fields**

**Cold tolerance of the warehouse beetle, *Trogoderma variabile*.**

The cold tolerance of *Trogoderma variabile* from lowest to highest was egg, adult, 3rd instar larvae, pupae and 5th instar larvae. Acclimation at 15 to 5°C over 6 weeks increased cold hardiness in 5th instar larvae from 32 to 240 d (Lethal Time for 95% mortality). Diapause increased cold tolerance. The supercooling point varied from a high of -9.9°C for 5th instar larvae non-acclimated to a low of -23.7°C for 5th instar larvae cold-acclimated.

2. **Abram, P.K., T. Haye, P.G. Mason, N. Cappuccino, G. Boivin, and U. Kuhlmann**

**The biology of *Synopeas myles*, a parasitoid of the swede midge, *Contarinia nasturtii*.**

Despite their importance as natural enemies for many species of phytophagous gall midges, very little is known about the biology of parasitoid wasps in the subfamily Platygasterinae. We conducted the first thorough investigations of the biological relationships between the platygastriid parasitoid *Synopeas myles* Walker (Hymenoptera: Platygasteridae) and its host *Contarinia nasturtii* Kieffer (Diptera: Cecidomyiidae) including host stage suitability, immature development, and host discrimination.

3. **Adams, E.M., B. Roitberg, and R.S. Vernon**

**Permeability of mesh exclusion fencing to ground beetle (Coleoptera: Carabidae) predators.**

The use of mesh exclusion fencing to control cabbage maggot (*Delia radicum*) could also exclude ground beetles, important predators of the pest. Laboratory experiments evaluated the ability of various ground beetles to cross the fence. Ground beetles were able to cross under the fence, with *Bembidion lampros* having the ability to fit through the mesh itself. Despite this ability, not all beetles crossed the fence; some beetles remained under the fence mesh for most of the observation period.

4. **Alzahrani, S., A. Ajlan and J. Hajjar**

**Susceptibility and resistance of *Musca domestica* in Riyadh, Saudi Arabia.**

To determine the resistance of *Musca domestica* in Riyadh, Saudi Arabia, field strains from five slaughterhouses (North, Azizia, Alsaadah, West, and Almowanisiyah) were tested with four insecticides (Diazinon, Deltamethrin, Lambda-Cyhalothrin and Alpha-Cypermethrin and two IGRs (Pyriproxyfen and Triflumuron). The LD50 values of the tested insecticides on field strains in contrast to the laboratory strain reflected the resistance of field flies in all five locations, with exception of Diazinonin (RF) 6.8, in the North. However, all field strains in the five locations were resisted to Triflumuron but not to Pyriproxyfen. The (RF) to the later IGR were 3.56, 2.824, 2.534, 3.278 and 4.612 respectively.

5. **Ashfaq, M., M. Ali, M. Noor ul Ane, and S. Ahmad**

**Heavy metal in insect food web: Transportation of chromium (VI) to *Bombyx mori* L. from mulberry plants grown at soil irrigated with chromium (VI) effluents.**

The present study was planned to evaluate Chromium (VI) toxicity in silkworm food web. The result indicated that silkworm can be used as template to indicate local Chromium (VI) pollution as its body length, body weight and mortality rate was found to be strongly related to its concentration. Higher the Chromium (VI) amount in mulberry leaves showed more toxic effects on silkworm population. So at 300 mg/L Cr (VI) concentration and pH 4 there was a maximum deposition of Chromium (VI) in soil.

6. **Atwood, T.B., E. Hammill, D.S. Srivastava, and J.S. Richardson**

**Predator-predator intimidation alters top-down effects on CO<sub>2</sub> emissions from an experimental bromeliad ecosystem.**

We examined the effects of predator-predator intimidation between damselfly larvae and adult diving beetles on the magnitude of trophic cascades and CO<sub>2</sub> flux from bromeliad mesocosms. We found that antagonistic behaviors between the two predators, culminating in the emigration of damselflies from the system, diminished top-down control and altered CO<sub>2</sub> flux from the system. Our results suggest that behavioral processes can alter the strength of top-down impacts on communities and carbon dynamics.

7. **Bahar, M.H., J. Soroka, D. Hegedus, and L. Dosedall**

**Thermal tolerance and HSP70 gene expression in DBM and *Diadegma insulare*.**

We determined the mortality and quantified the inducible HSP70 gene expression in diamondback moth (DBM), *Plutella xylostella* and its larval parasitoid *Diadegma insulare* exposed to sudden or gradual onset high temperatures. The tolerance to high stress temperatures by DBM adults was higher than that of *D. insulare*. There was no effect of heat stress of up to 40°C on either parasitized or non-parasitized DBM larvae. The relationships between survival and HSP70 expression are discussed.

**8. Barrie, C. and T. A. Wheeler**

**Effect of urbanization on ground beetle diversity (Coleoptera: Carabidae) in Montreal green spaces.**

Many studies have examined effects of urbanization on insects, but responses between taxa remain unpredictable and complex. Insects of several indicator taxa were collected from three old field habitats in each of three levels of urbanization in the Montreal region, to assess effects of urbanization on diversity and community composition. Preliminary analyses, based on Carabidae, will be used to assess correlations between diversity and the intensity of surrounding land use in these sites.

**9. Belland, R.J.**

**Patterns in the diversity of mosses in Canada.**

A broad overview of the geographic patterns of diversity of the moss flora of Canada is presented. This diverse group comprises 1062 taxa in Canada. The highest diversities are in BC, followed by Ontario and Quebec. Saskatchewan, PEI and Manitoba show the lowest numbers. Analysis of diversity patterns shows the highest numbers in physiographically and climatically diverse ecoregions. Other factors influencing diversity are considered.

**10. Beres, B.L.**

**Manipulating agronomic factors for sustainable control of the wheat stem sawfly.**

The wheat stem sawfly (*Cephus cinctus* Norton [Hymenoptera: Cephidae]) is a serious threat to wheat in the northern Great Plains. Responses of wheat stem sawfly and its natural enemies to cultivar selection, residue management, seeding rates, fertility regimes, and harvest management were assessed. An integrated strategy to manage wheat stem sawfly consists of pest surveillance, planting solid-stemmed cultivars, continuous cropping with proper pre-seed residue management, seeding rates  $\leq 300$  seeds  $m^{-2}$ , 60 kg N  $ha^{-1}$ , and harvest cutting heights  $\geq 15$  cm to conserve parasitoids.

**11. Bergeron, C.**

**Fire history, arthropod diversity, and indicators of sustainable forest management.**

Historical fire events play a role in structuring boreal forest as habitats for epigeic arthropods. I develop a data-based rationale to use trees as biodiversity surrogates in the boreal forest because they are easily surveyed over large areas, accurately represent composition of epigeic communities, and also reflect the ecological processes present in this ecosystem. I use ground dwelling arthropods collected over 84 km<sup>2</sup> of mixedwood forest to develop these ideas.

**12. Bird, H., B. Brunet, and F. Sperling**

**Jack pine budworm phylogenomics.**

Spruce budworm species (*Choristoneura fumiferana*) are destructive defoliators of Canada's boreal forests, and are a systematic conundrum. Species in this complex hybridize in the wild, weakening their genomic integrity and complicating delimitation. A phylogeny built from genome-wide Single Nucleotide Polymorphisms, discovered using Genotyping-By-Sequencing, will provide insight into the relationship between the Jack pine budworm (*C. pinus*) and the spruce/fir-feeding species of this complex.

**13. Blair, M.S. and T.A. Wheeler**

**Spatial and temporal diversity of Scathophagidae (Diptera) in northern Canada.**

Although the Arctic is the subject of current interest because of the biotic impact of climate change, we lack baseline data on many taxa. Because Diptera are especially dominant in the Arctic, they are a logical study group. I will assess the spatial distribution of selected Diptera from the northern boreal to the high arctic at 12 sites across Canada. I will also analyse temporal patterns, comparing selected families from the 1947-1962 Northern Insect Survey to current patterns at the same sites. This presentation will focus on Scathophagidae, a diverse group of calyptate flies in the north.

**14. Blake, A.J., L.M. Dossall, and J.A. Tansey**

**Nutritional effects on the glucosinolate composition of canola and its olfactory attractiveness to the cabbage seedpod weevil.**

The objective of this study was to determine the effects of nitrogen (N) and sulfur (S) fertilization on the glucosinolate (GSL) composition of *Brassica napus* L. and the behavioral responses of *Ceutorhynchus obstrictus* (Marsham) adults to the odor of these plants. Previous studies have shown both N and S to affect the GSL composition of *Brassica* spp. Results indicate an increased response to plants with greater N fertilization with the effect being more pronounced with greater S fertilization.

15. **Boone, C.K., G. Samarasekera, N.V. Bartell, N.V., B.S. Lindgren, J.E. Cooke, C.S. Davis, P.M. James, P.M., D.W. Coltman, K.E. Mock, and B.W. Murray**

**Spatial genetic structure of the mountain pine beetle (*Dendroctonus ponderosae*) in western North America.**

The most recent mountain pine beetle epidemic in North America has led to unprecedented mortality of lodgepole pine, and a significant range expansion beyond its historic range. Our objective is to determine the spatial genetic variation and structure among populations from 60 sampling locations throughout western North America. This study will illustrate the rapid range-wide response to the removal of climatic constraints, and the potential for range expansion of regional populations.

16. **Boquel, S., M.A. Giguère, C. Clark, J. Zhang, and Y. Pelletier**

**New insights into the effect of mineral oil on the acquisition of PVY.**

The objective was to quantify the effect of dosage and time from spray of mineral oil (MO) on the inhibition of PVY acquisition by *Rhopalosiphum padi*. Results showed that MO (1) efficiently decreased PVY acquisition and (2) change the aphid probing behaviour one day after the spray. However, the inhibition effect decreased with time from the spray. These results support the hypothesis that the mode of action of MO consists in a physical inhibition of PVY binding at the tip of the stylet.

17. **Bourassa, S. and J.R. Spence**

**Changing climate associated with homogenization of forest assemblages of boreal ground beetles (Coleoptera: Carabidae)**

Carabid assemblages were studied with pitfall traps in five habitats of the boreal mixedwood forest of central Alberta in 1981-82 and 2009-10. Overall, the catch rate was 39% lower in the later years. Species such as *Pelophila rudis*, *Platynus mannerheimii* and *Elaphrus clairillei* that were abundant in 1981-82 failed to be detected in 2009-10. An increase in temperature and a reduction of precipitation might explain a more homogeneous carabid assemblage.

18. **Bourchier, R.S., K.D. Floate, and L. Lesage**

**Assessment of the diversity of biocontrol agents at historic leafy spurge release sites in Southern Alberta.**

Successful biocontrol of leafy spurge has been attributed to primarily 2 of the 5 *Aphthona* species released in Canada. We conducted weekly beetle sampling to test the potential to improve *Aphthona* impact using local biotypes or cryptic species. Analyses of the seasonal patterns and species composition of *Aphthona* populations, at successful and historic release sites indicates the presence of up to 6 species and multiple biotypes which may be useful for spurge biocontrol in new habitats.

19. **Brandao, M., A. Nisole, J. Laroche, B. Boyle, L. Lumley, D. Doucet, F. Sperling, M. Cusson, R. Levesque**  
**The *Choristoneura fumiferana* transcriptomic profile.**

Few forest pests have drawn as much attention as the spruce budworm (SBW), *Choristoneura fumiferana*. High throughput molecular resources are currently limited for this group since most lepidopteran high throughput sequencing projects have so far focused on macrolepidoptera. Here we present a first draft of the SBW transcriptomic profile sequenced by 454 technology. This is a step toward unlocking the genomic basis of the budworm's phenomenal success and developing alternative management strategies.

20. **Brodie, B.S., R. Gries, S. VanLaerhoven, and G. Gries**

**Semiochemical and visual cues attract blowflies to recently deceased rats.**

Blowflies, *Lucilia sericata* Meigen, arrive at diseased animals within minutes, particularly when they had been injured. We captured head space volatiles of freshly deceased and incised rats on Porapak Q and analyzed extract by gas chromatographic-electroantennographic detection (GC-EAD) and GC-mass spectrometry. Bioassays determined that a synthetic blend was as attractive as the incised rats. Irrespective of the dose tested, dark but not bright visual cues further enhanced its attractiveness.

21. **Brunet, B., H. Bird, L. Lumley, M. Cusson, B. Boyle, R. Levesque, and F. Sperling**

**A Genotyping-By-Sequencing approach to the *Choristoneura fumiferana* species complex.**

New Genotyping-By-Sequencing (GBS) approaches enable the discovery and genotyping of millions of genetic markers across the genomes of multiple individuals in parallel. Using GBS, we are reassessing population structure of the spruce budworm species complex and developing a rudimentary genetic linkage map. This will serve as a useful resource for studying adaptive aspects of speciation and assist in genome assembly. Phylogenomic analysis of GBS-derived markers has also revealed new evolutionary relationships among budworm species.

**22. Buddle, C.M.**

**Canada's spider fauna: Benchmarks and opportunities for assessing the Biota of Canada.**

Large-scale inventories and biodiversity research has provided valuable data about Canada's arthropod fauna, including spiders. Although baseline knowledge about spiders is good, coordinating data, people and faunal lists is a priority. I will explore the opportunities for Araneology in Canada, with particular attention the need for research about northern Linyphiidae, fundamental life-history studies, and the value of spider-based citizen science in Canada.

**23. Buddle, C.M.**

**Everyone's Ivory Tower: perspectives on how social media is changing academia**

Social media is becoming an important player in all facets of academia. I will explore the ways that social media is affecting the "ivory tower", and will draw upon personal experiences that are at the intersection of social media and traditional academic pursuits (e.g., scientific publishing, undergraduate teaching, and research). I will finish by discussing how social media is changing my professional and personal life, and the ways social media is shifting paradigms about University.

**24. Byers, K. and H. Proctor**

**Sexual selection and genitalia in *Trouessartia* feather mites.**

Sexually antagonistic selection can influence ♂ and ♀ genitalic morphology. We collected Trouessartiidae from 96 avian host species and outgroups from 3 species. We measured size of ♀ and ♂ structures involved in copulation to test for coevolutionary relationships. Using molecular data we estimated host phylogeny and mapped mites onto the tree. In species where ♀♀ have long spermaducts ♂♂ have comparatively large genitalia. In all species the ♀ dorsal shield was more ornamented than that of ♂♂.

**25. Cannings, S.G.**

**The status of *Germaria angustata*, a dune-restricted tachinid fly, in North America.**

*Germaria angustata* (Zetterstedt) is a tachinid fly that is a dune specialist. Primarily Eurasian in distribution, in North America it is restricted to dunes in the southwestern Yukon. Until 2007 it was thought to be found only at the dunes at Carcross, Yukon, but recent surveys have located it at ten more sites in the region. The Committee on the Status of Endangered Wildlife in Canada has assessed this species as Special Concern; it has yet to be officially listed under the Species at Risk Act.

**26. Cárcamo, H.A.**

**The pea leaf weevil (*Sitona lineatus* L.) - an overview of recent research and knowledge gaps**

The pea leaf weevil occurs in southern Alberta and Saskatchewan where it poses a threat to field pea production. Integrated pest management tools include monitoring foliage damage and following economic thresholds at the seedling stage, trap cropping, and preventing yield loss through nitrogen fertility. Local forecasting of spring populations, to make management decisions before seeding, and chemical management remain a challenge. Biological control methods also need to be researched as part of a long term sustainable management plan.

**27. Cárcamo, H., C. Herle, B. Broadbent, T. Garipey, and L. Gualtieri**

**Neo-classical biocontrol of *Lygus* in canola in the Canadian Prairies-treading lightly.**

*Lygus* bugs are native pests of canola in the prairies. Native *Peristenus* wasps do not attack *Lygus* in canola. *Peristenus digoneutis* is an effective European parasitoid of *Lygus* nymphs established in eastern Canada. Our ongoing studies demonstrate that (1) it attacks the *Lygus* species that are common pests of Canola in the prairies and (2) it attacks *Lygus* species in canola in Ontario. Potential competitive interactions with native *Peristenus* species will be assessed prior to its release.

**28. Cárcamo, H.A., V. Hervet, L. Dosdall, S. Kher, and C. Chelle**

**Host range assays of *Tetrastichus julis* - an effective biocontrol agent of cereal leaf beetle.**

The cereal leaf beetle (Chrysomelidae) is a potentially serious pest of most cultivated cereals in the Canadian prairies. In southern Alberta, *T. julis* (Eulophidae) has followed the beetle and contributes significantly to its management.

However, the potential impact on non-target leaf beetles is unknown. We tested the host range of this parasitoid using local Chrysomelidae such as the weed biocontrol agent *Cassida azurea*. Preliminary results suggest that *T. julis* does not attack non-target beetles.

**29. Chahil, G.S. and G.C. Cutler**

**Consumption of weed seeds by *Harpalus rufipes*, a common beetle in lowbush blueberry in Atlantic Canada.**

Weeds are major pest problem of wild blueberry. Granivorous ground beetles consume weed seeds, contributing to pest control. In the laboratory, *Harpalus rufipes*, a common ground beetle in blueberry fields, consumed 30 and 17 seeds of red sorrel and hairy fescue (weeds) respectively in 4 days. When given a choice, *H. rufipes* consumed two times more red sorrel seeds than hairy fescue. Additional field experiments will clarify the potential of *H. rufipes* for weed biocontrol in lowbush blueberry.

**30. Chahil, G.S., R. Takkar, Gaganjot, R.S. Battu, and S. Balwinder**

**Dissipation kinetics of trifloxystrobin and tebuconazole on onion (*Allium cepa* L.).**

Study on dissipation kinetics of trifloxystrobin 25%+ tebuconazole 50% (Nativo 75WG) on onion showed that single application@ 300 g ha<sup>-1</sup> resulted in average initial deposits of 0.52 and 0.76 mg kg<sup>-1</sup> and half-life (t<sub>1/2</sub>) of 1.86 and 2.13 days (trifloxystrobin and tebuconazole), respectively. Mature onion collected after 43 days at harvest time did not reveal the presence of trifloxystrobin and its metabolite CGA 32113 at their determination limit of 0.05 mg kg<sup>-1</sup>.

**31. Chen, X.**

**Population level effects of the Azatin, on the *Ceriodaphnia dubia*.**

Although natural insecticides from the neem tree are generally perceived as less harmful to the environment than synthetic insecticides, new evidence indicates that these products may pose a risk to certain nontarget organisms. In this study, the acute and chronic effects of a commercial neem insecticide, Azatin on the aquatic invertebrate, *Ceriodaphnia dubia* were examined. Acute (48h) mortality estimates were determined followed by a population growth rate study after chronic (8 day) exposure. The acute LC50 estimate for Azatin was 238 µg/l. For the chronic study, *C. dubia* were exposed to concentrations equivalent to the acute LC1 (30 µg/l), LC9 (70 µg/l), LC35 (170 µg/l), LC72 (410 µg/l), and LC92 (910 µg/l). Exposure to Azatin concentrations ≥ 410 µg/l resulted in significant declines in offspring/female, population size, and population growth rate compared to the control. The worst-case scenario expected environmental concentration for azadirachtin, the active ingredient for Azatin, was estimated to be 33µg/l. Based on this EEC estimate, Azatin should not pose a hazard to chronically-exposed populations of *C. dubia* after agricultural application of this product for crop protection.

**32. Cigan, P., J. Karst, J. Cahill, and N. Erbilgin**

**Influence of mountain pine beetle infestation on litter and soil nutrient status in western Alberta, Canada.**

Nutrient concentrations of fresh-fallen litter and soils were quantified and compared across a mountain pine beetle (MPB) attack gradient surveyed across 11 lodgepole pine stands in western Alberta Canada. Stand-level measurements from the 2011 and 2012 growing seasons indicate associations between the age and intensity of MPB attacks and the nutrient concentrations of litter and soils. This work demonstrates the role played by bark beetle disturbances in altering short-term nutrient flows, while highlighting implications related to the timing and intensity of forest management responses such as reforestation.

**33. Cory, J.S., D.T. Woodward, and E.M. Kemp**

**Mixed infections in the eastern spruce budworm, *Choristoneura fumiferana*.**

Insects are infected by numerous pathogens and it is becoming clear that these often occur as mixed infections. We studied the interaction of two distinct baculoviruses isolated from eastern spruce budworm, *Choristoneura fumiferana*. One isolate (CfMNPV) has typical oral infectivity but the other does not and has been assumed to be dependent on CfMNPV for survival. Previous research suggested synergism between the two isolates. We found that co-inoculation rescues CfDEFNPV oral infectivity and enhances the CfMNPV dose response; however, the benefits to CfMNPV are dose dependent.

**34. Costamagna, A.C.**

**Comparison of predation in annual versus perennial agroecosystems aphid predation in soybean versus alfalfa in Manitoba.**

A field study was conducted in four pairs of neighboring alfalfa and soybean fields to compare natural enemy suppression of soybean and pea aphids. Natural enemy manipulations consisted in complete exclusion, ground predator exclusion and open controls using field cages. I will present the impacts of these manipulations on populations of sentinel aphids on alfalfa and on potted soybean plants.

**35. Courtney, G.W. and J.K. VanDyk**

**BugGuide: the community behind half a million submitted “specimens”.**

BugGuide.net is a hive of activity for citizens, scientists, and citizen scientists who enjoy learning about and sharing observations of insects and related arthropods. It offers a place where individual contributions add to the value of the whole. Incoming photographic submissions are identified and classified by volunteer editors creating a guide to North American insects that currently comprises over 40,000 pages and more than half a million images.

**36. Cumming, H.J. and T.A. Wheeler**

**Taxonomic problems in Nearctic *Callomyia* (Diptera: Platypezidae).**

The flat-footed fly genus *Callomyia* Meigen contains 20 species, 10 of which are Nearctic. Taxonomy of the Nearctic species is not well-resolved. Many species are defined primarily on adult colour. This is problematic because many species differ only slightly in colour and are variable. In addition, eight of the ten species are described from one sex only, and sexual colour dimorphism appears to be widespread. A new approach to *Callomyia* systematics, combining multiple character sets, is needed.

**37. Cumming, J.M., S.E. Brooks and T. Saigusa**

**Systematics of the *Hesperempis* genus group (Diptera: Empididae).**

The *Hesperempis* genus group currently contains three genera with five species in the Palaearctic and Nearctic regions. Revision of the group indicates that it should now include 10 species in only two genera, namely *Dryodromia* and *Hesperempis*. The genus *Melanderulus* (= *Toreus* Melander) should be synonymized with *Hesperempis*. Phylogeny and zoogeography of this essentially Holarctic genus group will be discussed, including its probable relationship within the Empididae.

**38. Currie, D.C.**

**Canada's black fly fauna: opportunities and challenges for a well-known family of biting flies.**

Canada is home to 162 species of black flies, virtually all of which are already well known in the larval, pupal, and adult stages. Except for the discovery of sibling species (or species migrating northward from the continental US), it is unlikely that many additional black flies will be discovered in Canada. I will use the Simuliidae as a test case for exploring what kinds of information could be included in a Biota of Canada contribution for a “well known” group.

**39. Currie, R., S. Desai, S. Jiang and J. Deonaraine**

**Impact of honey bee comb on the phenology and impact viruses on honey bee colonies.**

Honey bee viruses can have a major impact on honey bee colonies. Viruses move within and between hives by vertical and/or horizontal transmission between bees and mites but comparatively little is known about the role of comb in transmission of viruses. Virus was transmitted to new colonies by comb taken from colonies that had died the previous winter. Virus on comb was shown to impact colony performance. There were important interactions with comb and they dynamics of virus in the colony.

**40. Cusson, M., H. Maaroufi, A. Nisole, B. Boyle, J. Laroche, C. Béliveau, I. Kukavica-Ibrulj, D. Doucet, C. Lucarotti, F. Sperling, L. Lumley, B. Brunet, H. Bird, M. Brandão, and R.C. Levesque**  
**Unique features of the spruce budworm genome.**

To explore the genetic underpinnings of the spruce budworm's biological success, the Budworm Genomics Consortium has initiated comparative genomics analyses using both genome sequencing and transcriptomics data. The latter were obtained by sequencing (454) a normalized cDNA library developed from RNAs extracted from all budworm life stages, but also include RNA-seq data from different experiments. Genes identified as unique to this species offer promise for the design of novel control tools.

**41. Cutler, G.C.**

**Insects and hormesis: evidence and considerations for study.**

High amounts of stress are harmful, but low amounts may be beneficial. This biphasic response to a stressor, termed ‘hormesis’, has been seen in many insects following mild exposure to stressors, including pesticides. The importance of insects, their amenability to experiments, and a rich knowledgebase in insect toxicology, make the insect-insecticide model an excellent one to study questions surrounding hormesis. In this paper, I discuss examples and opportunities for study of insect hormesis.

**42. Danci, A., M. Hrabar, S. Ikoma, P. Schaefer, G. Gries**

**Even males can learn – male parasitoids memorize locations of host pupae.**

Males of the parasitoid wasp *Pimpla disparis* seek parasitized pupae of the gypsy moth, *Lymantria dispar*, and ultimately await the emergence of prospective mates. This concept of early mate detection hinges on learning skills by males. In field surveys and laboratory experiments with color-coded males, we tested the hypothesis that males learn and memorize the location of parasitized host pupae, tracking the development of prospective mates over time.

**43. De Clerck-Floate, R. and J. Dyck**

**Developing a biological control strategy for hawkweeds in Canada.**

The stolon gall wasp, *Aulacidea subterminalis* (Cynipidae) was first released in Canada in 2011 against several invasive hawkweed species (*Pilosella* spp; Asteraceae). It has successfully survived on *P. flagellaris* in British Columbia. An experiment to determine optimum release strategies based on host growth and phenology revealed morphological differences between *P. flagellaris* and *P. officinarum*. The more constrained growth of *P. flagellaris* suggests that it may be more damaged by galling.

**44. Delisle, J. and J. Régnière**

**Vertical distribution and seasonal changes of SBW mating success.**

To test whether the vertical position of SBW females in tree crowns influences their probability of attracting mates, and how this varies during the flight period, we compared mating success at 3 heights (3, 6, 12 m) on 8 dominant trees/plot in 6 plots, repeated 5 times. With a total of 1440 females tested, we found that mating success was consistently lowest at 3 m, intermediate at 6 m and highest at 12 m. We will discuss the impacts of these results on SBW population dynamics and management.

**45. De Silva, E.C.A., P. J. Silk, N.K. Hillier, and G.C. Cutler**

**Chemical ecology of female blueberry spanworm, *Itame argillacearia*, (Lepidoptera: Geometridae).**

Blueberry spanworm, *Itame argillacearia*, is an important defoliator of wild blueberry. The sex pheromone gland components were isolated from virgin female moths reared in the laboratory. GC-MS and GC-EAD analysis of pheromone gland components, in combination with field trapping studies, identified (3R, 4S)-epoxy- (Z,Z)-6,9-17:H and (Z,Z,Z)-3,6,9-17:H as the female produced sex pheromone. This pheromone may be useful as trap bait in management of this insect pest in wild blueberry production.

**46. Dupont, J.M., R. Westwood, and C. Hamel**

**Determination of key habitat and best management practices for the conservation of poweshiek skipperling, *Oarisma poweshiek* (Parker).**

The threatened Canadian population of *O. poweshiek* is scattered within the Manitoba Tall Grass Prairie Preserve (TGPP). The Nature Conservancy of Canada (NCC), and partners, are currently managing the TGPP using prescribed burning and grazing, which can impact the local survival of *O. poweshiek*. This study (2008-09), with surveys in 2010-12, were designed to determine critical habitat and management attributes for *O. poweshiek*. A range wide international species recovery effort has resulted.

**47. Dupuis, J.R. and F.A.H. Sperling**

**Molecular analysis of putative hybridization in the *Papilio machaon* species group in North America.**

Evidence of hybrid speciation in animals is becoming increasingly common in recent years. *Papilio brevicauda* and *P. joanae* are species of swallowtail butterflies endemic to the Maritime Provinces and the Ozark mountains, respectively. Morphologically they resemble *P. polyxenes*, but mtDNA clusters them with *P. machaon*, suggesting possible hybrid ancestry. Here, we use ten microsatellite loci in addition to nuclear and mitochondrial sequence data to clarify the ancestry of these flagship species.

**48. Dury, G. J., D. M. Windsor, M. Hersh, and J. C. Bede**

**Multiple origins of “cycloaexy” in neotropical leaf beetles inferred from a molecular phylogeny.**

In some herbivore insects, larvae form a defensive circle; “cycloaexy”. This occurs in many orders (Di-, Neuro-, Hymeno- and Coleoptera) but few spp. We observed larval grouping tendencies in 29 spp. of the leaf beetle genera *Platyphora* and *Proseicela* (Coleoptera: Chrysomelinae) in 5 Neotropical countries. Our observations suggest cycloaexy in all *Proseicela* but only some *Platyphora*. A molecular phylogenetic reconstruction suggests monophyly of these and <2 independent origins of cycloaexy.

**49. Ernst, C.M.**

**Why I spend so much time on the internet: social media as a tool for doing science.**

Students often hear that the only important currency of academia is journal papers: other activities are time-wasters. I argue that an investment in non-traditional modes of science communication - i.e., social media - can provide ample professional rewards. In this talk, I will describe how blogging, tweeting, and YouTube has enhanced my networking, collaboration, outreach and communication opportunities in ways that traditional science venues could not. I'll provide some tips and caveats for those considering taking the plunge and developing a professional social media presence.

**50. Ernst, C.M., B. Hanelt, and C.M. Buddle**

**Parasitism of Arctic ground beetles (Coleoptera: Carabidae) by hairworms (Nematomorpha: Gordiida).**

Beetles collected from Arctic sites were found to be infected by parasitic hairworms (*Gordiida*). Infected beetles include five species, all newly discovered hosts. Infection rates varied by site, habitat and trap type. Previous work indicates a paucity of terrestrial prey for carnivorous epigeic beetles in the north. Parasitism by hairworms suggests that flying insects with aquatic immature stages (i.e., paratenic hosts) provide important subsidies to terrestrial arthropod food webs.

**51. Evans, B. G., K.S. Jordan, M. Brownbridge, and R. H. Hallett**

**Potential soil biological control agents of the swede midge, *Contarinia nasturtii*, in organic agricultural systems.**

The swede midge, *Contarinia nasturtii*, is a serious pest of crucifers in North America. Although some control is achieved in conventional systems, organic growers have no effective option. The entomopathogenic nematodes *Heterorhabditis bacteriophora*, *Steinernema carpocapsae* and *S. feltiae* and the fungus *Metarhizium anisopliae* were considered as biological controls for soil-dwelling stages. Field trials assessed adult emergence and laboratory bioassays compared infectivity of larvae and pupae.

**52. Evans, M.M., R.V. Cartar, and M. Wonneck**

**Responses of grassland bees and flowers to grazing and landscape.**

Rough fescue grasslands are a dominant habitat in SW Alberta, where livestock graze in landscapes that vary in their extent of human footprint. We studied the communities of bees and the flowers that they visit, to ask how landscape and grazing jointly affect the pollination community. We used Structural Equation Modelling to relate landscape, grazing, flowers, and bees. Both grazing and landscape were found to influence the pollination community: landscape directly affected bees.

**53. Evenden, M.L., B.A. Mori and C.M. Whitehouse**

**Semiochemical-based management of agricultural pests in Alberta: current research and future needs.**

The reliance of insects on chemical cues for mate and host location makes chemical communication an ideal target for pest management. I highlight research on chemically-mediated interactions of agricultural pests in Alberta. The emphasis is on understanding the mechanisms by which insect behaviour is affected by semiochemical-based management tactics. Examples of the use of semiochemicals for monitoring and control of agricultural pests and future research needs will be presented.

**54. Fagua, G., J. Duran, E. Gil, J. Robles, and N. Ruiz**

**Resource use of *Mapeta xanthomelas* (Lepidoptera: Pyralidae): an aposematic herbivore of *Aristolochia*.**

*M. xanthomelas* is a bright moth and larval herbivore on *Aristolochia* plants. We found larval host plant preferences for 3 of 8 *Aristolochia* species when plants were offered at once. When caterpillars were feed with only one plant species across all instars, we found differences in their rates of development and survival. Our results were consistent with a hierarchy in resource use of host plants in the wild. We also detected aristolochic acid I in the moth, explaining its aposematic coloration.

**55. Farhan, J. and J. McNeil**

**The effects of abiotic factors on the number of male western bean cutworms (WBC), *Striacosta albicosta*, captured in pheromone traps.**

Pheromone traps are often an important component of IPM programs. However, as with the western bean cutworm (WBC), trap catches are not good indicators of subsequent infestations. In part, this is because we do not have good data on the influence of abiotic factors on either the emission of, or response to, pheromones. I will present the results of a two-year field study examining the effects of temperature, relative humidity and wind speed on the number of WBC males captured in pheromone traps.

**56. Ferris, K., S. Busch, C. Teasdale, and R. Prasad**

**Impact of invasive species on endemic arthropods of berries in SW B.C.**

Crop monitoring has helped berry growers manage pests with minimal insecticide sprays. Detection of *Drosophila suzukii* in 2009 has resulted in more frequent calendar sprays to limit maggot-infested fruit. We examined the impact of calendar sprays on pest and beneficial arthropods by comparing scouting records prior to *D. suzukii* (2007) and in the two years since (2011). In general, levels of aphids, weevils, and spider mites have not changed pre- and post-*D. suzukii*. However, half as many foliar predators were detected.

**57. Fields, P.G., A. Abdelghany, W. Taylor, and R. Hynes**

**Small bin trial of pea extract to control stored-product insects.**

Protein-rich pea flour is toxic and repellent to stored-product insects. A pilot-plant-scale extraction of the active compounds was carried out on 500 kg of protein-rich pea flour. A 3-month test with grain bulks of 350 kg showed that the pea flour (1000 ppm) reduced *Sitophilus oryzae* (rice weevil) and *Cryptolestes ferrugineus* (rusty grain beetle) but not *Tribolium castaneum* (red flour beetle) populations. Pea extract (500 and 1000 ppm) reduced *S. oryzae* but not *C. ferrugineus* or *T. castaneum*.

**58. Fitzpatrick, S.M., M.A. Cook, S. Mathur, B.J. Sinclair, B.D. Roitberg, and G. Gries**

**Evidence suggests cryptic speciation in *Dasineura oxycoccana* on cranberry and blueberry.**

*Dasineura oxycoccana* (Diptera: Cecidomyiidae) is commonly named cranberry tipworm (CTW) and blueberry gall midge (BGM). Oviposition occurs in developing buds of cranberry (by CTW females) or blueberry (by BGM females). Larvae feed on meristematic tissue in the buds. Adults and larvae of CTW are morphologically indistinguishable from those of BGM. The two populations are currently designated conspecific, but behavioural, chemical and genetic evidence suggests that CTW and BGM are cryptic species.

**59. Floate, K. and K. Nassera**

**Seasonal activity of dung beetles (Coleoptera: Scarabaeidae) on native grasslands in southern Alberta.**

Seasonal activity of coprophilous beetles was assessed at 3 native grassland sites in southern Alberta during the summers of 2008, 2009 and 2010. Operation of dung-baited pitfall traps recovered 202 877 specimens. This collection comprised twelve species of Scarabaeidae representing three guilds: two rollers (*Canthon* spp.), one tunneller (*Onthophagus nuchicornis*) and nine dwellers (*Aphodius* spp.). Species of Hydrophilidae and Histeridae (scavenging or predaceous habits) also were recovered.

**60. Floate, K., W. Blanckenhorn, J-P Lumaret, T. Tixier, L. Joost, J. Römbke**

**An international multi-species ring test to assess the non-target effects of residues in dung of cattle treated with veterinary pharmaceuticals.**

Registration of veterinary pharmaceuticals requires tests on multi-species ecosystems when single-species tests show adverse non-target effects of residues in dung of treated livestock. A suitable multi-species test has not been approved by international regulatory authorities. Here we report results of one potential such test performed with standard methods in four countries to assess the insecticidal activity of ivermectin residues in dung of treated cattle.

**61. Floate, K., J. Broatch, M. Erlandson, M. Evenden, J. Gavloski, S. Hartley, J. Hummel, R. Laird, S. Meers, C. Olivier, J. Otani, Jennifer, B. Sharanowski**

**New projects for control of cutworms (Lepidoptera: Noctuidae) affecting canola crops on the prairies.**

Cutworms form a complex of pest species that attack cereal and oilseed crops. Outbreaks affecting canola have been particularly severe across the prairies in each of the past four years. In response, the Canola Council of Canada is funding new projects beginning in 2012 to enhance the identification and management of cutworm larvae, and to increase knowledge of their biology and associated parasitoids.

**62. Franklin, M.T. and D.E. Henderson**

**Development of viral biopesticides for the control of lepidopteran pests.**

Naturally occurring insect viruses can provide effective alternatives to chemical based insecticides, however few have been developed for commercial use. We are in the preliminary stages of investigating the use of nucleopolyhedroviruses for the control of *Spodoptera* species in Cuba as well as the detection and development of viruses for lepidopteran pests in cole crops in BC. We will characterize viruses using molecular methods and examine their efficacy under laboratory rearing conditions.

**63. Franklin, M.T., J.H. Myers, and J.S. Cory**

**Population structure of the Western Tent Caterpillar and its relation to population cycles.**

Populations of the western tent caterpillar in the Southern Gulf Islands of BC cycle in density with peaks every 6 to 11 years. To determine if populations on different islands are genetically differentiated or if patterns of genetic variation change with density, we examined geographic and temporal patterns of genetic variation. Our analysis revealed little spatial or temporal genetic structure and suggests that considerable mixing among island populations is likely to be occurring.

**64. Fuentealba, A. and É. Bauce**

**Soil drainage class, host tree species and thinning influence host tree resistance to the spruce budworm.**

Field rearing experiments of spruce budworm (*Choristoneura fumiferana* (Clem.)) were conducted along with foliar chemical analyses through a gradient of stand thinning density and site drainage quality in the Montmorency experimental forest to evaluate the impact of these factors on host tree resistance. Our results show that thinning reduced balsam fir (*Abies balsamea* (L.) Mill)) resistance one year after treatment, except on hydric drainage. Three years after treatment we observed the opposite response. This increased resistance to spruce budworm last for at least 6 years, suggesting that thinning may be used as preventive control measure.

**65. Galloway, T.D.**

**Phthiraptera in Canada: current status, prospects and challenges.**

In Canada and Its Insect Fauna, Martin (1979) estimated there were 362 species of lice recorded and 413 species unrecorded or undescribed. Today there are at least 346 recorded species and 351 unrecorded species; the number of undescribed species is difficult to estimate. Still, less than 50% of the expected louse fauna has been recorded or described. Interest in the ecology of ectoparasites is growing. Strategies for improving our knowledge of the ectoparasite fauna will be discussed.

**66. Gariépy, T.D. and H. Fraser**

**Occurrence of Brown Marmorated Stink Bug in Ontario and potential for biological control.**

The Brown Marmorated Stink Bug (BMSB) is an invasive pest of Asian origin. In the US, severe economic losses have been reported in fruit and vegetable crops. In Canada, BMSB adults have been intercepted in shipments and have been found overwintering in homes. However, the first breeding population was located in Hamilton, Ontario in 2012. Here we discuss the impact of this find and the potential for biological control solutions for BMSB.

**67. Gaul, S.O. and G.T. Pitcher**

**Towards the identification of a pheromone for the green pug moth, *Chloroclystis rectangulata*, [Lepidoptera: Geometridae]**

The green pug moth (GPM) feeds on fruit buds of apple. Both laboratory and orchard trials were utilized to demonstrate the attractiveness of each of caged females of GPM and extracts to conspecific males. Preliminary investigations indicate the presence of unsaturated hydrocarbons, potential pheromone constituents in the family Geometridae.

**68. Gibson, G.A.P., M. Gebiola, and U. Bernardo**

**Cryptic species of the *Necremnus tidius* complex (Hym.: Eulophidae) revealed through molecules.**

Ongoing COI and 28S+ITS2 analyses indicate four cryptic species exist under the name *Necremnus tidius* Walker (Chalcidoidea), one in North America, two in Europe, and one in both regions. Study of specimens discriminated using molecular techniques has so far resulted in only partial species resolution using morphology. *N. tidius* has six junior synonyms. Prior synonymy of *N. duplicatus* under *N. tidius* appears to be incorrect, but correct names for the other two species remain to be determined.

**69. Gibson, J.F., S. Shokralla, I.W. King, and M. Hajibabaei**

**Assessing terrestrial insect biodiversity using next-generation sequencing.**

Conventional biodiversity research via individual identification is costly and slow. To draw conclusions about changes in communities in response to natural and anthropogenic effects, biodiversity analysis needs to become more rapid, comprehensive, and cost-effective. High-throughput next-generation sequencing technology (e.g. 454, Illumina) allows the arthropod biodiversity of a given locale at a given time to be determined rapidly, accurately, and at a much lower cost per sample.

**70. Gillespie, D. and B.I. Gillespie**

**Location of non-target species in an arthropod biocontrol programme.**

One of the challenges in classical biological control of arthropods is identifying and locating populations of endemic non-target host species that can be used in host-range testing. We examined herbarium collections to identify native,

western North American Brassicaceae that showed symptoms of attack by *Ceutorhynchus* spp. The exit holes left by larvae in pods and stems of Brassicaceae are characteristic, allowing the use of species and locality records to locate non-target weevil species.

**71. Grégoire, D., D. Quiring, and L. Royer**

**Host mediated interactions with an exotic homopteran phloem feeder alter the performance and preference of a native hymenopteran defoliator.**

Since its introduction from Europe, *Adelges piceae*, a gout inducing hemiptera, has spread throughout the fir forests of eastern Canada. We carried out manipulative field studies to examine how prior feeding by *A. piceae* influences the suitability of foliage for *Neodipron abietis*, a native hymenopteran defoliator and whether *N. abietis* feeding and oviposition choice are affected. Our study demonstrated that *N. abietis* survival decreases when larvae are reared on fir previously fed upon by *A. piceae*. Consequently, female *N. abietis* as well as early instar larvae avoid branches that have been gouted by *A. piceae*.

**72. Grossi, A.**

**Quantitative analysis of *Anatoecus* spp. (Phthiraptera) on Canada Geese and Mallards in Manitoba.**

*Anatoecus icterodes* and *A. dentatus* are chewing lice infesting Canada Geese and Mallards. *A. icterodes* and *A. dentatus* are only distinguishable by the male genitalia. Prevalence of *Anatoecus* spp. was 32.8% on Canada Geese (n=265); mean intensity was 15.3. On Mallards (n=280), prevalence of *Anatoecus* spp. was 27.9%; mean intensity was 5.9. *A. icterodes* was generally more prevalent and present in greater numbers than *A. dentatus* on both hosts. Details of infestation parameters will be presented.

**73. Hammond, H.E.J., D. Williams, D. Langor, S. Laplante, Y. Bousquet, and D. McCorquodale**

**The Cerambycidae of Canada and Alaska Project (Coleoptera: Cerambycidae).**

The family Cerambycidae include some of the most beautiful and destructive beetles in forests. We are in the process of putting together a field guide to the 300+ species of native, and some of the important invasive species, of Cerambycidae found in Canada and Alaska. The book will include illustrated and updated keys, revision of species groups, new range maps, and habitus photos. The genus *Semanotus* will be used as an example of an updated and revised group.

**74. Haye, T., L. Hohman, J. Zhang, D. Gillespie, P. Mason, and T. Garipey**

**Egg parasitism of brown marmorated stink bug, *Halyomorpha halys*, in China and Europe and implications for biological control.**

The brown marmorated stinkbug, *Halyomorpha halys*, invaded North America and Europe.

In its native range in China, egg masses are frequently parasitized by *Trissolcus halyomorphae* (Hymenoptera: Scelionidae), a promising biological control agent. We are evaluating its host specificity and present here first data on its ecological host range in China. Compared to North America *H. halys* populations in Europe are still small and we discuss whether egg parasitoids of native European pentatomids could be a limiting factor for *H. halys*.

**75. Hébert, R.**

**Wild Species 2010: The General Status of Species in Canada.**

The aim of the Wild Species program is to provide an overview on which species we have in Canada, in which provinces, territories or ocean regions they occur, and what is their status. In the 2010 report, 20 taxonomic groups were assessed, of which 12 are arthropods (spiders, odonates, predaceous diving beetles, ground beetles, lady beetles, bumble bees, black flies, horse flies, mosquitoes, selected macromoths, butterflies, crayfishes). Results indicate that several species are undetermined.

**76. Hervet, V.A.D. and J. Gavlovski**

**Natural enemies of army cutworm, redbacked cutworm and darksided cutworm (Lepidoptera: Noctuidae) in North America.**

Increased crop losses due to cutworms have renewed interest in this pest complex. As part of a larger study, we conducted a literature review on natural enemies for army cutworm, redbacked cutworm, and darksided cutworm. We found 29 hymenopteran parasitoids, 24 dipteran parasitoids, 36 arthropod predators, 4 vertebrate predators and 15 pathogens. The result of this survey is shown here but will also appear in a coming book: "Biological Control Programs in Canada 2001-2010".

**77. Hervet, V.A.D, R.A. Laird, and K.D. Floate**

***Cotesia plathypenae* Muesebeck (Hymenoptera: Braconidae): a potential biological control agent of cutworms (Lepidoptera: Noctuidae).**

*Cotesia plathypenae* is a parthenogenic parasitoid of noctuid larvae. To test its potential use against pest species, we exposed female wasps to nine cutworm species. Females were observed to insert ovipositors into all exposed larvae, but new adults only emerged from redbacked cutworm, *Euxoa ochrogaster* (Guenée), darksided cutworm, *E. messoria* (Harris) and early cutworm, *E. tristicula* (Morrison). We believe these are new host records.

**78. Hewitt, L. C. Scott-Dupree, L. Shipp, and R. Buitenhuis**

**Determining the better thrips predator: effect of season on predatory mites.**

Western flower thrips (*Frankliniella occidentalis*) (WFT) are a major pest of greenhouse flowers and vegetables. The predatory mites *Amblyseius swirskii* and *Neoseiulus cucumeris* are commercially available biocontrol agents for WFT control. *Amblyseius swirskii* often cost almost double that of *N. cucumeris*, and as a result their performance in summer and winter greenhouse conditions was assessed to determine the most efficient pest management strategy involving their use.

**79. Hillier, N.K., Olsson, S.B., Grosse-Wilde, E., Reinecke, A., and B.S. Hansson**

**Olfactory physiology of coeloconic sensilla in *Manduca sexta*.**

The contributions of antennal sensilla coeloconica (SC) to olfactory processing, and the role of ionotropic receptors, aka 'IRs' localized within, are poorly understood. We investigated the physiological function of SCs in the Sphinx moth, *Manduca sexta*. The behavioral relevance for key odorants was also investigated using extracts from *M. sexta* larval frass (excrement). This will enable functional and molecular characterization of SC's and a more complete model of insect olfaction.

**80. Hock, V., G. Chouinard, E. Lucas, D. Cormier, T. Leskey, A. Zhang, and S. Wright**

**Olfactometric responses of Plum curculio to natural and synthetic volatiles.**

Tests were conducted in a 2-choice still-air vertical olfactometer using several odours including live male plum curculios (as aggregation pheromone emitters), synthetic versions of the plum curculio aggregation pheromone, and different host plant odours. Live female curculios were used as responders in order to determine which odours were the most attractive. Additional factors assessed were physiological state of curculios, pheromone concentration and purity.

**81. Hoemsen, B., I. Phillips, D. Parker, A. Bell, J. Bergsveinson, and D. Chivers**

**Extended Family: New family of caddisfly (Trichoptera: Uenoidae) to Saskatchewan with notes on life history.**

Streams draining the Cypress Hills support unique and understudied biodiversity in Saskatchewan. We report the discovery of a family and species of caddisfly (Trichoptera: Uenoidae) there, extending its known range from the Rocky Mountains nearly a thousand kilometers east in the plains. The first larva was collected in May 2012, and is found to enter diapause in mid-June through to mid-September, emerging late September. The specimens were verified as *Neophylax splendens*, Denning 1948 by genetic analysis. This is a unique find encouraging further studies of the basic taxonomic inventory of Saskatchewan, and establishes the unique lifecycle of this species.

**82. Holliday N.J., A.E. Holliday, T.M. Mattingly, E.A. Williams, and K.M. Naccarato**

**Chemical parsimony in *Chlaenius cordicollis* (Coleoptera: Carabidae)**

The defensive secretion of *Chlaenius cordicollis* is largely 3-methylphenol, with  $\geq 8$  phenolic minor components. In some circumstances there is sexual dimorphism in the relative concentrations of the components. In Y-tube olfactometry during the spring reproductive season, males preferred, and females avoided, the olfactometer arm in which a female producing defensive secretion was confined, but responses to a male source did not differ among sexes. The pattern of responses differed in fall.

**83. Hrabar, M., A. Danci, S. McCann, P. Schaefer, and G. Gries**

**Contributions to the life-history of *Xenos peckii* (Strepsiptera: Stylopidae).**

*Xenos peckii* is a small and enigmatic endoparasite of *Polistes* paper wasps. Little is known about the *X. peckii* life-history except that the neotenic females never leave their host and the short-lived (< 5 hours) males must quickly locate and intercept them in order to mate. Observing parasitized wasps, we tracked the timing of extrusion of *X. peckii* male puparia relative to that of the adult females. We then video recorded at 30 or 1000 frames per second male eclosion, pheromone calling behaviour of females and diel periodicity of this behaviour, and ultimately the entire mating sequence.

**84. Huber, D.P.W., C.J. Keeling, J.A. Robert, M. Yuen, T. Bonnet, C. Pitt, S.J.M. Jones, and J. Bohlmann**

**Glutathione S-transferases in the mountain pine beetle, *Dendroctonus ponderosae* Hopkins (Coleoptera: Curculionidae).**

In insects, some glutathione S-transferases (GSTs) enable the excretion of plant secondary metabolites, pesticides, or other toxins. A draft genome for the mountain pine beetle (MPB) has revealed at least 28 representatives of this gene family. Eighteen belong to the two insect-specific classes (Delta and Epsilon) that are involved in detoxification, and a few may be novel to MPB or an ancestor. Work is underway to further characterize the function and expression of MPB GSTs.

**85. Hueppelsheuser, T., M. Sweeney, C. Teasdale, K. Ferris, K. Sakalauskas, T. Krishnaraj, A. Stjernberg, K. Spotted Wing *Drosophila*: Three years in British Columbia; What have we learned so far?**

Spotted Wing *Drosophila* (SWD), *Drosophila suzukii* is a serious threat to the berry, stone fruit, and possibly grape industries in British Columbia, and was first detected late in 2009 in southern British Columbia. Information is presented on wild hosts, year-round area-wide trapping in commercial berry fields, fruit quality and management issues, blueberry variety susceptibility, and impact of hang-time.

**86. Illerbrun, K. and J. Roland**

**Spatial variation in an alpine plant-herbivore interaction: behaviour, host attributes, and encroaching habitat edge.**

I explore interactions between alpine *Parnassius smintheus* butterfly larvae and their host plant, *Sedum lanceolatum*, in the context of rising alpine treeline, focussing on the roles of oviposition behaviour, larval foraging, host-plant distribution/quality, and treeline (edge) proximity. Showing spatial variation in these interactions, I highlight the dichotomy between realized and apparent habitat for this and other alpine species, with particular relevance to conserving endangered congeners.

**87. Illerbrun, K. and J. Roland**

**Haphazard? Butterfly oviposition in relation to larval and adult resources.**

I examine oviposition behaviour in the alpine meadow dwelling Rocky Mountain Apollo butterfly (*Parnassius smintheus*) in relation to host plant abundance and quality, nectar flower abundance, and proximity to the treeline-delimited meadow edge. Despite ovipositing away from the host plant ("haphazard" egg laying), female *P. smintheus* preferentially oviposit where host plants are abundant and previous herbivory damage is low, while responding to adult resource abundance only at larger scales.

**88. Jackson, M.D.**

**The community ecology and phylogeny of the insect blogosphere**

The insect blogging community is a rapidly evolving group of enthusiasts who promote entomology by sharing observations and information about insects. Interestingly, the insect blogosphere exhibits many ecological parallels to the natural world (mutualism, niche partitioning, etc.). The ecology of the insect blogosphere, including the diversity, distribution, demography and interactions of insect blogs will be discussed, and a phylogeny exploring bug blog relationships will be presented.

**89. Jackson, M.D. and S.A. Marshall**

**Unlocking insect identifications online**

Canadian entomologists have been discovering the insects of our nation and facilitating their identification for generations. As the world turns to the web with an insatiable appetite for information, the Canadian Journal of Arthropod Identification is uniquely positioned to expand upon this tradition, providing an open-access and cost-effective web-based portal for expert knowledge. CJAI's current and future role in the insect identification landscape will be examined.

**90. James, P., F. Sperling, and D. Coltman**

**Spatial and temporal variation in mountain pine beetle sex ratio in response to forest condition and outbreak stage.**

Using a sex-associated genetic marker (microsatellite) we examined spatial variation in mountain pine beetle (*Dendroctonus ponderosae*) sex-ratio across a region of extensive outbreak in western Canada. Understanding the spatial determinants of sex-ratio variation can improve estimates of effective population size and better inform models of population dynamics. We compared several mixed-effect logistic regression models of sex-ratio as a function of tree diameter (DBH), outbreak stage, and additional remotely sensed spatial variables. Results at the scale of individual

trees indicate support for the hypothesized role of tree diameter in affecting the number of female beetles, but not for outbreak stage.

**91. Janes, J.K. and F.A.H. Sperling**

**SNP selective sweeps in the mountain pine beetle (*Dendroctonus ponderosae*)**

Mountain pine beetle is a major forest pest making significant migrations north and east in Canada. We applied genome wide SNPs to search for loci that are potentially of selective adaptive significance in populations across Canada, particularly at the expansion front. Results indicate a number of loci associated with genes involved in cold tolerance, detoxification, and several hypothetical proteins are responding to the novel environment experienced as the beetle continues to migrate.

**92. Judge, K.A., P.A. De Luca, J.E. Van Eindhoven, A. Mason, and G.K. Morris**

**Evidence for hunger-driven hybridization in *Cyphoderris* spp.**

Insects in the genus *Cyphoderris* have a unique breeding system in which females mount males to feed on their specialized hindwings, but are then trapped by males until they consent to mate. We show that hunger can cause female *C. buckelli* to mate with male *C. monstrosa*, a congener that breeds in sympatry with *C. buckelli*. We also have evidence of hybridization in the wild, suggesting that the costs to females of hybridization are less than the benefits of acquiring material benefits.

**93. Kerr, J.T.**

**Detecting and predicting global change impacts on butterflies in Canada.**

Global change impacts on species are now pervasive and these impacts are sufficiently serious to accelerate extinction rates massively. Can we predict, and mitigate, these effects? Focusing on butterflies and bees in North America, we have tested whether historical datasets improve predictions of species' responses to climate & land use changes. This macroecological focus on the changing ranges of butterflies and other pollinators has benefited from the launch of the new eButterfly program.

**94. Keeling, C. I., M. Yuen, A. Nguyen, H. Henderson, M. Li, C. Chiu, D.P.W. Huber, I. Birol, S.J.M. Jones, and J. Bohlman.**

**Genome sequence of *Dendroctonus ponderosae* Hopkins and new insights into mountain pine beetle biology**

Mountain pine beetle (MPB) is a serious pest of western N. Am. pine forests. We assembled a draft genome sequence from a field-collected pupa. Insights gained from the genome sequence include details of sex chromosome evolution, discovery of horizontal gene transfer, and phylogenies of select gene families (e.g. P450s) important to MPB survival under adverse environmental conditions. We present results from functional characterization of P450s and applications of RNAi as a tool for MPB research.

**95. Kher, S. V., L.M. Dosdall, and H.A. Cárcamo**

**Host-plant nutrients and plant vigor effects on spatio-temporal distribution patterns of cereal leaf beetle, *Oulema melanopus* (Coleoptera: Chrysomelidae)**

We investigated the role of host-plant nutrient availability, and plant vigor on the spatio-temporal distribution of the cereal leaf beetle, *Oulema melanopus*, and its parasitoid, *Tetrastichus julis*. A 100 m X 100 m grid was used in a commercial wheat each of 3 years. The extent of spatial associations among the pest, the parasitoid, host plant nutrients (N, P, K, S), and the plant vigor was analyzed using Spatial Analysis by Distance Indices (SADIE) software.

**96. Kher, S. V., L.M. Dosdall, and H.A. Cárcamo**

**Understanding host-finding behaviour of cereal leaf beetle, *Oulema melanopus* (Coleoptera: Chrysomelidae) and its principal parasitoid *Tetrastichus julis* (Hymenoptera: Eulophidae) using olfactory bioassays.**

Bioassays to study behaviour and preferences of *O. melanopus* to particular crop hosts (wheat, oats, barley, triticale) were conducted using a two-chambered olfactometer in 2010 and 2011. The host-finding behaviour of *Tetrastichus julis* was also investigated with reference to cues associated with the fecal coat of *O. melanopus* larvae. Adult *O. melanopus* responded to cues associated with oats and wheat. *T. julis* adult females showed greater response to larvae smeared with a fecal coat than without.

**97. Kher, S. V., H.A. Cárcamo, L.M. Dosdall, and M. Goettle**

**Laboratory bioassay of *Beauveria bassiana* strain GHA (BotaniGard™) efficacy on cereal leaf beetle (*Oulema melanopus*) and non-target effects on its parasitoid *Tetrastichus julis***

The role of the entomopathogenic fungus, *Beauveria bassiana* in *O. melanopus* management has not been studied extensively. Our laboratory and field assays suggest that this fungus is efficacious to manage this pest and appears to have limited non-target detrimental impacts on the beetle parasitoid - *T. julis*.

**98. Klutsch J., S. Taft, and N. Erbilgin**

**Effect of woodboring beetle activity on mountain pine beetle in jack pine mediated by tree pathogen.**

As mountain pine beetle (MPB) expands into jack pine (JP), it will interact with a community of JP infesting organisms. Dwarf mistletoe, a damaging pathogen, alters tree chemical properties which may alter JP susceptibility to MPB. Further, woodboring beetles in weakened trees may compete with MPB. These interactions were monitored in JP, alongside effects of dwarf mistletoe. We will discuss consequences of plant-insect interactions that impact community dynamics and endemic MPB colonization.

**99. Knysh, K.M., D.J. Giberson, and M.R. van den Heuvel**

**Relationship between nutrient concentrations and aquatic insect diversity and abundance in Prince Edward Island cold springs.**

Groundwater springs are unique stenothermic habitats in PEI, where they can be affected by nutrient inputs from fertilizer leaching from agricultural lands. Ten sites (5 agriculture, 5 forest) were monitored to detect relationships between agricultural land-use and water chemistry and insect diversity. Regionally, nutrient concentrations related to surrounding land-use. High-nutrient agricultural springs had different species composition and higher abundance than low-nutrient forest ones.

**100. Konopka, J.**

**Effect of cadmium on insect herbivores with different feeding strategies.**

Metal-tolerant plants may be used to remove metals from the soil but if insect herbivores can tolerate the potentially toxic levels of metals, phytoremediation sites could be a source of pests. We examined the performance of the cabbage looper, and the green peach aphid, as well as its parasitoid, *Aphidius sp.* on *Brassica juncea* grown at different cadmium (Cd) concentrations. We also reared loopers on artificial diet with Cd. The phloem feeding aphid and its parasitoid were unaffected by Cd, while foliage-feeding loopers were affected in a dose dependent manner.

**101. Kulkarni, S.S, L.M. Dossdall, C. Willenborg, K.N. Harker, and J. Spence**

**Spatio-temporal distribution patterns of carabid species in canola agroecosystems**

A number of factors such as soil type, soil moisture, weed cover, above-ground seed availability and plant density determine carabid abundance and species composition in agroecosystems by modifying micro-climatic situations within the field. This research aimed to investigate the spatio-temporal distribution of carabid species in canola cropping systems with special reference to omnivorous ground beetle (Carabidae) communities.

**102. Kulkarni, S.S, L.M. Dossdall, C. Willenborg, K.N. Harker, and J. Spence**

**The effect of temperature on weed seed predation by ground beetles (Coleoptera: Carabidae)**

The ground beetles (Coleoptera: Carabidae) are important predators of post-dispersed weed seeds in various agroecosystems. This research investigated the effect of temperature on weed- seed feeding potential of two species of granivorous carabids. Daily weed seed consumption rates were tested at five different temperatures with a five degree increment from 10oC to 30oC. The carabid species tested included *Amara littoralis* and *Pterostichus melanarius*. Differences in seed predation were compared.

**103. Kwon, J. J., G. J. R. Judd, and M. L. Evenden**

**Development of a combined semiochemical-based attracticide to target the apple clearwing moth (*Synanthedon myopaeformis*) (Lepidoptera: Sesiidae) and the codling moth (*Cydia pomonella*) (Lepidoptera: Tortricidae) in apple orchards in British Columbia.**

*Synanthedon myopaeformis* and *Cydia pomonella* are introduced pests of apples in BC. We examined olfactory and visual cues of both species to develop a semiochemical-based attracticide using wax-based SPLAT. Combining both species' pheromones in black SPLAT proved attractive to males, and addition of phenylacetaldehyde attracted female *S. myopaeformis*. Incorporating 5% cypermethrin rendered the formulation repellent to *S. myopaeformis*, although increasing pheromone dose offset this repellency.

**104. Lachowsky, L.E. and M.R. Reid**

**Effect of maternal state on investment in daughters and sons by mountain pine beetles.**

If female insects in better condition produce bigger offspring, they should invest more in daughters. We varied maternal condition of mountain pine beetles, *Dendroctonus ponderosae*, and found that larger females in better condition laid larger and more numerous eggs, but egg size did not differ between sons and daughters. While the average primary

sex ratio was equal it varied greatly among mothers. Subsequent mortality of sons contributed to a female-biased secondary sex ratio.

**105. Lamb, B., P. MacKay, and A. Alyokhin**

**Seasonal dynamics of three coexisting aphid species: implications for estimating population variability.**

Seasonal patterns of abundance and population variability were determined for *Macrosiphum euphorbiae* (Thomas), *Myzus persicae* (Sulzer) and *Aphis nasturtii* (Kaltenbach) (Hemiptera: Aphididae) in potato plots from weekly samples for 28 years. Estimates of population variability (PV, a proportion between 0 and 1) based on the week of peak abundance were close to those for other sample weeks and mean seasonal abundance. PV provided a robust and precise metric for comparing population variability among species, regardless of their seasonal patterns of abundance.

**106. Langor, D.L.**

**Future direction of the Biological Survey of Canada.**

For 35 years, the BSC has compiled, synthesized and disseminated biodiversity information via S&T documents, databases, symposia, and newsletters. While the mandate of the BSC has not changed, its fresh vision is to: seek new partnerships; deliver novel products, utilizing new technologies, to meet biodiversity information needs; and be more taxonomically inclusive. The proposed Biota of Canada Project will implement that vision and mobilize scientific resources to catalog all Canadian species.

**107. Larrivée, M. and J.T. Kerr**

**Eastern Canadian butterflies range expansions.**

Temperate species are shifting their range north but potentially at slower rates than their climatic niche. We examined range expansions in butterflies of eastern Canada and contrast these expansions with shifts in their climatic niche. Eastern Canadian butterfly ranges have expanded north at rates well beyond averages documented in the literature. We contrast northward expansions with climatic niche shifts and discuss the potential impacts of gaps between realized and predicted ranges.

**108. Lee, S.-I., J.R. Spence and D.W. Langor**

**Threshold living tree retention patch size to maintain saproxylic beetle diversity in boreal white spruce stands.**

Retention of living trees in harvested landscapes has been strongly promoted as a way to conserve biodiversity. Nonetheless, it remains poorly understood how managing the amount and distribution of residual trees in harvest blocks can best meet conservation goals. Different patch sizes (0.63-5.93 ha) were chosen to determine if there is a threshold for retention patch size in spruce forest to minimize loss of saproxylic beetles on harvested landscape.

**109. Lemmen, J. and M.L. Evenden**

**Plasticity of response to semiochemical cues in a long-lived moth, *Caloptilia fraxinella* (Lepidoptera: Gracillariidae).**

Timing of mating and host location is vital to optimize fitness of insect herbivores. *Caloptilia fraxinella* undergoes reproductive diapause before mating and host location. Moth response to semiochemicals is plastic and depends on physiological state. Exogenous and endogenous factors affect diapause termination and response to sex pheromone and host volatiles. Behavioural and electroantennographic assays elucidate mechanisms underlying the plasticity of moth response to these semiochemicals.

**110. Levesque, R.C., H. Maaroufi, A. Nisole, B. Boyle, J. Laroche, C. Béliveau, I. Kukavica-Ibrulj, D. Doucet, C. Lucarotti, F. Sperling, L. Lumley, B. Brunet, H. Bird, V. Nealis, and M. Cusson**

**The Budworm Genomics Consortium: sequencing the spruce budworm genome.**

The spruce budworm is the most serious insect pest of spruce-fir forests in eastern Canada. In an effort to uncover the genetic basis of this insect's phenomenal success and help develop new management strategies, the Budworm Genomics Consortium has undertaken the sequencing and assembly its genome. Data were obtained by submitting shotgun and paired-end libraries of male DNA to both Roche 454 and Illumina sequencing. With a genome size of 516 Mb, current genome coverage is estimated at > 60x.

**111. Li, Y., K.D. Floate, P. Field, and P. Baoping**

**Methods to cure symbiotic bacteria in insects.**

Most, perhaps all, species of arthropods have infections of symbiotic bacteria that can dramatically affect host reproduction and survival. Manipulating these infections promises a novel method of pest control, but requires a clear

understanding of the host-symbiont relationship. Here we review methods of experimentally removing symbiont infections to facilitate comparisons between infected and uninfected populations of their arthropod hosts.

**112. Light, M.H.S. and M. MacConaill**

**In plain sight: Insect herbivores associated with wild orchids in Canada.**

Little has been published about insects that feed on orchids in Canada. Long term study of three orchid species in Gatineau Park, Québec, has provided insight into the diversity of their insect herbivores including *Ctenothrips bridwelli*, *Parallelomma vittatum*, *Paralobesia cyripediana* and *Stethobaris ovata*. Herbarium material has provided historical evidence of incidence and range. The introduced orchid, *Epipactis helleborine* is host to the *Ctenothrips* and *Stethobaris* but only rarely to the *Parallelomma* which is known to infest this orchid in Europe.

**113. Liu, Q., K.M. Knysh and D.J. Giberson**

**Non-biting midge (Diptera:Chironomidae) diversity in Prince Edward Island limnocene springs.**

Diversity of chironomids on Prince Edward Island is poorly known for nearly all aquatic habitats. Midges make up a large proportion of the insects found in freshwater springs on PEI, and in an effort to test the effects of agricultural land-use on spring water biodiversity the midges were identified to genus or species using larvae from benthic samples and adult males from emergence traps. Here we report a preliminary list of the genera and species of chironomids found in eastern PEI springs.

**114. Lucarotti, C.J., M. Cusson, V.G. Nealis, D.K. Thumbi, C. Béliveau, B. Morin, R. Turnquist, and R. Lapointe**

***Choristoneura* viruses**

Viruses from several families infect *Choristoneura* budworms. Amongst these, members of the Baculoviridae, in the genera *Alphabaculovirus* and *Betabaculovirus*, have the greatest potential for use in biological control programs directed against budworms such as *C. fumiferana* and *C. occidentalis*. The potential and impediments for use of these and other viruses in budworm control programs will be discussed in light of currently available ecological, genetic and pesticide regulatory information.

**115. Lumley, L., B. Boyle, B. Brunet, J. Kruse, J. Laroche, R. Levesque, F. Sperling, B. Sturtevant, and M. Cusson**  
**Development of molecular markers as tools to monitor spruce budworm (*Choristoneura fumiferana*) dispersal.**

We are currently using Genotyping-By-Sequencing to discover single nucleotide polymorphisms (SNPs) for the identification of spruce budworm populations. Our main goals are to use these genetic markers to study spruce budworm dispersal and the effect of dispersal on outbreak patterns, which can then be incorporated into the spruce budworm management decision support system. We will discuss our progress to date.

**116. Ma, C., C. Andres, B. Shan, M. Penzes, I. Lusebrink, M. Evenden, and N. Erbilgin**

**The influence of host jack pine and lodgepole pine species on the pheromone emission of mountain pine beetle.**

We investigated the effect of host tree species (lodgepole and jack pines) on pheromone emission of mountain pine beetle (MPB). We found that emission of pheromones was different between tree species. Particularly the amount of trans-verbenol, female aggregation pheromone, emitted from jack pine was twice more than lodgepole pine. We developed released devices to reflect differences in pheromone emission between species and tested them in the field. The results of both studies will be reported.

**117. MacKay, C., K. Hillier, and J. Sweeney**

**Olfactory physiology of the brown spruce longhorn beetle (BSLB), *Tetropium fuscum* (Fabr.) (Coleoptera: Cerambycidae).**

The brown spruce longhorn beetle, *Tetropium fuscum* (F.), is an invasive species native to Europe that has become established in Nova Scotia. Single sensillum recordings were used to investigate the response of *T. fuscum*, from both European and Nova Scotia populations, as well as native *T. cinnamopterum* Kirby, to biologically relevant olfactory stimuli. Data gathered will develop a sensillar profile of responses and may be useful for improving current olfactory-based mitigation initiatives.

**118. MacMillan, H.A., J.F. Staples, and B.J. Sinclair**

**Why do insects stop moving in the cold?**

At low temperatures, insects enter a reversible state of chill coma, however the mechanisms underlying chill coma are not well-understood. We examine chill coma onset and recovery in the fall field cricket, *Gryllus pennsylvanicus*

(Orthoptera: Gryllidae), and present a conceptual model explaining how insect chill coma is caused by the loss of ion gradients at the muscle membrane, but is driven by ion and water balance at the gut.

**119. MacQuarrie, C.J.K. and J. Fidgen**

**Estimating presence and intensity of jack pine budworm defoliation using boosted regression trees.**

We used boosted regression trees to predict the presence and intensity of jack pine budworm defoliation from 180 plots in Northern Ontario observed from 1992-2007. As expected, flowers and the amount of previous defoliation were the best predictors for the likelihood and intensity of defoliation. Unexpectedly, soil texture and soil type were the next most important variables, suggesting that soil composition may be important in predicting jack pine budworm damage.

**120. Maddison, W.P.**

**Jumping spider melodies.**

The beautiful diversity of jumping spiders holds patterns that are replicated across phylogeny. In the genus *Habronattus*, multiple evolutionary origins of Y sex chromosomes are associated with distal chiasmata, supporting a proposed constraint hypothesis. In the family as a whole, large-scale evolutionary radiations have occurred in different continental regions independently, yielding similar spectra of body forms and ecologies in each region.

**121. Maguire, D.Y., C.M. Buddle, and E.M. Bennett**

**Landscape structure and the regulation of insect herbivory by predators.**

Forest fragmentation affects processes within remnant forest patches, which influences ecosystem services. Southern Quebec is characterized by highly fragmented forest landscapes. In this region, maple syrup production is a service that can be significantly affected by the process of insect herbivory. We quantified how landscape structure influences patterns of herbivory in sugar maple forests. We tested whether patterns were due to the regulation of herbivores by avian predators.

**122. Mahood, T. and S. Whyard**

**Differential innate immunity responses in mosquitoes to West Nile Virus and bacterial infections.**

Vector capacitance of different mosquito species to transmit viruses are dependent on both the virus's ability to infect, and the mosquito's ability to defend against infection. In this study, differences in an innate immunity pathway in *Aedes* and *Culex* mosquitoes were examined, using both cell cultures and whole insects. Through bacterial/viral challenges, changes in immune response were identified. This research provides new insights into mosquito-virus interactions, in different insects.

**123. Manning, C.G. and M.L. Reid**

**Tree vs. beetle: impacts of monoterpenes on reproduction by mountain pine beetles.**

Female mountain pine beetles, *Dendroctonus ponderosae*, were exposed to low concentrations of monoterpenes (0, 31, or 125 ppm). Exposure did not affect survival or breeding establishment but did influence egg size and number. Compared to the control, egg size and number tended to be smaller in the highest concentration but greater for the middle concentration. These effects were influenced by female size, condition and order of egg laying that all generally increased oviposition traits.

**124. Marshall, K.E. and B.J. Sinclair**

**Impacts of repeated cold stress on overwintering spruce budworm larvae.**

In the field, insects often experience repeated bouts of stress, yet the prevailing paradigm has been to examine the responses to only a single exposure. The impacts of repeated cold exposure on life-history and physiology of overwintering spruce budworm were examined. Microarrays and RNAseq are in progress to untangle the benefits of protective responses from the costs of damage and repair during the recovery phase from different kinds of cold exposure.

**125. Marinas, M.A. and J.N. McNeil**

**Reproduction-flight syndrome in the true armyworm, *Pseudaletia unipuncta*.**

Most insect species initiate migration from deteriorating habitats as sexually immature individuals. However, resources used during long distance migratory flight could negatively affect subsequent reproductive output. Using the true armyworm, this study aims to determine if there are adaptations in wing and thoracic muscle structure to reduce such potential costs, by comparing migrant and non-migrant individuals reared under natural field, rather than controlled laboratory conditions.

**126. Mason, P.G., T. Haye, D.R. Gillespie, J.H. Miall, G.A.P. Gibson, L.M. Dodsall, U Kuhlmann, and P. Bouchard**  
**Risk assessment of biocontrol agents: the case of cabbage seedpod weevil, *Ceutorhynchus obstrictus*.**

Risk assessment of classical biocontrol agents is required by the regulatory process in Canada. Emphasis is placed on host range studies to determine potential breadth of non-target species attacked and levels of attack on suitable non-target species. Cabbage seedpod weevil is an invasive alien pest of canola in Canada. *Trichomalus perfectus*, a potential classical biological control agent, has been assessed for safety. Results indicate that *T. perfectus* may not be suitable for introduction.

**127. McCann, S., O. Moeri, T. Jones, R. Gries, G. Khaskin, S. O'Donnell, and G. Gries**  
**Do Red-throated Caracaras (*Ibycter americanus*) have a chemical wasp repellent? Investigating a mystery in the jungle of French Guiana.**

We tested whether Red-throated Caracaras, which are reputed to be specialist predators of social wasps, are chemically defended against their formidable prey. Chemicals found on captured birds included several potential repellents; but bioassay of these against sympatric social wasps failed to demonstrate a marked effect. We subsequently video recorded caracaras attacking wasp nests and discovered that behavioural strategies of these birds obviate the necessity for a chemical repellent.

**128. McCorquodale, D. and D. Giberson**  
**Canada's Beetles: Lessons from history and natural history.**

The next iteration of a checklist of beetles of Canada, coordinated by entomologists at Canadian National Collection of Insects, Arachnids and Nematodes builds on Bousquet's 1991 checklist and Wickham's works from the 1890s. The value for the Biota of Canada can be enhanced by recognizing the complementary roles of professional entomologists and amateur naturalists, understanding the value of small natural history collections and appreciating how the list is used by non-specialists.

**129. McGregor, R.R. and J. Bannerman**  
**Evaluation of the brown lacewing, *Micromus variegatus* for biological control of aphids on greenhouse peppers.**

Brown lacewings feed on aphids in both the larval and adult stages, and often display low developmental temperature thresholds. Despite these apparent advantages, brown lacewings have rarely been used in augmentative biological control programs. Here, we present results of a greenhouse cage experiment where the brown lacewing *Micromus variegatus* was released alone and simultaneously with the parasitoid *Aphidius matricariae* for management of the green peach aphid, *Myzus persicae*.

**130. McLeod, L. and T. Terzin**  
**Co-evolutionary race of mimicking beetles – Philippines as a new Galapagos.**

Hundreds of weevil species (mostly Pachyrhynchini), over 40 Cerambycidae (mostly Genus *Doliops*), and other Coleoptera, participate in at least 20 different large Mullerian-Batesian mimicry series specific for the Philippines. Some species demonstrate high variability fitting in several different mimicry series, similar like in *Heliconius* butterflies. We would like to draw attention to this unprecedented example of Coleopteran biodiversity generated by rapid co-evolution of mimicry systems.

**131. McNeil, J.N., G. Chen, and M. Bernards**  
**Does fluctuating asymmetry in male sex pheromones influence mating success?**

There is a considerable body of literature examining the importance of fluctuating asymmetry (FA) of bilateral morphological traits on mating success in a wide variety of species. It has also been suggested that FA in male sex pheromones may be important in certain insects but this has not been proven experimentally. We will present data showing that male mating success in the armyworm, *Pseudaletia unipuncta*, is affected by pheromone FA, but only under certain conditions.

**132. Mlynarek, J.J. and J. Acorn**  
**Testing enemy release in a damselfly with an expanding range.**

We tested enemy release hypothesis using a host species (*Enallagma clausum*) that is expanding its distribution. We compared prevalence and intensity of water mite infection in *E. clausum* in four historic sites and four new, range expansion sites. We also compared measures of parasitism to a sibling host species (*Enallagma boreale*) that has been well established at all the sites. Preliminary results show intraspecific variation between sites and *E. clausum* is not released from its enemies.

**133. Moffat, C.E. and S.B. Heard**

**Does intraspecific variation in host plant traits drive the ecological speciation of phytophagous insects?**

A likely driver of the diversification of phytophagous insects is their tendency to specialize and radiate. While extensive literature documents the roles of host plant interspecific variation in insect diversification and intraspecific trait variation in insect preference/performance, these two streams of study have rarely intersected. Using a goldenrod-herbivore system, I present my approaches to investigating if host plant intraspecific variation drives the speciation of phytophagous insects.

**134. Mori, B.A. and M.L. Evenden**

**Evaluation of pheromone puffer dispensers for mating disruption of *Coleophora deauratella*.**

Infestations of the red clover casebearer, *Coleophora deauratella* (Lepidoptera: Coleophoridae), can cause > 80% seed loss in clover. We test pheromone puffer dispensers in large plots to determine if pheromone treatment disrupts pheromone communication, reduces larval infestations and increases seed yield. Preliminary results indicate pheromone treatment significantly disrupts pheromone communication, but does not affect larval infestation in treated plots as compared to untreated control plots.

**135. Mosdossy, K. and L. Fedigan**

**Relative insect abundance in a tropical seasonal environment.**

I measured relative insect abundance in a seasonal Costa Rican tropical dry forest. From May 2011 through July 2012, I collected insects and weighed caterpillar frass in four habitat types. Preliminary results suggest consistent overall insect abundance, but frass weight differed across seasons (three-way ANOVA,  $F_{2,117}=67.9$ ,  $p<0.0001$ ) and habitats ( $F_{3,42}=7.2$ ,  $p<0.001$ ). Early rainfall in 2012 may have altered expected insect abundance. I assess rainfall effects on insect abundance in detail.

**136. Munir, S., L. Dossall, J. Soroka, and O. Olfert**

**Impact of water-stressed host plant on oviposition choices of diamondback moth, *Plutella xylostella*.**

Plant water status is one of the most important and limiting factors that influences insect biological traits. Some insects benefit from water-stressed plants, other do not. The effect of water stress of 4- and 6-wk-old canola (*Brassica napus*) plants on oviposition by diamondback moth (*Plutella xylostella*) was investigated. In a choice situation, females preferred to oviposit on 6-wk-old non-stressed plants and significant differences in oviposition were found between 4- and 6-wk-old plants. Selecting host plants with greater fitness (not water stressed) suggests that female moths prefer host plants that give their offspring greater chance of survival and developmental success.

**137. Murali-Mohan, A., C. Scott-Dupree, and C. Cutler**

**Gene regulation in green peach aphid during chemical hormesis.**

Chemical hormesis is a biphasic toxicological response displaying low-dose stimulation and high-dose inhibition. When green peach aphids were exposed to sublethal concentrations of imidacloprid we found down-regulation of stress and developmental genes in parental generation adults (G0) as determined by RT-PCR. Analysis of genes of G0 and G1 2nd instars suggest initial disruption followed by overcompensation hormesis. DNA methylation experiments will examine potential epigenetic effects.

**138. Myers, J.H, J. Buchhop, and J.S. Cory**

**Population cycles of forest Lepidoptera: the western tent caterpillar story.**

Populations of western tent caterpillar, *Malacosoma californicum pluviale*, in southwestern BC fluctuate every 6 to 11 years. Long-term monitoring of population numbers, overt and covert nucleopolyhedroviral disease, parasitism, and environmental conditions allow us to determine the relationships that best describe the patterns of population change. The primary drivers of the fluctuations are the epizootics of viral disease at peak populations followed by increased parasitism and reduced fecundity for several successive generations. Relations of this system to other cyclic populations will be considered.

**139. Nagalingam, T. and N.J. Holliday**

**Effect of *Lygus lineolaris* on navy beans in Manitoba.**

In edible beans in Manitoba, 83-91% of mirid bugs are *Lygus lineolaris*, adults of which enter the crop during flowering and give rise to a single generation in the crop. From 2009–2011 we characterized the effect of *L. lineolaris* on navy beans, by introducing *L. lineolaris* into 1 m<sup>2</sup> cages containing the crop at three different growth stages and leaving

insects in the cages until harvest. At harvest, seed quality and quantity were assessed, to provide a basis for estimation of economic impact.

**140. Newton, J.S. and H.C. Proctor**

**Influence of environmental stresses on soil mite abundance and biomass in an Albertan grassland.**

The productivity of grasslands, including pastures used for grazing, is influenced by soil organisms. In light of climate change, we applied environmental stresses - altered precipitation, warming, and simulated grazing by defoliation - to experimental plots at Kinsella Ranch to measure responses of soil mites. We found that mites were most affected by drought, which reduced abundance of most, but not all taxa. We also tested whether biomass distribution showed the same patterns as abundance.

**141. Nmor J.C., T. Sunahara, K. Goto, K. Futami, G. Dida, G. Sonye, and N. Minakawa**

**DEM resolution and performance of topographic predictive models: how significant is the impact?**

We argued that both the ability of single variables and multivariate models to explain malaria vector breeding sites (MVBs) occurrence may vary with the grid resolution of the DEM. To test this hypothesis, we used topographic indices derived from same DEM but of differing horizontal resolutions to develop models for predicting MVBs. The variance explained by the univariate models was found to vary among predictors and with spatial scales. The implications of our findings are discussed.

**142. Noor ul Ane, M. and M. Ashfaq**

**Importance of leaf characters: influence of morphological and chemical leaf characters of tomato (*Lyopersicon esculentum*, Miller) foliage on resistance to *Helicoverpa armigera* (Hübner) (Lepidoptera:Noctuidae) larvae.**

Morphological and chemical leaf characters of nine tomato varieties were measured and compared to determine their impact on *Helicoverpa armigera* larvae. The results showed hair density, Hair length and thickness of leaf lamina were negatively correlated with *H. armigera*. Nitrogen, magnesium, manganese and zinc content were high in susceptible varieties. Ferrous and calcium in leaves were most important factors for larval density of *H. armigera*. Maximum yield was recorded in resistant varieties.

**143. Noronha, C.**

**Blossom beetle , *Meligethes viridescens*: Is it poised to become a key pest in Canola in PEI?**

Canola production has increased in PEI from 158 acres in 2006 to 2,962 acres in 2011. A survey was conducted to determine baseline pest populations in canola fields across PEI. Blossom beetles were found in most fields across the island, however populations in the central region exceeded 350 beetles per sweep sample in 2012. Three to four larvae were found feeding within each blossom. Lack of pod formation indicated the potential for yield reduction in heavily infested fields.

**144. Olfert, O., R. Weiss, and T. Haye**

**Modeling the biological requirements of insects to assess the potential impact of climate change.**

Conditions related to global climate change may impact insect populations biologically and ecologically. Given that the magnitude of predicted surface temperature increases is beyond the historical experience of modern agriculture, it is unlikely that we can use historical data as analogues to predict the impact of climate change. As a result, simulation models have been used successfully to predict the distribution and extent of insect establishment in agricultural environments.

**145. O'Neil, D.R. and C. Cutler**

**Pesticides in honey bee hives in the Maritime provinces: residue levels and interactions with *Varroa* mites and *Nosema* in colony stress.**

In a broad screen for 174 pesticides in beeswax from honey bee hives sampled in NS, NB and PE, we identified residues of 17 active ingredients. For these same hives, differences among apiaries and regions were found in incidence of *Varroa* mite and *Nosema*. We will attempt to determine if there is a correlation between hive pesticide and pest loads. We also plan to do experiments examining effects of pesticide and/or *Nosema* infection on honey bee learning and memory retention.

**146. Owen, R.E. and S.M. Banerjee**

**The significance of diploid males in natural populations of bumble bees**

In many Hymenoptera sex is determined by a sex-determining locus. Heterozygotes are female, haploids are male, and homozygotes are diploid males which are a genetic cost. Diploid males occur in natural populations of *Bombus* at frequencies of 3-11%. We surmise that the effects of population subdivision may inflate diploid male frequencies in

each deme with the number of sex determining alleles remaining constant in the population as a whole. We are running computer simulations to test this.

**147. Peralta-Vazquez, G. H. and M. Reid**

**Phoretic symbionts of mountain pine beetle and pine engraver from selected sites of British Columbia and Alberta.**

Recent distribution of mountain pine beetle (MPB) in western Alberta has potential to produce new associations between MPB and phoretic symbionts. Theory also suggests that symbionts prefer to associate with good conditioned hosts. We tested these ideas using bark beetles and their mites collected from British Columbia and Alberta. Preliminary results show bark beetles had same mite species with different densities between sites; and mites associated similarly to good or bad condition hosts.

**148. Phillips, I.D., A. Matichuk, A. Schweitzer**

**The secondary production, life history, and diversity of aquatic insects supporting bigmouth buffalo fish in the Qu'Appelle River, Saskatchewan.**

The economic growth of Saskatchewan is renewing interest in freshwater resources for the support of expanding mining developments and communities. To accommodate this, the province needs to increase water conveyance in river systems containing listed species which potentially affected by hydrologic change; specifically, the bigmouth buffalo fish. We present a study in 2010-2012 on the secondary production of aquatic insects in these habitats, their life histories, and how they may be affected by change in hydrological management. As this entomological fauna are the diet base of bigmouth buffalo, this understanding is crucial in its management and recovery.

**149. Pinzon, J., S. Bourassa, and J.R. Spence**

**Small-scale variation of spider assemblages in an old-growth forest in Alberta.**

Spiders were collected from a 1Ha permanent plot of old-growth forest at the George Lake research facility (ca. 60Km NW from Edmonton). Samples were collected from the ground using evenly spaced pitfall traps and from the low understory using a beating sheet during the summer of 2011 and 2012, respectively. All stems (>1cm DBH) were mapped and understory vegetation recorded on a 10 x 10 m grid. The spatial distribution of spiders and their relationship to microhabitat variation are discussed.

**150. Pinzon, J., J.R. Spence, and D.W. Langor**

**Diversity, species richness and abundance of spiders in different strata of boreal white spruce stands in Alberta.**

Spiders were sampled from the ground, shrub and overstory layers in white spruce stands of the boreal forest. Composition and diversity patterns along the vertical gradient were assessed. The highest richness was observed from the ground, and the lowest from the shrub layer. Vertical stratification was apparent, richness decreased with height and species turnover among layers was evident. Results show the importance of including overstory layers in biodiversity studies in the boreal mixedwood.

**151. Pohl, G.R. and R. Hébert**

**A draft list of the Lepidoptera of Canada - how it was built, and lessons learned**

A draft list of the Lepidoptera of Canada is presented as an example of how a list can be built for a large taxonomic group. Produced via collaboration with the Canadian Wildlife Service, the list will form the basis for conservation ranking of all the Lepidoptera species in Canada. It is based on 100+ years of taxonomic publications, regional lists, and specimen data in selected collections. It currently contains over 5000 species in 75 families; verification and ground-truthing is in progress.

**152. Poirier, L.M. and B.W. Murray**

**Carabid beetle diversity in the ancient Interior Cedar-Hemlock forests of British Columbia.**

Unique temperate rainforests on windward slopes of inland mountain ranges in British Columbia are increasingly fragmented. A better understanding of their community structure and function is needed urgently. Carabid beetles, common bioindicators, were collected from the Interior Cedar-Hemlock biogeoclimatic zone east of Prince George, BC. Two species dominated; relatively few species were found in either clear cut or forested areas, and these tended to be habitat generalists.

**153. Proctor, H.C. and A. Kense**

**Fur mites of the genus *Schizocarpus* on beavers from central Alberta, Canada.**

Mites of the genus *Schizocarpus* inhabit the fur of both North American and European beavers. Despite *Castor canadensis* being an icon of Canada, there is only a single published record of *Schizocarpus* on beavers from this country. We rigorously examined 6 beavers from central Alberta for fur mites and recorded 6 spp., all previously described from beavers in the United States. Unlike in Europe, *Schizocarpus* assemblages on beavers in North America do not seem strongly geographically structured.

**154. Proctor, H.C. and D.E. Walter**

**Uncovering the diversity of Canadian mites, one quarter-section at a time**

The Acari are one of the few groups to rival the insects in diversity, but most of this is hidden from view by their small size and an acarine taxonomic impediment. We use our collection data at several scales (backyard, quarter-section, Alberta) to estimate the diversity of acarine species in Canada and to demonstrate that it seems far larger than the 1979 estimate of 10,000 spp. We also review the potential value of mites in biodiversity studies in Canada.

**155. Régnière, J., J. Delisle, D. Pureswaran, and V. Nealis**

**Recent discoveries in the population dynamics of the spruce budworms.**

As a new outbreak of spruce budworm is erupting in Quebec, several streams of knowledge and technology are converging: population dynamics, climate response ecology, reproductive biology, molecular biology and simulation modelling. These are the sources from which to draw increased understanding and predictive capabilities to address the complex questions raised by prediction and management of this insect's massive and recurrent outbreaks. In this presentation recent findings will be discussed.

**156. Rempel, C., R. Quik, A.F. Janmaat, and T. Kabaluk**

**Does *Agriotes obscurus* avoid the fungal entomopathogen, *Metarhizium brunneum*?**

Fungal entomopathogens can greatly reduce the fitness of their hosts, and it is therefore expected that susceptible insects will be selected to avoid exposure to pathogens. *Metarhizium brunneum* is a fungal pathogen that can infect *Agriotes obscurus*, which in its larval form is a destructive agricultural pest. Behavioural assays were conducted to determine if adult *A. obscurus* avoid *M. brunneum* spores or mycosed *A. obscurus* cadavers.

**157. Renkema, J.M. and G.C. Cutler**

**Ground beetle (Coleoptera: Carabidae) consumption of key pests in two Atlantic region crops.**

Ground beetles provide an agroecosystem service if they consume pests. Beetles common in lowbush blueberries consumed blueberry spanworm in cups with soil but were slower to find spanworm in cups with blueberry stems. Beetles reduced blueberry maggot pupae numbers, irrespective of soil moisture or beetle sex. In leafy greens, slug damage was reduced by 50% due to *C. nemoralis*. In a greenhouse, *P. melanarius* did not reduce slug numbers or cause yield increases but may have consumed cutworms.

**158. Robert, J.A., S. Luong, R. Montgomery, T. Bonnett, C. Pitt, C.J. Keeling, J. Bohlmann, and Huber, D.P.W.**

**RNA-seq analysis of mountain pine beetle detoxification identifies candidate cytochromes P450.**

The mountain pine beetle (MPB) has caused unprecedented damage to the forests of British Columbia. We compared the gene expression levels by RNA-seq in MPB male and female adults either starved or fed for 24 hours on host tree tissues in order to uncover genes involved detoxification of host metabolites. Our study identified six cytochrome P450 enzymes for further gene expression analysis following exposure to host secondary metabolites using quantitative RT-PCR.

**159. Rochon, K. and T. Lysyk**

**Habitat predictors of *Dermacentor andersoni* (Acari: Ixodidae) in Alberta.**

Rocky Mountain wood ticks (*Dermacentor andersoni*) were collected along defined transects at nine sites in Alberta. Habitat characteristics including elevation, slope, amount and type of vegetation were assessed every 10 meters within transects. Using logistic regression, we built a model to determine which characteristics were most useful to predict the presence of ticks in both prairie and montane habitats. The presence of *Rosa* sp. was the most consistent predictor for the presence of ticks.

**160. Roitberg, B.D.**

**Behaviour: Why so much diversity and why not more?**

Within any given species, there is documented evidence for an extraordinary range of expression for many behavioural traits. How might we explain this? I will show that context is the key using examples from parasitoids, bugs and aphids. I will discuss context from several different levels, including: individual, population and community. I will close by asking

why behaviour expression is sometimes narrow and explore whether this is a constraint or a solution to living in a complex world.

**161. Roland, J. and S.F. Matter**

**Climate and alpine butterfly dynamics; it's the winters that matter.**

We examine the long-term, 15-year pattern of population change in a network of 21 populations of alpine *Parnassius smintheus* butterflies in response to climatic variation. We found a strong non-linear relationship between population growth and winter values of the broad scale climate variable, the Pacific Decadal Oscillation index. Populations declined in both extremely warm dry and cold snowy winters. Decline of these populations will be exacerbated by a trend for increasingly variable winters.

**162. Royauté, R., C.M. Buddle, and C. Vincent**

**How does chemical disturbance affect behavioural expression in a jumping spider inhabiting agroecosystems?**

Contaminants are increasingly present in our environment and can cause negative effects on species fitness. Behavioural variation can help cope with environmental changes but how much it is affected by chemical exposure is unknown. Using agroecosystems and the jumping spider *Eris militaris* as models, we tested how sublethal insecticidal exposure affected activity and prey capture. Results indicate a strong effect of exposure on repeatability of activity but not prey capture.

**163. Rubinoff, D., W. Haines, A. Kawahara**

**The evolution of extraordinary biodiversity in Hawaii's endemic insects.**

Hawaii is a crucible of evolution, with thousands of endemic insects, including the moth genus *Hyposmocoma* with over 500 species. *Hyposmocoma* show complex patterns of evolution in larval morphology and ecology, including carnivorous and amphibious larvae. Because the archipelago is volcanic, there is an opportunity not only to understand complex evolution in *Hyposmocoma* but also to estimate the timing of their diversification across the archipelago, though this can be challenging.

**164. Rubinoff, D., W. Haines, A. Kawahara**

**Evolution of globally rare behaviours in endemic Hawaiian insects.**

Lineages that have colonized the Hawaiian archipelago are famous for adaptive radiations across a range of ecological niches. These diversifications can result in behaviours that are globally rare among groups. I will present known adaptations of Hawaiian arthropods, from groups like the Megalagrion Damselflies and Drosophila and introduce new discoveries in Lepidoptera and Hemiptera which demonstrate the importance of Hawaii in elucidating the plasticity of ecology under the right conditions.

**165. Sarfraz, R.M., J.S. Cory, and J.H. Myers**

**Localized plant induction: Impact on insect fitness and disease resistance.**

Plants can respond to herbivore damage with induced defences and it may be more efficient for plants to respond locally rather than systemically. We evaluated the influences of localized induction in red alder on fitness of western tent caterpillars. The localized induced changes in leaf quality could potentially influence insect populations in contradictory ways by reducing their growth and fecundity to a modest degree, while improving their survival and disease resistance to a larger extent.

**166. Sarfraz, R.M., H.M. Kharouba and J.H. Myers**

**Later instar western tent caterpillars thrive on tough mature leaves in warm environments.**

Warming climates have the potential to modify the interactions among species with uncertain outcomes on populations. We used sun-exposed and shaded trees to determine if the synchrony between egg hatch of tent caterpillar and budburst of its host red alder changes with different thermal environments. The robust relationship between leaf and larval development of insect suggests that warming climates may not have a strong negative impact on their success through shifts in phenological synchrony.

**167. Schwarzfeld, M.D. and F.A.H. Sperling**

**Life, the Universe and *Ophion*: The answer is 42.**

*Ophion* is a genus of large, nocturnal parasitoid wasps in the family Ichneumonidae. Despite their large size, abundance and ease of collection, the genus is almost entirely unknown in the Nearctic region; only 11 species have been described, though the fauna has been estimated at approximately 50 species. We used molecules, morphology,

wing morphometrics and a variety of analytical methods to answer the Ultimate Question: How many species of *Ophion* are there???

**168. Scott, C., R. Gries, G. Khaskin and G. Gries**

**Identification of a silk-borne pheromone component of the western black widow *Latrodectus hesperus*.**

Chemical communication is widespread in spiders but few pheromones have been identified. *Latrodectus hesperus* males engage in courtship behaviour when they contact webs of virgin females. We extracted webs of virgin females in methanol, analyzed extracts by gas chromatography-mass spectrometry, and synthesized a candidate pheromone. Behavioural responses of males to silk, silk extract, and the candidate pheromone indicate that we have identified a component of the *L. hesperus* pheromone.

**169. Seehausen, L., É. Bauce, J. Régnière, and R. Berthiaume**

**Silviculture in practice: Does partial cutting influence parasitism of two key insect defoliators?**

The influence of partial cutting on the parasitism of two lepidopteran defoliators, hemlock looper (*Lambdina fiscellaria* (Guen.)) and spruce budworm (*Choristoneura fumiferana* (Clem.)), was studied. Parasitism was significantly reduced in thinned stands for hemlock looper pupae and for spruce budworm larvae, one and two years after treatment respectively. Parasitoid abundance and activity as well as microclimatic differences between the treatments provide the basis to interpret these results.

**170. Semmler, S.J. and A.C. Worley**

**The short term effects of fire and climate on plant-insect interactions in Canada's tall grass prairie.**

Fires are important for the maintenance of tall grass prairie, but the effects of fire on pollinator services are poorly known. I assessed plant-insect interactions in habitats of differing burn ages over two flowering seasons. Flowers were more abundant and bloomed earlier in the first season following fire. Differences in bee and Syrphid activity appear to influence pollen limitation based on assessments of interaction matrices, pollen loads on insects, and pollen supplementation experiments.

**171. Sharanowski, B.J.**

**To know a species: Ecological taxonomy for Ichneumonoidea.**

With over 3600 species in Canada, and many more to be described, Ichneumonoid wasps make up a massive component of the Canadian fauna. I argue that taxon-based approaches to taxonomy limit our understanding of the biology of these wasps and the roles they play in ecological communities. I advocate for an ecological approach to taxonomy, to explore the ecology and biology of these parasitic wasps while increasing our core knowledge on species diversity.

**172. Shikano, I. and J.S. Cory**

**Dietary costs of genetic resistance to the microbial insecticide *Bacillus thuringiensis*.**

Insect genetic resistance to the bacterium *Bacillus thuringiensis* (*Bt*) is gut-based and associated with fitness costs. We asked if resistance alters the needs for dietary protein and carbohydrate, and found that *Bt*-resistant *Trichoplusia ni* self-compose a higher ratio of protein to carbohydrate that maximizes *Bt* resistance, while susceptible *T. ni* compose a lower ratio that maximizes fitness. We reveal that maintenance of a resistance trait alters nutritional intake to optimize that trait.

**173. Shikano, I. and J.S. Cory**

**Dietary nutrients alters performance of both host and pathogen in an insect-baculovirus system.**

Pathogen infections impose significant resource costs on hosts, in terms of energy and nutrients. We show that baculovirus infection shifts the optimal performance of *Trichoplusia ni* from a balanced dietary ratio to a higher ratio of protein to carbohydrate, as survival increases with dietary protein. However, virus production was also strongly associated with *T. ni* protein intake, indicating that higher protein intake has benefits for both host and pathogen.

**174. Silva-Brandão, K. L., Albernaz, K.C., Domingues, F.D, Cônsoli, F.L., and Omoto, C.**

**Population genetics support for IPM strategies to control pest species of Lepidoptera in Brazil.**

Information contributed by population genetics can and should be applied to support strategies for integrated pest management that control pest species under field conditions. Here we describe our results from population genetics studies using a variety of DNA markers to estimate the genetic variability of three economically important species of Lepidoptera in Brazil: *Heliothis virescens* (Noctuidae), *Diatraea saccharalis* (Crambidae) and *Grapholita molesta* (Tortricidae).

**175. Sim, K.A., C.M. Buddle, and T.A. Wheeler**

**Status of the *Pardosa lapponica* group (Lycosidae) in Canada based on morphological and genetic analysis.**

Wolf spiders (Lycosidae) are morphologically conservative and thus challenging to identify. Species in the genus *Pardosa* are primarily identified using genitalia, but interspecific variation can be so low that separating species is difficult. *Pardosa lapponica* and *P. concinna* are two such challenging species, raising questions about species boundaries. Analysis of the taxonomic status of the *P. lapponica* group in Canada based on COI sequences and genitalic morphology supports a single species.

**176. Singh, G., Chahil, G.S., K. Manda., S.K. Sahoo, R.S. Battu, and S. Balwinder**

**Environmental fate of spirotetramat and imidacloprid on chilli fruits.**

A study conducted on persistence for formulation of spirotetramat 12% + imidacloprid 12% (240 SC) at 120 g a. i. ha<sup>-1</sup> on chilli fruits revealed initial deposits of 0.55 and 0.73 mg kg<sup>-1</sup>, respectively, with half-life of 0.56 and 1.43 days, respectively. Residues of spirotetramat and imidacloprid dissipated below its determination limit at 5 and 7 days, respectively. Red chilli samples collected after 15 days did not show the presence of residues at their determination limit.

**177. Smith, A. and W.R. Kaufman**

**Characterization of vitellogenesis in the bont tick *Amblyomma hebraeum***

Although the process of vitellogenesis is well-characterized in insects, much less is known about this process in ticks. Full-length cDNAs encoding two vitellogenin (Vg) genes and the vitellogenin receptor (VgR) were isolated from the hard tick *Amblyomma hebraeum*. All three mRNAs encode high molecular weight proteins and are expressed only in females that have fed to repletion. The two Vgs are expressed primarily in the fat body and midgut whereas the VgR is expressed only in the ovary.

**178. Smith, A.M., E.S. Eveleigh, K.S. McCann, T. Eagalle, and C. Lucarotti**

**The spruce budworm food web.**

For a biologist to monitor individuals and populations is vitally reliant on correct species identification. While this point may seem obvious, identifying the majority of the more than 100 natural enemies involved in the spruce budworm (*Choristoneura fumiferanae*) food web is a non-trivial endeavor. Insect parasitoids play a major role in governing the population dynamics of budworm throughout North America. However, most of these parasitoids are at the leading edge of a taxonomic impediment.

**179. Solecki, A.M., A. Grégoire Taillefer, M.S. Blair, S. Rochefort, É. Vajda and T.A. Wheeler**

**Trophic structure in an Arctic terrestrial Diptera assemblage.**

Although Diptera is the dominant insect order in the Arctic, their ecology there is poorly known. We studied the trophic and community structure of Diptera at a low Arctic site in Kugluktuk, Nunavut, and compared them to patterns from a temperate peatland dataset in southeastern Canada with a longer active season. The arctic assemblage had high weekly species turnover and was dominated by predators, especially early in the season, whereas the temperate assemblage was dominated by saprophages.

**180. Soroka, J., J. Otani, J. Gavloski, and B. Elliott**

**The biology and control of flea beetles in Western Canadian canola crops: Is a species shift in progress?**

To test the validity of a purported increase in numbers of striped flea beetle *Phyllotreta striolata* over that of crucifer flea beetle *P. cruciferae*, we undertook a five year survey monitoring flea beetle populations in canola fields across the prairies. Although species proportions were site-specific, by the end of the survey only the southernmost sampling sites in all three Prairie Provinces had crucifer flea beetle as the predominant species. Possible reasons for this shift are discussed.

**181. Spence, J.R.**

**Understanding and managing Canadian forests: Entomologists made a difference.**

Canada has been a 'forestry country' for much of its modern development and Canadian efforts in forest entomology have contributed significantly to defining this discipline worldwide, and more broadly to the development of both entomology and forest management in Canada. Progress will be discussed in terms of work on 8 temporally sequenced topics: relationships of trees and insects, distribution of insects in forests, population dynamics of forest insects,

recognition of damage and control of insect outbreaks, handbooks for identification and bionomics, semiochemicals and insect behaviour, biodiversity and insect ecology and, finally, sustainable forest management. Canadian entomologists have moved from understanding what species affected trees in our forests, through evaluating their impacts and trying to understand their population dynamics and behaviour, to understanding insects as part of whole forest systems and, nowadays, to developing seamless relationships between insect and forest management.

**182. Sperling, F.A.H.**

**Speciation within the *C. fumiferana* species complex.**

Despite containing some of North America's most important pests of living conifer trees and many decades of intensive research on numerous aspects of the biology of the spruce budworm complex (*Choristoneura fumiferana* and closely related species), we remain unsure of the identity and number of these species. I will review historical efforts to delimit species, and explore the apparently disproportionate role of sex-linked genes in speciation in the spruce budworm complex.

**183. Srivastava, D. and E. Hammill**

**Behavioural cascades can impact food web structure and function.**

Community ecology usually considers only consumptive relationships between species. We present evidence from aquatic food webs in bromeliads that consumptive and non-consumptive interactions affect communities. Oviposition decisions by two insect trophic levels influenced microorganism density, decomposition rates and ecosystem respiration. These decisions were driven by the perceived likelihood of drought or predation, using cues such as bromeliad size or predator-alteration of water chemistry.

**184. Stanton, D. L. Dossdall, and R.C. Yang**

**Evaluation of associational resistance in mixed stand crucifers for breeding Canola resistant to *Delia* spp.**

*Delia* spp. (Diptera: Anthomyiidae) are important pests of canola (*Brassica napus* L.) in Canada. Resistance in *B. napus* cultivars from interspecific crosses may be an artifact of the choice test created by small plot research and may not result in crop resistance in monoculture. Mixtures of *B. napus* with *Sinapis alba* and *Brassica rapa* with *S. alba* were evaluated at various proportions. Identification of associational resistance may illuminate resistance mechanisms for future breeding targets.

**185. Steele, T. and S. Bjørnson**

**The effects of two microsporidian pathogens on the two-spotted ladybeetle, *Adalia bipunctata* L. (Coleoptera: Coccinellidae).**

Two-spotted and convergent lady beetles (*Adalia bipunctata* & *Hippodamia convergens*) are used for biological control in North America. These beetles host microsporidian pathogens that may affect their efficacy. Egg cannibalism was used to examine the effects of two microsporidia (alone and in combination) on *A. bipunctata* fitness (larval development and mortality, sex ratio, fecundity and adult longevity).

**186. Sturtevant, B.R., B. Brunet, B.J. Cooke, M.-J. Fortin, P. James, L. Lumley, and F. Sperling**

**Budworm dispersal and population structure in the Border Lakes region.**

We quantified long-distance dispersal of spruce budworm from a localized outbreak in Minnesota using statistical and simulation modeling. Results suggested dispersal on the order of 50-200km from the outbreak source with a strong directional component. Subsequent microsatellite analysis suggested weak population structure at this scale but nonetheless separated local budworm samples from immigrants. Such methods may provide insights into how dispersal contributes to outbreak synchrony.

**187. Swann, J.E., R.W. Longair and W.D. Fitch**

**An untapped well of biodiversity information.**

The University of Calgary's arthropod collection is a valuable resource for documenting the biodiversity of southern Alberta and eastern British Columbia. Until recently this collection has often been overlooked. Several new national and provincial records have been published from its approximately 200,000 pinned specimens over the past 4 years.

**188. Tabacaru, C.A., J. Park, and N. Erbilgin**

**Mountain pine beetles in post-burn lodgepole pine forests.**

Prescribed fires are used in Alberta to remove lodgepole pine, hosts of mountain pine beetles (MPB), but live, partly burned—and therefore stressed—trees may be more susceptible to MPB. We investigate how fire influences MPB and explanations for their responses. Early results show that burned trees are colonized more often than unburned trees,

but that MPB populations are decreasing in burned areas. Conversely, insect competitor populations are increasing, perhaps contributing to MPB responses.

**189. Tansey, J.A.**

**Mechanisms and strategies associated with insect-resistant canola.**

Insect-resistant canola genotypes pests have been developed through hybridization of *Sinapis alba* x *Brassica napus*. Several lines express antixenosis and antibiosis resistance and influence visual and olfactory responses of certain pests. However, responses of some insects differ. Differences can be attributed to specific plant traits. Although this means that a 'one-size-fits-all' approach to insect-resistant canola germplasm is impractical, resistant lines have value in specific contexts.

**190. Tatarnic, N.J.**

**Sexual mimicry and paragenital divergence between sympatric species of traumatically inseminating plant bug.**

Heterospecific mating can carry significant risks. When conflated with indiscriminate mating and harmful genitalia – characteristic of some mating systems – risks may be intensified, including physical damage and even death. Here I report the discovery of two sister species of the traumatically inseminating plant bug *Coridromius* living sympatrically on the same host plants in Tahiti. Both sexes of one mimic the males of the other, while the females of each are inseminated through different parts of the body. These are interpreted as adaptive responses to limit interbreeding.

**191. Teasdale, C., G. Judd, R. Gries, and G. Gries**

**Early detection and management of raspberry crown borer populations.**

The sex pheromone of the raspberry crown borer, *Pennisetia marginata* (Harris) (Lepidoptera: Sesiidae), has recently been identified. Through pheromone-based trapping of male *P. marginata* from 2010-2012 in raspberry and blackberry crops in British Columbia, we have gathered information on seasonal flight phenology. We have determined a trap catch threshold indicative of egg presence, and we are developing a predictive degree-day model for the timing of egg hatch.

**192. Terzin, T., I. Lumawig, and L. McLeod**

**World largest complex of Coleopteran mimicry revealed through eBay listings.**

Recent eBay activity of insect dealers from the Philippines, revealed much greater extent of Mullerian and Batesian mimicry among Philippine Coleoptera, than previously known. Using eBay as a source of our research material, we were able to obtain over 400 mimicking species and forms of various Philippine beetles in over 20 mimicry complexes. Moreover, eBay listings accompanied by images and descriptions of items we failed to physically obtain, represent a valuable source of scientific data.

**193. Therrien (Ariss), J., A. Adams, C. Currie, B. Aukema, K. Raffa, and N. Erbilgin**

**Impact of bacteria-fungus-host tree interactions on mountain pine beetle reproduction.**

Recent range expansion of the mountain pine beetle (MPB) threatens invasion of jack pine forests. We investigated how tree bacteria-fungi interactions impact MPB reproduction. Monitoring beetle reproduction in the presence of various bacterium fungus combinations in lodgepole and jack pines showed that the roles of the bacteria and fungi are mediated by tree species, and the importance of these microorganisms relies on the subcortical activities of the beetles.

**194. Thysse, A.**

**Insect Photography on the Web.**

The Internet enables the work of insect photographers to be enjoyed worldwide, often luring newcomers to the field. I will give an overview of select insect photographers and their tools and techniques. I will discuss how the digital revolution and the proliferation of insect photography allows professional entomologists to develop citizen science projects, thereby raising the profile of entomology with the general public, and informing them of the value of insects in the web of life.

**195. Timms, L.L., A.B. Bennett, C.M. Buddle, and T.A. Wheeler**

**Abiotic and biotic determinants of ichneumonid diversity in northern Canada.**

Parasitoids require a variety of resources to survive; in addition to hosts for larval development, adults require nectar, sheltering sites, and suitable climatic conditions. Most studies of the determinants of parasitoid diversity assess the influence of either hosts or environment, not both at once. We use specimens collected at Kugluktuk, NU, over an entire

Arctic summer to ask: Does host abundance or environment explain a greater amount of the variation in parasitoid diversity?

**196. Timms, L.L., J.J. Bowden, K.S. Summerville, and C.M. Buddle**

**Does species-level resolution matter? Taxonomic sufficiency in terrestrial arthropod biodiversity studies.**

We analyzed datasets from three major arthropod orders to determine whether altering the level of taxonomic resolution affected patterns in community composition and beta diversity under various forest disturbance treatments. Overall patterns of community composition and beta diversity did not differ across taxonomic levels; however, patterns in group structure and significance of treatment effects were often stronger at species and/or genus level.

**197. Toth, T., P. James and D. Kneeshaw**

**Patterns of spruce budworm dispersal in Quebec's north shore region.**

The spruce budworm (SBW) is a native defoliator of boreal conifers that is capable of long-distance dispersal. We quantified an aspect of SBW dispersal by comparing spatio-temporal observations of moth abundance with predicted moth occurrences derived from a climate-based phenological model (BioSim). By contrasting moth counts and predicted phenology over a large geographic region we can infer dispersal patterns and improve our ability to predict outbreak risk.

**198. Uddin, M. M. and K. Tsuchida**

**Genetic diversity of a paper wasp, *Polistes olivaceus* in Bangladesh.**

Use of nuclear microsatellite loci and mitochondrial DNA (mtDNA) revealed genetic diversity in *Polistes olivaceus* due to female philopatry and restricted female dispersal across a river system in Bangladesh. The nestmate queens were full sisters having equal reproductive potential but the dominant one monopolized colony reproduction. Worker reproduction was evident in *P. olivaceus* but the absence of worker-derived larvae or adult males indicated the removal of worker eggs by the other nestmates.

**199. Vandervalk, L.P., M. Nasr, and L. Dosdall**

**LD50 of miticides for *Varroa destructor*, an ectoparasitic mite of honeybees.**

The Western honeybee *Apis mellifera* has several health threats, the most serious being the mite *Varroa destructor*. As non-chemical methods are insufficient to control *V. destructor* infestations and existing miticides are developing resistance, new effective miticides are needed. A *scintillation* vial bioassay was used to evaluate the LD50 of five miticides not previously tested on *V. destructor*. Several miticides effectively cause *V. destructor* mortality, and have potential for field testing.

**200. Van Hezewijk, B.**

**Parasitoid dispersal can create sharp boundaries in the spatial synchrony of a forest defoliator.**

Understanding mechanisms that affect population synchrony is important in both conservation and pest management. Based on the two-year-cycle spruce budworm, a spatial model was constructed to explore dispersal as a mechanism governing the type of synchrony displayed in this species. Under certain parameters, regional patterns arose that are very similar to those observed in the field over the past 60 years. How well these parameters reflect reality will be addressed in future field studies.

**201. Vankosky, M.A. and S. VanLaerhoven**

**Optimal oviposition and omnivores: The effects of plant quality on omnivore oviposition behaviour.**

The effect of tomato plant quality on host choice for oviposition by the omnivore, *Dicyphus hesperus*, was investigated. Host quality was manipulated using four nitrogen (N) fertilization regimes. In cages mated female *D. hesperus* were given: a) no choice, or b) free choice of host plant from each fertilizer treatment. In both tests, fewer eggs were laid on plants receiving less N than on those receiving surplus N, suggesting that plant quality affects the oviposition behaviour of *D. hesperus*.

**202. Vibert, S., C. Scott and G. Gries**

**A meal or a male? The 'whispers' of black widow males do not trigger a predatory response in females.**

Courting male spiders must advertise their presence to the female without being mistaken for prey. We used laser vibrometry to compare vibrations produced by male hobo and black widow spiders with those of prey. Courtship signals of male black widows, but not hobo spiders, differed from prey cues. Female black widows did not respond aggressively to played-back low-amplitude vibrations irrespective of waveform, suggesting that males use 'whisper-like' courtship signals to avoid female aggression.

**203. Vy, J., A. Kostyniuk, A. Biswas, and T. Terzin**

**Wing scale vs. pixel – evolution of visual information in butterflies.**

We all admire biodiversity of butterfly wing patterns, but did we ever asked: what is the visual information content of a butterfly? Can we consider a single wing scale as a pixel of visual information? Using cabbage white as a simple model, we calculated the total number of wing scales per specimen. Furthermore we determined a correlation between the wing span and the average size of wing scales. Finally, we compared data with a very small and a very large Pieridae species, revealing a trend.

**204. Waite, M.O., C.D. Scott-Dupree, M. Brownbridge, R. Buitenhuis, and G. Murphy**

**The effect of honeybee-collected pollen and other diets on *Orius insidiosus*.**

In lab bioassays, the effect of supplemental food on *Orius insidiosus* (*Orius*) was assessed to determine which source provided sufficient nutritive value. Food sources selected included: honeybee-collected (spring mixture) cattail, corn and apple pollen; and *Ephestia kuehniella* eggs. Supplemental food sources were evaluated for impact on *Orius* oviposition, % emergence of nymphs, female longevity, nymphal development time to the adult stage and nymphal survival. Greatest oviposition and longevity of females occurred when they were fed *E. kuehniella* eggs and bee pollen.

**205. Walter, D.E.**

**Old dogs and new tricks: An aging acarologist's view of bugs on the web.**

Professional entomologists blog for reasons from the sublime ('an inordinate fondness for beetles') to the ridiculous ('for those who live and breathe Dipterology'), but appear motivated by their passion for arthropods and the peculiar assumption that others would be delighted to share it. I assess this assumption from the perspective of both one who blogs as a professional (Macromite) and as an amateur (HomeBugGarden) and conclude the www is infused with bug photography, science, and wonder.

**206. Wen, F., P.J. Krell, and D. Doucet**

**Genomic basis of cold hardiness in the spruce budworm.**

The spruce budworm is a freeze intolerant species that has evolved molecular strategies to cope with subzero temperatures. In addition to the accumulation of low molecular weight cryoprotectants before diapause, spruce budworm larvae also synthesize a collection of antifreeze proteins (AFPs) which contribute to freezings point depression. Progress on sbw genome sequencing allow us to provide new information on the genomic organization, isoform diversity structure-function relationships of AFPs.

**207. Wheeler, T.A.**

**Diptera of Canada: recent progress, key gaps and new paths.**

In 1979, "Canada and its Insect Fauna" estimated that half of Canada's likely 15,000 species of Diptera remained undescribed or unrecorded. I will review 30 years of progress in documenting our Diptera diversity, and identify some key remaining gaps. The way forward will require new partnerships and new approaches in taxonomy, inventory, identification and data management if we are to produce a comprehensive catalog of Canadian flies.

**208. Wheeler, T.A. and C.M. Buddle**

**Canada is really big: challenges to completing a National Biota.**

To achieve a comprehensive Biota of Canada we must overcome logistic, financial, geographic and taxonomic challenges. Some taxa and some regions will be easy; some will not. The large expanse of Canada north of the highways and cities hosts high diversity, especially in poorly known taxa. We will use our experiences from the Northern Biodiversity Program to illustrate the obstacles, and potential solutions, to compiling a biotic inventory of Canada's biggest frontier – the North.

**209. Whitehouse, C.M., N. Erbilgin and M.L. Evenden**

**Does pine host species affect mountain pine beetle flight activity?**

Mountain pine beetle (MPB), *Dendroctonus ponderosae*, is native to western North American forests but is undergoing a range expansion eastward. MPB principally infests *Pinus contorta* but now attacks *P. banksiana* in its expanded range. Adult MPB were introduced into *P. contorta* and *P. banksiana* bolts and offspring flight activity was measured with flight mills. Host species did not affect flight capacity but *P. banksiana*-reared MPB were heavier and lost proportionally less weight during flight.

**210. Wick, A.A., S. Pruss, J. Spence, and N. Erbilgin**

**Beyond the host plant: Habitat characteristics of the Mormon metalmark at two spatial scales.**

We analyzed the habitat of the Mormon metalmark using models for both microhabitat and landscape levels to test the influence of environmental factors on suitability of host plant sites as butterfly habitat in Saskatchewan. Results from the microhabitat analyses suggest that slope and host plant cover are the strongest predictors of butterfly presence. Landscape models using spatial data suggest that landform type, topographic ruggedness, soil acidity and soil salinity are also important.

**211. Wingsanoi, A., N. Siri, and J. N. McNeil**

**Assessment of infestation of different pepper species by *Bactrocera latifrons* (Hendel) in Thailand.**

In Thailand the Malaysian fruit fly, *Bactrocera latifrons* (Hendel) attacks a number of different species of pepper and a field trial was carried out to compare the susceptibility of three, commercially important, species. Damage was higher on different varieties of *Capsicum annuum* L., than on either *C. frutescens* L. or *C. baccatum* L. The importance of developmental stage, shape, colour and surface texture on oviposition will be discussed.

**212. Wist T.J. and M.L. Evenden**

**Semiochemically-mediated interactions in a tritrophic system: *Fraxinus*, *Caloptilia fraxinella*, and *Apanteles polychrosidis*.**

*Caloptilia fraxinella* (Gracillariidae) mines and rolls leaflets of ash, *Fraxinus* spp. in urban forests. Parasitoid wasps from four families use *C. fraxinella* with *Apanteles polychrosidis* (Braconidae) being dominant. Semiochemicals mediate host location by the moth and wasp and differential parasitism depends on the ash species. Semiochemically-mediated orientation by female *C. fraxinella* to ash occurs. We identify volatiles detected by both species and test a synthetic blend for moth attraction.

**213. Yunik, M.E.M.**

**Anaplasma and Rickettsiae in the tick *Dermacentor variabilis* in Manitoba.**

Ticks are obligate blood-feeding ectoparasites of terrestrial vertebrates. They are remarkably successful vectors of pathogens that impact human and animal health; they are hosts for many endosymbionts. *Dermacentor variabilis* is the most abundant tick in Manitoba. *D. variabilis* harbours *Anaplasma marginale*, the causative agent of bovine anaplasmosis, and Spotted Fever Group Rickettsiae. Results from active surveillance for these bacteria in ticks in Manitoba will be discussed.

**214. Zink, L., R. Cartar, and M. Wonneck**

**Effects of managed bees and landscape on wild bee abundance and diversity.**

Canola fields in southern Alberta were sampled over the season for managed and wild bees, and up to 3km of the surrounding landscape classified. The proportion of semi natural land was positively associated with wild bee abundance and diversity. The change in wild bee abundance over time was explained by interacting effects of landscape and managed bees, such that the negative effect of an increase in managed bee abundance on wild bee abundance was greater where there was more semi natural land.