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Up front / Avant-propos

Colin Favret, President of ESC / Président de la SEC

I'm an optimist.

When considering the sweep of 5,000 years of recorded human history, and in almost every way that counts, there is no better time to be alive than now. Though there may be temporary setbacks—the Black Death comes to mind—the trajectory has been overwhelmingly positive and there's no reason to suggest our future won't be as well.

However, the past few years have brought unprecedented change **destabilizing our inter-personal lives**. The media are replete with neologisms to describe facets of this malaise: deaths of despair, quiet quitting, social distancing, eco-anxiety, FOMO, fake news, dopamine hit, and science denial. These phenomena are real, documented in the psychological literature—if maybe with different vocabulary—and more likely to affect the young, the very ones who represent our collective future.

The media also frequently remind us that **our age is polarized** and many of the issues that supposedly divide us are at unprecedented vast scales: global, systemic, societal, and moral. Considering challenges of such magnitude, is it any wonder we feel disempowered, disconnected? We have social isolation on the one hand and global-scale challenges on the other. For all the commencement speeches calling on us to sally forth and change the world, there really is not that much most of us can do at such scale.

As if all that doom and gloom weren't enough, some have claimed we live at a time

Je suis un optimiste.

Si l'on considère les 5 000 ans d'histoire de l'humanité, et à presque tous les égards, il n'y a pas de meilleur moment pour vivre que maintenant. Bien qu'il puisse y avoir des revers temporaires—la peste noire me vient à l'esprit—la trajectoire a été extrêmement positive et il n'y a aucune raison de penser que notre avenir ne le sera pas aussi.

Cependant, ces dernières années ont été marquées par des changements sans précédent qui ont **déstabilisé nos vies interpersonnelles**. Les médias regorgent de néologismes pour décrire les différentes facettes de ce malaise : les morts de désespoir, la démission silencieuse, la distanciation sociale, l'éco-anxiété, *FOMO* (peur de rater quelque-chose), les fausses nouvelles, coup de dopamine et déni de la science. Ces phénomènes sont réels, documentés dans la littérature psychologique—même si c'est avec un vocabulaire différent—et les jeunes en sont plus susceptibles, ceux-là mêmes qui représentent notre avenir collectif.

Les médias nous rappellent aussi fréquemment que **notre époque est polarisée** et que bon nombre des questions qui sont censées nous diviser se posent à une échelle sans précédent : mondiale, systémique, sociétale et morale. Face à des défis d'une telle ampleur, faut-il s'étonner que nous nous sentions désemparés, déconnectés? Nous avons d'un côté l'isolement social et de l'autre des défis à l'échelle mondiale. Malgré les discours de collation des grades nous invitant à nous élancer et à changer le monde, la plupart d'entre nous ne peuvent pas faire grand-chose à une telle échelle.

Comme si tout cela ne suffisait pas, certains affirment que nous vivons à une époque où

where **life-meaning has become elusive**. But deriving meaning by trying to change the world is quixotic, and living for only oneself is narcissistic. A binary distribution of social atomization on the one side and insurmountable global challenge on the other leaves the middle empty; uncoincidentally, it is not conducive to finding meaning.

There is a hierarchy of belonging: in my case, I belong to myself, and to my wife, and to my family, friends, neighborhood, church, and so on all the way up to nation, country, and humanity. **We are social animals**: it is well documented that social interaction is critical to our psychological well-being. As such, it's important not to neglect the middling belongings that lie along the continuum between the self and the whole world.

If you read my *Up front* column from the last issue of the *Bulletin*, you may have already guessed where I'm going with this: among my middling belongings, I belong to the Entomological Society of Canada. Perhaps the single most important facet of the ESC is that we, its membership, all share two things in common. No matter what else may divide us, we all have a tie to Canada, and **we all pursue entomological vocations or avocations**. What a privilege it is to be counted among such a group!

And with privilege comes responsibility: not the dull forced kind, but the fulfilling and meaningful kind that can only be gained through service to others. *And so*, as John F. Kennedy famously said—and here I paraphrase, *my fellow Entomologists: Ask not what the Entomological Society of Canada can do for you – ask what you can do for your Society.* The beauty of this sentiment is that **not only does service bring its own reward, but even just participating in an organization with a common cause is rewarding**. Engagement and social joining within the ESC really does help us, in a small but important way, lead hopeful and meaningful lives*.

As your board of directors develops the ESC's strategic plan, think about what role

le sens de la vie est devenu insaisissable. Mais donner un sens à sa vie en essayant de changer le monde relève du donquichottisme, et vivre pour soi seul relève du narcissisme. La distribution binaire de l'atomisation sociale d'un côté et des défis mondiaux insurmontables de l'autre laissent le milieu vide ; ce n'est pas par hasard qu'il n'est pas propice à la recherche d'un sens.

Il existe une hiérarchie d'appartenance : dans mon cas, j'appartiens à moi-même, à ma femme, à ma famille, mes amis, mon quartier, ma paroisse, et ainsi de suite jusqu'à la nation, au pays et à l'humanité. **Nous sommes des animaux sociaux** : il est bien établi que les interactions sociales sont essentielles à notre bien-être psychologique. C›est pourquoi il est important de ne pas négliger les appartenances intermédiaires qui se trouvent sur le continuum entre le soi et le monde entier.

Si vous avez lu ma chronique *Avant-propos* du dernier numéro du *Bulletin*, vous avez peut-être déjà deviné où je veux en venir : parmi mes appartenances intermédiaires, j'appartiens à la Société d'entomologie du Canada. L'aspect le plus important de la SEC est peut-être le fait que nous, ses membres, avons tous deux choses en commun. Peu importe ce qui nous sépare, nous avons tous un lien avec le Canada et **nous poursuivons tous des vocations entomologiques**. Quel privilège de faire partie d'un tel groupe !

Les privilèges s'accompagnent de responsabilités : non pas celles qui sont ennuyeuses et forcées, mais celles qui sont gratifiantes et significatives et qui ne peuvent être acquises qu'au service des autres. Ainsi, comme l'a dit John F. Kennedy—que je paraphrase ici, *chers collègues entomologistes : ne demandez pas ce que la Société d'entomologie du Canada peut faire pour vous, mais plutôt ce que vous pouvez faire pour votre Société.* La beauté de ce sentiment est que **non seulement le service apporte sa propre récompense, mais que le simple fait de participer à une organisation ayant une cause commune est gratifiant**. L'engagement et l'adhésion sociale au sein de

you would like to see our Society play. More importantly, what can you do to help execute it? Do it in service to the ESC and its membership and do it for yourself as well!

*As it so happens, your ESC is seeking service-oriented members to step up to the roles of Society co-secretary and assistant editor of the *Bulletin*. Please contact me at ESCPresident@esc-sec.ca if you feel so called.

la SEC nous aident réellement, d'une manière simple toutefois importante, à mener une vie d'espoir et de sens*.

Alors que votre conseil d'administration élabore le plan stratégique de la SEC, réfléchissez au rôle que vous souhaiteriez voir jouer par notre Société. Plus important encore, que pouvez-vous faire pour contribuer à sa réalisation ? Faites-le en service à la SEC et à ses membres et faites-le aussi pour vous-même !

*Il se trouve que votre SEC recherche des membres ayant le sens du service pour assumer les rôles de co-secrétaire de la Société et de rédacteur en chef adjoint du *Bulletin*. Veuillez me contacter à l'adresse ESCPresident@esc-sec.ca si vous vous sentez

You are cordially invited to the 2024 ESC-SEQ Joint Annual Meeting

The Entomological Society of Quebec is delighted to invite you to the joint annual meeting with the Entomological Society of Canada! The annual meeting will be held from October 20 to 23, 2024, at Le Concorde Hotel in the province's capital, Quebec City. The theme of the annual meeting will be **The Good, the Bad and the Ugly**, because it's all **a question of perspective**! Indeed, insects can be considered harmful in some situations, and quite beneficial in others. Not every species gets the good press it deserves, and the big screen sometimes brings a whole new dimension to these creatures. Details of the event and important dates can be found on the event website:
https://event.fourwaves.com/seq-esc2024/pages

Vous êtes cordialement invité à la réunion annuelle conjointe 2024 SEC-SEQ

La Société d'entomologie du Québec a l'immense plaisir de vous inviter à la réunion annuelle conjointe de la Société d'entomologie du Canada et de la Société d'entomologie du Québec! La réunion annuelle se tiendra du 20 au 23 octobre 2024 à l'hôtel Le Concorde dans la charmante capitale de la province, Québec. Le thème de la réunion annuelle sera **Le bon, la brute et le truand** puisque tout est **Une question de perspective!** En effet, les insectes peuvent être considérés comme nuisibles dans certaines situations, et être tout à fait bénéfiques dans d'autres. La bonne presse n'est pas donnée à toutes les espèces et le grand écran apporte parfois une tout autre dimension à ces créatures.

Les détails de l'événement ainsi que les dates importantes peuvent être consultés sur le site Internet de l'événement:
https://event.fourwaves.com/fr/seq-esc2024/pages

STEP Corner / Le coin de la relève

Rowan French and Berenice Romero

SEPAC welcomes a new Co-Chair, Berenice Romero!

With the new year came two major changes in SEPAC leadership. First, we were dismayed to say goodbye to Matt Muzzatti as co-chair of SEPAC. Matt's term as co-chair began in 2021, and he has since played a vital role in both SEPAC and the ESC at large. Examples of Matt's exceptional contributions include his service as the inaugural elected representative of students and early professionals on ESC's Board of Directors, as well as his role as a key co-organizer of the 2022 Joint Annual Meeting of the Entomological Societies of Canada, America, and British Columbia in Vancouver. Fortunately, Matt will remain a member of SEPAC and will retain his position as an ESC board representative for students and early professionals. We look forward to continuing to work with you, Matt!

Second, we are excited to announce that SEPAC's Director of Social Media, Berenice Romero, will be filling Matt's shoes as a new SEPAC co-chair! In her new role, Berenice will serve alongside SEPAC's continuing co-chair, Rowan French. We asked Berenice to tell us a bit about herself, her history with SEPAC, and her plans as a new co-chair. She shared this:

"I am Berenice Romero and I have been a member of SEPAC for several years. I completed my degree in Biology at the University of Buenos Aires, Argentina, where I worked with insect pests in

Le comité des affaires étudiantes et de début de carrière accueille une nouvelle co-présidente, Berenice Romero!

La nouvelle année a été marquée par deux changements importants dans le comité des affaires étudiantes et de début de carrière. Tout d'abord, nous avons été consternés de dire au revoir à Matt Muzzatti en tant que coprésident du comité. Le mandat de Matt en tant que coprésident a débuté en 2021, et il a depuis joué un rôle essentiel tant au sein du comité que de la SEC dans son ensemble. Parmi les exemples des contributions exceptionnelles de Matt, citons son service en tant que premier représentant élu des membres aux études et en début de carrière au sein du conseil d'administration de la SEC, ainsi que son rôle en tant que coorganisateur clé de la réunion annuelle conjointe de 2022 des Sociétés d'entomologie du Canada, de l'Amérique et de la Colombie-Britannique à Vancouver. Heureusement, Matt restera membre du comité des affaires étudiantes et de début de carrière de la SEC et conservera son poste de représentant des membres aux études et en début de carrière au sein du conseil d'administration de la SEC. Nous nous réjouissons de continuer à travailler avec toi, Matt !

Deuxièmement, nous sommes ravis d'annoncer que la directrice des affaires étudiantes et de début de carrière du comité, Berenice Romero, remplacera Matt en tant que nouvelle coprésidente du comité! Dans son nouveau rôle, Berenice travaillera aux côtés de la coprésidente actuelle du comité, Rowan French. Nous avons demandé à Berenice de nous parler un peu d'elle, de ses antécédents au sein du comité des affaires étudiantes et de ses projets en tant que nouvelle coprésidente. Voici ce qu'elle nous a dit :

« Je m'appelle Berenice Romero et je suis membre du comité des affaires étudiantes et début de carrière depuis plusieurs années. J'ai obtenu mon diplôme en biologie à l'Université de Buenos Aires, en Argentine,

soybeans. I defended my PhD thesis in December 2023, shortly after the 2023 ESC JAM, and I have obtained my PhD in Plant Sciences from the University of Saskatchewan. My PhD project focused on the interactions among plant species, an insect vector (aster leafhopper), and a bacterial pathogen that this insect species transmits (Aster Yellows phytoplasmas). I initially joined the SEPAC committee to help with the research roundup initiative, which highlighted different publications from ESC student members. I have also volunteered at many ESC JAMs to help with the silent auction and I have been part of the ESC Communications committee. More recently, I accepted the position of co-chair of SEPAC, along with Rowan French. One of the things I look forward to in my new position is the opportunity to provide new avenues for student engagement in the society."

Thank you, Matt, for the exceptional work you have done for the society as a SEPAC co-chair, and welcome, Berenice!

Getting Involved with the ESC

SEPAC is always keen to take on new members! Volunteering for SEPAC is a great way to get involved with the Society and promote entomology across Canada. If you are interested in joining or just have suggestions for new initiatives in the coming year, email us at students@esc-sec.ca, or contact us personally at rowan.french@mail.utoronto.ca and berenice.romero@usask.ca. We look forward to hearing from you!

où j'ai travaillé sur les insectes ravageurs du soja. J'ai soutenu ma thèse de doctorat en décembre 2023, peu après la réunion annuelle conjointe de la SEC 2023, et j'ai obtenu mon doctorat en sciences végétales à l'Université de Saskatchewan. Mon projet de doctorat portait sur les interactions entre les espèces végétales, un insecte vecteur (la cicadelle de l'aster) et un agent pathogène bactérien transmis par cette espèce d'insecte (le phytoplasme de la jaunisse de l'aster). J'ai d'abord rejoint le comité des affaires étudiantes et de début carrière de la SEC pour aider à l'initiative de l'aperçu de la recherche, qui mettait en lumière différentes publications des membres aux études de la SEC. J'ai également été bénévole lors de nombreuses réunions annuelles de la SEC pour aider à la vente aux enchères silencieuse et j'ai fait partie du comité de communication de la SEC. Plus récemment, j'ai accepté le poste de coprésidente du comité des affaires étudiantes, avec Rowan French. L'une des choses que j'attends avec impatience dans mon nouveau poste est la possibilité de fournir de nouvelles voies pour l'engagement de la communauté étudiante dans la société. »

Merci, Matt, pour le travail exceptionnel que tu as accompli pour la société en tant que coprésident du comité des affaires étudiantes et de début de carrière, et bienvenue, Berenice !

S'impliquer au sein de la SEC

Le comité des affaires étudiantes et de début de carrière est toujours prêt à accueillir de nouveaux membres. Le bénévolat au sein du comité est une excellente façon de s'impliquer dans la Société et de promouvoir l'entomologie à travers le Canada. Si vous souhaitez devenir membre ou si vous avez des suggestions pour de nouvelles initiatives pour l'année à venir, envoyez-nous un courriel à students@esc-sec.ca, ou contactez-nous personnellement à rowan.french@mail.utoronto.ca et berenice.romero@usask.ca. Nous attendons vos commentaires avec impatience!

Thesis Roundup / Foisonnement de thèses

SEPAC wants to recognize and celebrate the accomplishments of newly minted entomology grads! If you or a student you know has recently defended an entomology-related thesis at a Canadian University, please send the following details to students@esc-sec.ca : student's name, date, degree, thesis title, supervisor(s), and university. This information will appear on the ESC website and in the next ESC Bulletin.

Le comité veut reconnaître et célébrer les réalisations des nouveaux diplômés en entomologie! Si vous, ou un étudiant que vous connaissez, a récemment soutenu sa thèse dans un domaine lié à l'entomologie dans une université canadienne, merci d'envoyer les informations suivantes à students@esc-sec.ca nom de l'étudiant, date, diplôme, titre de la thèse, directeur(s) et université. Cette information apparaîtra sur le site web de la SEC et dans le prochain Bulletin de la SEC.

People in the news / Gens qui font les manchettes

Steve Marshall (Professor Emeritus, University of Guelph) has just been awarded the Dartmouth Medal for his book on the natural history of bees and wasps. The Dartmouth Medal is for the most outstanding reference work:
https://rusaupdate.org/2024/01/2024-dartmouth-medal-winner-announced/

Entomological Society of Saskatchewan

The ESS had a quiet annual Fall meeting, in person, in Saskatoon, at the AAFC building on the afternoon of December 8th. There were four student presentations as part of the annual student presentation competition. Congratulations to **Tyler Hartl**, our student presentation award winner and to **Lesa Giesbrech**, **Jeremy Irvine**, **Berenice Romero** and **Scout Butler-Siemens**, who received ESS Activities Awards for conference travel this year.

ESS welcomes Dylan Sjolie as our Vice President and Jordan Mihalicz as our incoming President for 2024. The ESS executive met on January 26 for onboarding and to discuss upcoming activities such as our Spring meeting (tentatively April 5).

Entomological Society of Ontario

The 2023 Entomological Society of Ontario Annual General Meeting was a great success! Over 115 people registered to attend in person at the Arboretum at Guelph, thanks to many generous sponsors. Conference participants presented great talks and posters, and plenary speaker, Dr. Thomas Hossie inspired attendees to engage more with our communities to get them excited about insects. In addition, there was an exclusive presentation from the team at Bugdex all about their interactive insect identification app, which will be coming soon.

Acadian Entomological Society

The Acadian Entomological Society will host it's first annual meeting in the province of Newfoundland and Labrador since 2009. This meeting will take place on the very scenic west coast of the Island in Corner Brook, NL from August 14-16, 2024. The plenary speaker will be Dr. Maxim Larrivée (Insectarium, Espace pour la vie, Montréal). We will also take this opportunity to honour the late Dr. Peggy Dixon, with student travel award opportunities to attend this meeting.

The IPM Pyramid Applied to a Career in Teaching, Research and Service in Entomology in Canada

It is a tremendous honour to have been nominated for and to receive the Gold Medal Award from the Entomological Society of Canada (ESC). I would first like to thank my close friends and colleagues, Drs. Heather Proctor and Felix Sperling, for nominating me for this award. To receive such an award from one's home scientific society causes one to reflect on their career path and the opportunities afforded to them. I am fortunate to work at the University of Alberta on Treaty 6 territory. It was therefore an extra special honour to receive the Gold Medal Award at the Joint Annual Meeting (JAM) between the Entomological Societies of Saskatchewan and Canada in Saskatoon, which is also located on Treaty 6 territory. Furthermore, the meeting chair at the JAM in Saskatoon, Dr. Tyler Wist (AAFC, Saskatoon), conducted his PhD in my laboratory, which added to the specialness of the occasion for me. Unfortunately, celebrations at the 2023 JAM were also marked with sadness at the untimely passing of Dr. Lisa Poirier (UNBC, Prince George), my former lab mate during graduate studies at Simon Fraser University.

I consider myself an applied entomologist, so I decided to link my Gold Medal Address to some Integrated Pest Management (IPM) theory in the form of the IPM pyramid(s) (Figure 1). Traditional IPM pyramids have a foundation based on the prevention of pest activity and damage through monitoring and application of economic thresholds. Layers making up the remainder of the pyramid represent pest management tactics and their frequency of use in the IPM system. Tactics at the bottom of the pyramid such as cultural and mechanical controls are commonly applied, whereas tactics at the top of the pyramid such as augmentative biological and chemical controls are used sparingly. More modern renditions of the IPM pyramid (Egan et al. 2020; Lundin et al. 2021) incorporate the effects of management tactics on natural enemies and pollinators. Inclusion of non-target species into the IPM pyramid emphasizes differences between proactive and reactive approaches based on the promotion of biodiversity or the inclusion of human input into the system (Figure 1). Regardless of the era of the pyramid, a functioning IPM system relies on a strong program foundation and integration among the layers of said pyramid that represent the multiple tactics used in the program.

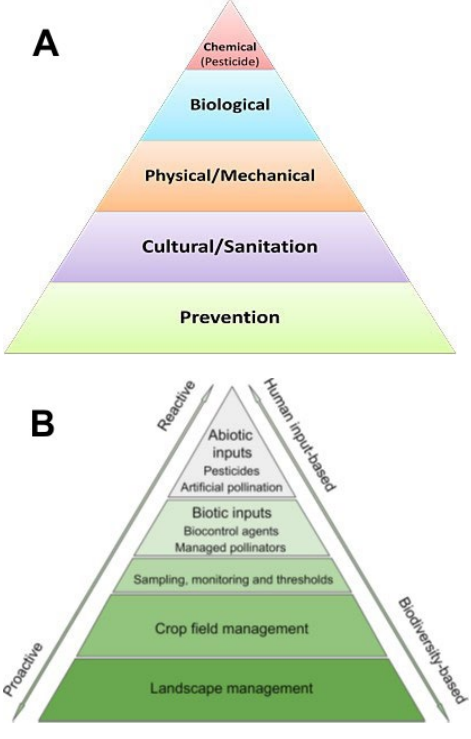

Figure 1. Different renditions of the Integrated Pest Management (IPM) pyramid based on A) management of the target pest; and B) management of the target pest and impacts on non-target organisms in the managed system (Lundin et al. 2021).

When I received the news that I was to be honoured with the 2023 ESC Gold Medal Award, I reflected on my foundation and the experiences that I have had throughout my career that get me to this point. I built a career pyramid to reflect these interactions (Figure 2).

My career pyramid has a foundation based in a supportive family and experiences with fantastic mentors, colleagues, and trainees that led to the ESC bestowing this great honour on me. Once I built the career pyramid that culminated in the Gold Medal Award, I dreamily compared my pyramid to that of my heroes…the Canadian Women's National Soccer Team (CWNT). I am a huge fan of women's soccer in Canada, and the recent CWNT Gold Medal performance at the Tokyo Olympics (2021) allowed me to compare their journey to mine! The CWNT has a strong foundation in Canada Soccer, the interactions of coaches (mentors), teammates (colleagues) and new members (trainees) promote strong interactions that eventually led to their gold medal success!

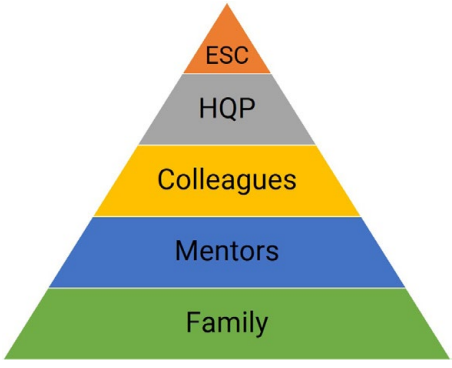

Figure 2. Maya Evenden's career pyramid leading to the receipt of the ESC Gold Medal Award

I woke up from my dream about the CWNT and continued to reflect on my career pyramid with its foundation based in family. My parents, Polly Evenden and Dr Len Evenden provided a strong foundation for my siblings (Dr Matthew Evenden and Kirstin Evenden) and me (Figure 3). My parents taught me many things over the years, but most important were a strong work ethic and a love for nature and the outdoors. My "super siblings" are supportive and fun to be around. We shared many experiences together as children and continue to support one another as adults (Figure 3).

A large part of my pyramid's foundation is my current family that consists of my "super spouse" Steven Dokken and my wonderful (soccer playing) daughters, Hannah and Nyssa Dokken, aged 23 and 17 (Figure 4). Steven is a major reason that my career in Entomology has been a successful one. Steven is a real ento-enthusiast. Despite being a History-

M. Evenden

L. Evenden

B. Effer

Figure 3. Maya Evenden's family that forms the foundation of her career pyramid. A) Maya's parents celebrating their 60th wedding anniversary in August, 2023; B) Maya and her siblings circa. 1974; C) Maya and her siblings, 2020.

Figure 4. Maya Evenden's family that forms the foundation of her career pyramid. A) Maya's "super" spouse, Steven Dokken; B) Maya's soccer playing daughter, Hannah Dokken; C) Maya's soccer playing daughter, Nyssa Dokken.

Geography double major, Steven took an undergraduate Entomology course from Dr Richard Ring at the University of Victoria and he was hooked! Over the years, Steven has been my unofficial laboratory technician who has counted thousands of moths, climbed hundreds of ladders, and built multiple wind tunnels in laboratories located across North America! Steven's most important job, however, is the dad to our wonderful daughters. My daughters bring purpose and meaning to my life and make up a large part of my family foundation. Hannah and Nyssa are pursuing careers in STEM and both enjoy the outdoors, but more for recreation than employment. In fact, my daughters informed me that one entomologist in the family is enough!

Experiential learning and early exposure to research in insect biology shaped my career in Entomology. I grew up in Vancouver but conducted my BSc in Co-op Biology at the University of Victoria (UVic). One of the reasons that I got into the co-op program was due to my experience as a volunteer at the Vancouver Aquarium during my teenage years. My first work term in the co-op program focused on water chemistry of streams and rivers affected by agriculture in central BC. The remaining three work terms all centered on entomological themes. I had hands-on work experience in assessing the efficacy of insecticidal soap against spider mites, insect biological control of greenhouse pests, and deployment and monitoring of pheromone-baited traps in bark beetle surveys. At UVic, I also had the great fortune of interacting with Dr Richard Ring. Dr Ring was an inspirational instructor, and I took all three of the Entomology courses offered at UVic. In addition, I had my first experience with research in the laboratory of Dr Ring, where I studied the diversity of flies in the family Phoridae collected from the canopy of the old growth forest in the Carmanah Valley, BC. Following my final year as an undergraduate student, I received an NSERC Undergraduate Student Research Award (USRA) to conduct more research, this time in the lab of Dr Murray Isman at the University of British Columbia (UBC). In Isman's lab, I studied the insecticidal properties of tar oil pitch using cutworm models, which introduced me to pest management applications of natural products chemistry.

Through my last co-op work term, I became interested in Forest Entomology and I learned about the Master of Pest Management (MPM) program at Simon Fraser University (SFU). I applied to work under the supervision of Dr John Borden (Figure 5), which was a decision that changed my life. John was a true "super"visor who led by example and fostered both independence and collaboration in his trainees. John accomplished many things in his decorated career that spanned 37 years in academia and 20+ years in industry (>400 publications, >$11 million in grant support), but perhaps his most enduring contributions are his trainees.

Figure 5. Maya Evenden's graduate "super"visor at Simon Fraser University, Dr. John Borden, and with Maya at her PhD graduation.

John trained 101 graduate students who received 119 graduate degrees, many of whom are entomological professionals holding positions in academia, government and industry. John encouraged, supported and promoted me throughout my career in Entomology. At the ESC JAM 2023 meeting in Saskatoon, many of John's trainees celebrated his many contributions to Entomology in Canada and around the world.

I completed both my MPM and PhD degrees at SFU with Dr John Borden, but I was also fortunate to have had other important mentors during my graduate studies. During my time at SFU, I interacted closely with Drs Gary Judd and Gerhard Gries, and Regine Gries; both Gerhard and Gary were also John Borden's trainees. Gary co-supervised my PhD and was an important mentor who taught me a lot about doing science and applying basic science to practical problems. My PhD work focused on interspecific chemical communication in tortricid moths, but also resulted in the development of a pheromone-based mating disruption tool for non-insecticidal control of a multi-species complex of leafroller pests of apple. My interactions with Gerhard and Regine Gries taught me about observing the natural world, chemical ecology methodology, scientific writing and much more. I am fortunate to have had sustained collaborative relationships with Gary and the Gries Lab throughout my career. Following my PhD, I moved to Lexington, Kentucky, supported by a postdoctoral fellowship in the lab of Dr Ken Haynes at the University of Kentucky. It was so much fun working in the Haynes lab and experiencing a new academic environment in a Department of Entomology. In Kentucky, I used quantitative genetics tools to study the evolution of resistance to pheromone-based mating disruption in the cabbage looper, *Trichoplusia ni* (Hübner) (Lepidoptera: Noctuidae). Living in Lexington also introduced me to the "Big Blue Nation" and I became a life-long University of Kentucky Wildcats Fan!

My first academic position was at West Chester University of Pennsylvania. At West Chester, I had my first experience teaching undergraduate students. I taught a wide variety of lab and lecture courses and supervised undergraduate researchers. I had a small lab group who worked on projects in collaboration with Pennsylvania tree fruit producers to develop pheromone-based attracticide formulations that target key moth pests of apple production. After 2 years as an Assistant Professor at West Chester, I was awarded an NSERC University Faculty Award for Women in Science, which allowed me to join the Department of Biological Sciences at the University of Alberta (UAlberta) in 2003. At UAlberta, my lab (Figure 7) studies insect behaviour and chemical ecology of insects considered pests in managed ecosystems in western North America. We work in forest, agricultural and horticultural systems and apply our findings to IPM in these systems.

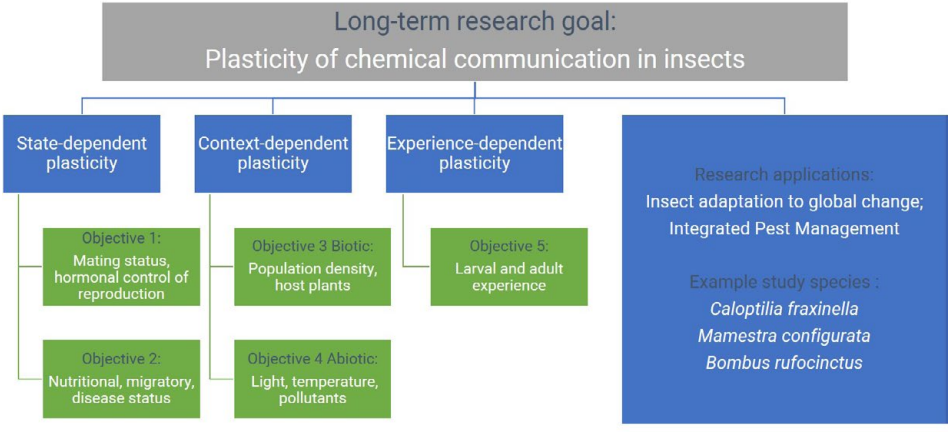

Figure 6. Relationship between the long-term and short-term goals and applications of Maya Evenden's NSERC-funded research program on the plasticity of chemical communication in insects at the University of Alberta.

One thing I learned quickly when I moved to Edmonton is that Alberta is full of entomologists! The Entomological Society of Alberta became my new home where I met colleagues and friends from across the province. It has been a privilege to be active in this regional society over the years. Some of these colleagues are my close collaborators. My departmental colleagues, Drs Andrew Keddie, Heather Proctor and Felix Sperling, have been wonderful collaborators, supporters, mentors, and friends. Collaborations with the late, great Dr Lloyd Dosdall launched my work in agroecosystems in Alberta. Lloyd helped me secure agricultural industry funding, introduced me to producer groups and co-supervised graduate students with me. Dr Boyd Mori, who conducted his PhD in my laboratory, was hired as Lloyd's replacement at UAlberta and is an important collaborator on agricultural projects with my research group. Other colleagues with whom I have worked closely in agroecosystems in Alberta include government of Canada and Alberta researchers, Dr Héctor Cárcamo, Jennifer Otanni, and Scott Meers. Collaborations with government colleagues expand the networks of my trainees and provide us with access to facilities not available in our laboratory.

Close collaborators on forestry-related projects include UAlberta colleagues Drs Jens Roland and Nadir Erbilgin. Jens was my official faculty mentor when I first joined UAlberta. He helped me find field sites and establish connections with others working in Forest Entomology in Alberta. Nadir is a fellow chemical ecologist and collaboration with his lab has allowed us to work on chemically mediated plant-herbivore interactions from the plant defense angle. Our recent work on interactions between insect disease and diet in the forest tent caterpillar, *Malacosoma disstria* Hübner (Lepidoptera: Lasiocampidae) has been in collaboration with Dr Leah Flaherty at Grant MacEwan University. Our chemical ecology and population biology studies on mountain pine beetle, *Dendroctonus ponderosae* Hopkins (Coleoptera: Curculionidae: Scolytinae), have benefitted greatly from close collaborations with Drs Dezene Huber (UNBC) and Allan Carroll (UBC).

Research in my lab addresses questions on the plasticity of chemical communication in insects (Figure 6). Across a variety of different insect taxa, we examine state-, context- and experience-dependent plasticity in chemical communication. For studies on state-dependent plasticity in chemical communication, we examine the effect of mating, diapause, nutrition, migration and

disease on the production and response to chemical signals. We examine the effects of biotic (population density, host plants) and abiotic (light, temperature, pollutants) factors that drive context-dependent plasticity in chemical communication. We also study how insect experience at the larval and adult stages can affect the production and response to chemical cues. We apply findings from this basic research to IPM of ecologically and economically important pest species.

Many of our research questions about state-dependent plasticity of chemical communication are addressed using the ash leaf coneroller, *Caloptilia fraxinella* Ely (Lepidoptera: Gracillariidae) as a study system. What we know about this system is mostly due to the work of two PhD students in my lab (Drs Lemmen-Lechelt and Wist). This is a long-lived moth that undergoes a prolonged reproductive diapause (Evenden et al. 2007) from adult emergence in mid-summer to the following spring when mating and oviposition on newly flushed ash leaflets occurs (Evenden 2009). The ash leaf coneroller displays state-dependent plasticity in response to pheromone (Evenden and Gries 2008) at the peripheral nervous system level (Lemmen and Evenden 2009). Hormones and biogenic amines control pheromone response plasticity of male ash leaf conerollers (Lemmen and Evenden 2016). Females use volatiles released from freshly flushed ash to orient to hosts for oviposition (Wist et al. 2014). Response to ash volatiles is plastic and depends on female physiological state and nutritional status (Lemmen-Lechelt et al. 2018). Ash volatiles released by trees infested with ash leaf coneroller are attractive to the generalist parasitoid, *Apanteles polychrosidis* Vierek (Hymenoptera: Braconidae) (Wist et al. 2015). Research conducted by MSc student, Sarah McPike, showed that we can use synthetic ash volatiles to attract parasitoids to infested trees to promote non-insecticidal management of ash leaf coneroller (McPike and Evenden 2021).

In our laboratory, we examine context-dependent plasticity of chemical communication that is driven by abiotic and biotic interactions. Plant host use by insects is often dictated by response to host plant volatiles that vary with plant condition. Recent work by PhD student, Dr. Chaminda Weeraddana, examined context-dependent plasticity of response to host plants by the generalist herbivore bertha armyworm, *Mamestra configurata* Walker (Lepidoptera: Noctuidae). Chaminda showed that infection of canola by the clubroot pathogen, *Plasmodiophora brassicae*, increases resistance to bertha armyworm herbivory (Weeraddana et al. 2020). Bertha armyworm females lay fewer eggs on clubroot-infected canola plants and select uninfected hosts over infected hosts when given a choice. The volatile profiles of uninfected and infected canola plants differ, as do plants that are preferred and rejected for oviposition by female moths (Weeraddana et al. 2020). Bertha armyworms also detect changes in canola plants as a result of previous oviposition (Weeraddana and Evenden 2022) and herbivory (Weeraddana and Evenden 2019) by the brassica specialist, the diamondback moth, *Plutella xylostella* L. (Lepidoptera: Plutellidae). The presence of diamondback moth eggs increases the susceptibility of canola to herbivory by bertha armyworm (Weeraddana and Evenden 2022). Diamondback moth herbivory does not influence oviposition decisions by bertha armyworm females but does affect offspring fitness (Weeraddana and Evenden 2019). In addition, variation in canola nutrition achieved through fertilization influences bertha armyworm oviposition decisions and offspring performance (Weeraddana and Evenden 2018).

Much of the basic chemical ecology research in my lab can be applied to behavioural manipulation of insect pests, and therefore contribute to IPM of ecologically and economically important species. We have developed semiochemical-based tools to monitor and control species considered to be pests in agricultural, horticultural and forested ecosystems in western Canada. While developing semiochemical-based monitoring tools for cutworm and armyworm (Lepidoptera: Noctuidae) pests of wheat and canola, we noticed a large bycatch of bumble bees in the genus *Bombus* (Hymenoptera: Apidae). A collaborative effort between PhD student, Dr Ronald Batallas, and MSc student, Nick Grocock, showed that *Bombus* spp. are attracted to

noctuid moth pheromones, but attraction varies with pheromone identity and crop, with more bumble bee capture in canola than in wheat fields (Grocock et al. 2020). Although 11 *Bombus* species were regularly collected in noctuid moth pheromone-baited traps, the vast majority of specimens were *Bombus rufocinctus* (Hymenoptera: Apidae). Electrophysiological assays show that antennae of both *B. rufocinctus* and the commercially available *B. impatiens* detect noctuid moth pheromone components (Grocock et al. 2020). Perception of chemical signals produced by insects in a different order may be due to the structural similarity between moth and bumble bee pheromones. Nick's work also revealed that both local (flowering plant abundance) and landscape factors (proportion of forested habitat) influenced capture of *B. rufocinctus* in noctuid moth pheromone-baited traps (Grocock and Evenden 2020).

My trainees or highly qualified personnel, who do all the work, occupy the pinnacle of my career pyramid (Figure 2). Over the years, it has been a great honour to supervise 4 research associates, 4 postdoctoral fellows, 11 PhD students, and 22 MSc students in my laboratory (Figure 7). I also encourage experiential learning for undergraduate students through exposure to research in my laboratory. In collaboration with my graduate students and post docs, I have supervised >90 undergraduate research projects. In addition, we support programs that give high school students exposure to scientific research. Our lab has provided research experiences for 14 grade 11 students as part of the Women in Scholarship, Engineering, Science and Technology program at UAlberta. Most of the research in my laboratory has both lab and field components. We respectfully conduct fieldwork on Treaties 6, 7 and 8, traditional territories of many First Nations and homeland of the Métis Nation. The privilege of interacting with terrific trainees is the most rewarding part of my job and gives me the greatest sense of accomplishment.

Figure 7. Maya Evenden's trainees (highly qualified personnel) at the University of Alberta. A) Maya's first lab cohort, from left to right: Andreas Wins-Purdy, Alex Argals, Brad Jones, and Christina Elliott; B) Part of Maya's lab group in October 2022, back row from left: Leanne Petro, Priya Chennamkulangara, Zach Weller, Renz Layugan, Olajide Fatukasi, Maggie MacDonald; middle row from left: Ang Thompson, Maya Evenden, Sharavari Kulkarni, Yiyang Wu; front row from left: Keegan Van Slyke, Taylor Volappi, Mary Cruz, Antonia Musso, Asha Wijerathna. Missing: Ilan Domnich, José Correa-Ramos.

At UAlberta, my position requires 40% research (detailed above), 40% teaching and 20% service. My teaching responsibilities include several Entomology courses and an upper-level course in chemical ecology. Through the digital learning strategy at UAlberta, I had the opportunity to lead the development of a Massive Open Online Course (MOOC). In June 2019, Bugs 101: Insect-Human Interactions launched on the coursera.org platform. This university-level course consists of 12 modules that range from insect biology and locomotion to the functional role of insects in ecosystems to sustainable pest management, insect conservation and the role of insects in human culture (Figure 8). The course is freely available to learners with an internet connection and an on-campus version of the course (Ent 101) is available for credit to UAlberta students. MOOCs increase

Figure 8. Modules covered in the Massive Open Online Course, Bugs 101: Insect-Human Interactions.

accessibility to university-level education for learners around the globe. As of October 2023, 43069 learners from > 132 countries enrolled in Bugs 101 and 4881 completed the course (Table 1). Learners rate Bugs 101 highly; 92% of the 1296 ratings received by October 2023 were 5-stars. The "Best Online Course" award at the Ember Awards 2019 of Digital Alberta honoured the production quality of Bugs 101. A Science Communication award from the Entomological Society of America in 2022 recognized the reach of Bugs 101 to learners around the world. The development, production and maintenance of Bugs 101 has been a team effort. I worked with a team of content experts who researched, developed and wrote the content presented in course videos. Content included video recordings that incorporated interviews with entomological experts, interactive learning objects to gamify learning, videos, animations and more. Entomological experts reviewed content from each module and a team of educational developers ensured that the course development and delivery was pedagogically sound. We worked closely

Table 1. Number and geographic distribution of Bugs 101 learners from the top 6-7 countries of >132 countries of learner origin. Enrolled learners at 2 and 4 months, 2.3 and 4.2 years post course launch on August 28, 2019, October 29, 2019, November 9, 2021, and October 12, 2023. Numbers in the first three columns refer to learners enrolled from countries listed on the left hand side; numbers in fourth column refer to learners enrolled from countries listed on right hand side. Note: At 2 years post launch, there were more enrolled learners from India than the United Kingdom, and *Brazil had 833 enrolled learners but was not listed in the table because that was the only time point that it fell in the top 7 countries.

Country	Number Enrolled Learners				Country
	2 months post launch (August 2019)	4 months post launch (October 2019)	2 years post launch (November 2021)	4 years post launch (October 2023)	
United States of America	2614	3004	9379	12695	United States of America
Canada	1237	1545	4735	6554	Canada
United Kingdom	251	315	1208	4274	India
India	164	205	3507	1564	United Kingdom
Australia	134	163	767*	1005	Philippines
Mexico	74	103	728	1001	Australia

with professionals at the company that produced the course (Onlea). As we continue to facilitate the course offering, we work with colleagues at coursera.org to ensure seamless delivery of course content. In the 5 years since course launch, we have conducted one review of course content.

It is appropriate to end my Gold Medal Address highlighting the importance of scientific service. Twenty percent of my workload should be dedicated to service-related activities. Service to entomological societies has been an enriching part of my career. Through service to the Entomological Society of Alberta, the Entomological Society of Canada, and the International and Eastern Branches of the Entomological Society of America, I have expanded my entomological network and given back to the societies that supported me throughout my career. I served as the president to the Entomological Societies of Alberta (2006), Canada (2010) and the International Branch of the Entomological Society of America (2017). There were some important initiatives launched in those societies during my tenure on the executive councils. I was involved in the inaugural virtual symposium of the ESA International Branch, which provides a venue for entomologists from around the world to present their research and interact with international colleagues. During my tenure as the ESC president, we changed journal editors and publishers for *The Canadian Entomologist*, and digitized all the back issues of the journal. Over the years, I have kept up with cutting edge entomological research through serving on the editorial boards of several Entomology and Ecology journals (*Canadian Journal of Arthropod Identification, Entomologia Experimentalis et Applicata*, *Frontiers in Ecology and Evolution, Journal of Insect Behavior, Physiological Entomology, The Canadian Entomologist*). My other major service contributions include administrative roles in my department. I served as the Assistant-Associate Chair of Graduate studies (2012-2013) and the Associate Chair Undergraduate Studies (2021-2023). As Associate Chair Undergraduate Studies, I was responsible for the smooth running of the course offerings in our department (~140 courses!). This included teaching assignments, training instructors, course budgets, and grade approvals. As the timing of my tenure as Associate Chair coincided with "the COVID years", there was a lot of trouble shooting to meet the needs of students and instructors. During those two years, my service load was definitely >>>20%! I have also given back to the City of Edmonton through participation as an active member (2020-present) and chair (2021-2022) of the IPM Advisory Group. This active committee provides strategic advice on IPM issues in Edmonton. This includes formulating IPM recommendations to City Administration and facilitating public perspective on IPM issues in support of the City's IPM Policy.

My career in entomology to date has been an enriching one, but it's not over yet! Receiving this award and developing this address helped me reflect on the opportunities I have had and some very important people who helped to generate those opportunities. I'd like to finish by thanking all the layers of my career pyramid (Figure 2), including the ESC, for support, community, and friendship throughout my career.

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Forage Entomology on the Prairies, Selected Pests, and a Tale of Two Insects

Julie Soroka

Introduction

All of my entomological experience has been obtained while employed in western Canada by Agriculture Canada Research, in its many iterations. In his 2014 Heritage Lecture, Owen Olfert gave an extensive overview of the Department's entomological footprint in the province of Saskatchewan (Olfert 2014). This presentation focuses on some features of a less publicised chapter in the story of Prairie crop protection, that of Forage Entomology and forage entomologists.

Forages are an integral component of the $50 billion Canadian livestock industry, in that they comprise food for livestock, including pasture and browse plants, baled hay, silage, pellets and cubes. Additionally, cultivated grasses, alfalfa (*Medicago sativa* L.), and alfalfa-grass mixtures rank third in the Canadian agricultural economy in terms of crop production value and land base, behind only wheat and canola (Statistics Canada 2022). Beyond these obvious positive attributes are less apparent ones, causing forages to be labeled the overlooked keystone of Canadian agriculture. Forages, especially perennial forages, contribute to increased soil and water conservation, improved soil structure and nitrogen fertility, increased carbon sequestration, decreased soil erosion and fuel costs, permanent groundcover and increased biodiversity, decreased use of pesticides and/or delay in pesticide resistance (Anonymous 2013).

Most forage species belong to the grass (Graminae) or legume (Fabaceae) families. In western Canada, bromegrasses (*Bromus* spp.), wheatgrasses (*Agropyron* spp.), fescues (*Festuca* spp.), and timothy (*Phleum pratense* L.) are the most commonly grown grass species, while alfalfa is the most widely grown forage legume species across Canada. Although vital to the livestock industry, forages have a tradition of being grown on less arable or marginal lands, especially in western Canada, and are often seen as the poorer relative of more "valuable" cash crops. Likewise, research into protection of forage crops often has received proportionally less priority and fewer funds than such research of other crops.

Federal Governance of Forage Research

To promote the livestock industry in Canada as its population grew, in 1911 the Dominion Department of Agriculture established the Division of Forage Crops, based at the Central Experimental Farm (CEF) in Ottawa. The Division's mandate was to investigate the breeding of meadow, pasture, and silage crops, which included timothy, alfalfa, red clover, soybeans, corn, and other such crops adapted to eastern Canada (Anonymous 1939).

At about the same time, the Department formed the Entomological Branch for research of agricultural and forest pests. On the Prairies, Dominion Entomological Laboratories were established at Treesbank (eventually Brandon) and Lethbridge in 1913, and at Saskatoon in 1918.

Julie Soroka was a long-time member of the Research Branch of Agriculture and Agri-Food Canada. Prior to her retirement she was a research scientist at AAFC Saskatoon Research and Development Centre, where she investigated the distribution and ecology of pest and beneficial insects in legume and grass forages and oilseed crops across the prairie provinces.

With limited personnel, the three jurisdictions opted for a division of labour, with Manitoba under Norman Criddle spearheading early grasshopper studies, Saskatoon, initially under A.E. Cameron and then Ken King, investigating wireworms and red-backed cutworms, and Lethbridge's E.H. Strickland and Howard Seamans leading work on wheat stem sawflies and pale western cutworms (Riegert 1980, Anstey 1986). Insect pests specific to forages tended to be placed in the "Other Pests" category in annual reports to Ottawa.

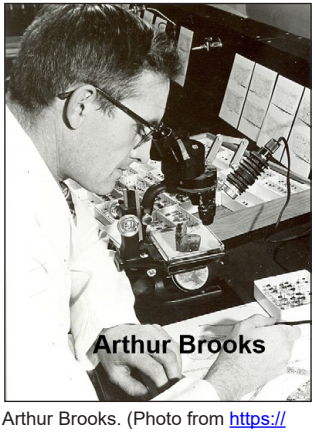
An adjunct Dominion Forage Crops Laboratory was created in Saskatoon in 1931. Its purpose was to develop forage crop breeding programs and integrated methods for control of forage crop pests in order to make the best possible use of cultivated and natural grasslands in western Canada (Anonymous 1986). The Saskatoon Forage Laboratory did an excellent job of introduction and breeding of forage species adapted to the Prairie Region. For example, smooth, meadow, and hybrid brome grass lines bred by R.P. Knowles proved to be a suitable hay and pasture crop for the Parkland region (Anonymous 1939). However, the position of a dedicated forage entomologist was not established at Saskatoon until 1946, when Harold McMahon was assigned the task of identifying and determining the distribution of all harmful and beneficial insects affecting legumes and grasses (Riegert 1990).

Insect Pests of Forage Grasses

Before the middle of the last century, the principal components of Prairie forage landscapes were native grasses. Rangelands and hay fields were not intensely managed, and insect pests were tolerated. Today, 80% or more of native Prairie grasslands have been repurposed (Bailey et al. 2010). Advances in forage breeding have developed tame forages suited to the prairie climate, but these crops require inputs, including seed. Tolerance to insect injury, which is usually greater in native hay stands than tame ones, and in perennial rather than annual crops, decreased. Any tolerance that existed was drastically reduced in all types of forage seed production.

The main insect pests of forage grasses are generalist feeders, including grasshoppers, cutworms, and wireworms, which always have been and still are key pests of cereal crops on the Prairies (Riegert 1980, Anstey 1986, Olfert 2014). The importance of these pests is reflected in the subject matter of the 156 graduate theses of entomological students from the Universities of Saskatchewan and Regina from 1926 to 2019; 30% of these examined aspects of orthopteran, wireworm, or cutworm biology (Riegert 1990, Vankosky et al. 2019). Only two theses, both examining legume seed pests, dealt specifically with forage insects.

One example of insects that feed mainly on forage grasses are the grass plant bugs in the Family Miridae, such as black grass plant bugs in the genera of *Labops, Capsus,* and *Irbisia,* and green grass plant bugs, including species of *Stenodema, Leptoterna, Litomiris,* and *Trigontylus*. Severe plant bug feeding on vegetative tissue decreases forage quality, but is of less economic impact than feeding on seed stalks or seeds, which can cause sterile seed heads or silvertop. and drastically reduce seed production.

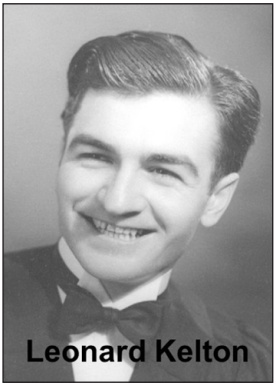


Arthur Brooks. (Photo from https://www.entsocsask.ca/brooks_scholarship.html)

The taxonomy and ecology of these mirids, and many other prairie insects, were studied by the prolific systematist Arthur Brooks (1917–1962), a Saskatchewan native and alumnus of the University of Saskatchewan. Brooks spent 10 years as a dipterist in the Systematic Entomology Unit at CEF in Ottawa, then obtained a Master's degree under the renowned mirid specialist Harry Knight at the University of Iowa in 1947, before returning to Saskatoon as a regional systematist

with the federal Department of Agriculture. By conducting extensive surveys throughout the Prairie provinces and analyzing the thousands of specimens collected annually, many of which he deposited in the Canadian National Collection, Ottawa, Brooks made considerable headway in identifying the insect fauna of the Prairies. He completed monographs on the ubiquitous Orthoptera and Elateridae of the Prairies, conducted research on lygus bugs and root maggots, and prepared handbooks on Heteroptera, Odonata, Plecoptera, and Trichoptera before his untimely death (Riegert 1990).

Leonard Kelton (1923–2011) immigrated at the age of nine with his family from what is now Ukraine to Saskatchewan in 1932. Kelton, like Brooks, was a U. of Sask graduate; after obtaining his undergraduate degree, Kelton joined the Systematic Entomology Unit at Canada Department of Agriculture based in Saskatoon, where he worked on Heteroptera. While based in Saskatoon, Kelton, also like Brooks, conducted graduate work under Harry Knight at U. of Iowa, obtaining his MSc in 1954 and PhD in 1957. Kelton spent the rest of his career in the Systematic Section of the Canada Department of Agriculture in Ottawa. During his career, Kelton described four genera and 85 species, 76 of which were mirids (Henry and Gill 2016). His seminal publication *The Plant Bugs of the Prairie Provinces of Canada* (Kelton 1980) became one of my principal forage insect reference books.



Leonard Kelton. (Photo from Henry and Gill 2016).

Forage Legumes and Their Insects

Historically, alfalfa and sweetclover (*Melilotus* spp.), were the two principal legume forages grown on the Prairies. Currently, a wide variety of forage legumes are produced across western Canada, including alfalfa, red, white, alsike and other clovers, vetches, trefoil, and sainfoin (Fabaceae). However, alfalfa is by far the most widely grown legume forage in all of North America.

Native to Europe, alfalfa was domesticated in central Asia over 6,000 years ago as food for horses. Brought to North America by European colonists, it has been called “the queen of forages”, as close to a perfect forage plant as can be had. It is relatively high in nitrogen and fibre for animal growth, and can fix nitrogen in the soil; it is deep rooted, drought tolerant, and if properly managed, can be a long-lived perennial. Seed production in alfalfa is almost entirely insect dependent.

The insect pest of greatest economic impact to alfalfa hay production on the Canadian Prairies today and the first of two insects I will discuss, is alfalfa weevil, *Hypera postica* Gyll. Initially found in Canada in 1954 on both sides of the Alberta-Saskatchewan border near the Montana boundary (Figure 1; Hobbs 1954), alfalfa weevil gradually spread eastward to Manitoba, but caused little economic damage except in the area of initial introduction (blue area on the map) until the mid-1990s. From the first report of hay volume reduction in the southwestern corner of Manitoba

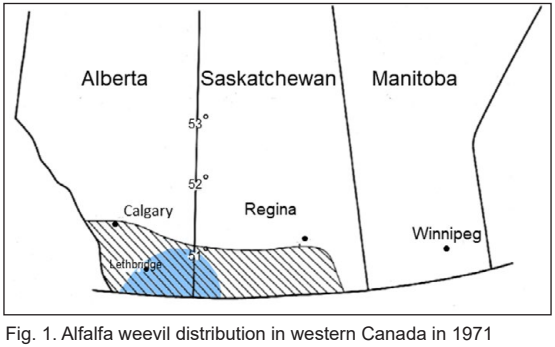


Fig. 1. Alfalfa weevil distribution in western Canada in 1971 (stripes), with area of initial introduction in blue. (Craig 1972)

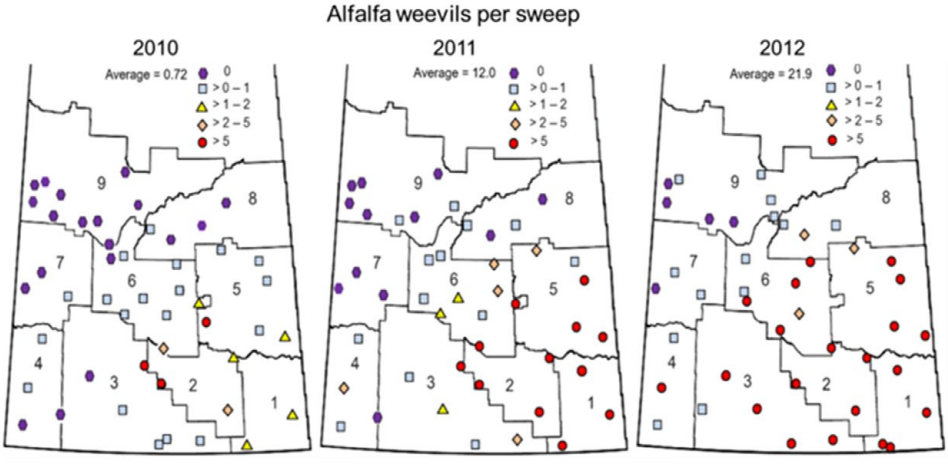


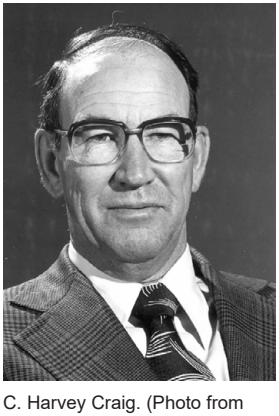
Fig. 2. Densities of alfalfa weevil in nine crop districts in Saskatchewan, 2010-12. (Soroka et al. 2020)

in 2000, its distribution spread eastward and northward in the province, and then westward across the Parkland Region (Figure 2; Soroka et al. 2020, and references therein).

Bathyplectes curculionis (Thomson), a Paleartic ichneumonid wasp, was introduced into the southwestern states of North America in 1911 to control alfalfa weevil, with limited success. It was first found in Alberta along with the weevil in 1954 (Hobbs 1954). The wasp appears to have spread slowly eastward; it was recorded from Manitoba for the first time in 2014 (Soroka et al. 2020). The steady advance of *B. curculionis* distribution, along with increasing numbers of the introduced parasitoids *Oomyzus incertus* (Ratzeburg) (Eulophidae) and *Microctonus colesi* Drea (Braconidae) (Soroka et al. 2020, and references therein), raises hope for biological control as a viable control method of alfalfa weevil in western Canada in the future.

The greatest insect problems in alfalfa occur in seed production, and include bud-blasting, flower-aborting hemipteran species in the genera *Adelphocoris, Lygus, Plagiognathus* and others, pea aphids *Acyrthopisum sativa* L., and *Bruchophagus* seed chalcids.

After several years investigating pollination and pollinaters of legume crops under Harold McMahon, C. Harvey Craig (1924–-2019), a U. of Saskatchewan graduate and Canadian Navy veteran like McMahon, was appointed forage entomologist at the Saskatoon Research Station in 1957. Harvey screened many pesticides for efficacy against forage pests, while being mindful of their effects on pollinators and other beneficial insects. He eventually developed and advocated a temporally based program for insect management in alfalfa seed production on the Prairies. I replaced Harvey as a Research Scientist in 1987, and continued to promote this pest management program, which is used by most prairie alfalfa seed producers to this day.



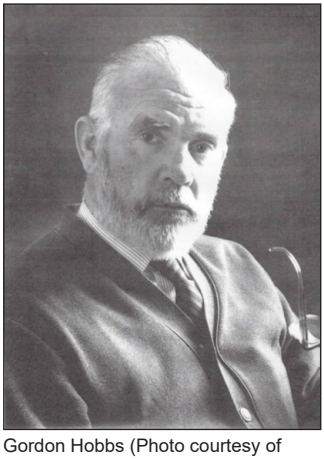
C. Harvey Craig. (Photo from Olfert 2019).

Alfalfa Pollination, Pollinators, and Seed Production

Not only is alfalfa seed production almost totally insect dependent because of its unique flower components and fertilization system, but these same features also influence which insects are its best pollinators. Each pistil/stamen column is covered by a membrane on the keel petal that is not opened until pressure, such as that of an insect landing, is applied to the keel and the membrane breaks. The staminal column then snaps upward to the standard petal, and a shower of pollen is released (pictoral depiction in Pitts-Singer and Cane 2011). This snap or thump ("tripping" or fertilizing) may deter some would-be pollinators from future landings. Also, alfalfa nectaries are at the base of the long flower column, and long-tongued bees such as bumblebees and leafcutting bees are most adept at reaching them from the flower throat. Instead of penetrating the flower to collect nectar, spreading pollen in the process, many insects prefer to 'rob' the flower, extracting nector from between the base of the petals, and having no contact with the stamens.

In 1914–18, F.W. Sladen, the first Dominion Apiarist, made several collecting trips to the Prairies. He found *Megachile* leafcutting bees to be the best alfalfa flower pollinators. Sladen observed one native species, *M. dentitarsus* Sladen (=*diligens)*, to be very diligent, visiting alfalfa flowers at the rate of 17 per minute, with a pollination rate of nearly 100%; bumblebees were much slower and less efficient in tripping, while honey bees were nectar robbers that did very little if any pollination. Sladen suggested that placement of man-made nesting habitats near alfalfa fields for leafcutting bees could stimulate alfalfa pollination (Riegert 1999). Regional entomologists investigating alfalfa pollination for the next four decades disputed or verified Sladen's work. H.E. Gray, Lethbridge Research Laboratory, felt that weather conditions were responsible for tripping alfalfa. R.W. Salt, also at Lethbridge, proposed that honey bees rob alfalfa nectar because of their short tongues, while longer tongued LCBs and bumblebees effectively trip the flowers. Forage crop breeders from the Saskatoon laboratory W.J. White, J.L. Bolton, R.P. Knowles, and Ottawa entomologist O. Peck substantiated Sladen's observations; Knowles confirmed Sladen's figure of 17 visits per minute by *M. dentitarsus* (Riegert 1999). Gradually, the premise that native leafcutting bees played a pivotal role of in alfalfa pollination in western Canada was accepted. However, with the clearing of much of the Parkland region of the Prairies by mid-twentieth century, alfalfa fields increased in size, field-forest interfaces shrunk, native pollinators decreased in number, and alfalfa seed yields diminished. Different alfalfa pollination and pollinator management was needed.

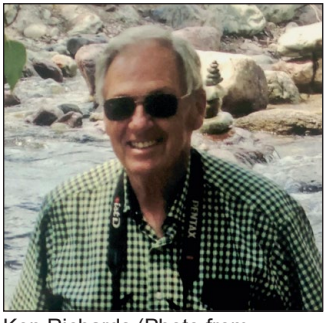
The alfalfa leafcutting bee *Megachile rotundata* F. (ALCB), the focus of my second insect tale, is a solitary bee native to Eurasia that was accidentally introduced into North America around 1930. It spread naturally, reaching the western United States in the 1950s (Torchio and Parker 1975). Shortly thereafter, it was found in southern British Columbia, but could not overwinter unaided in most parts of Canada. Commercial pollination of alfalfa with ALCB started in the western United States in the early 1960s. American studies found ALCB had high parasitism, predation, and disease rates, high male to female sex ratios, and relatively low tripping rates (Parker et al. 1976). This led some Canadian researchers to opine that reliance upon the single species *M. rotundata* for improved alfalfa seed production did not hold much promise in Canada. Fortunately, Gordon Hobbs (1916–1977), renowned bumble bee researcher at the Lethbridge Research Station, did not agree, and imported



E. Gushul

Gordon Hobbs (Photo courtesy of Weldon Hobbs).

ALCB larvae from two commercial producers in the United States in 1962–63 to examine their alfalfa-pollinating potential. His prodigious research spawned an Agriculture Canada Research Bulletin "Importing and managing the alfalfa leaf-cutter bee", which was revised and reprinted several times, becoming an extension best-seller (Holmes 1977). His investigations and extension activities on ALCB kickstarted the ALCB industry in Western Canada, which developed into a multi-million-dollar business (Hobbs 2019). K. W. Richards (1946–2019), Hobbs' replacement as forage entomologist at Lethbridge, carried on his predecessor's work on ALCB, refining management to reflect producers' management needs, and conducting international projects using ALCB.



L. Richards

Ken Richards (Photo from Shorthouse 2020).

Traits of ALCB that favour its use as an alfalfa pollinator include its docility; gregarious nesting habit; ready acceptance of man-made nesting material; use of leaves for lining nests; production of sturdy leaf cells and cocoons, which provide suitability for mechanized management operations; predictability in incubation of adult stage; high alfalfa pollination efficiency; synchronicity of bee emergence and alfalfa bloom; long field life; and high rate of reproduction (Hobbs 1965, Richards 1985, Pitts-Singer and Cane 2011). Alfalfa leafcutting bees seldom forage outside the fields where they nest and are unlikely to wander, making them less susceptible than others to pesticide drift. While naive honeybees switch to robbing nectar from alfalfa blossoms after a thump from the stamen column in their first flower visit, ALCB females appear unaffected by the contact.

In terms of natural enemies, the principal parasitoid of ALCB on the Canadian Prairies is the chalcid wasp *Pteromalus venustus* Wlkr. (Hobbs 1965, Richards 1985). D. Wayne Goerzen, with the Saskatchewan Alfalfa Seed Producers' Association, investigated *P. venustus* incidence and control methods in ALCB for many years. He also studied infection of ALCB larvae by the chalkbrood disease *Ascosphaera aggregata* Skou and related diseases, as well as the occurrence of other harmful microflora (fungi/bacteria) in ALCB populations. His and other researchers' recommendations for management of these pests have helped the industry to rear, utilize, and market high-quality ALCB larvae for domestic use and export.

Conclusions

The preceding has been a bare-bones snapshot of some western Canadian forage insects and the entomologists who studied them as seen from my perspective. I could not include many other insects and deserving researchers, but their omission is a reflection of space limitation, not unworthiness. I also could not add the many fascinating details that bring history alive. Leonard Kelton, for example, apparently avoided bureaucratic minutiae like leave forms and other types of paperwork, not surprising since many of his new species descriptions were from specimens captured from prime fishing areas (Henry and Gill 2016). Suffice to say that the insects that inhabit forage crops in western Canada are fascinating lot, and the researchers who studied them were tenacious, inventive, and quirky, much like entomologists everywhere.

Acknowledgements

I thank Wayne Goerzen, Owen Olfert, and Héctor Cárcamo for helpful suggestions, and Weldon Hobbs for his father's portrait.

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A Special Topics compendium: A Role for Entomology in Education

For many of us, Entomology is a hobby, a profession, an obsession or maybe a lens through which we view the world. It is also true that Entomology can function as an important tool for teaching facts and concepts about the natural world. Further, there are many different ways in which this tool can be employed. In this Special Topics compendium, a select group of entomologists give us their take on the role of Entomology in Education, ranging from mentoring one-on-one to massive virtual Entomology courses where the number of students might total in the thousands. Each article is a stand-alone piece however there are clear connections among the articles, and, in particular, the authors share a joy in the opportunity for enlightening others through the study of arthropods.

Mentoring from the Bronze Age to the Anthropocene

Emma Despland

The word 'mentor' came to English via medieval French and Latin from a word associated with 'mind', originally from the name of the advisor of the young Telemachus in Homer's Odyssey. Telemachus was the son of Odysseus (or Ulysses in the Latin version of his name), who found himself in charge of the kingdom at a young age, while his father was off fighting the war against Troy, then slowly finding his way home over many adventures.

What are implications of this 8th century BCE digression for mentoring in the 21st century AD (almost 3000 years later)? What can the original mentor, Mentor, teach us about mentoring?

The person in charge of the kingdom of Ithaca was Telemachus, not Mentor. The role of Mentor was not training Telemachus to follow in his footsteps. Instead, as an older person, he was sharing his experience with the younger Telemachus to help him make the best decisions in his own responsibilities.

How does this apply in practice?

- All students are different; they have different goals and need different sorts of mentoring. One of the best pieces of advice I received when I started teaching was to remember that most students are probably not like me. In particular, if EDI commitments imply that we take students from under-represented or even marginalized backgrounds, we should be aware that some of these students will have faced and still be facing challenges that we might find hard to imagine. They might have needs, goals and motivations different from ours. Here is an example of an academic entomologist explaining the obstacles he faced as an international graduate student from the Global South (Khelifa 2023).
- The career landscape is changing. Only about one third of people with science PhDs obtain research positions. So, the majority do other things, many highly meaningful, important, impactful things. This implies that we should not see our job as only training researchers. The path we followed is not the necessarily the best or the only one. It might not even exist anymore. However, many other new paths are opening, and while we cannot know about all of them, we can certainly be open-minded in encouraging trainees to explore their options.

Emma Despland (Emma.Despland@concordia.ca; Professor, Concordia University) obtained her doctorate at Oxford studying desert locusts. She currently works on plant-insect interactions at the level of the individual organism, including behaviour, nutrition and chemical ecology. She studies caterpillar sociality and multi-trophic interactions, with a focus on outbreaking pest insects and insect conservation.

Entomological knowledge is needed in many different areas, and we should not narrow our students' vision.

- The world is changing. Generative AI is becoming an everyday tool. The climate and biodiversity crises are becoming more and more urgent. However, the state of knowledge about the proximate and underlying causes and about measures required to address these crises is also much better (the IPCC (2023) and IPBES (2019) executive summaries lay things out very clearly, great examples of science communication). Entomologists have precious knowledge of biodiversity—insects being the majority of animal species and playing keystone roles in terrestrial and freshwater ecosystems. We have a role to play in meeting biodiversity commitments, and this implies opportunities in governments, businesses and NGOs for young entomologists with expertise in agriculture, forestry, conservation, water quality, food-and-feed production, organic waste treatment etc… (more thoughts on this in Despland 2023).

As an academic, mentoring is a large part of my job, yet something for which I had little or no training. When I started my position at Concordia University, most what I knew about leading groups I had learned through the hiking society to which I had belonged as a student. All the changes listed above make it hard to give specific advice, but some general principles of human experience still hold true, and wisdom is the art of knowing what to pass on. In addition to telling your own story, I tell those of friends and colleagues too, especially those of people who overcame obstacles ("failing a class was the best thing that ever happened to me" from a senior scientist) or who followed different paths ("not doing a PhD was the best decision I ever made" from a national-level research manager).

Training in mentorship is gradually becoming more available and can be a meaningful investment in the future as well as a voyage of self-discovery and a tool for positioning oneself in the world. Mentoring is obviously part of academic positions but can also become a significant role in many other walks of life as one gradually becomes an older, more experienced (hopefully wiser) person.

David Suzuki reflected on reaching his 86th birthday (Bosak 2022): "I'm an elder. This is the most important part of my life. (…) I'm in the position of sifting through a lifetime, and saying what have I learned that I can pass on? That's my job." Reflecting on past experiences to share the valuable bits with upcoming generations is the essence of mentoring and it can start much earlier in life, as soon as you have experiences worth sharing. Seeing the strength in others and drawing on what you've learned to support them is one of the most rewarding and meaningful things in life. It's a way of growing into yourself and creating a legacy. You're never too young to be an elder-in-training.

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Entomology Outreach in Saskatchewan: Bringing Insects to the Community

Meghan Vankosky, Chrystel Olivier, Iain Phillips, Graham Parsons, and Tyler Wist

In our experience as scientists (and entomologists) at outreach events, there is nothing quite like a few boxes of pinned insects or a cage of live insects (and other arthropods) to catch people's attention and start a conversation. We have observed this phenomenon during research and science-based open houses, field days, trade shows, and at in-school events. Children love to tell us about the insects they have seen, about the insect that they like, and about what scares them. Adults tend to ask us about what might be eating their tomatoes or how to get rid of aphids in their houseplants. Everyone seems to have a picture of some 'weird bug' or 'huge spider' on their phones to show us, often accompanied by the question "WHAT is THIS?" Insects serve as a gateway to more serious conversations with people in our communities regarding insect diversity, ecology, insect/plant and insect/human interactions, invasive species, and how to manage pest species. These conversations, while maybe uncomfortable for some, can also make it easier for people to engage with other scientists at these events.

The Entomological Society of Saskatchewan (ESS) is not huge in terms of members, but the ESS has a core of members that are keen to talk about insects to anyone willing to listen. We are not unique among the regional entomological societies in Canada, but perhaps our experiences will be helpful to our colleagues who also engage in insect outreach in their communities.

Insect Outreach Events in Saskatchewan

The Youth and Amateur Encouragement Committee of the ESS, currently co-chaired by Dr Chrystel Olivier and Dr Tyler Wist, organizes ESS participation in outreach events and keeps track

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Meghan Vankosky (meghan.vankosky@agr.gc.ca; Research Scientist, AAFC Saskatoon Research and Development Centre) is the co-chair of the Prairie Pest Monitoring Network and studies the ecology, population dynamics, and pest management of several important pests of prairie field crops. She is interested in biological control and studied biological control at the University of Windsor and University of California, Riverside, before moving to Saskatoon. Chrystel Olivier (AAFC Saskatoon Research and Development Centre) completed her doctorate at Université de Bourgogne in France and has spent most of her Entomology career working on insect vectors of phytoplasmas. Although her current role as Acting Director of Research, Development and Technology takes up a lot of time, Chrystel remains dedicated to outreach and Entomology communication in Saskatchewan. Iain Phillips (Senior Aquatic Macroinvertebrate Ecologist, Water Security Agency) obtained his doctorate from the University of Saskatchewan. His work at the Water Security Agency is focused on biomonitoring and understanding how the abiotic characteristics of waterbodies influence macroinvertebrate communities. He is a founding member of Troutreach Saskatchewan and has served as the ESS Secretary since 2010. Graham Parsons is the Pollinator Biosecurity Specialist with the Saskatchewan Ministry of Agriculture, where he works on projects to promote healthy pollinator populations, including a recent study focused on spraying insecticides for lesser clover weevil at night rather than during the day. Graham talks about pollinator biosecurity at outreach events throughout the year. Tyler Wist (Research Scientist, AAFC Saskatoon Research and Development Centre) spends the summer chasing wheat midge, flea beetles, and all sorts of aphids in field crops in Saskatchewan. He is the chair of the ESC Student Awards Committee, the Entomological Society of Saskatchewan Treasurer, and chair of the ESS Youth and Amateur Encouragement committee.

of additional events attended by ESS members each year. Despite our best efforts, the Youth and Amateur Engagement Committee reports in the ESS Proceedings do tend to underestimate the involvement of ESS members in outreach across Saskatchewan. The biggest annual event that ESS attends is Gardenscape (currently sponsored by Saskatchewan Blue Cross), where ESS volunteers staff a booth about insects (Figure 1) and where Tyler Wist gives a presentation about beneficial insects in gardens at the Blue Cross Main Stage. This yard-and-garden tradeshow takes place over three days (Friday–Sunday) and ESS receives an invitation to participate in the tradeshow in exchange for giving a presentation titled "Good Bugs/Bad Bugs" to Grade 3 classes on the preceding Tuesday, Wednesday, and Thursday. "Good Bugs/Bad Bugs" is part of the "Garden Experience" program, an educational series organized by *Ag in the Classroom*, where Grade 3 students learn about plants, composting, insects, and other yard and garden related topics. The "Good Bugs/Bad Bugs" session includes a short presentation, tailored to a Grade 3 audience, about insects and what makes an insect 'good' or 'bad' according to humans. Then we set the schoolkids loose to check out the insects and arthropods in the ESS insect collection and answer their questions about the collection (e.g., are these REAL?" is the most common question each year). "Good Bugs/Bad Bugs" is very popular and our most common feedback from teachers is that 15 minutes per classroom is just not enough time (at least one student has cried when it was time for them to leave "Good Bugs/Bad Bugs").

T. Wist

Figure 1. Dr Chrystel Olivier, the co-chair of the Entomological Society of Saskatchewan Youth and Amateur Encouragement Committee at the ESS Booth at Gardenscape.

Members of the ESS participate in a wide variety of agriculturally focused outreach events, for the ESS and for our work, using ESS resources (Figure 2). Recent agricultural outreach events where Entomology was well represented include *Ag in the City*, *Crop Production Show*, and *Ag in Motion*. Of these, *Ag in the City* (Figure 3) is an opportunity for people of all ages in Saskatoon to learn about farming and is held in one of the local malls; the other events are targeted towards farmers, agronomists, and other agricultural stakeholders. During the COVID-19 pandemic, *Ag in the Classroom* leveraged virtual meetings so that agricultural scientists could 'visit' high school classrooms. For example, Dr Meghan Vankosky presented to a high school class about her career path (how DOES one become an entomologist?) and the research she does at Agriculture and Agri-Food Canada in Saskatoon. Virtual outreach lacks the hands-on fun of in-person outreach, but for virtual events, we leverage amazing insect pictures taken in our labs and in the field during our research to help engage with audiences. Dr Wist

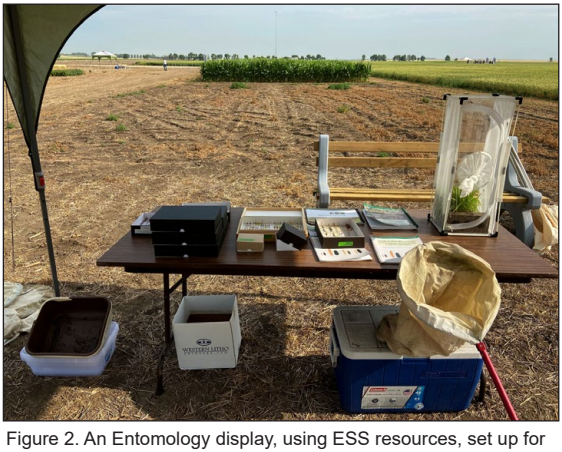
M. Vankosky

Figure 2. An Entomology display, using ESS resources, set up for a field day at Watrous, Saskatchewan. The display was hosted by Dr Meghan Vankosky and attendees were invited to sweep the surrounding crop areas for insects.

has presented about beneficial insects in agriculture using "insect-death videos" for several years in a row to students across Canada (on average 6000 live and post-presentation) on a virtual teaching platform called "Exploring by the seat of your pants". In a rather unique agricultural outreach opportunity before the pandemic, Dr Chrystel Olivier presented the ESS collection to visitors to the Western Development Museum in North Battleford, Saskatchewan during the visit of a travelling exhibit, *Canola: A Story of Canadian Innovation*.

M. Vankosky

Figure 3. Part of the ESS display from *Ag in the City*, including display boxes from the ESS collection, some Petri dishes of live insects, and insects (and other arthropods) preserved in resin.

Outside of agriculture-focused events, ESS members participate in a variety of other outreach events. Examples since 2015 include *Gone Wild for Wildlife*, hosted at various venues in Saskatoon, the BioBlitz Canada 150 event held in Regina in 2017, and student visits to our labs for Take Your Kids to Work Day (November of most years) and International Women's Day. The ESS is regularly invited to give insect presentations at provincial parks across Saskatchewan by the Provincial Park Interpreters and Chrystel Olivier has dedicated her time to attending these events where she is known as "The Bug Lady." Several ESS members are also part of the team at Troutreach Saskatchewan, an organization supported by the Saskatchewan Wildlife Federation. Troutreach Saskatchewan supports the education of graduate and undergraduate students in Saskatchewan, teaches children in Saskatchewan communities about insects, and has curated a collection of Saskatchewan insects. Troutreach Saskatchewan has a mandate to continue with community education and outreach in the future.

Our community is also eager to learn about pollinators and several ESS members are uniquely situated to talk about pollinating insects, including Graham Parsons, the Pollinator Biosecurity Specialist with the Saskatchewan Ministry of Agriculture and former ESS President. In the past year alone, Graham taught over 600 students from 15 schools around Saskatoon about pollinators as part of an *Ag in the Classroom* event, and showed off an observation hive and pinned insects at two events: the Lloydminster Exhibition and the Food Farm event at the Conservation Learning Centre.

Finally, ESS members are regularly invited to visit classrooms at schools in our communities. We are invited to classrooms at schools our children attend and to schools without family connections. Our presence at events like Gardenscape helps us to make connections in our communities, resulting in requests for visits to schools, for example. Otherwise, educators, clubs, and other groups interested in insects can find us online and will reach out to the ESS President or Secretary with requests for insect outreach.

Tools for Successful Outreach

The ESS, with some financial support from the Entomological Society of Canada through the Public Education Grant, has access to tools that are vital to successful insect outreach. These include:

1. ESS Insect Collection: The collection includes pinned and labeled insects ready for display (Figure 3). The various display boxes in the collection give examples of the different insect orders, insects found in Saskatchewan, insect pests of certain crops, and a variety of eye-catching tropical insects. We also have a set of insects preserved in resin, perfect for handling

and observation by people of all ages (we just have to make sure that none are absconded with or borrowed by our keen audiences).

2. Live insects: Thanks to our work at various institutions across Saskatchewan, we have access to a variety of live insects that we can include in our displays. Most of these insects are borrowed or donated from colonies that we rear for research, including diamondback moth, bertha armyworm, grasshoppers, and honey bees. We often have access to multiple life-stages of the live insects from research colonies and these are perfect for teaching audiences about insect lifecycles and two types of metamorphosis. In her role as the Rearing Biologist at AAFC, Dr. Ruwandi Andrahennadi has traditionally provided us with diamondback moths, bertha armyworm, and grasshoppers, while also volunteering at events herself. At outdoor outreach events in the spring, summer, and fall, we also demonstrate how to use sweep nets and other insect collecting equipment. This exercise often provides a diversity of insects for our audiences to hold and (gently) investigate.
3. Pictures: Many ESS members are keen amateur photographers and willingly share their pictures for outreach.
4. Presentations: In the last 5–10 years, the ESS has developed and is always revising, a slide deck for "Good Bugs/Bad Bugs" and a slideshow of insect pictures, showcasing pest insects and beneficial insects, that we play on repeat at some outreach events. The ESS has also invested in a projector and a mobile screen that we can set up at nearly any outreach event, so long as we have access to power to run the projector and either an Apple TV (donated by an ESS member) or a computer.
5. Keen volunteers: ESS members have a history of creating outreach opportunities and finding new ways to engage with our community about insects. During the COVID-19 lockdown in spring of 2020, for example, Dr Owen Olfert borrowed some of the ESS collection and set up a display table in his front yard in Saskatoon. While maintaining appropriate physical distance and wearing PPE, Owen spent a few days engaging his neighbours and the many people out walking in conversations about insects.
6. Event coordinator(s): The co-chairs of the Youth and Amateur Encouragement Committee ideally serve as a centralized point of contact for outreach requests (although our system is not perfect) and are the primary organizers of large events, like Gardenscape. In their current role as committee co-chairs, Tyler and Chrystel are a point a contact for event organizers, schedule volunteers, and plan for the transport and storage of ESS display materials.

Factors Limiting Outreach by the ESS

Volunteers are among the most important tools for successful outreach events and are also the single most limiting factor. The ESS takes on a lot of outreach, but we also have to turn down requests because volunteers are not available. Outreach events that take place during hours of work limit which ESS members can volunteer. Similarly, events held in the evening, on weekends, or otherwise outside of work hours can also affect who is willing or able to volunteer. We must all balance outreach and other volunteer opportunities with our school, career, and personal obligations. As a result, outreach events that take place nearest to where entomologists live in Saskatchewan (e.g., Saskatoon, Regina, Prince Albert) are easiest to commit to. Events where ESS members can sign up for shifts are also easier to accommodate, as the work is spread among many instead of assigned to only one or two people. The willingness of ESS student and emeritus members to volunteer contributes significantly to the ability of ESS to commit to insect outreach and we thank each and every one of our ESS volunteers for their time, enthusiasm, and energy.

Saskatchewan may not be densely populated, but the ESS is invited to and finds opportunities to engage in insect outreach on a regular basis. Our insect collections break the ice and initiate conversations that sometimes test our knowledge, but that are always engaging, and we hope, are always educational.

Development of a Massive Open Online Course for Teaching and Outreach of General Entomology

Maya L. Evenden and Ilan Domnich

Introduction

Massive Open Online Courses (MOOCs) are accessible, university-level courses offered by reputable universities that are generally available free of charge to anyone with an internet connection. It is the accessibility of MOOCs that distinguishes them from other on-line learning resources that target limited audiences. The first MOOC was created in Canada in 2008 (Baturay 2015), and since then many universities have developed courses offered on several different on-line platforms. The University of Alberta launched its first MOOC, *Dino 101: Dinosaur Paleobioogy* in 2013 (McGreal et al. 2015), and now offers seven MOOCs with 10-12 modules that are equivalent to semester-long university courses. In addition, the University of Alberta offers multi-course MOOC programs and specializations, as well as shorter mini-MOOCs with 4-5 lessons on specific topics (www.ualberta.ca/admissions-programs/online-courses). Bugs 101, Insect-Human Interactions, launched 28 June 2019 as a full, 12-module course on the *Coursera* platform (www.coursera.com) (Figure 1). Since the fall 2019 semester, a version of Bugs 101 has

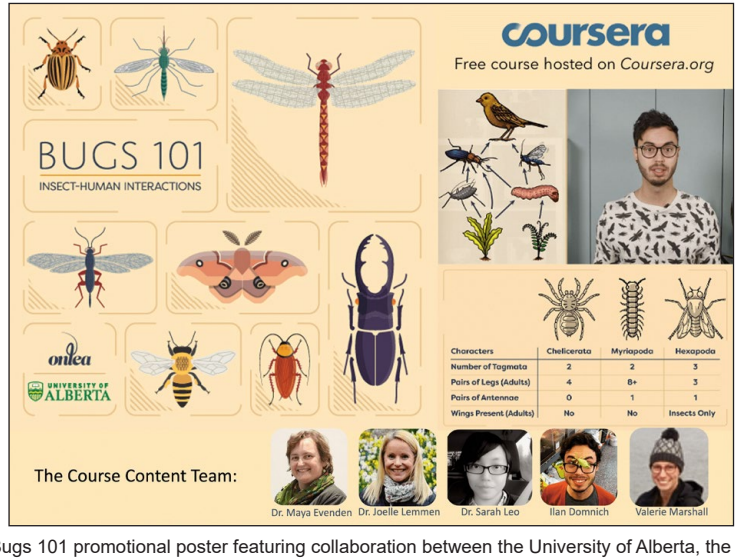

Figure 1. Bugs 101 promotional poster featuring collaboration between the University of Alberta, the production company Onlea, and the MOOC platform *Coursera*. Insect title cards used in course modules were designed by Onlea. Members of the course content team include Drs Maya Evenden, Joelle Lemmen and Sarah Leo, Ilan Domnich, and Valerie Marshall. Food web and arthropod body form diagrams were created by Ilan Domnich who is pictured in a screen shot from the course videos next to the food web diagram.

Maya Evenden (mevenden@ualberta.ca) received Master of Pest Management and PhD degrees from Simon Fraser University. She is currently a professor in the Department of Biological Sciences at the University of Alberta, where she teaches Entomology and Chemical Ecology. Her research focuses on insect behaviour, chemical ecology, plant-insect interactions and semiochemical-based pest management. Ilan Domnich (domnich@ualberta.ca) graduated with a BSc and MSc from University of Alberta. Ilan helped create the content for Bugs 101, and facilitated the course for 1 year. Ilan combined his interests for art, science, and education during his involvement in the MOOC.

also been offered as ENT 101, for credit, to University of Alberta students. Our goals in developing Bugs 101 were to: 1) develop a widely available and accessible general Entomology course; 2) engage and educate learners about insect-human interactions; 3) promote Entomology at the University of Alberta and in the province of Alberta; and 4) to develop an introductory Entomology course offering for University of Alberta students. This overview is an update and expansion of an earlier account of the development and implementation of Bugs 101 published in the *American Entomologist* (Evenden and Domnich 2020).

Course Development and Content

As part of the digital learning strategy at the University of Alberta, the development of Bugs 101 followed a 4-step instructional design method from 'Discovery' to 'Implementation' to imagine and develop the course content, produce the videos and facilitate the offering following course launch (Table 1). During the 'Discovery Phase', we submitted a funding application that outlined the learning outcomes for all course modules (Table 2) and a course map that illustrated the flow and connectedness of the modules. Funding to support the MOOC came from various levels of university administration including central administration (Discovery Phase), the Faculty of Science (Development, Production, and Implementation Phases) and the Department of Biological Sciences (Implementation Phase) (Table 1). Funding acquisition was crucial for MOOC development and production, as course development was an expensive process that involved hiring content experts to work with educational developers and production professionals. Two full-time subject matter experts were employed for two years to research material, write scripts and course notes, and present material in the Bugs 101 videos (Figure 1). In addition, two computing science students were hired on short term contracts (four months) to develop code for the interactive learning objects in the course. Most of the budget was dedicated to costs associated with working with the production company (onlea.org) who filmed the lessons and interviews, and developed many of the diagrams

Table 1. Activities and funding contributing to the 4-step instructional design process used in the development of Bugs 101.

Instructional Design Phase	Activities	Funding Source
Discovery	• Imagine course possibility • Develop course map • Develop course learning objectives • Apply for funding	Central Administration, University of Alberta
Development	• Research topics to be covered • Create scripts • Acquire visual assets • Develop Integrated Learning Objects • Write course notes • Develop assessments	Faculty of Science, University of Alberta
Production	• Create video content • Conduct interviews	Faculty of Science, University of Alberta
Implementation	• Course launch • Course maintenance • Course review and improvement	Faculty of Science and the Department of Biological Sciences, University of Alberta

and animations to support the learning outcomes (Table 2). Pedagogical support for Bugs 101 was provided by educational developers in the Science Education and Learning Innovation Facilitation Team (Faculty of Science, University of Alberta). Once the MOOC was launched on *Coursera*, a version was developed for credit for students enrolled at the University of Alberta. The on-campus version of the course has been offered in each fall and winter semester since fall 2019. Both course versions were supported by a full-time course facilitator for one year following course launch. Since that time, facilitation of the worldwide web and on-campus versions of the course has been part of the workload of an academic teaching staff member in the Department of Biological Sciences.

Table 2. Modules in Bugs 101 with associated learning objectives. Modules are grouped into three groups pertaining to 1) evolution and biology of insects (green), 2) ecosystem functions provided by insects (yellow), and 3) sustainable insect-human interactions (orange). The number of lessons and video time are shown in brackets. Table modified from Evenden and Domnich (2020) .

Module Number and Name (Lesson Number and Video Time)	Learning Objectives
1. Introduction to insects and their terrestrial relatives (9 lessons, 84 min)	• Describe the evolutionary relationships between insects and their terrestrial arthropod relatives • Define the traits that distinguish insects from other terrestrial arthropods • Identify the evolutionary traits that contribute to insect success and diversity • Inventory major groups of insects and examine their diversity • Discuss the importance of insect collections and museums • Apply knowledge gained to initiate personal insect collection
2. The business of being an insect: Basic Biology I (6 lessons, 36 min)	• Identify the three major body regions of an insect • Recognise and define the functions of mouthparts and locomotory, sensory and reproductive structures • Discuss the structure and function of insect digestion and excretory systems • Explain the structure and function of insect circulatory and gas exchange systems
3. The business of being an insect: Basic Biology II (7 lessons, 51 min)	• Discuss the structure and function of the insect nervous system • Identify the different cues used by insects to locate and attract mates • Describe the structure and function of the insect reproductive system • Discuss the different modes of reproduction found in insects • Examine how knowledge of insect reproduction contributes to pest management

(continued)

Table 2. Modules in Bugs 101 with associated learning objectives. (continued)

Module Number and Name (Lesson Number and Video Time)	Learning Objectives
4. Insect locomotion (12 lessons, 66 min)	• Discuss the difference between passive and active dispersal in insects • Discuss how insect muscles operate • Examine insect leg modifications and their functions • Examine insect wing structure and identify common wing modifications • Identify different types of insect flight muscles • Discuss research methods for measuring insect flight • Explain the biology of insect migration and the adaptive traits for long-distance migration • Analyse the importance of insect migration to pest management and conservation
5. Insects as decomposers (6 lessons, 52 min)	• Evaluate and summarise the roles insects play in nutrient cycling • Identify insect detrivores in different insect orders and feeding guilds • Discuss the effect of temperature on insect postembryonic development and calculate degree-day accumulations • Demonstrate applications of insect biology, behaviour and development to forensic investigations • Apply concepts from ecological succession and postembryonic development to Forensic Entomology
6. Plant feeding and impacts of herbivory (7 lessons, 59 min)	• Compare and contrast specific and diffuse co-evolution and resource tracking • Distinguish the costs and benefits of plant-feeding specificity in insects • Discuss plant defense mechanisms against insect herbivory • Identify different feeding guilds of herbivorous insects, their specialised adaptations and the associated plant damage • Assess the impact of insect herbivores on agriculture, forestry and horticulture
7. Pollination and beekeeping (9 lessons, 76 min)	• Define pollination and discuss its evolutionary history • Differentiate cues used by plants to attract insect pollinators • Assess human impacts on natural pollinator populations • Evaluate the economic and ecological importance of pollinators • Discuss the history of apiculture and compare species of bees reared • Discuss bee eusociality and the biological traits associated with eusociality • Examine variables that affect bee population decline and ways to manage them

(continued)

Table 2. Modules in Bugs 101 with associated learning objectives. (continued)

Module Number and Name (Lesson Number and Video Time)	Learning Objectives
8. Insects and disease (6 lessons, 67 min)	• Compare and contrast modes of disease causation and transmission by insects • Discuss the historical importance of insect disease transmission and the roles of insects in emerging infectious diseases • Compare and contrast Medical, Veterinary and Agricultural Entomology • Assemble examples of insect-borne human diseases and recognise the insect vectors • Evaluate the impact of insect-borne human diseases on public health • Analyse insect-borne animal diseases, identify the insect vectors and recognise the impact on domesticated animals • Identify common insect-borne plant diseases and discuss their transmission and ecomomic impact
9. Sustainable insect-human interactions-IPM (6 lessons, 77 min)	• Explain the principles of Integrated Pest Management (IPM) • Identify the ecological and economic benefits of IPM • Compare and contrast different tactics used in IPM • Discuss the benefits and problems associated with insecticide use • Examine the modes of action of different insecticide classes • Discuss the evolution of resistance to insecticides and approaches to slowing its development
10. Sustainable insect-human interactions-IPM (Biological and Cultural Control) (6 lessons, 90 min)	• Evaluate biological control in IPM and discuss the benefits and drawbacks to this tactic • Compare and contrast classical, augmentative and conservation biological control • Differentiate parasitoids, predators and pathogens as biological control agents • Define cultural control as an IPM tactic • Compare ways to implement cultural control and the impact on pest populations • Evaluate host resistance as a cultural control measure
11. Insect conservation (7 lessons, 110 min)	• Evaluate the importance of insect conservation • Rationalise the need for insect conservation • Identify and explain the causes of insect population and species decline • Develop approaches to insect conservation • Recognise the importance of citizen science to insect conservation
12. Insects in human culture (6 lessons, 101 min)	• Define Cultural Entomology • Asses the role of insects in myths, religions, and symbology • Interpret the incorporation of insects in various art forms • Appraise biomimicry and discuss the insect inspired products in science and technology • Evaluate the sustainability of entomophagy

Modules

Bugs 101 has 12 modules, each made up of several lessons, each of which are meant to be completed in one week (Table 2). The first four modules provide an introduction to the evolution, diversity and biology of insects and other terrestrial arthropods. The middle of the course (modules 5-8) highlights the ecosystem function roles that different insects play. The final third of the course provides insights into sustainable insect-human interactions including integrated pest management, insect conservation and the position of insects in human cultural activities (Table 2). Each module has an introduction video, several content or lesson videos and a conclusion video that ties the content to the next module. Video content is accompanied by course notes that reiterate and expand upon content in videos. There is a quiz at the end of each module, but students need not complete the quiz to move on to the next module.

Visual Assets

Photos, diagrams, videos and animations were used extensively in Bugs 101 to promote visualization of course content (Figure 1) and to increase the production value of course videos. The content experts spent a lot of time acquiring and developing digital assets to complement course content. Many of the diagrams used to illustrate key course concepts were drawn by Ilan Domnich, one of the content experts and others were produced by the production company, Onlea (Figure 1). For images obtained from outside sources, we worked with the University's copyright office to ensure all permissions were in place for all images used in the course.

Interviews

To enrich student learning and expose learners to career opportunities in Entomology, we included interviews of 26 experts in a variety of fields who spoke about a number of different entomological topics. Our budget limited travel, so all but one (Dr. Gail Anderson) of the interviews was based in Alberta. Interviewing Albertan entomologists, however, contributed to our goal of promoting Entomology at the University of Alberta and in the province. Recorded interviews (~30 minutes long) were edited to ~5-minute segments and embedded directly into videos in 9 of the 12 course modules. Interview questions were displayed on the screen as interviewees provided the answers. At the end of each interview, experts shared their favourite insect with learners and explained what was so interesting about that insect.

Interactive Learning Objects

Interactive Learning Objects (ILOs) are small interactive web apps that promote active learning to enrich, strengthen and steer online learning (Kay and Knaack 2007). Interactive Learning Objects bring a component of gamification to online courses and help learners grasp concepts with active reinforcement. Bugs 101 contains thirteen ILOs (www.bugs101-interactives.ca) that mostly consist of simple drag-and-drop matching or puzzle games with instant feedback on correct answers.

A highlight of the course is a capstone ILO that is much more complicated than the simple drag-and-drop games. We developed the capstone ILO over a four-month period working with a computing science student, Konishkya Roy Chowdhury, who did all of the coding behind the application. Learners who complete the capstone ILO need to synthesize and apply knowledge obtained from previous course modules to the complex concept of Integrated Pest Management (IPM) in a virtual managed agroecosystem. Learners choose to manage the virtual crop with or without insecticidal inputs under warm or cool seasonal conditions. Learners decide on the most appropriate pest management tactics to apply at times that make biological sense based on pest monitoring, the mode of action of the tactic, and environmental conditions. Development

and implementation of the pest management program helps learners understand the effect of management decisions on economic and ecological factors, including non-target species like pollinators and natural enemies, in the managed ecosystem. We incorporate economic variables such as management costs and market prices along with environmental and biological variables into the ILO, so that learners understand the reach of management decisions beyond crop yield.

Course Implementation

Course reach

Bugs 101 launched on 28 June 2019 and data about learner access to the course material was gathered from www.coursera.org at two months (28 August 2019), four months (29 October 2019), two years (9 November 2021) and four years (12 October 2023) post course launch. Bugs 101 was noticed on the *Coursera* platform quickly, as there were 22,910 unique visits to the course site at two months post launch, which increased to 31,792 unique visits at four months post launch. There were 143,899 and 197,900 unique visits recorded at two- and four-years post launch, respectively. At two months post launch, there were 5688 learners enrolled, and by four months post launch that had increased to 6844 learners. There were 33,025 and 43,069 enrolled learners at two- and four-years post launch, respectively. As was the case for many MOOCs, Bugs 101 experienced a peak in enrollment during the Covid-19 pandemic. Although Bugs 101 learners should complete the course during the thirteen-week time period of a university term, 52 learners finished the course by eight weeks, post launch, and 298 learners completed the course at the expected thirteen weeks, post launch. At two- and four-years post launch, 3520 and 4881 learners had completed the course. As would be expected, the percentage of enrolled learners who complete Bugs 101 has increased with time post launch. At two months post launch, less than 1% (0.91%) of enrolled learners had completed the course. By four months post launch, however, course completion had increased to 4.3% of enrolled learners. Course completion increased to over 10% (10.65%) of enrolled learners by two years post launch and has held steady at four years post launch (11.33%).

Bugs 101 learners originate from >132 countries worldwide, but the majority are from North America (Table 3). This differs from other *Coursera* MOOCs in which the largest group of learners is from Asia (coursera.org). India, however, had the third most Bugs101 learners by two years post launch and the number of learners from the Philippines is the fifth most numerous by four years post launch (Table 3). About as many female learners (50%) are enrolled in Bugs 101 as male learners (48%), which varies from the demographics of learners enrolled in other *Coursera* MOOCs that have ~60% male learners (coursera.org). Similar to other MOOCs on the *Coursera* platform, most Bugs 101 learners (45.07%) are in the 25-34 age group (coursera.org). There are, however, more Bugs 101 learners who are 55 and older (10.96%) than in other *Coursera* MOOCs (5.81%).

ENT 101 at the University of Alberta

A version of Bugs 101 has been offered for credit to University of Alberta students (ENT 101) every fall and winter semester since Fall 2019. The MOOC offering was augmented with the addition of several assessments including projects, and midterm and final exams. Students in ENT 101 also have the opportunity to interact directly with the instructor during in-person field trips and review sessions. There are no prerequisite requirements to enroll in ENT 101, and it can be counted as a science option in many programs across the university. Enrollment in ENT 101 has been fairly steady (62-136 students) each semester during the nine course offerings, to date. Although our intention was to introduce Entomology to University of Alberta students early in their programs, students across all years of study enroll in ENT 101 (Y1= 25.2%; Y2=21.9%;

Table 3. Top six-seven countries of > 132 countries of origin of enrolled learners in Bugs 101, at two and four months, and two- and four-years post launch on 28 August and 29 October 2019, 9 November 2021 and 12 October 2023.

Country	Number of Enrolled Learners			
	2 months post launch	4 months post launch	2 years post launch	4 years post launch
United States of America	2614	3004		
Canada	1237	1545		
United Kingdom	251	315		
India	164	205		
Australia	134	163		
Mexico	74	103		
United States of America			9379	
Canada			4735	
India			3507	
United Kingdom			1208	
Brazil			833	
Australia			767	
Mexico			728	
United States of America				12695
Canada				6554
India				4274
United Kingdom				1564
Philippines				1005
Australia				1001

Y3=16.7%; Y4=32.7%). Students in ENT 101 come from a variety of programs, but 47.1% of enrolled students are in Bachelor of Science programs. Bachelor of Arts students make up 29.7% of the enrolled students in ENT 101, and 12.2% and 6.24% of enrolled students are in Bachelor of Education and Bachelor of Commerce programs, respectively.

Course reception

Learners have responded positively to Bugs 101. By four years post launch, Bugs 101 learners had provided 1296 ratings of the course with 92% of those being five stars. Some learners (533 by four years post launch) also took the time to write positive course reviews. The launch of Bugs 101 also resulted in interest from local media outlets that resulted in 12 radio, television, podcast and newspaper interviews within a few weeks of launch. One of the initial television interviews

led to a regular television segment as part of the local news featuring Ilan Domnich. In addition, insect-themed outreach at the Edmonton public library branches was initiated as a result of Bugs 101. The course received national exposure through a collaboration with the Entomological Society of Canada on "National Insect Appreciation Day" held on 8 June 2019. Bugs 101 has been promoted internationally through presentations at conferences (Entomological Society of America, International Congress of Entomology, *Coursera* Partners Conference) and on social media platforms. The production value of Bugs 101 was recognized with the "Best Online Course" at the Ember Awards given out by Digital Alberta (https://digitalalberta.com/ember-awards-2019/2019-winners/) in November 2019. The outreach value and pedagogical approach of Bugs 101 was recognized with the Science Communication Award from the Entomological Society of America in 2022 (https://Entomologytoday.org/2022/10/18/insect-science-interpreted-2022-science-communication-award/).

Conclusion

Bugs 101 is an award-winning Massive Open Online Course that provides broad-reaching access to a general, Introductory Entomology course. It is important for people to be aware of the importance of insects to human society, particularly with the on-going biodiversity crisis of insect decline. This course focuses on insect-human interactions, and provides background information on insect evolution, biology, and ecology. The course consists of 12 modules and is equivalent to a 13-week university course. In addition to video lessons, course readings and quizzes at the end of each module, the course is enriched by the inclusion of 26 interviews from experts on a range of topics from Forensic Entomology to insects in art. We incorporated several interactive learning objects into the course for students to actively interact with the course material. Students complete a complex capstone project to develop and test an IPM program in a virtual agroecosystem. The course is available for free to a wide range of learners from around the world and as a first-year science course to University of Alberta students.

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Volunteering as part of the Entomology student experience: valuable training or moral dilemma (or both)?

Donna J. Giberson

When I was approached to write an essay on the general topic of "The Role of the volunteer in Entomology labs ", I was quite keen. After all, volunteering in a lab or for a field project provides a student with valuable experience and skills, and can help students define a field of interest, obtain a graduate position, and perhaps even a job. Volunteering gives a student a real taste of research, as well as real-world exposure to a variety of field, laboratory, and analysis methods. On the other side of the coin, volunteers in the lab benefit faculty or project leaders by providing low to no cost help with projects thereby helping extend or replace grant funds. Enthusiastic volunteers enliven the lab, and provide new opportunities for engagement.

These are pretty broad statements, but for many, I suspect, they ring true. A straw poll I conducted over Christmas this past year told me that everyone I heard from who is currently working in Entomology (n=11) had some volunteer experience under their belt, and credited those opportunities in some way towards succeeding in their careers. Other examples can be found through a simple web search. For example, Dr Jessica Ware (Curator-in Charge, Invertebrate Zoology, American Museum of Natural History), wrote of the importance of volunteer opportunities in her own career in a 2015 essay (Ware 2015). Dr Maya Evenden also noted the importance of volunteering in her career during her 2023 ESC Gold Medal Address (see p. 11, this issue).

Here, I would like to distinguish between two major categories of volunteering in Entomology studies. The one I focus on in this article is the volunteer, often a student, in the lab or field, helping with various research projects and hopefully obtaining the benefits described above. The second category, the growing role of volunteers in citizen science initiatives, such as iNaturalist, eButterfly, eTick, BugGuide, The Global Biodiversity Information Facility (GBIF), and others, is also valuable (e.g., reviews by Acorn 2017; Gardiner and Roy 2022), but is not considered here.

My own experience mirrors the points made in the first paragraph, above. As a fairly unfocussed Biology undergrad in the 1970s, I got my start in Aquatic Entomology by volunteering to "sort bugs" in the aquatic labs at the University of Calgary. This experience subsequently led to helping U of Calgary graduate students with field work in mountain streams (further cementing my interest in stream insects) and finally to summer employment in Biology with the Alberta Government. Despite signing up for every field-based course I could find, the volunteer experience gave me more skills and opened many more doors to future opportunities than any coursework could. Later, at the University of Manitoba in the 1980s, I received more skills training by volunteering to help fellow graduate students with their field work. My CV was expanding as I added these new skills to my list.

I also benefitted from volunteerism in Entomology Education from the other side of the coin, as a faculty member at the University of Prince Edward Island. Information on volunteer opportunities may spread by word of mouth, or be advertised in related courses or on university bulletin boards, and they can be very popular, especially in study areas involving charismatic macrofauna. Hence my work in Aquatic Entomology was never quite as popular as, for example, the mammalogy or ornithology studies carried out by my colleagues, but I generally had a few applications every year for work in my lab. I worked hard at providing an enriching and mentoring experience for the one or two students I took on each year, making sure that they weren't just washing dishes or doing data entry. Students working in my lab were involved in all parts of the projects and had the opportunity to work on projects of their own. I was happy to be able to provide the same sort of experiences that were so useful for me at their stage of development.

All of the above would lead most readers to think that there isn't much of a downside, if any, to providing, or taking part in, volunteer opportunities in the Entomology (or other Biology-related) laboratory. One obvious downside, however, is the possibility of some project leaders exploiting

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volunteer labour, taking advantage of students' desires for experience without providing any mentoring or skills development in return.

A second problem, and one I have struggled with over my career, is inclusiveness. It is becoming increasingly apparent that these sorts of volunteer opportunities are not as universally available as we might think, and can actually exclude many students—students whose lived experience isn't considered because they *have* been excluded. For example, students who have to work long hours outside of class time to pay for their programs don't have the luxury of committing several hours per week (or several weeks during the summer) of unpaid time towards volunteering. Similarly, students who are juggling childcare responsibilities as well as work and coursework don't have the flexibility in timing to commit to specific hours of volunteer work. Many of these students will be in demographics that Universities are specifically trying to recruit into faculty positions to increase diversity (Orfinger 2020), including BIPOC groups and women, yet they are at a clear disadvantage in obtaining this experience that would further their careers (see reviews by Fournier and Bond 2015, Vercammen et al. 2020, Jensen et al. 2021, McKee 2023). Again, drawing on my own experience, I held three part time jobs and carried a full course load at the time that I was volunteering in the aquatic labs at the University of Calgary—a situation that led to a (temporary) breakdown in my health as well as a serious hit to my gradepoint average. In hindsight, it helped my career, but at what cost?

In my last decades of teaching and researching at UPEI, I made the conscious decision to only accept students into my lab if I could pay them. A caveat to that statement is that I frequently had unpaid students in the lab working on special projects for course credit that related to my research area, but which did not require more of a time commitment than a standard course in a student's program. Perhaps surprisingly, this decision did not reduce the number of students in my lab, though it did increase my workload in hunting for grants and programs that would provide the funding. A recent conversation that I had with Jessica Ware (mentioned earlier in the context of the importance of volunteering to her own career) confirmed that I'm not alone in this—she is also prioritising finding funding or other benefits to students working in her lab group.

In the end, I find myself torn on the morality of offering volunteer opportunities as part of an Entomology education program. Such opportunities can be immensely valuable to those who can participate (assuming that the PI provides appropriate training and skills development), but who do we exclude by only offering these opportunities to a select few who can afford them. Do we remove this type of opportunity for some, because it disadvantages others? Clearly, we should be seeking solutions that provide these opportunities more fairly, including providing more paid opportunities (which of course is funding-dependent), but also designing volunteer work around course credits or alternative forms of compensation. We need to be more flexible in timing as well, and recognise challenges faced by different demographics.

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Entomology Labs!

Bob Lalonde

When Bernie asked me to put this article together, I reflected on the experiences that led me into the Entomology game. My formal Entomology training (outside of lecture) began with the traditional bug-on-a-stick approach to laboratory delivery; no collection was required, nor any experience with live insects. The course professor WAS notably enthusiastic, but the local university culture ran more toward this rather formal approach. Personally, at this point I had already drunk the Entomology Kool-aid, so while I certainly enjoyed myself in those labs and did learn the material, I could easily see how some might not find this way of lab-delivery particularly inspiring. Labs are a great opportunity to engage students since they directly connect with the subject material in a way that lectures cannot. So, when as junior faculty, I was tasked with developing an Introduction to Entomology course from scratch, I thought about the experiences that actually made me want to become a more-or-less competent entomologist. I was forced to conclude that my undergraduate lab experience had rather little to do with it.

One major thing that I can recall is the "holy cow look at that!" Entomology moment that powered me through. Just out of high school, I had a summer job as an actor at Old Fort William in Thunder Bay, Ontario. The theme park is located on a floodplain, surrounded by a hardwood forest bounded by the Kaministiquia River. Walking in to the Fort on my first day on the job, I saw the most beautiful insect that I had ever seen in my life (up to that point). It was a River Jewelwing, clinging to the underside of an Ostrich Fern (Figure 1). It was not too mobile, as the morning was on the fresh side, so I got down on my hands and knees for a really good look at it. The low morning light shone through the fronds and set off its green iridescence and darkened wings to perfection. That was it for me. Two years later I registered in my intro Entomology course at Lakehead University. On my own, I also ordered pins and Schmitt boxes from a supplier and started making my own collection. Later, at grad school, I picked up a lot more techniques and eventually went on to develop a research program in the ecological end of Entomology.

R. Lalonde

Figure 1. Many years later, I returned to Old Fort William forest trail and managed to get a shot of a female River Jewelwing on some of those same Ostrich Ferns.

One thing that I try to do in my current labs is to arrange that "consume the Kool-Aid" moment. Achieving this, of course, is highly subjective and I recognize that the best I can do is set the table and hope for the best. I am well aware that many students do indeed get jazzed when exposed to insect specimens in a traditional lab setting, and this component of an Entomology lab is necessary. However, many more students find their moment when they see and handle insects in

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nature or do interesting things with those insects in the lab. My other consideration for lab design is (of course) to reinforce the basic educational goals of our Biology program. Accordingly, we are at pains to emphasize problem-solving, writing and data analysis as any good lab experience should tick off those boxes. So, my goal is to provide all of those experiences without overtaxing the students.

My Entomology lab periods themselves have two components, each of which occupy a portion of the allotted three hours. The first is the taxonomic component. I present the key features of the major hexapod orders, and I drill down into a few of the more familiar families for those really speciose insect orders. The second component comes from one of three lab studies which employ insect models. The nature of the three studies has evolved over the years, but currently students complete:

1. a molecular study (assaying specimens that they collect themselves for the presence of *Wolbachia* endosymbionts and identifying those specimens using CO1 barcoding),
2. a field sampling study (flowerhead insects in Diffuse Knapweed flowerheads; Figure 2), and
3. a physiological study (using a flight mill apparatus to evaluate the effect of adult diet on flight endurance for blowflies; Figure 3).

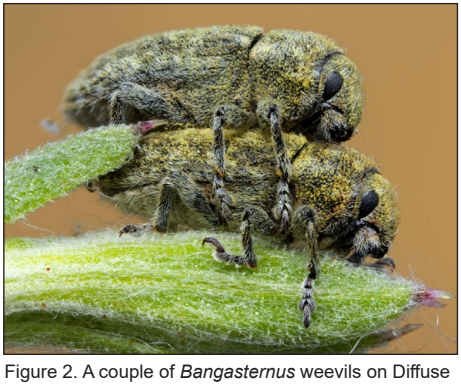

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Figure 2. A couple of *Bangasternus* weevils on Diffuse Knapweed: one of about a half dozen different insects that show up during the field sampling exercise.

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Figure 3. The flight mill lab shows students a simple approach to use for quantifying flight endurance.

The labs require analysis of data in different ways, appropriate to each type of study. The molecular study requires running BLAST searches online, and use of phylogenetic tree building as part of the write-up. The field study requires use of post-hoc inferential statistics while the flight mill exercise's statistical approach involves the use of a more balanced, planned design. I do not dictate the statistical package that students use, but our Biology program requires training in the use of R, and the majority of students use this package to analyze their lab-obtained data.

Finally, the classic assignment for an Entomology course is submission of an independently collected, curated and keyed out insect collection. I have the students submit 50 specimens, spanning 12 orders and 25 families. The number of required Orders and Families are calculated to be sufficient to make the collection challenging, but be do-able with less-than-heroic effort. Students are given a Schmitt Box, a selection of pins and a pinning block. They are also given access to points, featherweight forceps, spreading boards, dissecting 'scopes, shellac gel, various keys, and are walked through the common techniques of collection and curation during the first

lab period. The actual collecting is done on the students' own time. I point out collecting opportunities as the course progresses. For example, if there happens to be an early snowfall, I tell them about Snow Scorpionflies and the other kinds of insects that end up on the snow surface (and thus become eminently collectable!; Figure 4).

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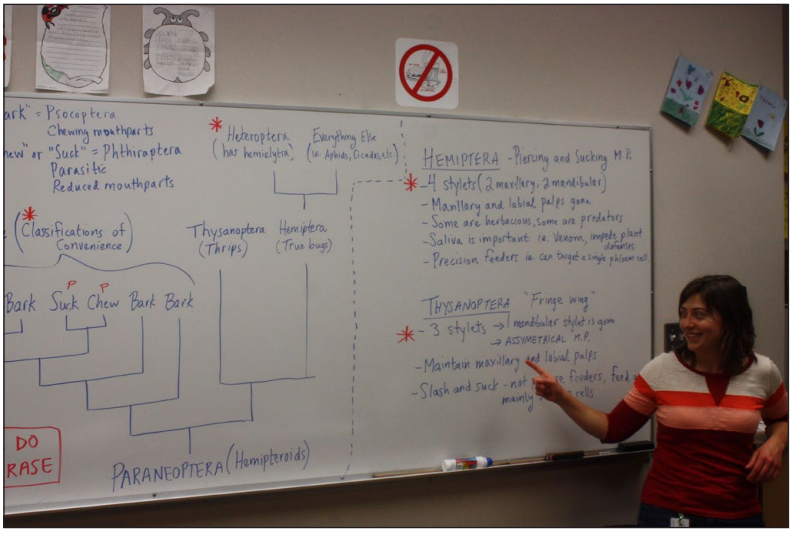
Figure 4. An early snowfall is an opportunity to find rare groups of insects, such as these Snow Scorpionflies.

The more astute students realize that the orders and families covered during lab periods represent many of the insect groups that they are likely to be collecting (Figure 5), and as long as they work through their collections as the labs unfold, they generally find that completing this assignment is straightforward.

Many students enjoy the flowerhead dissections, the opportunity to try out PCR, or conducting an experiment in the lab with living insects. Most find that going out on their own time with fellow classmates to seek out insects, finding neat insects in an unexpected habitats, and keying out obscure specimens sets the stage for a student to really look at insects and come to appreciate them for the remarkable animals that they are.



R. Lalonde

Figure 5. The taxonomy portion of the course. The evidently enthusiastic TA has gone on to a productive career in Entomology.

Tips for teaching low- and no-take Entomology

R.E. Batallas, V.A. Shegelski, and H.C. Proctor

Undergraduate Entomology courses commonly require students to build a collection of field-caught arthropods or to dissect recently killed specimens to examine morphology. Such projects can be distressing to some participants; it is becoming more common to encounter students and instructors who are morally opposed to killing insects solely for teaching purposes. Furthermore, there is an increasing demand for instructors to offer alternative course formats that can be completed remotely. For both reasons, there is a growing interest in creating low- or no-take options for teaching undergraduate courses that have a laboratory component. When appropriate, minimizing the collection and preservation of specimens in an Entomology course can reduce the actual and perceived animal welfare and ecological impacts from teaching, and can make learning more accessible and equitable.

Benefits and drawbacks of reducing or removing specimen collecting in teaching Entomology

The killing of insects serves many purposes in the study of Entomology. Pohl (2009) notes that arthropod collections provide vouchers for future research and records of biodiversity that inform conservation efforts. These specimens are also resources for teaching morphology and identification skills. But, however valuable these specimens are, there are also potential benefits to reducing the need for new specimens in Entomology lessons. Although the environmental impacts of conscientious collecting are generally negligible (Pohl 2009), overzealous or untrained individuals can locally reduce populations by over-collecting or can damage habitat (e.g., by turning over rocks and logs without replacement). When a course requires collecting and killing arthropods, there are associated monetary expenses and accessibility challenges, as well as the potential to alienate participants who do not want to kill insects, but would otherwise be engaged. There are many nonlethal ways insects and insect-related data can be collected (reviewed by Lövei and Ferrante 2024), but an alternative is to digitize available specimens and course materials. Digitized or online courses can bring Entomology to new demographics by removing social, monetary, and personal barriers to learning (this is discussed further in Evenden and Domnich, p 32, this issue). That said, some experiences cannot easily be replaced with digital alternatives. Without hands-on collecting, students do not experience the logistics, teamwork and perseverance required for collecting trips. Without hands-on preservation, pinning and dissections, the experience of curating specimens will be limited, and anatomy remains an abstract two-dimensional concept.

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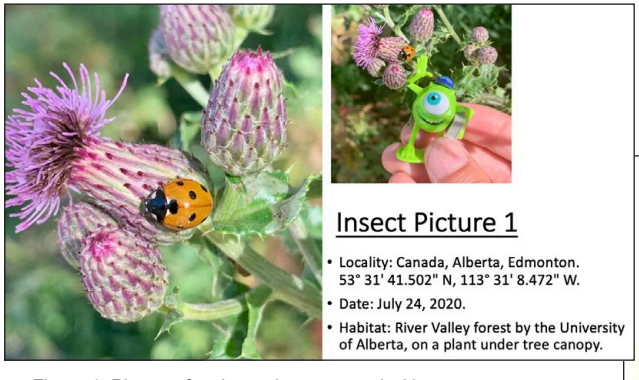
Examples of low- and no–take resources for remote teaching

During the pandemic, instructors had to pivot from in-person lab activities to achieve the learning outcomes. Most of the restructuring of undergraduate Entomology labs in our Department led to the development of remote activities. Here are three examples from different labs:

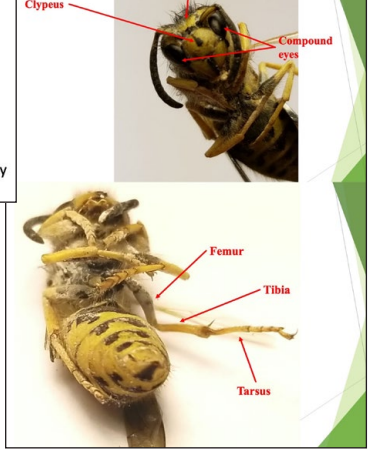
1. Students were instructed to explore their surroundings and natural areas and use cellphone cameras to photograph ten different insects and five items providing evidence of insect activity (i.e., defoliation, galls, leaf-mines). To ensure photographs were not taken from online sources, students included a small unique 'token' in the picture (Figure 1). Students also had to collect five insects for subsequent lab activities, although these could include already dead insects found inside buildings, on windowsills, etc.

   Students used these photos and specimens to apply what they learned by labelling structures and adaptations (Figure 2), identifying insects to the order level, and constructing a dichotomous key. Students submitted their photos to iNaturalist to confirm the identification and encourage participation as citizen scientists.
2. We designed a butterfly rearing project where students received a kit with all the materials to rear a commercially produced caterpillar of the painted lady butterfly (*Vanessa cardui*). Students documented and photographed the development of the butterfly from the egg to adult stage and prepared a lab report detailing their experience (Figure 3).
3. Students conducted an herbivory experiment on the performance of lab-grown cabbage looper larvae (*Trichoplusia ni*) fed on three host plants (using artificial diet as a control). Each student received a kit with all the materials to set up the experiment except for host plants, which students purchased from their local grocery store. Students recorded the developmental time from third instar to the pupal stage as a proxy of larval performance, and each student was responsible for setting up and collecting data for one replicate of each treatment (Figure 4). Students then shared their data with the class for a statistical analysis of the combined data, and each student prepared a lab report detailing their main findings on this plant-insect interaction.



R. Batallas

Figure 1. Photos of an insect in nature and with a token to verify students took the picture themselves.



J.Correa Ramos

Figure 2. Student labelling external morphological features on a photograph of an insect captured by themselves.

J.Correa Ramos

Figure 3. Photo of a painted butterfly (*Vanessa cardui*) from the "Butterfly Rearing Project" from a student after rearing it at home.

L. MacLeod

Figure 4. Photos of the Entomology kit and set up from a student of the herbivory experiment on cabbage looper (*Trichoplusia ni*) larval performance on different hosts.

Image-recognition tools complicate remote assessment of identification skills

The common goal of many Entomology courses is to teach students how to collect, preserve and identify organisms. This was difficult to do during COVID-19 when field trips were not allowed, and students had minimal opportunity to do lab work. To test their identification skills, many instructors had to use photos and drawings of invertebrates in electronically delivered assignments and exams. In 2020, this proved sufficiently challenging, but with many tools now available for identifying images of organisms (e.g., iNaturalist, Google Lens [see Raphael 2023]), how can one minimize the ability of students to get their IDs from AI rather than based on their own knowledge? In a time-restricted exam situation, it is unlikely that students will have the time to upload images to iNaturalist, but Google Lens can work simply by pointing a cell phone camera at an image on a computer monitor. Here are some suggestions for reducing students' reliance on AI for ID purposes based on testing Google Lens' ability to correctly identify photographs of freshwater invertebrates:

1. Avoid perfect portraits and learn to love clutter (Figure 5 vs Figure 6).
2. Odd angles increase the challenge (Figures 5 and 6 vs. Figure 7).
3. Ask students to identify as many taxa as they can in a timed question (e.g., daphniids, corixids and dytiscids in Figures 5-7).
4. If you can't fool Google Lens, ask students to explain why the specimen belongs to taxon X rather than to taxon Y (e.g., if Google Lens identifies the specimen as Dytiscidae, ask students to explain why it is a dytiscid and not a hydrophilid).

Take advantage of available Entomology collections

Museums and pre-established collections have immense value in the scientific community (Pyke and Ehrlich 2010), with an increasingly important role in teaching Entomology. Students with an aversion to collecting or killing specimens often have no problems working with curated

H. Proctor

Figure 5. Too easy! Google Lens' top five suggestions for the identity of this classically posed diving beetle larva were 'Dytiscidae'.

H. Proctor

Figure 6. Clutter makes it more challenging for Google Lens. Depending on how much of the surrounding image is included, Google Lens may return different identifications. A 'cropped' cellphone camera view of the pair of dytiscids did have the correct identification among the top suggestions, but also returned caddisfly and mosquito larvae. Submission of a full view to Google Lens returned suggestions that the beetle larvae were isopods as often as dytiscids.

H. Proctor

Figure 7. Odd angles and a mouth full of corixid stumped Google Lens! Top suggestions were Archaeognatha, Thysanura, and various plants.

specimens, which also increases the accessibility of entomological learning. Repeated use of specimens already in collections can offset the initial costs of collecting and encourage hesitant students. Not every institute has its own collection, but previous students' specimens can be kept and curated, and access to larger institute specimen collections can often be arranged. Established collections contain a diversity of material that provides students with opportunities for hands-on experience with curation and identification. Care needs to be taken as amateur use causes wear on specimens, but often collections will have unaccessioned material with insufficient data for research purposes, and such specimens can play an integral role in education.

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Teachable Moments: How we convince guests of the Monteverde Butterfly Garden to love bugs

Bryna Belisle

Butterflies are pretty, and people enjoy looking at them, but the butterflies we take care of are not just pretty faces, they're ambassadors that we employ to connect people with all kinds of arthropods. In 2012, I left Canada to take over as Director of the Monteverde Butterfly Gardens (MBG), the longest-running butterfly exhibit in Costa Rica. For over 30 years, the MBG has branded itself as a Butterfly Garden, mostly because it is way too hard to sell tickets to an insectarium. While I really like cockroaches, the majority of the 14,000 people who visit us each year don't, at least not at first. While we are not the only butterfly garden to house other live non-lepidopterans, we may be the only facility that makes our visitors spend 30 minutes getting to know such insects before they can see any butterflies. After luring people in with the beautiful butterflies, we work very hard to get each visitor to understand just how complex butterflies' lives are, and find value in all kinds of 'bugs'.

C. Vargas

Figure 1. Bryna B with an Orange Kneed Tarantula.

We keep a surprisingly small population of butterflies at the MBG, at most up to 35 different Costa Rican species. They are exhibited within four greenhouses, with each one designed to mimic a specific habitat type in the country. Which butterfly goes in which garden depends on where they are found in the wild, and we satisfy their needs by splitting them up into the gardens that best replicate their natural habitats. While people want to see butterflies flying, butterflies don't actually fly much when their needs are met, however they will fly to find food, defend territories, find mates, search for plants to lay their eggs on, or migrate. While we may not have a ton of active butterflies to rely on to please our guests, we do train our guides to provide tours with a ton of information shared in creative and dynamic ways so that visitors are always impressed. One of my favourite exhibits is our greenhouse full of *Heliconius* butterflies; it's curated to look like a Costa Rican grandma's garden. It's full of potted flowers, fruits, and vegetables, has a little sitting area, and loads of different kinds of passionflower vines. Guests are always blown away when I explain that while this may feel peaceful to us, we are actually standing in the middle of a co-evolutionary war zone. Taking the time to show each person the fake egg spots on the

R. Heckerman

Figure 2. A group of tourists in our insectarium.

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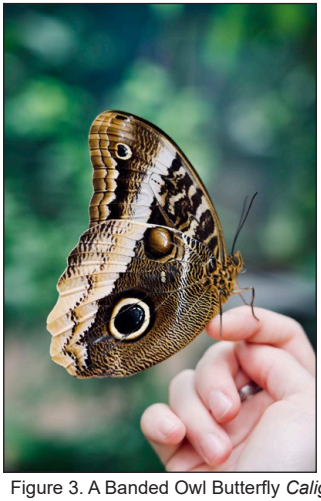


B. Belisle

Figure 3. A Banded Owl Butterfly *Caligo atreus*.

R. Heckerman

Figure 4. Some of the incredible diversity we have recorded at the MBG.

B. Belisle

Figure 5. A Julia butterfly from our grandma's garden.

B. Belisle

Figure 6. A glass wing butterfly feeding from aster.

Passiflora leaves, the sap they leak to attract ants as pest control, and explain about the toxins they produce to kill caterpillars, lets people truly see how *Passiflora* has evolved to defend itself against the butterflies and how butterflies evolutionarily respond in kind. More importantly, it cultivates a sense of wonder for the complex relationships that sustain life on our planet.

As someone who is compelled to take advantage of teachable moments, a common model used by butterfly exhibits—butterflies just flying around only for people's visual appreciation—has never sat well with me. Sometimes it appears that industry exploits butterflies the same way a circus does with its elephants or tigers, with dozens of diverse species, and thousands of chrysales shipped from around the world, crammed into a single habitat, on top of little to no effective science communication about butterflies; this can be challenging to justify from an education perspective. I acknowledge it takes time to develop and implement training programs, but I believe that the people acting as the voice of these butterflies need to know what they are talking about, and how to share it. More than once I have heard a docent or guide at a butterfly exhibit say, "Don't touch the butterflies, they need the dust on their wings to fly." No, they don't, and it doesn't take any longer to say, "Don't touch the butterflies, they get scared, plus their wings are super breakable. We don't want you to hurt one by accident." It's exciting to share the clear membrane under the scales on a butterfly's wings, or explain that that dust makes different patterns so that each species can find a mate or escape predators. At the MBG, we keep customers coming through the door by combining calm butterflies that people can photograph with a dynamic tour full of information.

Getting a chance to convince people that 'bugs' are cool is often the hardest part of the job, so we take full advantage of a visit to the butterfly garden as an opportunity to share just how incredible these creatures are. Most people who show up aren't looking for an Entomology lecture, but that doesn't stop us from taking the chance to build understanding and appreciation. We engage our guests by creating personal connections and translating the information into a digestible and relevant format for whoever is in front of us. Grown-ups especially, often dislike opening up and learning about something they have decided they don't like, whether that be insects, or learning in general, but by telling the facts as fun stories they may not even realize they are learning. When someone visiting the MBG starts off by saying they don't like bugs, I try to create a personal connection with them first by sharing the time I had to get a tarantula out of a washing machine. It hits like a stand-up comedy routine and loosens them up.

"So I answered the phone the other day to my neighbour screaming "Bug lady, there's a tarantula in my washing machine!" So I mobilized the team- just kidding, I walked over to her house.

Her washer was full of stinky, dirty laundry, and the poor tarantula had each of her 8 legs in a different hole in the washing machine barrel, holding on for dear life! Tarantulas are fragile, and a fall could rupture her abdomen… nothing ruins your day like your butt exploding!

I'm trying to get her legs free one by one, but every time I get one free, she slips the leg into a different hole! AH! This quickly became the most frustrating experience of my life—and I have two kids and an ex-husband, so my bar is REALLY high!

I had been tugging on her legs, so she was sure I wanted to eat her. I kept telling her I'd already had breakfast, but she really didn't believe me. How do I know? Because the moment I made the ridiculous mistake of freeing her two back legs at the same time, she chose violence. When tarantulas get scared, they rub their hind legs on their abdomen and fling their butt hairs in the face of the predator, and in this case, I was the predator.

How rude is that?!

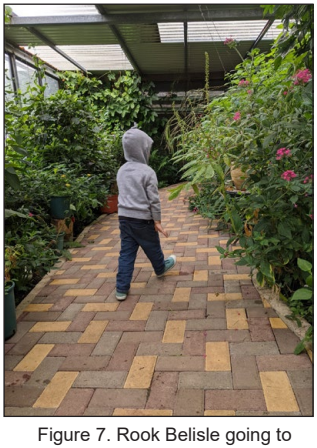
I was halfway inside a washing machine, my feet couldn't touch the ground, with a face full of butt hairs that make you incredibly itchy.

But I survived, just like every human who has ever had an encounter with a tarantula. They can't actually kill people!"

Initially visitors may not have been interested in arthropods, but by weaving in novel (and funny) experiences, they want to hear more. The facts about tarantulas I sneaked in are more likely to be remembered when making them part of this compelling personal anecdote.

I hope that one day all butterfly exhibits will take advantage of teachable moments and share with their guests how incredible insects are, using the opportunity seriously by keeping the butterflies as comfortable as possible and having well-trained staff. We should take science translation more seriously by creating a foundation of understanding about these creatures, but also take the way we share information with non-scientists less seriously. You can use anthropomorphisms for comedic effect or to create a connection without being inaccurate—you're not defending your thesis. Funny, relatable stories stay with the listener longer and make them more likely to share the story (and the facts!). Throughout human history, narratives are the way we have communicated important information to one another, and everyone enjoys a good laugh. Let's be serious; visitors don't have to pass an exam after a visit to a butterfly garden. I never get tired of hearing people describe the incredible change in the way they feel about insects after being tricked into learning about them when they just showed up for the butterflies. It's a butterfly bait-and-switch that delivers more value to our visitors, and our planet.

You can find more info about the MBG's science translation internship on the webpage www.monteverdebutterflygardens.com



B. Belisle

Figure 7. Rook Belisle going to water grandma's garden.

Claude Guertin (1959-2023)

Né le 17 janvier 1959, Claude Guertin a vécu son enfance à Saint-Hubert (Québec) entouré de ses parents et de ses quatre sœurs. Jeune homme, il s'orientait vers une carrière en sports et plein air mais une blessure au genou a changé le cours de sa vie et l'a amené à se réorienter vers des études universitaires en sciences biologiques et environnement.

Claude a obtenu son B.Sc. en 1985 et sa MSc en 1987 en biologie de l'Université du Québec à Montréal, et son PhD en biologie en 1992 de l'Université Concordia. En 1993, il a fait un stage postdoctoral à l'Institut Armand-Frappier (maintenant rattaché à l'Institut national de la recherche scientifique- INRS) avant d'y entreprendre sa carrière professorale en écologie microbienne et entomologie. Entre 1993 et 1998, il a été professeur boursier au Centre de recherche en virologie.

En 1998, il a été nommé professeur à l'INRS. Ses recherches étaient axées sur l'étude des communautés microbiennes d'insectes, notamment sur le potentiel de certains agents entomopathogènes (granulovirus, polyédrovirus, cypovirus et *Bacillus thuringiensis)* comme outils de lutte biologique contre les populations de ravageurs ainsi que la réponse du microbiome des insectes ravageurs.

Claude a été membre de plusieurs groupes de recherches, dont Directeur du Centre multirégional de recherche en foresterie (1997–1998); Directeur de la chaire sur les biopesticides (2001-2003); Membre fondateur du Groupe de recherche ECOBIOM (2013-2023); Membre du Groupe de Recherche en Microbiologie de l'Environnement du Centre Armand-Frappier Santé Biotechnologie de l'INRS.

Parmi ses activités sociétales, mentionnons son engagement à titre de Président du conseil d'établissement de l'*École Soleil-de-l'Aube, de la Commission scolaire des Affluents (*2003-2009); Membre du conseil d'administration, *Centre de recherche agroalimentaire de Mirabel* (2009-2012); Membre du conseil d'administration, *Fondation Armand-Frappier (2019-2023);* Membre du conseil d'administration, *Centre québécois en innovation en biotechnologie (CQIB) (2019-2023);* Membre d'office au conseil d'administration, *Fondation INRS (2021-2023).*

En 2019, il a été nommé à la direction du Centre Armand-Frappier Santé et Biotechnologie, puis Directeur scientifique de l'INRS en 2021.

Au cours de sa carrière, il a dirigé 16 étudiants de MSc, 11 PhD. 6 Post-doc, 9 étudiants de premier cycle et 3 étudiants du niveau collégial. Il a publié 43 articles scientifiques et donné plus de 50 conférences.

Voici des témoignages de collègues et étudiants :

« Claude Guertin était un scientifique et un collègue hors pair. La peine que nous ressentons est à la hauteur de l'homme qu'il était : quelqu'un de profondément humain, passionné par la mission de l'INRS, et surtout un homme capable d'écoute et de sagesse. Il va laisser un grand vide au sein de la direction et de la communauté de l'INRS. » **L-AG**

« J'ai eu la chance de côtoyer Claude au cours des quinze dernières années à l'INRS. Claude a été un collègue, un partenaire de négociation, un mentor empreint de créativité, un patron intègre et passionné mais surtout un ami. Je me souviendrai toujours des fous rires que nous avons eus, des discussions animées mais surtout de sa grande gentillesse. Il me manquera beaucoup. » ***LS***

« J'ai co-dirigé un étudiant de MSc avec Claude. Le sujet de la thèse était l'utilisation de Beauvaria bassiana comme agent de lutte contre la punaise terne, Lygus lineolaris. Nous avons passé des heures avec l'étudiant dans une fraisière expérimentale sur la ferme

d'Agriculture et agroalimentaire Canada à Frelighsburg, Qc. Nous avons eu de nombreuses rencontres constructives à l'UQAM et à l'INRS - Centre Armand-Frappier Santé et Biotechnologie *pour la préparation d'expériences et la rédaction de la thèse. Claude et moi allions souvent manger dans un restaurant asiatique situé près de l'INRS-Laval pour discuter recherche et autres sujets connexes. Ce que je retiens de Claude, c'est son sourire. »* **CV**

« Claude était avant tout un humain bienveillant de même qu'un scientifique rigoureux et soucieux que son travail soit utile. Il était un mentor très apprécié de ses étudiants et stagiaires. J'ai eu la grande chance de collaborer avec lui sur quelques projets de recherche, et c'était toujours un réel plaisir de travailler ensemble. Un leader naturel, il était très impliqué, et il faisait la différence dans une équipe. Son départ prématuré laisse un grand vide. » ***ED***

« C'est avec une profonde tristesse que j'ai appris le décès subit du professeur Claude Guertin. Depuis mon arrivée au Canada en 2007, l'INRS-Centre Armand-Frappier Santé Biotechnologie, et plus précisément le laboratoire du Pr Guertin, est devenue ma deuxième maison. Après avoir obtenu la bourse du Programme de bourses de la francophonie (PCBF), Claude m'a accueilli dans son laboratoire en tant qu'étudiante à la maîtrise. J'ai ensuite eu le privilège de continuer mes études au doctorat sous sa direction et la codirection du Dr Robert Lavallée. Après avoir obtenu mon diplôme de 3ème cycle, j'ai continué ma carrière scientifique dans son laboratoire en tant que stagiaire postdoctorale, puis associée de recherche. C'était fort agréable de travailler avec lui. Sa grande disponibilité, sa compréhension et ses conseils m'ont permis de garder confiance dans les moments difficiles. Durant les 16 années passées dans son laboratoire, je n'ai que d'excellents souvenirs de lui. Claude était un chercheur exceptionnel et passionné. Il a toujours été plus qu'un directeur. Il était un mentor et un modèle pour moi-même et pour d'autres étudiants. Il aimait prendre soin des gens qu'il côtoyait, montrant ainsi sa grande générosité et son humanité. Pour toutes ces années, merci infiniment Claude de m'avoir partagé ton expertise professionnelle et personnelle. Tu as contribué significativement dans ma réussite aujourd'hui. Ton départ laisse un grand vide. Repose en paix Claude! » ***NS***

« C'est avec profonde tristesse que j'ai appris ton décès le 8 Juillet dernier. Depuis ce jour, rares sont les journées ou je n'ai pas une pensé pour toi en m'installant dans ta chaise dans le bureau du directeur ou en contemplant les arbres du campus que tu aimais tant. Même après ton départ, tu continues à nous influencer en nous faisant réaliser que le bonheur est ailleurs, que la vie est courte et qu'il faut en profiter chaque jour. Cependant, ta qualité essentielle ne sera sans doute jamais assez mise en valeur : Tu étais un homme au grand cœur qui se souciait de tout un chacun. C'est aujourd'hui à ce directeur au grand cœur, à ce professeur et homme qui a changé le cours de tant de vies, y compris la mienne, que je souhaite rendre hommage et dire merci. » **DC**

« J'ai rencontré Claude pour la première fois en 1986 et nous avons toujours gardé contact depuis. J'ai côtoyé Claude comme étudiant, par la suite comme collègue en développement des projets de recherche ou en supervisant des étudiants aux cycles supérieurs. Claude au cours des dernières années était membre de la direction à l'INRS et j'ai eu le plaisir de siéger avec lui au conseil d'administration de cet établissement. Je garde à ce jour un précieux souvenir de nos rencontres. Il a été pour moi avant tout un ami, mais aussi un chercheur chevronné doté d'une grande générosité et d'humanisme. Son côté bon vivant et sa bonne humeur me manqueront, car le départ d'un ami cher crée un vide difficile à combler. » **YM**

« *C'est avec beaucoup de regrets que j'ai appris le décès de Claude dont je conserverai toujours le souvenir d'un très bon collègue de recherche. Nous avons passé de nombreuses années à unir notre temps et nos efforts pour réaliser des projets de recherches conjoints en entomologie forestière. Il était fort plaisant de travailler avec Claude car il était aussi habile*

sur le terrain qu'en laboratoire. Il était un créatif, voir un patenteux! J'ai beaucoup appris avec lui. Claude était un passionné et toujours minutieux dans son travail. Il était toujours partant pour un nouveau projet de recherche sur un nouvel insecte. Nous avons eu souvent l'occasion de prendre la route vers nos places d'études sur le terrain dans le sud de l'Ontario, vers Halifax et Terre-Neuve pour différentes problématiques entomologiques. Ces longs trajets en auto étaient toujours propices pour échanger sur la science, la vie de famille et nos buts respectifs. Ces heures passées ensemble ont été à la source d'idées nouvelles qui ont fait avancer nos stratégies de lutte biologique contre certains insectes et notamment de développer le système d'autodissémination d'un champignon entomopathogène contre l'agrile du frêne et le longicorne brun de l'épinette. Si ce champignon est aujourd'hui homologué par Santé Canada, comme un outil de lutte contre l'agrile, c'est en grande partie grâce aux efforts de Claude et de sa collègue la Dr Narin Srei. Je suis heureux d'avoir partagé avec Claude de très belles années en science et d'avoir maintenant avec lui une certaine pérennité dans le monde scientifique grâce à nos articles scientifiques qui sont et seront cités dans le futur dans la lutte biologique contre les insectes forestiers. Mes plus sincères condoléances à Marie-Claude, Jean-Michel et Laurence dans ces moments incroyablement difficiles. J'offre aussi mes sympathies à sa mère Marguerite, qui perd son fils, et aux autres membres de sa famille, ses amis et amies et ses étudiants actuels ou anciens. » **RL**

« Je me rappelle d'une occasion où mon fils avait un projet à développer à l'école en 4ème année. Il voulait décrire le problème de l'Agrile du frêne. Mon fils et moi parlions souvent de sujets reliés à ce qu'il observait, et je lui racontais pourquoi les frênes autour de nous dépérissaient à cause d'un insecte. J'ai raconté cela à Claude sans rien lui demander. Le lendemain matin, celui-ci m'a apporté une affiche descriptive du cycle de vie de l'insecte et des images des ravages de l'Agrile sur les arbres, en plus de nous prêter un tronc d'un arbre ravagé par l'insecte avec toutes les galeries visibles sous l'écorce. La présentation de mon fils à l'école fut très appréciée. Merci Claude pour ta générosité. Tu nous manques énormément. » **RV**

« *Les plus beaux souvenirs que je garderai de Claude sont nos sorties mémorables sur le terrain où un équilibre parfait entre le travail accompli avec rigueur et les fous rires était toujours atteint. J'ai eu la chance de débuter mes journées au gym avec Claude pendant deux ans : des entraînements intensifs dès les 6h00! Notre mission en Guadeloupe et notre virée au Nouveau-Brunswick resteront gravées dans ma mémoire.* » **PC**

Claude est décédé subitement le 8 juillet 2023 à l'âge de 64 ans. Il laisse dans le deuil sa conjointe depuis 40 ans, Marie-Claude Baril, et ses enfants Jean-Michel et Laurence.

Charles Vincent, Yves Mauffette, Luc-Alain Giraldeau, Robert Lavallée, Louise Savard, Éric Déziel, David Chatenet, Philippe Constant, Narin Srei, Richard Villemur.


UNBC photo

Lisa Marie Poirier
(7 May 1963 – 15 October 2023)

Lisa Poirier passed away suddenly and unexpectedly on 15 October 2023. She was an outstanding teacher, mentor, researcher, entomologist, and friend. She was a rich source of entomological knowledge and engagingly answered Entomology questions from students, colleagues, and the public alike. Lisa was an important member of the entomological community in British Columbia, Canada and beyond.

Lisa was born in North Cobalt, Ontario on 7 May 1963. Her mother was British Indian—born of British parents but raised in India. She moved to England just before the outbreak of WWII. She met Lisa's father, a Canadian Serviceman, during the war and moved to Canada after the war. Lisa's father was a school principal. She had two much older sisters, Hilary and Caroline, so she was the baby of the family. Lisa was very close to her parents; she was proud of her family, and she traveled to England a few years ago to donate her grandfather's medals—awarded in India in the early 1900s—to a museum.

Lisa met her husband Mike in high school in 1979 and they were together until her death. They went to university together and got married after she graduated with a BSc in Biology and Ecology from the University of Guelph in 1984. After the wedding, they piled all their belongings into their car, including one large and very opinionated cat (who howled the whole way over), and drove to BC. Sylvester (the cat) got sick on the long drive, and they spent all their wedding gift money on saving him. He lived to a ripe old age.

Lisa completed the Master of Pest Management Program at Simon Fraser University in 1989, and immediately enrolled in a PhD program under the supervision of Dr John Borden. Lisa's PhD dissertation (1995) focused on the role of oral exudate in western spruce budworm. She was a Board-Certified Entomologist, a professional designation offered by the Entomological Society of America. Between 1996 and 2001, she held positions as Sessional Instructor at the University College of the Fraser Valley and the University of British Columbia, and as Senior Laboratory Technician at UBC.

In 2001, she was recruited to the University of Northern British Columbia starting as an Instructor V, primarily to cover sabbatical leaves for Forest Health faculty. This required knowledge of both pathogens and insect pests—material normally co-taught by a pathologist and an entomologist. Lisa was one of the few people who could handle both, and she permanently took over the Forest Entomology part when Staffan Lindgren retired in 2015. From the beginning, Lisa demonstrated an incredible versatility and breadth in teaching, making her indispensable to the Biology and Forestry degrees. She was a passionate instructor and taught 18 different undergraduate courses, one graduate course, and supervised five independent courses or reports. She won an Excellence in Teaching award at SFU while still a graduate student. At UNBC, students nominated her twice for excellence in teaching. One of her former students wrote: "*Lisa was always so kind and supportive of me as a student, and I will always credit her with teaching me how to write scientifically in her ecology class. She was an excellent teacher who really cared about her students. She was also just an incredibly kind person*".

In 2007, Lisa was promoted to Assistant Professor, tenure track. She was granted tenure

on 1 July 2012, and promoted to Associate Professor in 2018. She contributed greatly to the university by serving on a number of committees. When she took over primary responsibility for the Entomology course in the Biology program, she put together an extensive lab guide (https://pressbooks.bccampus.ca/unbcbiol322/) which was provided to students. She also brought order to the insect teaching collection, and a plaque has been erected to commemorate her efforts. Lisa also served her profession, notably as President of the Entomological Society of British Columbia 2018-2019, and by organizing and contributing to conferences, e.g., the Western Forest Insect Work Conference. Lisa was passionate about Entomology and frequently shared her expertise by responding to questions from the public or media and giving presentations in the community. She was also an e-mentor for the Ms. Infinity program of the Society for Canadian Women in Science and Technology, encouraging female youth into STEM fields.

Lisa was author or co-author of 15 peer reviewed publications, with two more upcoming, and she presented numerous papers at conferences on a variety of topics, including mosquito biology, biodiversity, and plant-insect interactions. Her work on the biodiversity of insects in downtown Prince George versus in the forest was particularly important as most biodiversity surveys tend to focus on non-urban areas or parks, and neglect downtown areas. She supervised three graduate students and was a member of the supervisory committee for an additional 11 graduate students.

Lisa inherited her love for animals from her mother, who was always surrounded by various animals; for example, her mother trained Siberian Huskies for the Iditarod and other dog races. Lisa's mother was also always rescuing animals on the point of death to give them "a nice place to die", but they usually ended up surviving and thriving under Lisa's mother's care. Consequently, Lisa grew up with a collection of animals, including monkeys! This instilled in her a great life-long love of animals. She loved giant dog breeds, in particular, she raised Bernese and Greater Swiss Mountain Dogs, which were socialized by bringing these beautiful dogs to UNBC for meet-and-greets with faculty and staff. Her dogs, as well as Mike, were always her research assistants and traveled deep into the bush on trap and insect collection expeditions. She always insisted that everyone, particularly the dogs, had high quality packs so they could carry their own water, food, and snacks. Lisa also rescued numerous cats, and even birds. Joshua, her cockatiel, was 35 years old when he died earlier this year, one year short of the Guinness Book of Records.

Lisa's passing was announced by UNBC by lowering the flags at half-mast. She is greatly missed by her many friends and colleagues.

Gail Anderson and Staffan Lindgren

M. Poirier

Books available for review / Livres disponibles pour critique

The ESC frequently receives unsolicited books for review. A list of these books is available online (http://esc-sec.ca/publications/bulletin/#toggle-id-2) and is updated as new books are received.

If you wish to review one of these books, please send an email to the Chair of the Publications Committee (Véronique Martel, veronique.martel@NRCan-RNCan.gc.ca).

You should briefly indicate your qualifications to review the topic of the book, and be able to complete your review within 8 weeks.

Preference will be given to ESC members.

La SEC reçoit fréquemment des livres non demandés pour des critiques. Une liste de ces livres est disponible en ligne (https://esc-sec.ca/fr/publications/bulletin/) et est mise à jour lorsque de nouveaux livres sont reçus.

Si vous souhaitez critiquer un de ces livres, veuillez envoyer un message au présidente du comité des publications (Véronique Martel, veronique.martel@NRCan-RNCan.gc.ca).

Vous devez brièvement indiquer vos qualifications pour critiquer le sujet du livre, et être en mesure de terminer votre critique en 8 semaines.

La préférence est donnée aux membres de la SEC.

Guidelines

Book reviews should be approximately 800-1200 words in length. They should clearly identify the topic of the book and how well the book meets its stated objective. Weaknesses and strengths of the book should be described.

Formatting of the review should follow that of reviews in recent issues of the Bulletin. A scan of the book cover (jpeg or tiff format, about 500 kb) should be submitted with the review.

Lignes directrices

Les critiques de livre doivent compter entre 800 et 1200 mots. Elles doivent clairement identifier le sujet du livre et si le livre rencontre bien les objectifs énoncés. Les forces et faiblesses du livre devraient être décrites.

Le format des textes doit suivre celui des critiques des récents numéros du Bulletin. Une version numérisée de la couverture du livre (en format jpeg ou tiff, environ 500 kb) devra être soumise avec la critique.

Books available for review / Livres disponibles pour critique

Kondo, T. and G. Watson [Eds]. 2022. Encyclopedia of Scale Insect Pests. CABI. ISBN: 978-1-80062064-3.

Marshall, S.A. 2023. Hymenoptera: The Natural History and Diversity of Wasps, Bees and Ants. Firefly Books. ISBN: 9780228103714.

Wrigley, R.E., de March, L., Huebner, E. 2022. Tiger Beetles of Manitoba: Ecology, Life History and Microsculpture. Robert E. Wrigley. ISBN: 978-1-7781065-0-7 [paperback].

Ziska, L. 2022. Invasive species and global climate change, 2nd Edition. CABI. 978-1-80062-143-5. [hardcover]

Highlights of Recent Board of Directors meetings

The Board of Directors and many Officers of the ESC met on Wednesday 17 January 2024, with President Colin Favret chairing. The meeting started off with a Board orientation, led by Executive Director Geoff Powell, to familiarize the new Board and Officers with their duties and responsibilities.

The Board received updates about upcoming joint annual meetings (JAMs). The 2024 meeting will take place at Hôtel Le Concorde in Québec City from 20–23 October. The meeting organization is going well and things are on track for a successful conference. The conference website https://event.fourwaves.com/seq-esc2024/ is now live and will be updated with registration and abstract submission functionalities soon. JAM 2025 will be held in Calgary, Alberta from 5–8 October 2025. A contract with the Best Western Premier Calgary Plaza Hotel and Conference Centre has been signed, and the local organizing committee is working to develop the theme of the meeting, design a logo, and to build a meeting website.

Planning for JAM 2026 (with the Entomological Society of Manitoba) and JAM 2027 (with the Acadian Entomological Society) is in the early stages, but it seems likely that JAM 2027 will be held in St. Johns, Newfoundland and Labrador.

President Colin Favret updated the board on the status of another joint meeting with the Entomological Society of America, which will occur in 2028. Colin, along with Julien Saguez of the Société d'Entomologie du Québec, met with representatives of the ESA to tour potential sites in Montréal, and have decided to hold the conference at the Palais des Congrès de Montréal in October 2028. A contract with the venue has since been signed by ESA, and a memorandum of understanding between the ESA and ESC is in the works. Having the meeting in Québec so soon after JAM 2024 means that the JAM cycle will need to be adjusted, and the ESC Annual Meeting Committee is looking into how best to do this with minimal disruption.

ESC Treasurer Bryan Brunet reported that he and the Physical Assets Committee have now completed the move of ESC physical assets to a new storage locker in Ottawa. There have been ongoing issues with moisture and leaking at the old storage facility, and the new unit is far better maintained than the previous facility.

In October 2023, the ESC held a Strategic Planning session to help identify priorities for the Society going forward. Prior to the January meeting, the Board received a draft Strategic Road map based on discussion held during the planning session, and was asked to engage with their respective regional societies to collect and provide feedback on the draft plan to Past President Chris MacQuarrie by mid-January. Once the feedback has been collected, the Board will review and approve the final plan and then it will be made available to the membership more broadly. The planned timeline for this is likely before the JAM in fall 2024.

President Colin Favret informed the Board that a new contract with Strauss has been signed; a copy of the contract will be shared with the ESC Board of Directors. The Board also heard that ESC's attorney had recently changed law firms. Executive Council has been happy with the service this attorney has provided in the past, and has decided to continue to retain their services at their new firm, Mann Lawyers in Ottawa; document transfers to the new firm are currently underway.

President Colin Favret informed the Board that the ESC contract with Cambridge University Press (CUP) for the publication of *The Canadian Entomologist* is set to expire at the end of 2025. Given some ongoing issues with CUP, the ESC is considering whether it wants to continue working with CUP or look into other options for publication. If the ESC chooses not to renew, it must provide written notice to CUP by September 2024. Colin has recently assembled a task force to investigate potential options, which will then be presented to the Board at an upcoming meeting prior to September. Members of the task force include representatives from the ESC Publications Committee, the Editors-in-Chief of *The Canadian Entomologist*, and other ESC members with varied editorial experience.

Executive Meeting – Call for Agenda Items

If members have any items they wish to be discussed at the next Board of Directors or Executive Council meeting, please send them to the Co-Secretaries (see inside back cover for contact details), as soon as possible.

Réunion du conseil exécutif – Points à l'ordre du jour

Si des membres aimeraient ajouter des points à l'ordre du jour pour discussion à la prochaine réunion du Bureau des directeurs ou du Conseil de l'exécutif, merci de les envoyer aux cosecrétaires (voir le troisième de couverture pour les informations de contact), le plus tôt.

Call for nominations: Societal Director, Director at Large

The Society will hold an online ballot to select candidates for a Societal Director and Director at Large. The selected candidates will then be presented as a slate for formal election by members at the Annual Meeting in Quebec City in October. Nominations for these positions must be signed by three active members of the Society and be received by a Co-Secretary of the Entomological Society of Canada, by 30 March 2024 (see inside back cover for contact details).

Appel à candidatures : direction sociétale, conseiller ou conseillère

La Société tiendra un vote en ligne afin de sélectionner des candidatures pour les postes de direction sociétale et de conseiller ou conseillère. Les candidatures sélectionnées seront ensuite présentées à la réunion annuelle à Québec en octobre pour une élection formelle par les membres. Les nominations pour ces postes doivent être signées par trois membres actifs de la Société et être reçues par un ou une co-secrétaire de la Société d'entomologie du Canada au plus tard le 30 mars 2024 (voir le troisième de couverture pour les informations de contact).

74th Annual Meeting of Members and Board of Directors Meetings

The 74th Annual Meeting of Members of the Entomological Society of Canada is planned to be in conjunction with the Joint Annual Meeting with the Société d'Entomologie du Québec, and is expected to take place sometime between 20–23 October at Hôtel Le Concorde, in Québec City, QC.

74e Assemblée annuelle des membres et réunions du Conseil d'administration

La 74e assemblée annuelle des membres de la Société d'entomologie du Canada se tiendra en même temps que l'assemblée annuelle conjointe avec la Société d'entomologie du Québec, et devrait avoir lieu entre le 20 et le 23 octobre à l'Hôtel Le Concorde, à Québec, QC.

Members' discounts

Entomological Society of Canada members can enjoy discounts on publications from Annual Reviews, Elsevier, Cambridge University Press, and the Entomological Society of America. Details of how to benefit from these discounts are available on the member's area of the Entomological Society of Canada website at: https://esc-sec.site-ym.com/.

Remise pour les membres

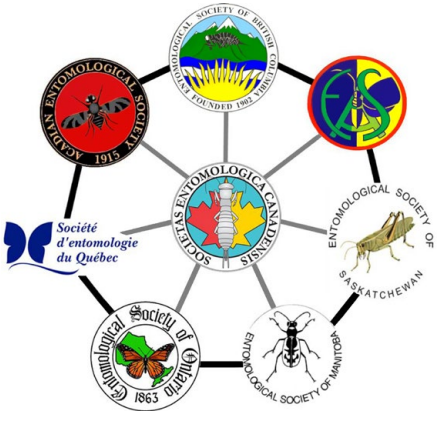
Les membres de la Société d'entomologie du Canada peuvent bénéficier d'une remise lors d'achats de publications de : Annual Reviews, Elsevier, Cambridge University Press et de la Société d'entomologie d'Amérique. Les informations nécessaires pour profiter de ces remises sont disponibles dans la section des membres du site de la Société d'entomologie du Canada à : https://esc-sec.site-ym.com/.

ESC Co-Secretary

The Entomological Society of Canada is looking for a member willing to serve in the position of Co-Secretary. The ESC's two Co-Secretaries share the secretarial duties in support of the President and Board of Directors by:

- Scheduling meetings of the Executive Council, Board, and the Members, preparing agendas, obtaining reports from Officers and others, sending out notices of meetings, attending the meetings, and recording minutes.
- Working with our Association Management Company (Strauss event & association management) to ensure that records of Society activities such as agendas, minutes, reports, and correspondence are preserved, and to prepare the Society's annual filings with Corporations Canada and other government agencies.
- Providing information on Society business to the Bulletin Editor, Webmaster, and Strauss for publication, posting, and circulation to the membership as necessary.
- Maintaining up-to-date lists and contact information for the Society's Board and Committees.
- Overseeing plebiscites to recommend candidates for nominations as Societal Director and Director-at-Large, and for any other questions on which votes may be required, and notifying of the results of voting. Advising affiliated societies when they need to provide names for nominations as Regional Directors.

A familiarity with the Society's by-laws, rules, and guidelines, past experience as a Board member, and the ability to work in French and English would all be assets. This is a great opportunity to serve one of the oldest biological societies in North America and to deepen your contacts with the Canadian entomological community. Any member interested in serving in this position may contact Erin Campbell (Erin.Campbell@inspection.gc.ca) for further information. Applications should be made to the President, Colin Favret (ESCPresident@esc-sec.ca). The final selection will be made by an ad hoc committee convened by the President.



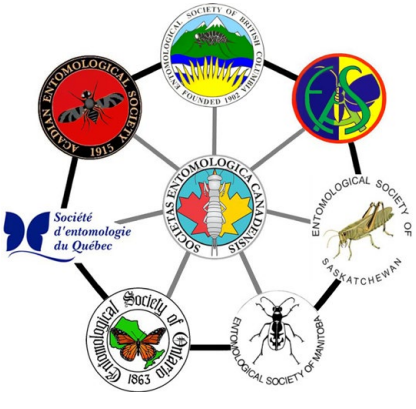
Cosecrétaire

La Société d'entomologie du Canada est à la recherche d'une personne membre souhaitant occuper le poste de cosecrétaire. Les deux cosecrétaires de la SEC se partagent les tâches de secrétariat en soutien à la présidence et au CA de la SEC :

Planifier les réunions du Conseil exécutif, du CA et des membres, préparer les ordres du jour, obtenir les rapports des dirigeants et dirigeantes et d'autres personnes, envoyer les avis de convocation, assister aux réunions et rédiger les procès-verbaux.

- Travailler avec notre société de gestion d'association (Strauss event & association management) pour s'assurer que les documents relatifs aux activités de la Société, tels que les ordres du jour, les procès-verbaux, les rapports et la correspondance, sont conservés et pour préparer les déclarations annuelles de la Société auprès de Corporations Canada et d'autres agences gouvernementales.
- Fournir des informations sur les activités de la Société au rédacteur du bulletin, au webmestre et à Strauss pour qu'ils les publient, les affichent et les fassent circuler parmi les membres si nécessaire.
- Maintenir à jour les listes et les coordonnées du CA et des comités de la Société.
- Superviser les plébiscites visant à recommander des candidatures pour les postes d'administration de la Société et de conseiller ou conseillère, ainsi que pour toute autre question nécessitant un vote, et notifier des résultats du vote. Conseiller les sociétés affiliées lorsqu'elles doivent fournir des noms pour les nominations aux postes d'administration régionale.

Une bonne connaissance des règlements, des règles et des lignes directrices de la Société, une expérience passée en tant que membre du CA et la capacité de travailler en français et en anglais sont autant d'atouts. Il s'agit d'une excellente occasion de servir l'une des plus anciennes sociétés biologiques d'Amérique du Nord et d'approfondir vos contacts avec la communauté entomologique canadienne. Toute personne membre intéressée par ce poste peut contacter Erin Campbell (Erin.Campbell@inspection.gc.ca) pour de plus amples informations. Les candidatures doivent être adressées au président, Colin Favret (ESCPresident@esc-sec.ca). La sélection finale sera effectuée par un comité ad hoc convoqué par le président.



Seeking a new Assistant (technical) editor: *Bulletin of the Entomological Society of Canada*

The Assistant Editor works closely with the Editor to produce four quarterly editions of *The Bulletin of the Entomological Society of Canada*, in March, June, September, and December. The Assistant Editor's work involves laying out each issue of the *Bulletin* using the edited material provided by the Editor.

Duties include formatting the annual cover for the *Bulletin* using photos provided by the photo contest committee; formatting and preparing the edited material received from the Editor in Chief for publication; laying out the edited material from the Editor in Adobe InDesign desktop publishing software (provided), following instructions from the Editor; distributing the proof copy to contributors to proof their contributions, and making necessary corrections; arranging to have the corrected copy uploaded to the website; arranging to have an eblast message sent to members of the Society to notify them that the *Bulletin* has been uploaded to the website; clipping articles from the *Bulletin* to distribute e-prints to contributors; clipping book reviews from the *Bulletin* to send to the Chair of the Publication Committee; and clipping In-Memory pieces from the *Bulletin* to send to the Webmaster for posting on the Obituaries page of the website.

The applicant should be familiar with and have access to a current version of Microsoft Word. Experience with Adobe InDesign is an asset, but training can be provided.

Interested parties should contact the Publications Committee Chair, Véronique Martel (veronique.martel@NRCan-RNCan.gc.ca), the current Assistant Editor, Donna Giberson (giberson@upei.ca) or the Editor, Bernie Roitberg (roitberg@sfu.ca) for further discussion.

À la recherche d'une personne pour la rédaction adjointe (technique) : *Bulletin de la Société d'entomologie du Canada*

La rédaction adjointe travaille en étroite collaboration avec la rédaction pour produire quatre éditions trimestrielles du *Bulletin de la Société entomologique du Canada*, en mars, juin, septembre et décembre. Le travail de cette personne consiste à mettre en page chaque numéro du *Bulletin* en utilisant le matériel édité fourni par la rédaction.

Les tâches incluent mettre en forme la couverture annuelle du *Bulletin* en utilisant les photos fournies par le comité du concours photo; mettre en forme et préparer le matériel édité reçu de la rédaction en chef pour la publication, mettre en page le matériel édité par la rédaction en chef dans le logiciel de publication assistée par ordinateur Adobe InDesign (fourni), en suivant les instructions de la rédaction; distribuer les épreuves d'impression aux contributeurs et contributrices pour qu'ils vérifient leurs contributions et apportent les corrections nécessaires; faire en sorte que la copie corrigée soit téléversée sur le site web; organiser l'envoi d'un message électronique aux membres de l'association pour les informer que le *Bulletin* a été téléversé sur le site web; prélever des articles dans le *Bulletin* pour distribuer aux contributeurs; prélever les critiques de livres dans le *Bulletin* pour les envoyer à la présidence du comité des publications et prélever les articles « En mémoire » du *Bulletin* pour les envoyer au webmestre afin qu'ils soient publiés sur la page « Notices nécrologiques des membres » du site web.

La personne qui postule doit être familiarisée avec Microsoft Word et avoir accès à une version récente de ce logiciel. Une expérience avec Adobe InDesign est un atout, mais une formation peut être dispensée.

Les personnes intéressées peuvent contacter la présidente du comité des publications, Véronique Martel (veronique.martel@NRCan-RNCan.gc.ca), l'actuelle rédactrice adjointe, Donna Giberson (giberson@upei.ca) ou le rédacteur, Bernie Roitberg (roitberg@sfu.ca) pour de plus amples informations.

The Canadian Entomologist

Issue 155: Year in Review

Total Manuscripts: 37
Research Papers: 29
Notes: 8
Open Access: 16

Countries* : (23), (04), (03) (02), (02), (01) (01), (01)
*based on corresponding author

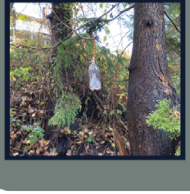
Editors Choice - 2023

Giant fossil ants

Archibald SB, Mathewes RW, Aase A. Eocene giant ants, Arctic intercontinental dispersal, and hyperthermals revisited: discovery of fossil *Titanomyrma* (Hymenoptera: Formicidae: Formiciinae) in the cool uplands of British Columbia, Canada. *doi:10.4039/tce.2022.49*

Cryptic multiple matings in bees

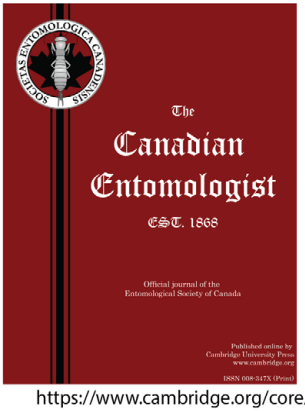
Duff LB, Proulx ANM, Corbin LA-J, Richards MH.
Evidence for multiple mating by female eastern carpenter bees, Xylocopa virginica (Hymenoptera: Apidae).
doi:10.4039/tce.2022.51



Diversity of necrophagous flies

Smith CAR, Poirier LM, Anderson GS. The effect of season and urbanisation on Calliphoridae (Diptera) diversity in British Columbia, Canada, using baited traps. doi:10.4039/tce.2023.11

Check out our new cover!



Did you know?

The Canadian Entomologist has many Open Access options?

- Free OA for many ESC members with new Read & Publish Agreements
- All members have reduced OA fees

Free Open Access!

https://www.cambridge.org/core/services/open-access-policies/read-and-publish-agreements

Twentieth Annual Photo Contest

The 20th Annual Photo Contest to select images for the 2025 cover of the Bulletin of the Entomological Society of Canada is now underway.

Contest rules:

Photos of insects and other arthropods in all stages, activities, and habitats are accepted. To represent the scope of entomological research, we also encourage photos of field plots, laboratory experiments, insect impacts, research activities, sampling equipment, etc. Photos should, however, have a clear entomological focus.

Digital images must be submitted in unbordered, high-quality JPG format, with the long side (width or height) a minimum of 1500 pixels.

Entrants may submit up to five photographs. A caption must be provided with each photo submitted; photos without captions will not be accepted. Captions should include the locality, description of activity, if the main subject is other than an insect (if appropriate), and any interesting or relevant information. Captions should be a maximum of 40 words.

The entrant must be a member in good standing of the Entomological Society of Canada. Photos must be taken by the entrant, and the entrant must own the copyright.

The copyright of the photo remains with the entrant, but royalty-free use must be granted to the ESC for inclusion on the cover of one volume (4 issues) of the *Bulletin*, and on the ESC website, and in various social media posts by the ESC (credited to the photographer, of course).

Rather than a judging committee, this year, the photo contest organizer will open voting to our members on a website. Photographers of the top three photos chosen will be awarded the following prizes: **1st**: $200 gift certificate for Henry's Camera. **2nd**: $100 gift card for Henry's Camera. **3rd**: $50 gift card for Henry's Camera.

Submission deadline is 15 September 2024. Submit photos at this URL: https://pollunit.com/en/polls/esc_sec_photos_2024

Vingtième concours annuel de photographies

Le 20e concours annuel de photographie visant à sélectionner des images pour la couverture du Bulletin de la Société d'entomologie du Canada pour 2025 est en cours.

Règles du concours :

Les photographies d'insectes et autres arthropodes à tous les stades, activités et habitats sont acceptées. Afin de représenter l'étendue de la recherche entomologique, nous encourageons également les photographies de parcelles de terrain, d'expériences de laboratoire, d'impacts d'insectes, d'activités de recherche, de matériel d'échantillonnage, etc. Les photographies doivent toutefois être clairement axées sur l'entomologie.

Les images numériques doivent être soumises dans un format JPG de haute qualité, sans bordure, avec le grand côté (largeur ou hauteur) d'un minimum de 1500 pixels.

Chaque personne peut soumettre jusqu'à cinq photos. Une légende doit être fournie avec chaque photographie soumise; les photos sans légende ne seront pas acceptées. Les légendes doivent indiquer la localité, la description de l'activité si le sujet principal est autre qu'un insecte, et toute information intéressante ou pertinente. Les légendes doivent comporter un maximum de 40 mots.

Les personnes qui soumettent des photos doivent être membres en règle de la Société d'entomologie du Canada. Les photographies doivent être prises par la personne qui les soumets, et cette dernière doit en détenir les droits d'auteur.

Le droit d'auteur des photographies reste la propriété des photographes, mais une utilisation libre de droits doit être accordée à la SEC pour être incluse sur la couverture d'un volume (4 numéros) du Bulletin, sur le site web de la SEC et dans divers médias sociaux de la SEC (avec mention du nom de la personne qui a pris la photo, bien entendu).

Plutôt qu'un comité de jugement, cette année, l'organisation du concours de photographie ouvrira le vote sur ce site web. Les photographes des trois meilleures photos retenues se verront attribuer les prix suivants : 1er : 200 $ de chèque-cadeau pour Henry's Camera. 2e : 100 $ de carte cadeau pour Henry's Camera. 3e : 50 $ de carte cadeau pour Henry's Camera.

La date limite de soumission est le 15 septembre 2024. Soumettez vos photographies à cette URL : https://pollunit.com/en/polls/esc_sec_photos_2024

Interested in print copies of ESC publications?

Reserve your own print copy of any of the ESC's available back issues of *The Canadian Entomologist*, *Memoirs*, and *Bulletin*, for the cost of shipping. Alternatively, save on shipping and pick your requested print copy up in person directly from ESC's Physical Assets Committee in Ottawa.

So long as printed copies are available no request shall be deemed too large; request multiple issues or complete volumes if you wish!

Following October 19, all requests will be processed and shipped in bulk, and any remaining copies in the ESC's possession—save for its own complete and bound set which will be retained for archival purposes—will be disposed. We repeat, any unclaimed extra hard copies of ESC publications will be disposed after October 19, so act soon and send in your requests.

Requests can be directed to the Chair of the Physical Assets Committee, Patrice Bouchard (patrice.bouchard@agr.gc.ca) or the ESC Treasurer, Bryan Brunet (bryan.brunet@agr.gc.ca).

Disclaimer: Availability of hard copies of ESC publications will be determined following October 19, and requests will be prioritized on a first come, first served basis.

Donate to the Entomological Society of Canada Scholarship Fund!

The Scholarship Fund is a registered charity in Canada which provides financial awards and support to university students studying entomology. Donations are tax deductible and directly support a number of students in a range of entomological disciplines.

Want to learn more? Check out https://members.esc-sec.ca/donations/ to get more information and find out about specific awards.

Want to donate? Visit our donation webpage https://www.paypal.com/donate/?hosted_button_id=NECD6U7Y7VKGE or scan the QR code below to donate to any of our scholarships.

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Scholarship Fund: Registered Charity Number 118900463RR0001

Insect specimens available from Cape Bathurst Peninsula, Northwest Territories

The Government of the Northwest Territories has specimens available for interested entomologists. From 13–18 August 2022, a malaise trap was deployed on Cape Bathurst, Northwest Territories, on the tundra near the Beaufort Sea (70.508°N, 128.053°W). This area is a glacial refugium and subject to stress from climate change, including rapid coastal erosion. One specimen bottle from the malaise trap is available, containing what appears to be primarily small flies. The specimens need long-term homes and identification. We are pursuing a residue sharing approach. You can keep the portion of the specimens you're interested in for your own collection/research purposes; we simply ask that you provide us with identification information (genus or family if species level identification isn't possible) for inclusion in our territorial biodiversity records. Specimens were collected under Northwest Territories Scientific Research License No. 17025. If interested, please contact: Joanna Wilson, Government of the Northwest Territories at Joanna_Wilson@gov.nt.ca.

Location of Malaise Trap (yellow pin), Cape Bathurst NT.

Malaise trap sample

Advertising in the *Bulletin* / Publicité dans le Bulletin

The *Bulletin* welcomes enquiries regarding advertising within its pages.

For 2024, the advertising rates in the *Bulletin* have been set at $260/annum for a half-page advertisement, and $455/annum for a full-page advertisement, in each of the March, June, September and December issues.

For further information, please contact the *Bulletin* Editor (roitberg@sfu.ca).

Le *Bulletin* accueille les demandes de publicité dans ses pages.

Pour 2024, les tarifs publicitaires du *Bulletin* ont été fixés à 260 $/an pour une demi-page et à 455 $/an pour une page entière dans chacun des numéros de mars, juin, septembre et décembre.

Pour de plus amples informations, veuillez contacter le rédacteur du *Bulletin* (roitberg@sfu.ca).

List of Contents: Regional Journals / Table des matières : Revues des sociétés régionales

Contents of regional society journals

This regular feature highlights research published in the five regional society journals that include peer-reviewed papers. It should be noted that some regional society journals are not published on a regular basis and may not always include peer-reviewed articles.

Contenu des revues des sociétés régionales

Cette rubrique régulière met en lumière la recherche publiée dans les cinq revues des sociétés régionales qui incluent des articles révisés par les pairs. Veuillez noter que certaines revues des sociétés régionales ne sont pas publiées sur une base régulière et peuvent ne pas toujours inclure des articles évalués par les pairs.

Journal of the Entomological Society of British Columbia, Vol. 120 (2023)

https://journal.entsocbc.ca/index.php/journal

Articles

Tyler D. Nelson, Kristoferson Cu, Joel F. Gibson, Karen M. Needham, Esme John, Gary J. R. Judd, Chandra E. Moffat. 2023. An annotated checklist of clearwing moths (Lepidoptera: Sesiidae) in British Columbia and Yukon Territory. J. Entomol. Soc. BC 120:e2575 PDF

Lorraine E. Maclauchlan, Julie E. Brooks. 2023. Temperature requirements for western balsam bark beetle (*Dryocoetes confusus* Swaine (Coleoptera: Curculionidae: Scolytinae) development in southern British Columbia. J. Entomol. Soc. BC 120:e2593 PDF

Andrew S. Mitchell, Dezene P.W. Huber, Lisa M. Poirier. 2023. Biodiversity and community composition of ground-dwelling invertebrates across three disturbance regimes in a sub-boreal spruce forest. J. Entomol. Soc. BC 120:e2589 PDF

Scientific Notes

David K. Burton. 2023. Distribution of the genus *Paraleuctra* (Plecoptera: Leuctridae) in Canada. J. Entomol. Soc. BC 120:e2579 PDF

Joshua Milnes, Michael R. Bush, Wee L. Yee, Tayna S. James, Jeffrey L. Feder, Telissa Wilson, Sapphitah Dickerson. 2023. First Reported Infestation of a Native Honeysuckle by a native *Rhagoletis* Fly (Diptera: Tephritidae) in North America. *J. Entomol. Soc. BC 120:e2577* PDF

Aysha B. McConkey, Yonathan Uriel, Jade Sherwood, Warren Wong, Tracy Hueppelsheuser, Michelle T. Franklin. 2023. The invasive strawberry blossom weevil, *Anthonomus rubi* Herbst (Coleoptera: Curculionidae), uses *Dasiphora fruticosa* for reproduction in British Columbia. J. Entomol. Soc. BC 120:e2595 PDF

Natural History & Observations

Lorraine E. Maclauchlan, Julie E. Brooks, Barbara Zimonick. 2023. *Pissodes strobi* attack on lodgepole pine in the Kamloops Timber Supply Area. J. Entomol. Soc. BC 120:e2591 PDF

Journal of the Entomological Society of Ontario Volume 154 (2023)

https://journal.lib.uoguelph.ca/index.php/eso

Articles

Brodo, F., Jumean, Z., and Beresford, D.V. 2023. Crane flies (Diptera: Tipuloidea) of far northern Ontario and their distributions in the neighbouring regions of subarctic Canada. Journal of the Entomological Society of Ontario. 154: 27pp. PDF

John Huber, J. and Jennifer D Read, J.D. 2023. Review of *Gastrogonatocerus* Ogloblin (Hymenoptera: Mymaridae) in North America**.** Journal of the Entomological Society of Ontario. 154: 26pp. PDF

Skvarla, M., Poh, K. Norman, C., Struckhoff, E.D. Machtinge, E. 2023. A comparison of European deer keds (Diptera: Hippoboscidae: Lipoptena cervi (Linnaeus)) and blacklegged ticks (Ixodida: Ixodidae: Ixodes scapularis say) on elk (Cervus canadensis (Erxleben)) and white-tailed deer (Odocoileus virginianus (Zimmermann, 1780)) in Pennsylvania. Journal of the Entomological Society of Ontario. 154: 13pp. PDF

Gleason, J. E., Maw, E. Summerfield, A, Jandricic, S. E. and Brunet, B. 2023. First records of invasive agricultural pests *Thrips parvispinus* (Karny, 1922) and *Thrips setosus* Moulton, 1928 (Thysanoptera: Thripidae) in Canada. Journal of the Entomological Society of Ontario. 154: 12pp. PDF

Scientific Notes

Burroughs, S.L. Jackson, M.D. and Gillung, J. P. 2023. First records of direct kleptoparasitism in yellowjacket wasps (Vespidae: Vespula). Journal of the Entomological Society of Ontario. 154: 7pp. PDF

Canadian Weed Science Society
Société canadienne de malherbologie

CWSS-SCM Newsletter

The Society has adopted a new style for its newsletter so that there is no longer a Table of Contents. To see what's new in Canadian weed science since the last *Bulletin*, go to: https://weedscience.ca/newsletters/

Dec 2023 ***https://c8x545.p3cdn1.secureserver.net/wp-content/uploads/2023/12/12december-2023.pdf***

THE CANADIAN PHYTOPATHOLOGICAL SOCIETY

LA SOCIÉTÉ CANADIENNE DE PHYTOPATHOLOGIE

CPS-SCP News

VOL. 67, NO. 4 (December 2023)

https://phytopath.ca/wp-content/uploads/2023/12/CPS-SCP-News-67-4-December2023.pdf

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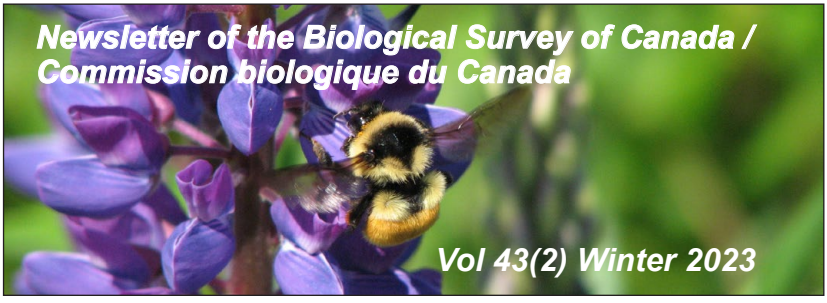

https://biologicalsurvey.ca/publications/newsletters/

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Meeting Announcements/Réunions futures

The Impact of Extreme Events: Royal Entomological Society Hybrid Symposium
London, England, 25 April 2024
https://www.royensoc.co.uk/event/the-impact-of-extreme-events/

National Conference on Urban Entomology
Mobile, Alabama, 19–22 May 2024
https://ncue.tamu.edu/

Canadian Society for Ecology and Evolution
Vancouver, BC, 26–29 May 2024
https://csee-scee2024.ca/en/

Third International Congress of Biological Control (ICBC3)
San Jose, Costa Rica, 24–27 June 2024
www.IOBC-ICBC.com

XXVII International Congress of Entomology / Le XXVII International Congress of Entomology
Kyoto, Japan 25–30 August 2024
https://ice2024.org

Ento24 Royal Entomological Society AGM
Liverpool, England, 10–12 September 2024
https://www.royensoc.co.uk/event/ento24/

6th European Conference on Infectious Diseases
Amsterdam, The Netherlands 3–4 October 24
https://crgconferences.com/infectiousdiseases/sessions/infectious-diseases

Entomology 24 (Annual Meeting of the Entomological Society of America)
Phoenix, Arizona, 10–13 November 2024
https://www.entsoc.org/events/annual-meeting

Entomology 25 (Annual Meeting of the Entomological Society of America)
Portland, Oregon, 9–12 November 2025

11th International Congress of Dipterology
Zagreb, Croatia 10–16 July 2027
https://dipterists.org/icd.html

Readers are invited to send the Bulletin Editor notices of entomological meetings of international, national or Canadian regional interest for inclusion in this list.
Les lecteurs sont invités à envoyer au rédacteur en chef des annonces de réunions entomologiques internationales, nationales ou régionales intéressantes afin de les inclure dans cette liste.

Bulletin of the Entomological Society of Canada

Editor: Bernard Roitberg
Assistant Editor: Donna Giberson

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The Entomological Society of Canada was founded in 1863 primarily to study, advance and promote entomology. It supports entomology through publications, meetings, advocacy and other activities.

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Rédacteur: Bernard Roitberg
Rédactrice adjointe: Donna Giberson

Le *Bulletin de la Société d'entomologie du Canada*, publié depuis 1969, présente trimestriellement des informations entomologiques, des occasions, des renseignements sur les opérations de la Société, des dossiers scientifiques d'importance et des analyses d'ouvrages.

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La Société d'entomologie du Canada a été établie en 1863 principalement pour promouvoir l'étude et l'avancement de l'entomologie. Elle soutient l'entomologie par l'entremise de publications, de réunions et d'autres activités.

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Editor's note: *Society Directors and Officers are reminded to check these lists, and submit corrections, including the names and positions of new officers.*

Entomology is life!

To borrow a phrase from Dani Rojas (the fictional character in the award-winning series, Ted Lasso) “Entomology is life!”.

For many of us, Entomology is our life: we take photos of insects, we visit insect zoos and, much to their chagrin, when on outings with family and friends, we can’t help noticing and pointing out the beauty and the essential services that arthropods provide to our planet. So, maybe Entomology is pretty much everything.

Entomology also provides tremendous opportunities to teach others about the natural world and in more than just a natural history kind of way (though there is nothing wrong with that either). The late, great W.H. Hamilton (1964) used hymenopterans to teach us about inclusive fitness and sociality, C.S. (Buzz) Holling (1959,1961) envisioned arthropods to develop his universally-accepted functional response concept and, recently, Lars Chitka (2022) taught us that cognition is not exclusively a feature of the vertebrate brain. The discovery of these important concepts is what we might refer to today as teachable moments.

In this issue of the *Bulletin*, we present a series of essays on Entomology as an educational tool. The papers cover the range from Emma Despland’s thoughts on one-on-one mentoring to Maya Evenden and Ilan

L’entomologie, c’est la vie!

Pour reprendre une phrase de Dani Rojas (le personnage fictif de la série primée Ted Lasso), « L’entomologie, c’est la vie! »[1].

Pour beaucoup d’entre nous, l’entomologie est notre vie : nous prenons des photographies d’insectes, nous visitons des zoos d’insectes et, à leur grand dam, lors de sorties en famille ou entre amis, nous ne pouvons nous empêcher de remarquer et de souligner la beauté et les services essentiels que les arthropodes rendent à notre planète. L’entomologie, c’est donc un peu tout.

L’entomologie offre également de formidables possibilités de faire découvrir le monde naturel à d’autres personnes, et pas seulement sous l’angle de l’histoire naturelle (bien qu’il n’y ait rien de mal à cela non plus). Le grand et regretté W.H. Hamilton (1964) a utilisé les hyménoptères pour nous apprendre ce que sont la valeur adaptative inclusive et la socialité, C.S. (Buzz) Holling (1959, 1961) a envisagé les arthropodes pour développer son concept de réponse fonctionnelle universellement accepté et, récemment, Lars Chitka (2022) nous a appris que la cognition n’est pas exclusivement une caractéristique du cerveau des vertébrés. La découverte de ces concepts importants est ce que l’on pourrait appeler aujourd’hui des moments propices à l’apprentissage.

Dans ce numéro du Bulletin, nous présentons une série d’essais sur l’entomologie en tant qu’outil pédagogique. Les articles couvrent une gamme allant des réflexions d’Emma Despland sur le mentorat individuel jusqu’à la discussion de Maya Evenden et Ilan Domnich sur leur cours en ligne massif ou MOOC, avec des classes dont la taille peut

[1] Traduction libre de « Entomology is life! »

Domnich's discussion of their massive online course or MOOC, with class sizes potentially numbering in the thousands. Each paper has high stand-alone quality and the full suite works well as a compendium on the topic.

While you are reading these thoughts on the hows and whys of mentoring, there is another way that you can help burgeoning entomologists, through contributions to the ESC Scholarship Fund: https://members.esc-sec.ca/donations/

Moving forward, I plan to publish a compendium on an important topic, each March edition. I have given some thought to the next few compendia, however, should you have specific topics you would like to see addressed, please contact me: roitberg@sfu.ca

Thanks again to those of you who continue to contribute to the Bulletin and you, the readers.

Bernie

atteindre des milliers de personnes. Chaque article est d'une grande qualité et la suite complète fonctionne comme un recueil sur le sujet.

Pendant que vous lisez ces réflexions sur le comment et le pourquoi du mentorat, il y a une autre façon d'aider les entomologistes en herbe, en contribuant au Fonds des bourses de la SEC : https://members.esc-sec.ca/donations/.

À l'avenir, j'ai l'intention de publier un recueil sur un sujet important dans chaque édition du mois de mars. J'ai déjà réfléchi aux prochains recueils, mais si vous souhaitez que des sujets spécifiques soient abordés, n'hésitez pas à me contacter : roitberg@sfu.ca.

Merci encore aux personnes parmi vous qui continuent à contribuer au Bulletin et à vous, le lectorat.

Bernie

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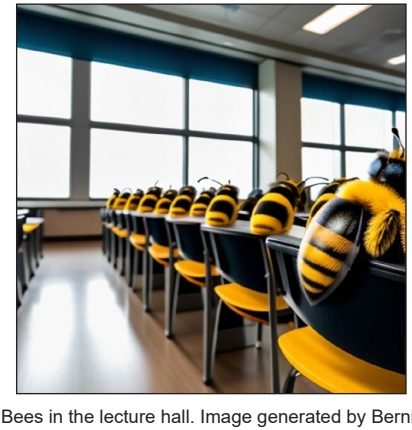

Figure 1. Bees in the lecture hall. Image generated by Bernie Roitberg using Picsart / Image générée par Bernie Roitberg à l'aide de Picsart (https://picsart.com/create).

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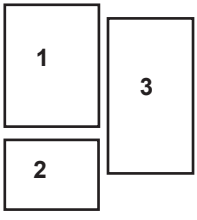

Front cover/Page couverture:

1.The charismatic brown wasp mantidfly (*Climaciella brunnea*) mimics the appearance of paper wasps (*Polistes* sp.), Winnipeg, Manitoba
Le charismatique Mantispidé, *Climaciella brunnea*, imite l'apparence des guêpes à papier (*Polistes* sp.), Winnipeg, Manitoba
Photo: Thilina Hettiarachchi

2.Two male huskflies (*Rhagoletis completa*) fight for territory on a peach, Kelowna, BC.
Deux mâles de la mouche des brous du noyer (*Rhagoletis completa*) se battent pour un territoire sur une pêche, Kelowna, C-B.
Photo: Robert LaLonde

3.Ovipositing *Arotes amoenus*, Ontario.
Une femelle *Arotes amoenus* en train de pondre, Ontario
Photo: Jeong Jae Yoo

Back cover/Quatrième de couverture:

Io moth caterpillars walking along a ginger leaf, Louisiana, USA.
Des chenilles *Automeris io* marchant le long d'une feuille de gingembre, Louisiane, É-U.
Photo: Claudia Husseneder

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