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NSERC-CANPOLIN
CANADIAN POLLINATION INITIATIVE

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MESSAGE FROM THE DIRECTOR

The last five years have been a remarkable journey. Thanks to the efforts of literally hundreds of scientists, graduate students, undergraduates, partners and supporters, NSERC-CANPOLIN represents a massive step forward in our understanding of pollination decline in Canada and what we can do to address the crisis. I am both pleased and proud that what began as a germ of an idea more than 10 years ago has blossomed into a successful network that is now regarded internationally as a model for large scale collaborative research in pollination.

Many of you have wondered what will happen after CANPOLIN ends. We know there is widespread interest in seeing the research continue. One possibility is a National Centres of Excellence, although the next call will not be until 2016. In the meantime, we expect that many CANPOLIN researchers and partners will continue to collaborate formally or informally and build on the impressive progress that CANPOLIN has made.

And although the end of CANPOLIN is nigh, we are not quite finished yet! The Network has a no-cost extension that will take us to August 2014. During this time we will wrap up our final SNEI activities (see pg 7) and fulfill our reporting obligations. Keep an eye out for future website updates and even a newsletter or two - we still have many exciting research discoveries to share. CANPOLIN recently passed the ' century mark' with 100 papers submitted or published—it is likely to be just the tip of the iceberg.

Happy Holidays to all.

Peter Kevan,
Scientific Director

Happy Holidays from NSERC-CANPOLIN

Photo credit: Laurence Packer

SNEI Round Up

An update on some of the valuable training and networking opportunities funded through NSERC`s 'Strategic Network Enhancement Initiative' (SNEI).

First Honeybee Diagnostics Course a Buzzing Success

Six participants enjoyed the first ever **Honey Bee Diagnostics Short Course** at the new National Bee Diagnostics Centre in Beaverlodge, AB, in late August. The students received training in molecular techniques (some of which were developed with CANPOLIN funding) to identify and/or quantify bee pathogens such as *Nosema* spp, viruses and American Foulbrood. The course offered valuable hands-on experience and participants spoke highly of the small class size and extraordinary level of one-on-one support from the instructors.

Top: York University Graduate Student Mariya Cheryomina conducting a lab exercise during the Diagnostics short course. *Bottom:* participants received certificates after completing the course (from left: Mariya Cheryomin, Andree Rousseau, Dr. Carlos Castillo (instructor), Alison Parker, Eric Stromgren, Jason Sproule, Pegah Valizedah and Patricia Wolfe Veiga (instructor) *(photo credits: Lee-Ann Alde)*

Climate Change, Invasive Species Front and Centre at Northern Workshop

CANPOLIN and the Arctic Institute of North American co-hosted the **"Pollination, Climate Change and Invasive Species in Arctic and Alpine Ecosystems**" workshop at the Kluane Lake Research Station in the Yukon on July 22-25. About 25 researchers from academia, government and First Nations took part in the workshop. Participants shared learnings, identified emerging issues and developed new collaborations to address issues related to pollination, climate change and invasive species in northern and alpine ecosystems.

Top: Participants at the workshop at Kluane Lake, Yukon. *Middle: (from left)* David Inouye, James Thomson and Syd Cannings enjoy the scenic surroundings. *Bottom:* examples of the local floral and insect fauna *(photo credits: Tom Woodcock and Anna Hargreaves)*

STUDENTS SHARE TIPS AND HONE PROFESSIONAL SKILLS AT SFU WORKSHOP

Eighteen CANPOLIN graduate students from across Canada gathered at Simon Fraser University in late July to share research techniques in pollination biology and hone some of their professional skills. The three-day training workshop featured presentations by students on methodologies they have refined or developed through their research projects, followed by a special half-day workshop on R led by CANPOLIN post-doc Scott Chamberlain. The workshop then switched gears to address a range of professional skills, including grantsmanship, time management, writing an effective CV and public speaking. The event wrapped up with a special career roundtable with guests from academia, industry and government discussing career options in different sectors.

Graduate student presentations were compiled into a Tips and Tricks Guide for Pollination Biologists that can be downloaded from the CANPOLIN website.

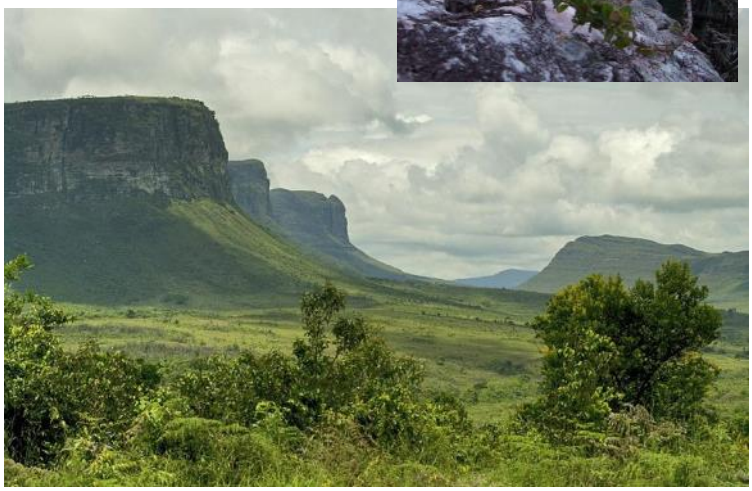
Graduate students at the Career Roundtable, one of the events at the HQP training workshop held at Simon Fraser University (photo credit: Raime Fronstin)

BEES AND MATH: NEW APPROACHES TO OLD PROBLEMS

CANPOLIN collaborator Hermann Eberl organized a special one-day workshop on bees and math in Tempe, AZ following the Society for Mathematical Biology annual meeting in June. CANPOLIN researchers and colleagues from the US, Australia and Europe shared new mathematical approaches to a range of questions such as the economics of crop pollination, hive population dynamics, modelling air flow within hives and applying artificial intelligence models to understand pollination networks in ecology.

STUDENTS GAIN NEW PERSPECTIVES IN BRAZIL

Six students affiliated with CANPOLIN participated in the International Pollination Biology Field Course for two weeks in early December. The 2013 edition of the course took place in the Chapada Diamantina National Park in Brazil. The highly regarded course covers pollination ecology, evolution of animal-plant interactions, and pollinator conservation biology. Field and lab exercises complement the lecture program, and each student completes a small project. This is the third year that SNEI funds have supported the participation of CANPOLIN students in this popular course.



The Chapada Diamantina National Park. Inset: an example of the park flora (photo credit: deltafrut)

Meetings in Brief

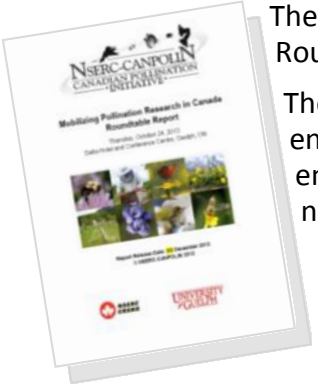
Final Network Meeting Highlights Five Years of Research

CANPOLIN's final meeting was held in conjunction with the 150th anniversary meeting of Entomological Societies of Ontario and Canada in Guelph on October 20-23 at the Delta Hotel and Conference Centre. A full-day symposium was devoted to the "*Canadian Pollination Initiative: five years of integrative research addressing pollination decline in Canada*". The event featured overviews of each of the eight working groups by their respective leaders, as well as 12 presentations on individual research projects. Our only regret is that we only had one day for the Symposium—it allowed us to highlight just a fraction of all the work that has taken place in CANPOLIN. Several researchers and students also made research presentations or presented posters in other sessions of the meeting. CANPOLIN would like to thank everyone who attended the meeting and in particular the many researchers and graduate students who made presentations or presented posters. All the presentations were very well-received, and it was truly amazing to see the full range of accomplishments that the network has achieved over the last five years. (If you were unable to attend the meeting, several of the presentations have now been posted on the CANPOLIN website; see the Presentations page). A special banquet for Network members was held the same evening. This was the last opportunity for network members to gather as one group and good food and great company were enjoyed by all.


Left: Peter Kevan gives opening remarks at the CANPOLIN symposium; *Middle:* CANPOLIN Board members John Borden, Anne Breau, Alison Janidlo and Karen Kraft Sloan at the banquet; *Right:* Etienne Normandin, Valerie Fournier and Amelie Gervaise (photo credit: Tom Woodcock and Victoria MacPhail)

CANPOLIN Research Resonates at Special Stakeholder Meeting

On October 24th, immediately following the ESC meeting and CANPOLIN Symposium, CANPOLIN and the Office of Research at the University of Guelph hosted a special roundtable event for Working Group Leaders, CANPOLIN board members and representatives from government, industry and the environmental sector. After learning about the Network's major research discoveries, participants brainstormed ideas on how to mobilize the findings into positive action for pollinator protection. To learn more about the outcomes of the meeting, download the Mobilizing Pollination Research in Canada Roundtable Report from the CANPOLIN website.



The Guelph Mercury also wrote an article about the Roundtable.

The Roundtable event featured a video presentation of Scientific Director explaining how CANPOLIN came into existence and what the Network has achieved. The video can now be viewed on YouTube.

Top right: WG7 Leader Jeremy Kerr provides a synthetic overview of CANPOLIN's research; *Bottom:* Peter Kevan video interview on Youtube.

Research Buzz

CANPOLIN recently passed a major milestone - we now have 100 publications submitted or in print! Many more are yet to come with data analysis still in full swing. New papers are regularly posted on the CANPOLIN website Examples of newly published papers are listed below.

(If your institution does not have access to any of the publications listed, please email canpolin@uoguelph.ca for assistance.)

Spafford, R.D. and C.J. Lortie. 2013. Sweeping Beauty: is grassland arthropod community composition effectively estimated by sweep netting? Methods in Ecology and Evolution. DOI: 10.1002/ece3.688

Spafford, R.D., C.J. Lortie and B. Butterfield. 2013. A systematic review of arthropod community diversity in association with invasive plants. Neobiota 16: 81–102, doi: 10.3897/neobiota.16.4190.

Bobiwash, K., S.T. Schultz and D.J. Schoen. 2013. Somatic deleterious mutation rate in a woody plant: estimation from phenotypic data. Heredity 111: 338–344 (see also associated commentary by D. Scofield)

Locke, M.M. and J.H. Skevington. 2013. Revision of Nearctic *Dasysyrphus*. Zootaxa 3660: 001–080 DOI:10.11646/zootaxa.3660.1.1

Reeh, K.W. and C.G. Cutler. 2013. Laboratory efficacy and fungicide compatibility of *Clonostachys rosea* against Botrytis blight on lowbush blueberry. Canadian Journal of Plant Science 93: 639 642 doi:10.4141/CJPS2012-306

Sheffield, C.S., A. Pindar, L. Packer and P.G Kevan. 2013. The potential of cleptoparasitic bees as indicator taxa for assessing bee communities. Apidologie DOI 10.1007/s13592-013-0200-2

Nunes-Silva, P, M. Hnrcir, L. Shipp, V.L. Imperatriz-Fonseca and P.G. Kevan. 2013. The behaviour of *Bombus impatiens* (Apidae, Bombini) on tomato (*Lycopersicon esculentum* Mill., Solanaceae) flowers: pollination and reward perception. Journal of Pollination Ecology 11:33-40

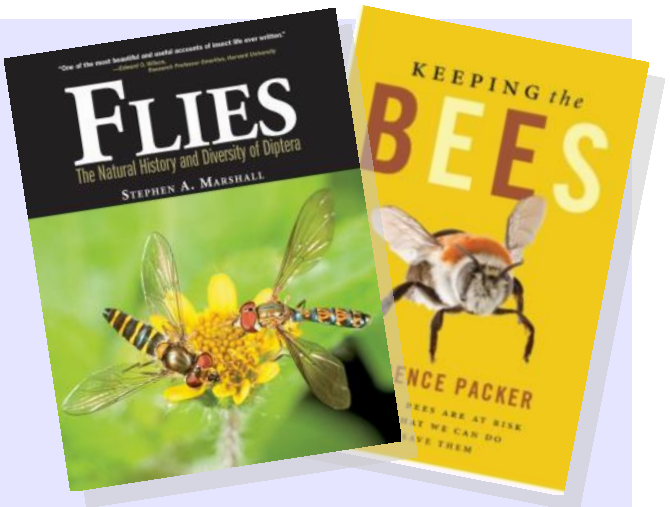
Cutler, C.G., C. Scott-Dupree and D. Drexler. 2013. Honey bees, neonicotinoids and bee incident reports: the Canadian situation. Pest Management Science DOI: 10.1002/ps.3613

Wray, J.C, L.A. Neame and E. Elle. 2013. Floral resources, body size, and surrounding landscape influence bee community assemblages in oak-savannah fragments. Ecological Entomology DOI: 10.1111/een.12070

Looking for some lighter reading, or perhaps a last minute gift idea? Check out these two popular science books also authored by CANPOLIN members.

Flies: The Natural History and Diversity of Diptera (2012, Firefly Press) by Stephen Marshall is described by E.O. Wilson as "one of the most beautiful and useful accounts of insect life ever written".

Keeping the Bees: Why All Bees are at Risk and What We Can do to Save Them (2011, Harper Collins) by Laurence Packer is an "engaging, illuminating read" that is part "travelogue, part natural history and part environmentalist essay."



Spotlight on Research:

Darwin's Blueberries: a study in plant evolutionary genetics has practical implications for growers

Genetic mutations occur naturally in plant cells as they divide and produce vegetative growth (e.g., branches, stems, and leaves). Biologists call these "somatic" mutations, because they do not occur in the reproductive tissues of the plant. But vegetative growth eventually leads to the production of flowers, and the gametes generated by the flower (i.e., the pollen and eggs) may carry these somatic mutations. Biologists have long wondered about the role of somatic mutations in plant evolution. But until now, there have been no empirical studies to measure the actual rate of somatic mutation in a plant, or its average effect on the fitness of its offspring.

CANPOLIN researchers Dan Schoen and Kyle Bobiwash at McGill University have changed all this with a groundbreaking study on lowbush blueberry.

"A large, long-lived perennial plant like lowbush blueberry is likely to have more somatic mutations than an annual plant," explains Bobiwash, who recently graduated with a MSc. "But we don't know how frequently these mutations occur, or how they affect the size and number of fruit produced."

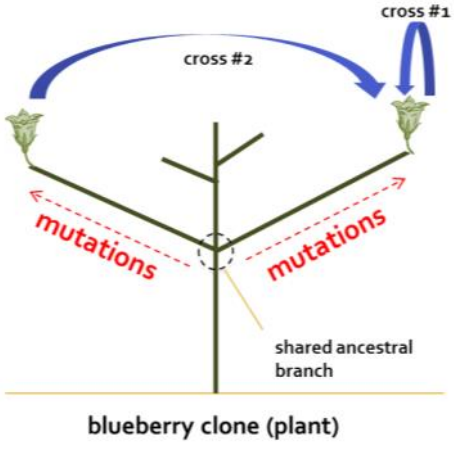
To find out, Bobiwash and Schoen conducted two types of controlled crosses on blueberry plants in a commercial field in Neguac, NB. In the first cross, flowers on one branch were self-pollinated (see diagram). In the second cross, flowers of one branch were pollinated with pollen from a different branch on the same plant. Because both branches shared a common ancestral growth point, the difference in fruit set between the two crosses provided an estimate of the rate of somatic mutation occurring in these branches.

"Fruit set should be the same in both cases if there is no significant mutation occurring along the branches," says Schoen. "But if there *is* (recessive or partially recessive) mutation occurring, it will be expressed in the self-pollinated fruit of the same branch because the seed can have two copies of the same deleterious somatic mutation, whereas seed from self-pollinated fruit on different branches cannot"

The team found that there was significant inbreeding depression in the self-pollinated flowers, and moreover, fruit set after from within-branch self-pollination was significantly lower than that observed for between-branch self-pollination.

A mathematical model was used to estimate that each branch contained an average of three deleterious somatic mutations—a "very high" mutation rate, says Bobiwash. "With that many mutations, a flower that undergoes within-branch self-pollination is expected to produce weak seeds and have low fruit set."

Top: Dan Schoen, McGill researcher and leader of the Plant Reproduction Working Group; *Middle:* graduate student Kyle Bobiwash; *Bottom*: example of poor fruit set in blueberry (photos courtesy of D. Schoen)



The findings have important implications for the role of insect pollinators in blueberry production. "We already know that insect pollinators are important for physically transporting pollen between flowers to make sure fertilization takes place, " says Schoen. " But they may be just as important as agents of 'pollen mixing' on a larger spatial scale. "

The study, which was published in the July issue of Heredity, is being hailed not only as a step forward in the study of plant evolutionary genetics, but also as a important contribution to the management of a major agricultural crop. A special commentary on the study was published in the same journal.

UPCOMING EVENTS

Blueberry Pollination Workshop

Feb 21 - 22, 2014
Moncton, NB

CANPOLIN and Bluets NB Blueberries will host a special workshop on blueberry pollination at the Ramada Crystal Palace in Moncton. Growers, beekeepers and other interested parties are invited to this follow-up event to the 2010 Maritime Action Forum on Pollination Research. Researchers will share lessons learned from five years of blueberry research; topics will include bee health and conservation, plant reproduction and pollination ecology in blueberry agroecosystems. The event will also serve as an important forum to discuss next steps for blueberry pollination research in Canada. Watch for further announcements and a detailed agenda to follow early in the New Year.

Virtual Workshops on Crop Pollination

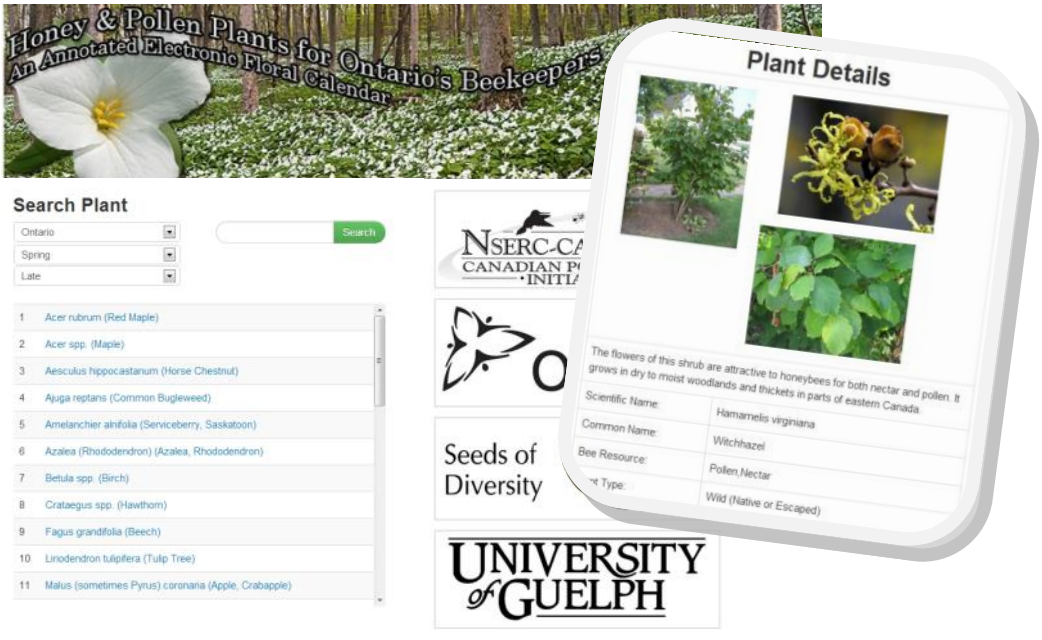
With colleagues in Central and South America, CANPOLIN is planning a series of three webinars to address pollination issues in three crops of Pan-American interest: canola, greenhouse crops and pome fruits. The webinars will share the latest findings and research developments, and create an opportunity to build new international collaborations and partnerships. The webinars will take place in late winter/early spring in 2014 (exact dates and times TBA, stay tuned for more details).

NEW FLORAL CALENDAR FOR ONTARIO BEEKEEPERS

Beekeepers are naturally interested in the flowers that provide sustenance for their bees. Some flowers provide mostly nectar which the bees make into honey, others produce only pollen which is the protein source for bee nutrition, and most produce both. Beekeepers find it useful to know what flowers are in bloom and when in their areas of operation. Thus, books on the floral resources used by honeybees have always been part of beekeeping lore. Today, with older books on floral resources largely out of print, the time is right for an electronic version. With funding from the Ontario Ministry of Agriculture and Food, CANPOLIN has developed such a resource. It is called "Honey & Pollen Plants for ON Beekeepers" and is available at www.beeflowerseasonON.ca The site, which hosted by Seeds of Diversity, lists over 270 kinds of plants, along with the main resources (nectar, pollen, resins) they provide to honeybees and other valuable flower visiting and pollinating insects. The list is easily searched by the scientific and common names of the plants or by season (Spring, Summer, Fall). Each plant entry offers a brief description of the plant and its value as a bee resource, along with relevant photos. A mobile version of the website is also available for tablets and smartphones.

CANPOLIN invites anyone using the Floral Calendar to send comments or suggestions to canpolin@uoguelph.ca. We are looking to replace many of the photos with images taken in Ontario; please send your photos to the above address and appropriate credit will be given.

CANPOLIN plans to expand the site in the near future to include floral resources in other provinces —stay tuned!



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