WG5, Ecosystems

Elizabeth Elle and Jana Vamosi
Objectives of WG5, Ecosystems

• Assess whether seed set of native and non-native plants (including commercial crops) increases or decreases with increased number or diversity of native or non-native pollinators.

• Assess whether the biodiversity of native pollinators increases or decreases with increases in non-native pollinators.

• Assess whether non-native plants adversely affect the pollination of native or crop plants.

• Assess the importance of connectance of pollination webs and generalization and specialization of pollination for the above.

• Assess how plant phenology and the spatial distribution of habitats in the landscape affect pollination services.
Matrix and Fragment Characteristics

Plant Diversity & Abundance

Pollinator Diversity & Abundance

Seed Production (Pollen Limitation)
<table>
<thead>
<tr>
<th>Researcher</th>
<th>Biodiversity Pattern</th>
<th>Landscape/Treatment</th>
<th>PL/seed set/yield</th>
<th>Ecosystem type (<em>crop in italics</em>)</th>
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</thead>
<tbody>
<tr>
<td>Ali</td>
<td></td>
<td></td>
<td></td>
<td>Interaction Web Analysis</td>
</tr>
<tr>
<td>Burke/Nol</td>
<td>X</td>
<td>X</td>
<td>+</td>
<td>Great Lakes/St. Lawrence</td>
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<tr>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>Montane Cordillera</td>
</tr>
<tr>
<td>Cartar</td>
<td>X</td>
<td>X</td>
<td>+</td>
<td>Shortgrass Prairie</td>
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<tr>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Northern Boreal Forest</td>
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<tr>
<td>Cutler</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td><em>Atlantic Maritime, lowbush blueberry</em></td>
</tr>
<tr>
<td>Dorken</td>
<td>X</td>
<td>+</td>
<td>X</td>
<td>Great Lakes/St. Lawrence</td>
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<td>X</td>
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<td>Elle</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Pacific Maritime; <strong>natural plus highbush blueberry</strong></td>
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<td></td>
<td>Montane Cordillera</td>
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<tr>
<td></td>
<td>X</td>
<td>X</td>
<td>+</td>
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<td>X</td>
<td><em>Boreal, lowbush blueberry</em></td>
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<tr>
<td></td>
<td>X</td>
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<td></td>
<td>Arctic</td>
</tr>
<tr>
<td>Hunter</td>
<td>X</td>
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<td><strong>Carolinian, carrot</strong></td>
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<td>Kevan/Woodcock</td>
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<td></td>
<td>Carolinian</td>
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<td>X</td>
<td>X</td>
<td></td>
<td>Great Lakes/St. Lawrence</td>
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<td></td>
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<td>X</td>
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<td>Montane Cordillera</td>
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<tr>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>Arctic</td>
</tr>
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<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Great Lakes/St. Lawrence</td>
</tr>
<tr>
<td>McNeil</td>
<td>X</td>
<td></td>
<td>X</td>
<td><strong>Great Lakes/St. Lawrence, highbush blueberry</strong></td>
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<td>Mineau</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td><strong>Great Lakes/St. Lawrence, various</strong></td>
</tr>
<tr>
<td>Vamosi</td>
<td>X</td>
<td>+</td>
<td>X</td>
<td>Pacific Maritime</td>
</tr>
<tr>
<td>Worley/Westwood</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Tallgrass Prairie</td>
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</table>
Activities of WG5:

1. Research on crops and their relatives
2. Pollination Ecology
3. Responses of pollinators and pollination services to disturbance
4. Plant-pollinator interaction webs
5. Summary/next steps
1. Research on crops and their relatives

- Lowbush blueberry (Cutler, Hermanutz, Fournier, plus WG3)
- Highbush blueberry (McNeil)
- Ground Crops (Mineau, Elle)
Managed lowbush blueberries ‘growing wild’
Native bees pollinating crops in the absence of commercial pollinators

Margie A. Wilkes¹, Luise Hermanutz¹, Chris Cutler²
¹ Memorial University of Newfoundland ² Nova Scotia Agricultural College

Lack of commercial pollinators in Newfoundland berry fields allows for unbiased assessment of native pollinators

Do managed lowbush blueberry fields mirror wild patches in terms of:

1) Pollinator diversity & abundance
2) Floral composition & availability
3) Berry production

Primary study site: blueberry farm in Grand Falls-Windsor, NL - 3 wild & 3 managed plots
Island-wide sweep sites for B. impatiens
Preliminary Results

• Diverse bee community observed at both wild and managed sites

• Comparable floral resource base at field edges & wild sites
  • Native floral resources distributed throughout managed fields

• Similarly high rates of fruit set between wild and managed patches
  • Comparable rates of fruit set between field edges and centres

For more details, please see our poster
How are wild bees distributed in lowbush blueberry fields of Nova Scotia?

Pam Craig, MSc Student, with Chris Cutler, NSAC
How does bee composition change over time?

- **A. mellifera**
- **Lasioglossum**
- **Andrenidae**
- **Bombus**
- **Halictus**

### Collection Date

- **24 May**
- **27 May**
- **3 June**
- **10 June**
- **17 June**
- **8 July**
- **22 July**
- **12 Aug**

### Number of Bees Collected

![Bar graph showing bee composition changes over time with specific dates and numbers. The graph highlights a peak in the number of bees collected on 8 July.](image-url)
Next step: does landscape pattern (time and space) explain variability in bee communities?

- Steve Javorek & Chris Cutler
- Will combine botanical surveys and land-cover maps (red = poor bee forage, green = good bee forage)
Valérie Fournier (Laval) & Madeleine Chagnon (UQAM)

• Blueberry Hit Squad
• M.Sc. student (started Jan. 2010) : Joseph Moisan DeSerres
• Objectives:
  1. Determine the effect of different types of wind-breaker on abundance and diversity of pollinators in Lowbush blueberries (2010)
  2. Evaluate how distance from forest borders influence abundance and diversity (2009 and 2010)
  3. Determine pollinators’ specificity to blueberry pollen (2009)
  4. Identify taxa of pollen grains found on pollinators (2009)
Valérie Fournier (Laval) & Madeleine Chagnon (UQAM)

- over 5000 specimens were captured (2009 + 2010)
- pollen loads: extracted from ~800 specimens
- specimens and pollen grains are being identified

• investigate the effect of **riparian buffer zones** on abundance and diversity of pollinators in Qc’s agricultural landscape

Pollen grain photos: Mélissa Girard, Fournier Lab
Do visitors to highbush blueberry differ in effectiveness?

Jeremy McNeil, UWO
Bee Diversity in Organic and Conventional Hedgerows
In Eastern Ontario
Joanna James & Pierre Mineau

Two sampling techniques on 9 pairs of O/C sites:

- Pan traps
- Bumblebee netting

Farm type: No effect
Pesticides: No effect
Floral diversity: No effect
Natural habitat: No effect

Above-ground bees: No effect
Below-ground Bees: No effect

Natural habitat = Abundance
Species Evenness

Natural habitat = Species
Evenness

Tillage
No effect

No effect

Above-ground bees
No effect
Do wild bees contribute to crop pollination in the Okanagan Valley, BC?
Lisa Neame, with Elizabeth Elle, SFU

Cherry, Apple:
Vast majority of pollination services from honeybees

Squash:
Native bees may be important
Importance of native bees to pollination depends on landscape context.
2. Pollination Ecology

- Invasive species (Vamosi)
- Climate and diversity gradients (Elle)
- Alpine Pollination (Lortie)
- Wild *Vaccinium* floral biology (Davis)
- Floral color (Hunter)
- Restoring Pollinators (Woodcock)
Community Pollination and Invasive Species

MSc candidate Jennifer Muir, with Jana Vamosi

5 broom, 5 uninvaded sites
5 native species; 30 ind/spp/site
Seed set, pollen delivery data, in progress
Two Possible Outcomes:

**Competition**
- Decreased pollen quantity
- Decreased pollen quality
- Pollen Limitation

**Facilitation**
- Increased community attractiveness
- Increase pollinator visitation
- Increased Pollination

1. 1
2. 2
Variation in pollinator composition

- Pollinator community composition influences interspecific competition and selfing in *Plectritis congesta* (L. Adderley; see poster)
How do pollen limitation and plant-pollinator interaction webs change with increasing plant and pollinator diversity?

Grahame Gielens, MSc candidate, with Elizabeth Elle, SFU

- 6 sites along rainfall gradient, bee species richness range 40-65, forb richness 16-27
- Estimated pollen limitation for 6 wildflower spp., 2 yrs
- Whole-community interaction webs in progress
Visitor assemblage and pollen limitation in Common Camas

- Visitors to Camas
  - Year: '09, '10
  - Sites: GO, MZ, SM, CR, FS
  - Visitors: Bombus spp., Apis mellifera, Mid-sized bees, Small bees, Butterflies, large flies, Small flies

- Pollen limitation
  - Higher diversity sites
  - Lower diversity sites

- Go MZ SM CR FS
- '09 '10 '09 '10 '09 '10 '09 '10
APE (Alpine Pollination Ecology) in BC, Canada

1. Identify mountain level differences in pollinator abundance and diversity.

2. Identify plant drivers of pollinator patterns.

3. Determine fine-scale patterns of plant effects on alpine pollinators and predict change.
Regional alpine pollinator contrasts

Seasons & mountains vary dramatically.
Fine-scale alpine pollinator contrasts

Cushions are floral islands for pollinators.
See Reid & Lortie poster & videos at meeting.
Pollination and Floral Biology of Two Native Vaccinium Spp. in Central Saskatchewan

Danielle Stephens (M.Sc. candidate) and Art Davis
University of Saskatchewan, Saskatoon, SK
Key results for *V. myrtiloides*:

- Nectar production begins at anthesis, continues at least 4 days
- Pollen:ovule ratio suggests mating system intermediate to autogamy and xenogamy
- Hymenopterans most common visitors

Danielle will speak about more of her results
Does the dark floret in Queen Anne’s lace affect floral visitor composition?
Fiona Hunter, Brock, with Donnie Aedy
Woodcock – Pollinator Restoration

Restoration:

• Flower visitation/pollination connectance webs at three regenerating former agricultural sites (1, 4, 7 years old)
• Parallel restoration projects at Eastview (Guelph Pollination Park) & Waynco (Pit and Quarry Rehabilitation, Ecosystem Function)

Other/in progress:

• Evaluation of ornamental cultivars as pollinator resources
• Pollination monitoring program for Environment Canada
• Surveys in Churchill/Wapusk, Hudson Bay Railroad ~290km N-S transect across boreal-tundra ‘ecotone’
3. Responses of pollinators (and pollination services) to disturbance

- Logging (Nol, Dorken)
- Grazing (Cartar, Elle)
- Fire (Worley & Westwood)
Bees and Syrphids in Algonquin Park’s Hardwood Forests
Eleanor Proctor, MSc, with Erica Nol

- 80 species of bee and 140 species of syrphid
- Harvested stands had higher abundance, richness, and diversity of pollinators than unharvested stands
  - Pollinator communities were similar before canopy closure
- In summer, harvested stands were dominated by *Lasioglossum* and *Toxomerus* while unharvested stands were dominated by *Bombus* and *Melanostoma mellinum*
In the short term, group-selection harvesting increases pollinator communities within canopy gaps, while continuous forests are dominated by forest-specialists.
Does canopy closure affect sex ratio and pollinator availability for a dioecious plant?

Emony Nichols, MSc candidate, with Marcel Dorken, Trent

- 14 sites, Algonquin Park
- Measured sex ratio, plant traits, pollinator abundance and diversity
The Frequency of Female Shoots of *Aralia nudicaulis* is Higher in More Open Sites

![Graph showing the relationship between percent canopy closure and proportion female shoots, with a GLM: $t = 2.2, P < 0.05$]

Emony Nicholls, with Marcel Dorken
Pollinators Are More Common in Sites With More Females

But--no direct relationship between canopy closure and pollinator abundance

$r = 0.78, df = 7, P < 0.05$

Enony Nicholls, with Marcel Dorken
Influences of grazing & landscape on bee pollinators and their floral resources in rough fescue prairie

14 sites, each with a moderately & a heavily grazed location.

Megan Evans - MSc Candidate
Supervisors:
Ralph Cartar - University of Calgary
Mark Wonneck - Agriculture Canada

Objective: To explain the abundance, diversity, & flower visitation behaviour of the bee pollinator community in rough fescue prairie in relation to: the density and phenology of flowering plants • grazing intensity • landscape • their interactions
The conceptual model

Solid lines: predicted strong effects
Dotted lines: predicted weak effects
Red lines: effects estimated in path analysis
Path coefficients & their significance shown

Still to come:
Structural equation model
Interaction webs
Non-native plants

Landscape → Flower Abundance
Grazing → Flower Abundance
Landscape → Grazing
Flower Abundance → Pollinator Abundance
Flower Diversity → Pollinator Diversity
Pollinator Abundance → Pollinator Diversity

0.49 (p=0.02)
-0.46 (p=0.02)
0.16 (p=0.44)
The impact of grazing on plant and pollinator diversity and community interactions in the South Okanagan shrubsteppe

MSc candidate Sherri Elwell, with Elizabeth Elle, SFU

Four pairs of sites:
  Spring grazed + ungrazed $\geq 15$yrs

Measured:
  Plant cover and diversity
  Pollinator abundance and diversity

In progress: interaction webs
Vegetation structure - percent cover

Mean Percent cover

- * indicates significant difference between Grazed and Ungrazed conditions.
Pollinator abundances

**Total abundance**

<table>
<thead>
<tr>
<th>Site pair</th>
<th># of individuals</th>
</tr>
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<tbody>
<tr>
<td>HL</td>
<td>1000</td>
</tr>
<tr>
<td>OK</td>
<td>1500</td>
</tr>
<tr>
<td>WL</td>
<td>2000</td>
</tr>
<tr>
<td>SO</td>
<td>2500</td>
</tr>
<tr>
<td>Mean</td>
<td>196</td>
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</tbody>
</table>

Arrows = Net collected
Solid = Pan collected

**Grazed** 

**Ungrazed**

**Cavity nesters (Megachilidae)**

<table>
<thead>
<tr>
<th>Site pair</th>
<th># of Individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL</td>
<td>50</td>
</tr>
<tr>
<td>OK</td>
<td>100</td>
</tr>
<tr>
<td>WL</td>
<td>200</td>
</tr>
<tr>
<td>SO</td>
<td>300</td>
</tr>
<tr>
<td>Mean</td>
<td>200</td>
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</tbody>
</table>

**Ground nesters (Bombus/Andrena)**

<table>
<thead>
<tr>
<th>Site pair</th>
<th># of Individuals</th>
</tr>
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<tbody>
<tr>
<td>HL</td>
<td>50</td>
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<tr>
<td>WL</td>
<td>300</td>
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<tr>
<td>SO</td>
<td>50</td>
</tr>
<tr>
<td>Mean</td>
<td>150</td>
</tr>
</tbody>
</table>

Grazed
Ungrazed

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Pollination networks in the tall grass prairie
Sarah Semmler¹, Anne Worley¹, Richard Westwood²

How do fire and annual climate affect pollination network structure and interaction quality (pollen limitation) in the tall grass prairie?

– 6 sites at Tall Grass Prairie Preserve in southern Manitoba
– 3 sites also surveyed in 2009 before the fire
Preliminary Results for 2010 (also see Sarah’s poster for details)

- New burns had:
  - Higher density of open flowers
  - More insects contacting floral sex organs
  - Greater early season flowering

- Pollinators:
  - Diptera most abundant, followed by Hymenoptera.
  - Hymenoptera abundance peaked in June at new burn sites and in August in intermediate burns.

- Abundant flowering species were not the most frequently visited, indicating that relative abundance does not drive network structure.
4. Interaction webs: a common Theme

- Webs being built by: Cartar, Elle, Westwood & Worley, Woodcock
- Analysis of web structure (Ali)
Hierarchical Pollination Webs

- **Ayesha Ali, with Cathy Crea, Liam Callaghan, Guelph**
- Use **graphical models** to represent mechanisms driving observed plant-pollinator interactions
  - **Visit type** – not all are pollination visits
  - **Linkage rules** – complementarity traits of plants and pollinators, forbidden links
- **Hierarchical models**: probability that insect-plant pair interact depends on other variables
- **Need access to real data**
  - *Liam and Cathy have posters*
5. Summary and Future Directions
Matrix and Fragment Characteristics:
Cartar, Cutler, Dorken, Elle, Hermanutz, Worley, Westwood

Plant Diversity & Abundance:
Elle, Hermanutz, Lortie, Mineau, Nol, Vamosi, Worley, Westwood

Pollinator Diversity & Abundance:
Everyone

Seed Production (Pollen Limitation):
Dorken, Elle, Hermanutz, Vamosi
Objectives of WG5

• Assess whether seed set of native and non-native plants (including commercial crops) increases or decreases with increased number or diversity of native or non-native pollinators.
  – Well-covered

• Assess whether the biodiversity of native pollinators increases or decreases with increases in non-native pollinators.
  – Well-covered

• Assess whether non-native plants adversely affect the pollination of native or crop plants.
  – Covered, sparsely

• Assess the importance of connectance of pollination webs and generalization and specialization of pollination for the above.
  – Covered, but work-intensive

• Assess how plant phenology and the spatial distribution of habitats in the landscape affect pollination services.
  – Morphed somewhat into two separate lines of inquiry: 1) the effects of climate and 2) spatial distribution of habitats on pollination services
Next Steps

• Symposium at the Canadian Society of Ecology and Evolution (CSEE) conference in Banff, May 12-15  **REGISTRATION DEADLINE MARCH 1!**

• Speakers and Topics:
  – Canada’s pollinator biodiversity (*Laurence Packer, York*)
  – Linking pollinator biodiversity to pollen limitation (*Jana Vamosi, Calgary*)
  – Pollinator communities and landscape change (*Neal Williams, UC Davis*)
  – Do wild pollinators contribute to crop pollination? (*Dan Schoen, McGill and Linley Jesson, New Brunswick*)
  – Linking behavioural ecology and landscape ecology (*Ralph Cartar, Calgary*)
  – The past and future of pollinators in Canada (*Jeremy Kerr, Ottawa*)
Next Steps

• Review paper—what is currently known about how plant/pollinator diversity affects pollination? (Yvonne Davila: WG5 postdoc)
Next Steps

– Landscape scale analyses of biodiversity patterns, analyses of interaction webs
– Can our results be merged into a Canada-wide meta-analysis?
  • Despite disparate methods, locations, & scales, common theme = context-dependency of pollination