Wild bee abundance and diversity in *canola fields in relation to landscape composition and density of managed honey bees

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*...and adjacent to
Pollination of Crops

Insect-pollinated food crops and livestock forages contribute about 1/3 of the Canadian diet (Richards and Kevan 2002)

These pollination services can be provided by both managed and wild bees

600,000 honey bee colonies in Canada (Canada Honey Council 2010)
- 80,000 ⇒ canola
- 35,000 ⇒ blueberries
- 15,000 ⇒ apples
How might managed bees affect wild bees?

shared resource + limited supply ⇒ ↓ growth/survival/reproduction ⇒ ↓ abundance/diversity
Impacts of Honey Bees on Wild Bees

Evidence for competition

- Foraging niche overlap up to 90%
- ↓ wild bee flower visitation and resource harvesting
- ↓ bumble bee worker size and reproductive success

…but inconsistent findings overall.

(Thomson 2004, 2006; Goulson and Sparrow 2009; Paini 2004)
Impacts of Managed on Wild Bees: Landscape Ignored

Landscapes with less semi-natural land have lower wild bee diversity & abundance

Impacts of managed bees may be confounded with landscape context

The effects of managed bees and landscape on wild bees may interact

(Paini 2004; Butz Huryn 1997; Goulson 2003)
How might managed bees and landscape affect wild pollinators?
How might managed bees and landscape affect wild pollinators?

A managed bee * landscape interaction

![Graph showing the relationship between managed bee abundance and the abundance/diversity of wild bees in high and low semi-natural land areas.]
Study Area

Southern Alberta

H = hybrid seed production canola (n=15)
C = commercial canola (n=15)
R = hybrid seed canola research trials (n=2)

Variation in density of managed bees

25 km

H1 H2 H3 H5 H6 H7 H8 H9 H10 H11 H12 H13 H14 H15
C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14

n=15 n=15 n=2
Study Sites: Variation in Landscape Context

H1: >80% semi-natural

C12: <1% semi-natural
Quantification of Landscape
Quantification of Landscape
Sampling Bees and Flowers

3 visits/site (~before, during, after canola flowering)

On each visit:
- four 100m transects in field edges
- two 100m transects in canola crop

On each transect:
- Aerial netting (15 min)
- Sweep netting (100 sweeps)
- Flower counts
Bee Abundance Thru Time

Total bees:
7523 managed
1549 wild
Floral Resource Overlap

3416 flower visits recorded in field edges

Percentage overlap (wild & managed):
  57% plant species (29/51)
  98% floral abundance

Hurlbert’s Index: (>1 indicates overlap)

Managed/wild = 9.34 (95% CI: 9.09-9.59)
A. mellifera/wild = 12.39 (95% CI: 12.03-12.75)
M. rotundata /wild = 3.22 (95% CI: 3.16-3.28)
Wild Bee Diversity

5 families; 26 genera; 54 species and 44+ morphospecies
Response to Landscape Scale

WILD BEE MEASURES:

- Simpson’s Diversity Index
- Abundance

Graph showing the response of wild bee measures across different landscape scales.
Effects of Managed Bees and Landscape Context on Wild Bee Abundance

$$WBA \sim MBA \times %\text{SemiNat} + \text{site}(\text{random})$$

(p=0.92) (p=0.009)
Effects of Managed Bees and Landscape Context on Wild Bee Diversity

\[ WBD \sim MBA \times \%\text{SemiNat} + \text{site}(\text{random}) \]

(p=0.24)

(p=0.013)
Effects of $\Delta$Managed Bee Abundance and Landscape Context on $\Delta$Wild Bee Abundance

$\Delta WBA \sim \Delta MBA \times \%\text{SemiNat} + \text{site(random)}$

(p=0.048)

Proportion Semi-Natural Habitat to 250m (quintiles: 0, 25, 50, 75, 100)
Wild bee communities are structured by concurrent effects of landscape context and managed pollinators.

Semi-natural land is positively associated with wild bee abundance and diversity, but at different scales.

Managed bees have a greater impact on wild bees in more natural landscapes.

- temporal comparisons are more powerful for detecting impacts of managed bees than correlations of raw abundances.
Implications

Integrated land use may lead to greater impacts on wild bee communities.

Where possible managed bees should be located in areas dominated by cultivated land.

Potential of long term suppression of wild bee communities by managed pollinators.

Photo: Meaghan Crawford
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