Comparison of current and historic wild bee body length, head width, and intertegular distances

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Introduction

Bees are hyperdiverse taxa with over 20,000 species globally. Across species, bees vary in size from the 2mm in length (Leurotrigon muelleril) to 38 mm (Megachile pluto). Within species, individuals may also vary in size. Body size can have profound effects on fitness as it may influence a bee's ability to obtain **floral rewards, regulate body temperature, and forage over long distances. A number of factors can influence body size including nesting habitat, temperature, and the abundance and type of food resources. For example, some bee larvae reside in plant stems and the type and size of available vegetation can influence and limit adult body size. Further, the plants they use to forage may also affect their body sizes. Some bee species depend only on a genus or family of flowers, or nest in stem cavities, so their body sizes may change as floral morphology changes. Plant succession over time can change which can affect bee body sizes, especially with more rapid successions due to climate change. This study focused on analyzing the differences in historical and current bee body sizes which included head width, body length, and intertegular distance, which is the length between the wing bases. The hypothesis was that bee body sizes will change over time.**

Materials and Methods

Source of bees:

- Historic bees- University of Minnesota Insect Collection
- Current bees- Enhancing Pollinator Landscapes: Wild Bee Survey

Location:

- Twin Cities metro area (Ramsey, Hennepin, Anoka, and surrounding counties in MN)

Time periods:

- Historical- 1900's to 1950's
- Current- 1990's to 2016

Species*

- *Andrena miserabilis*
- *Andrena crataegi*
- *Andrena vicina*
- *Halictus ligatus*
- *Halictus confusus*
- *Lasioglossum pilosum*
- *Ceratina mikmaqi*

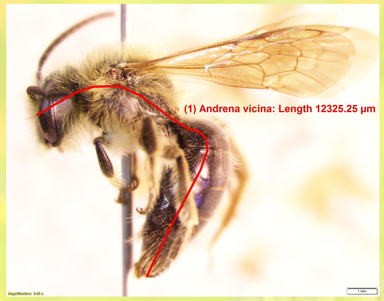
* When available, 10 bees from each sex were measured

R statistical software (version 3.3.2) was used for to analyze the data

Measuring Methods

An Olympus SZX16 microscope was used alongside with its 5MP DP27 camera to accurately measure the head width, body length, and intertegular distances of the bees in micrometers, which were converted to millimeters in the results section. Digital measurements were made using CellSens Standard software. Head width was defined as the widest part of the head when viewed from above with the microscope. Body length was determined using the polyline tool measuring through the middle of the bee's side profile. Intertegular **distance was measured from the center near the inner edge of the wing bases. Over 300 bees were individually measured within the seven species listed.**

Body Length



Current *Andrena vicina* male body length measurements

Intertegular Distance

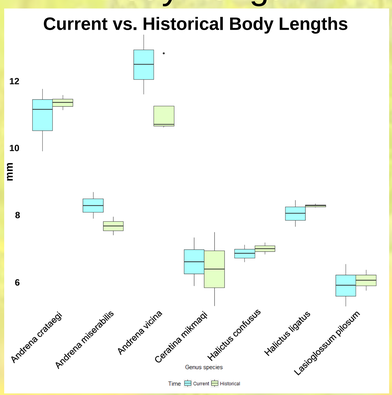
Current *Halictus confuses* female intertegular distance(the space between wing bases)

Head Width

Historical *Ceratina mikmaqi* female head width measurements

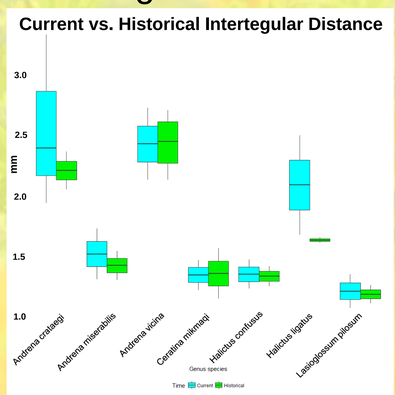
Results

Body Length



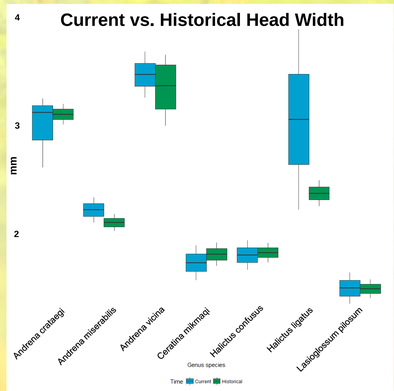
Historical and current body lengths (mm) were compared.

Intertegular Distance



Historical and current intertegular distance (mm) were compared.

Head Width



Historical and current head widths (mm) were compared.

One Sample t-test	t	Mean Difference	df	p	95% CI-Lower	95% CI- Upper
Body Length	-0.998	-166.3	6	0.49	-717.11	384.509
Intertegular Distance	-1.838	-131.72	6	0.12	-307.09	43.66
Head Width	-0.997	11.45	6	0.36	-329.25	352.14

Conclusions

The results from the one sample t-tests indicated the changes of body lengths, head widths, and intertegular distances overall for these bees were not statistically significant. As the p-values were greater than 0.05, we could not reject the null hypothesis that bee body sizes do not change over time. The mean species difference between historic and current species was not statistically significant with species of bee as the replicate. The habitat changes may not have been great enough to impact bee body sizes over time. This may indicate bee body sizes are not changing as fast as ecological changes and could take longer for bees to coevolve with changes in habitat.

All species in this study were generalists and prefer to nest underground. Ceratina mikmaqi can nest underground or in plant stems, pith, or dead wood. Most the bees in this study were solitary, including all Andrena, Lasioglossum pilosum, and Ceratina mikmaqi. Halictus ligatus and Halictus confusus were eusocial, with two generations of bees in a nest. Mother(s) and daughters take care of the nest and young. Ground nesting bee body sizes may change less than that of only stem nesting bees. Their range of diets may also have an impact on their body sizes. The bees in this study were all generalists, so they may be able to alter their diets due to availability rather than investing in changing their body sizes over time.

Literature Cited

Cariveau DP, Nayak GK, Bartomeus I, Zientek J, Ascher JS, Gibbs J, et al. (2016) The Allometry of Bee Proboscis Length and Its Uses in Ecology.

Roulston, TH., and Cane JH. (2000) The Effect of Diet Breadth and Nesting Ecology on Body Size Variation in Bees (Apiformes). Journal of the Kansas Entomological Society 73: 129-42.

Acknowledgments

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Bee Lab

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