Effects of temperature on metabolic rate during development in the alfalfa leafcutting bee, *Megachile rotundata*

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Introduction

- Spring temperatures in temperate regions fluctuate drastically, ranging from optimal to sublethal conditions.
- Alfalfa leafcutting bees, as well as other insects that are undergoing development during the season, are sensitive to the varying conditions, which can lead to physiological injuries.
- To comprehend how exposure to various temperatures during pupal development affects metabolism, we generated a thermal performance curve using oxygen consumption for *Megachile rotundata* during this life stage.

Objective

Measure metabolic rate in *Megachile rotundata* across temperatures ranging from 6°C to 45°C.

Methods

Diapause

- Overwintering prepupal bees were kept in 6°C incubator.

Initiating Development

- Diapause was terminated by placing bees in 29°C to initiate development.

Treatment

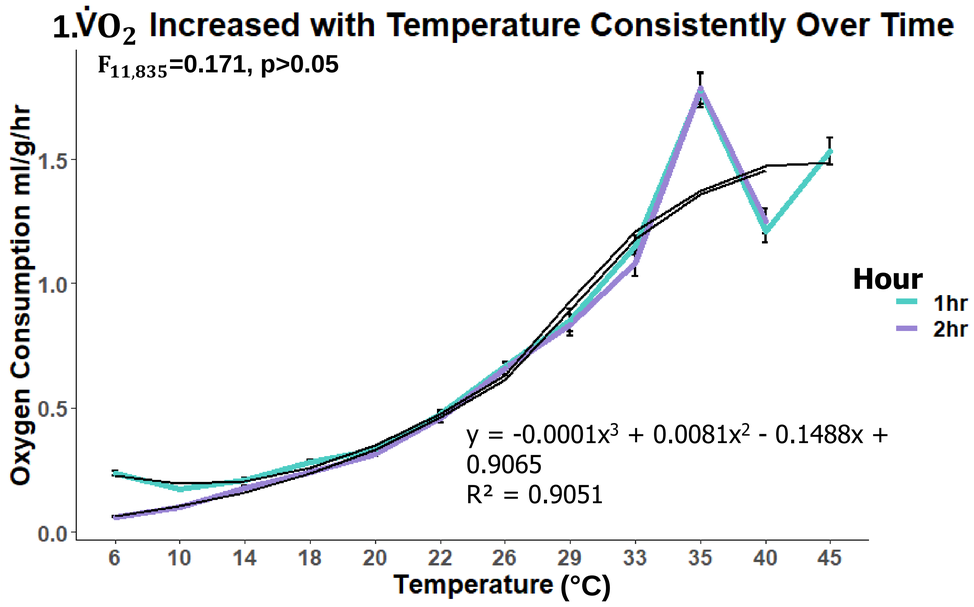
- After two weeks, 40 pupae were set in the microplate system for 2 hours to measure oxygen consumption (VO_2) at 12 different temperatures, ranging from in 6°C to 45°C.

Resume Development

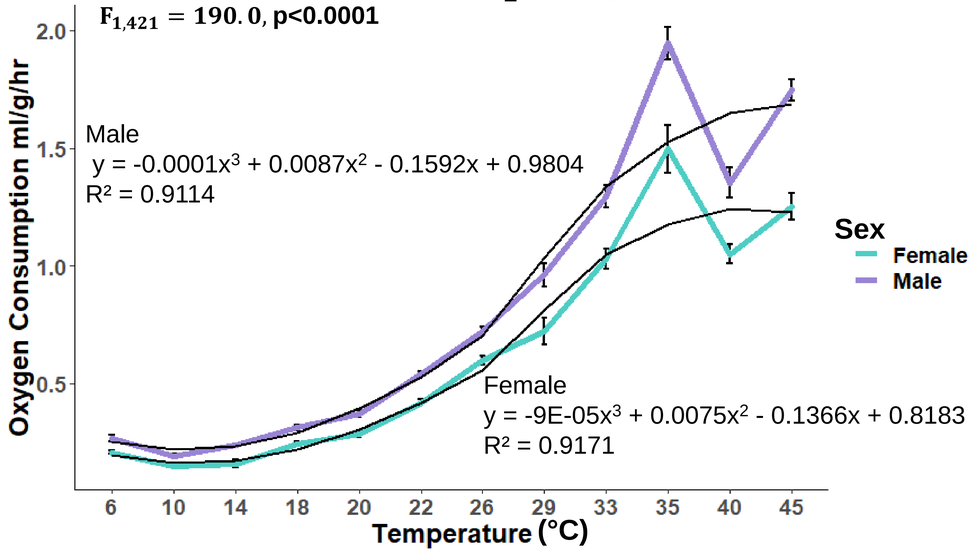
- Following exposure to the experiment, bees were weighed and placed in 29°C to resume development.

Results

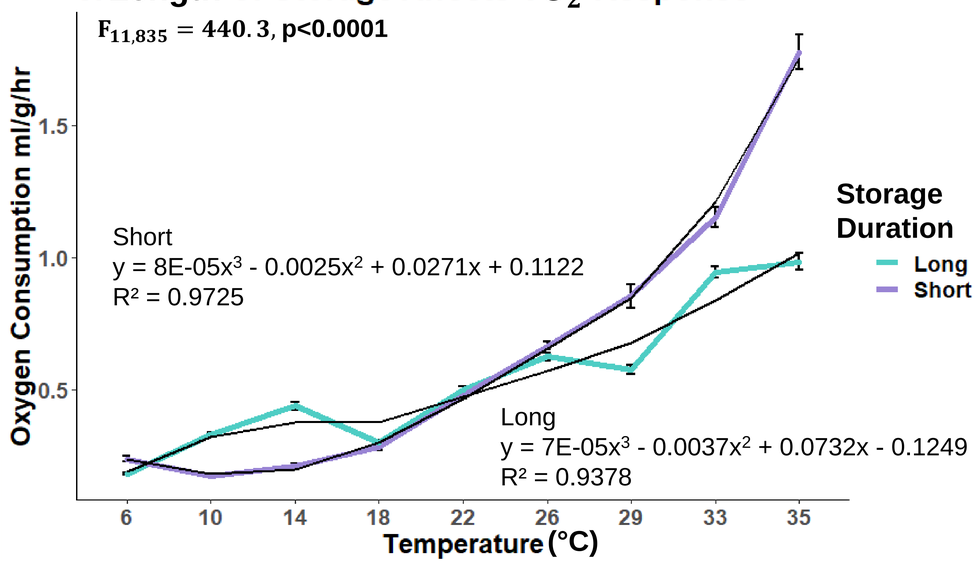
1. $\dot{V}O_2$ Increased with Temperature Consistently Over Time



2. Males Have Increased $\dot{V}O_2$ at High Temperatures



3. Length of Storage Affects $\dot{V}O_2$ Response



Conclusion

- Metabolic rate between 10 °-20 °C increased more rapidly ($Q_{10} = 1.87$) than between 35 °-45 °C ($Q_{10} = 0.86$).
- Metabolic rate did not change after initial exposure, indicating that only the first hour needs to be measured to generate reliable data.
- At higher temperatures, physiological responses differ between sexes.
- Males had significantly higher metabolic rates than females (p<0.0001), suggesting that they are more sensitive to stress.
- Length of post-diapause storage has a direct effect on metabolic rate.
- *M. rotundata* that were collected during Spring (short storage) had higher metabolic rates than those collected during Fall (long storage; p<0.0001).

Future Directions

- Compare measurements with other closed respirometry systems.
- Investigate why there are differences in metabolic rates between sexes at higher temperatures.
- Investigate the physiological effects caused by 40-50 °C in *M. rotundata.*
- Determine period that *M. rotundata* can be stored without affecting VO_2 response.
- Compare productivity of *M. rotundata* after being stored during short and long periods.
- Generate thermal performance curves during different life stages.
- Compare metabolic rate of *M. rotundata* after receiving stress treatments at the same pupal stages.

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