

Effect of Senescence on Chill Coma Recovery Time in Alfalfa Leafcutting Bees (*Megachile rotundata*)

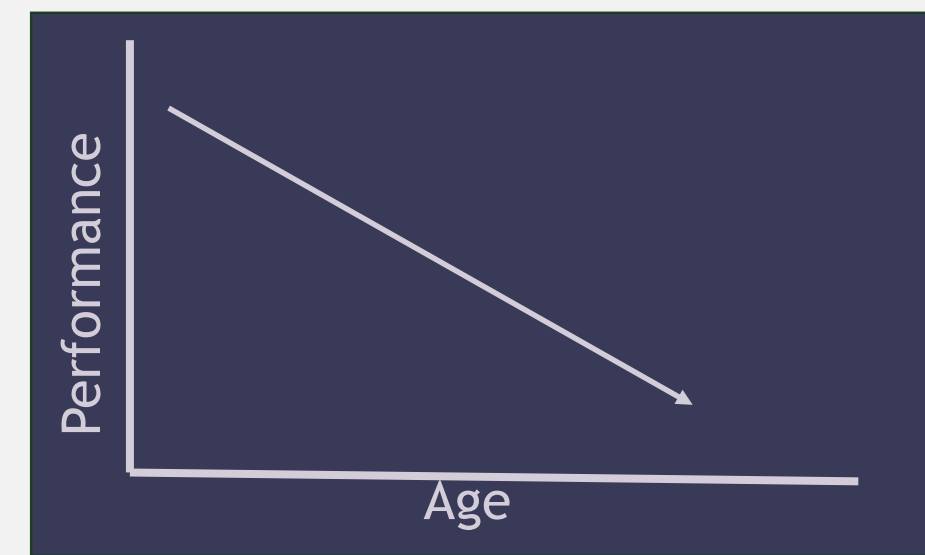
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Introduction

- Alfalfa leafcutting bees (*Megachile rotundata*) are solitary and efficient pollinators, crucial for alfalfa crop production¹.
- Chill coma recovery time (CCRT) is indicative of overall performance and fitness of an organism and can gauge rate of senescence over time.
 - Chill coma is a reversible paralysis induced by exposure to enough of a low temperature.



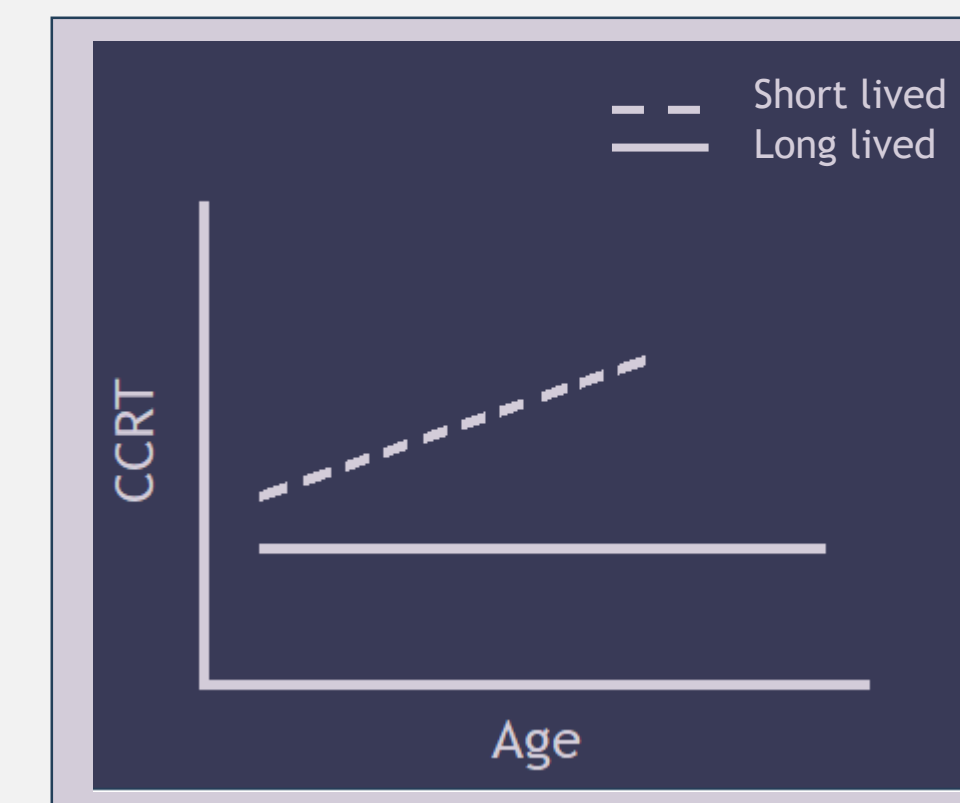
As an organism ages, its performance generally declines. A longer chill coma recovery time is indicative of poor fitness and an increase in the affect of senescence on the individual.³

- Understanding the longevity of these bees is beneficial for both farmers in the Midwest as well as the scientific community.

Predictions and Results



Prediction A) Since performance declines with age, bees will have progressively longer recovery times as they age.



Prediction B) Bees that take relatively the same amount of time to recover throughout their life will live longer than those that take longer.

Conclusions

- The results support my hypothesis that there are indicators in chill coma recovery time that allow us to predict the longevity of the Alfalfa leafcutting bee.
- Late season cold snaps will likely have greater negative effect on bees.
- The rate of performance decline is faster in males than in females, likely due to the shorter lifespan of males.
- Female and male bees “destined” to live longer upon emergence as adults have underlying traits that benefit them for cold tolerance.
- Young bees will recover quicker from cold snaps.

Research Question and Hypothesis

Research Question

- Can we predict which bees will live longer?

Hypothesis

- We can predict which bees will live longer by noticing variations in chill coma recovery time (CCRT) between long versus short lived bees.
 - Prediction A)** As the bees age, they will have longer recovery times.
 - Prediction B)** Bees that senesce quicker than others will have longer recovery times.

Methods

- Mark 10 bees with individual colors of oil-based paint and house them in boxes with food (50% Prosweet/50% deionized water) for 14 replicates.
- Fill foam box with ice for chill coma recovery experiment.
- Gently place bees from one housing box into 50mL tube.
- Place tube into ice (0°C) for 45 minutes to induce chill coma.
- After cold exposure, place bees on their backs on a filter paper and record recovery time (CCRT).

Setup Diagram

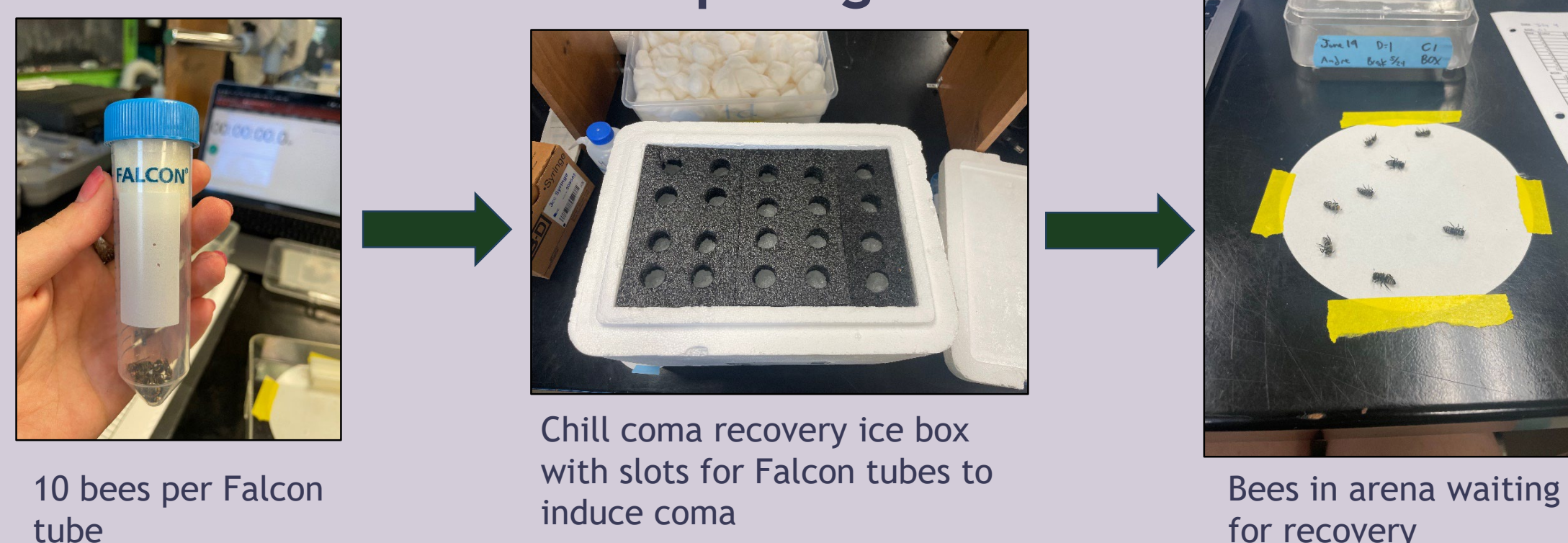


Figure 1. Chill coma recovery time is not affected by mass upon emergence.

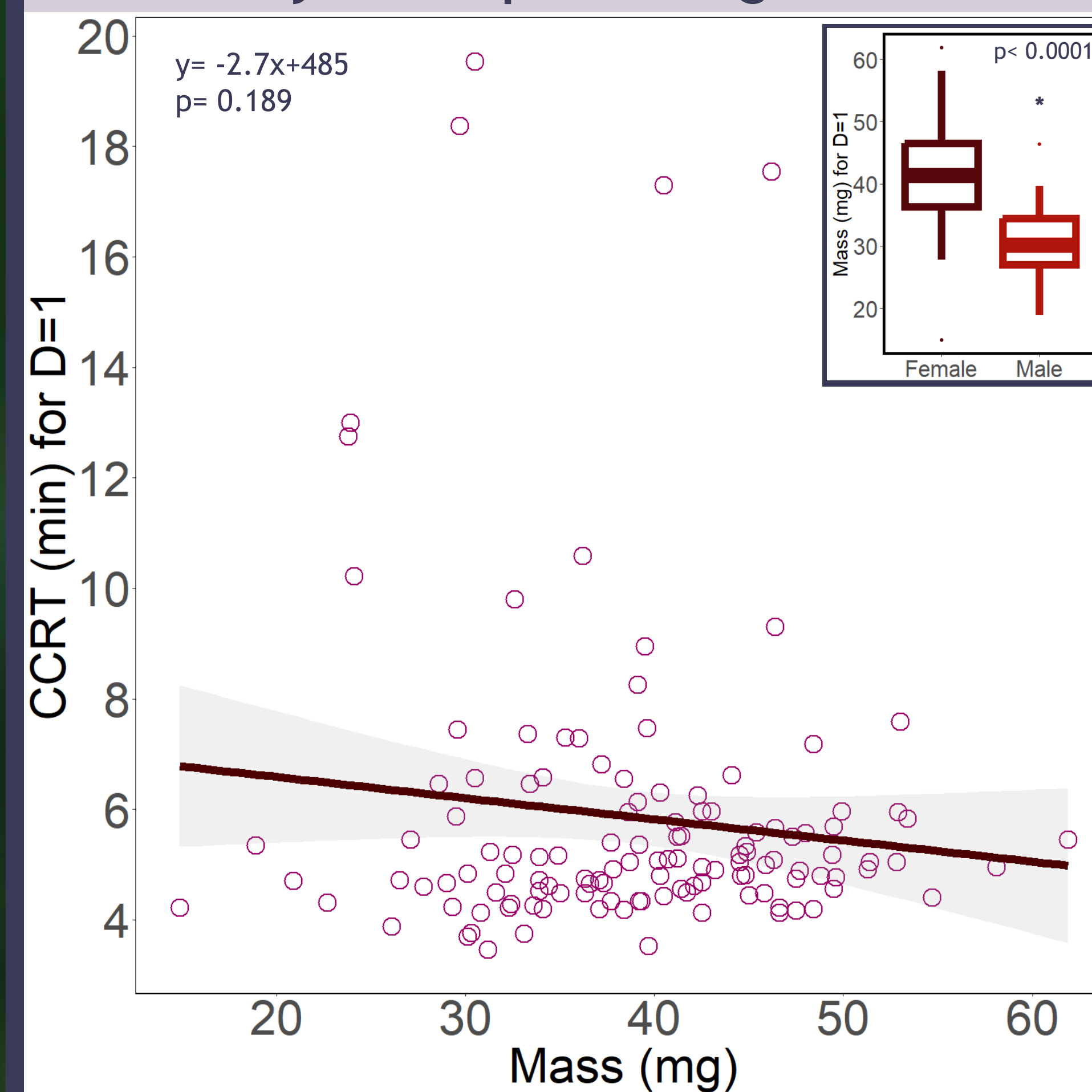


Figure 2. Males consistently take longer than females to recover as they age.

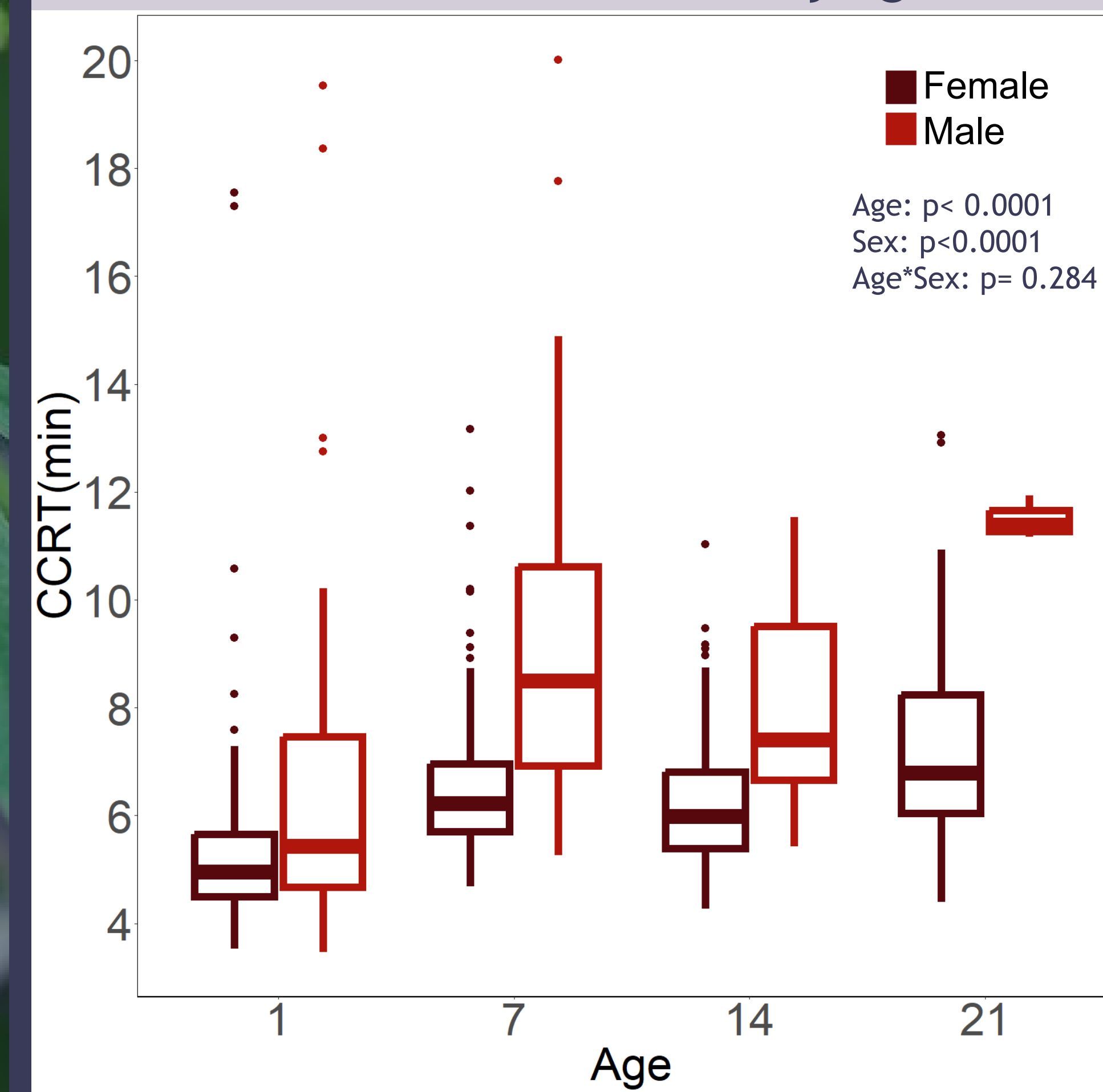


Figure 3. Female bees that died within 21 days recover slower after Day 7.

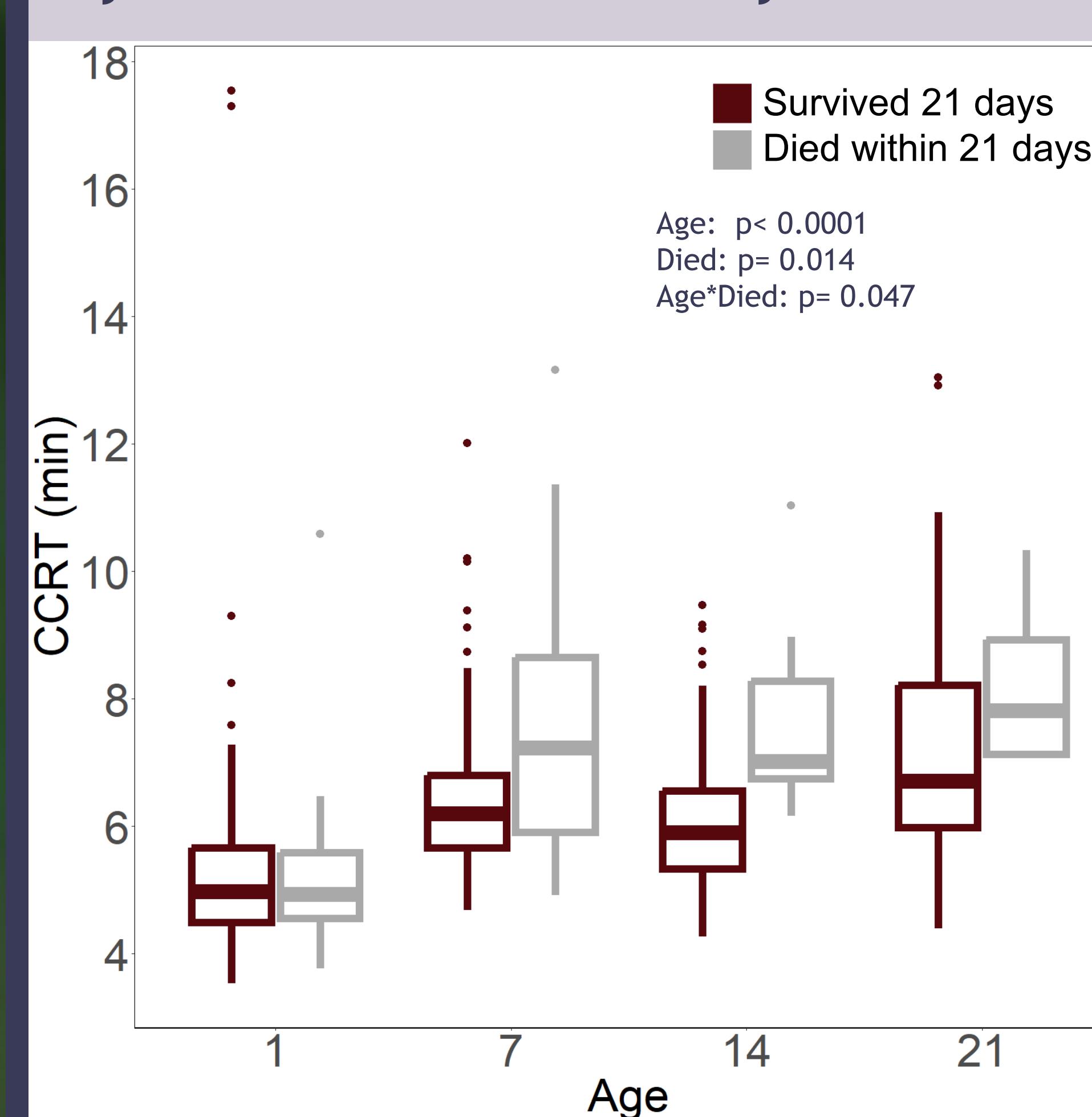
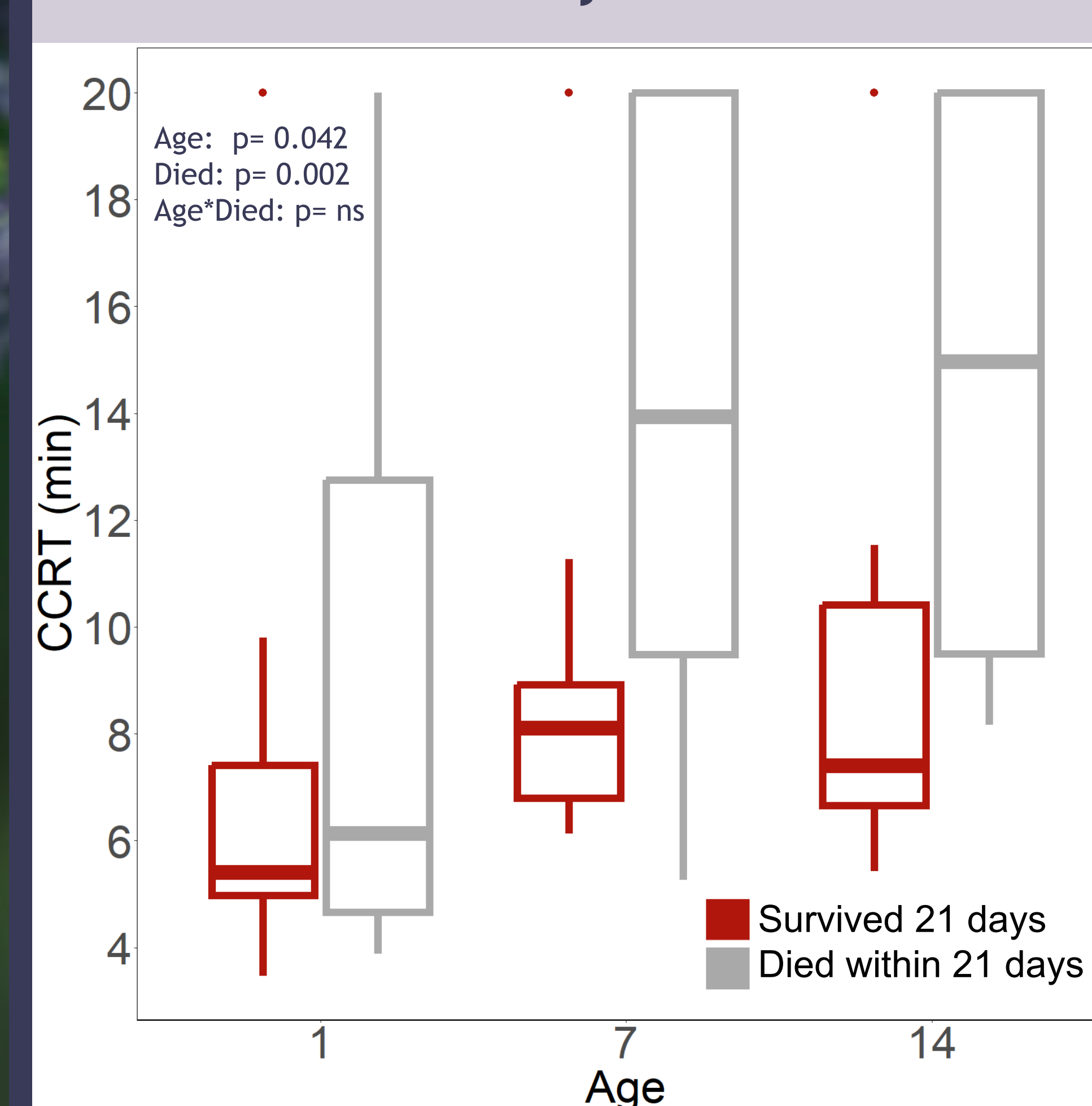


Figure 4. Male bees deteriorate quicker than females after Day 7 and live shorter.



Future Directions

- Understanding why there are certain bees that are able to fully return to homeostasis yet refuse to flip over
- Testing metabolic rate and locomotor activity in Alfalfa leafcutting bees to assess whether they are a better determinant of lifespan than chill coma recovery time
- Continue to assess what drives longevity by measuring telomere length between long and short lived bees

Acknowledgements

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