

# The Effects of Cell Position on Adult Emergence of the Alfalfa Leafcutting Bee, *Megachile rotundata*

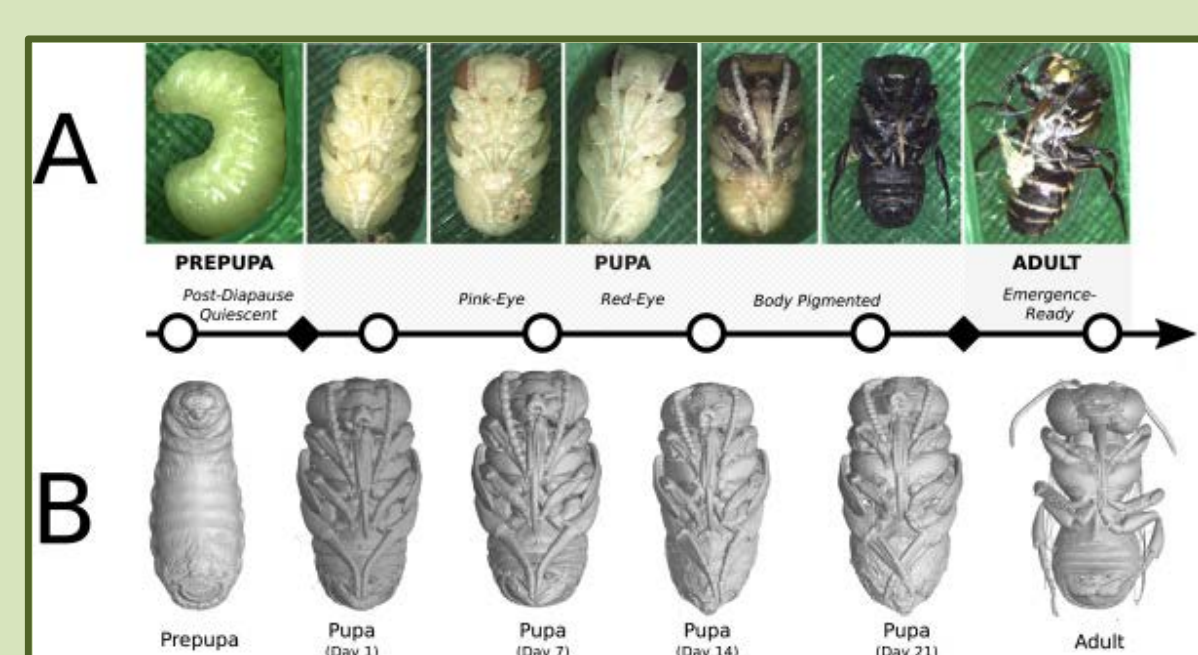
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## Introduction

- The Alfalfa Leafcutting bee, *Megachile rotundata*, is a highly managed commercial pollinator.<sup>3</sup>
- This solitary, cavity-nesting bee constructs a series of brood cells.



- Females spend most of their lives cutting leaflets for the brood cells. After depositing pollen and nectar along with an egg, she will cap the cell with more leaflets. Offspring develop to adulthood within the brood cell.



Developmental stages of the Alfalfa Leaf Cutting Bee.<sup>1</sup>

- Males will emerge 1-3 days before their female nest mates.<sup>2</sup> Therefore, likely to avoid infanticide, females are typically found in the back of the cavity.



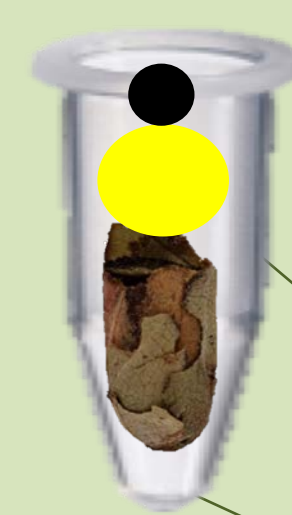
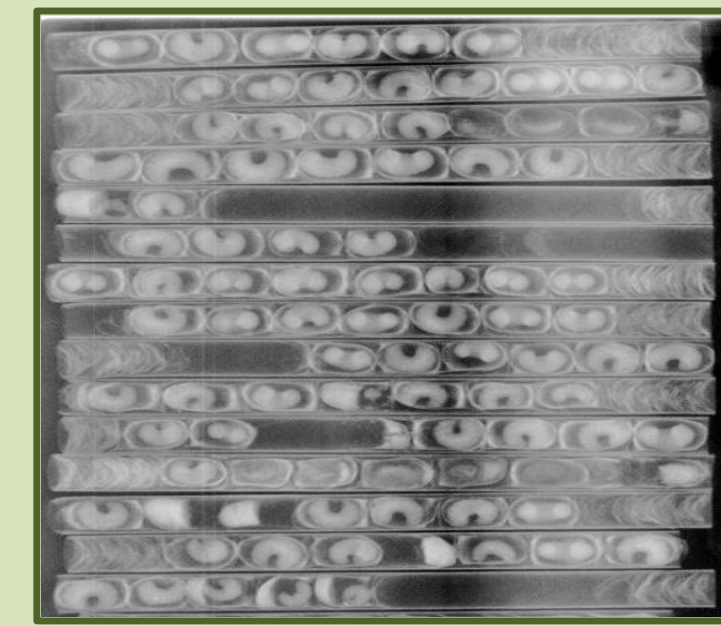
### Does cell position affect the time of adult emergence?

**Hypothesis:** Cell position affects the time it takes to emerge as adults.

**Prediction:** Offspring towards the front of the cavity will emerge earlier than those in the back.

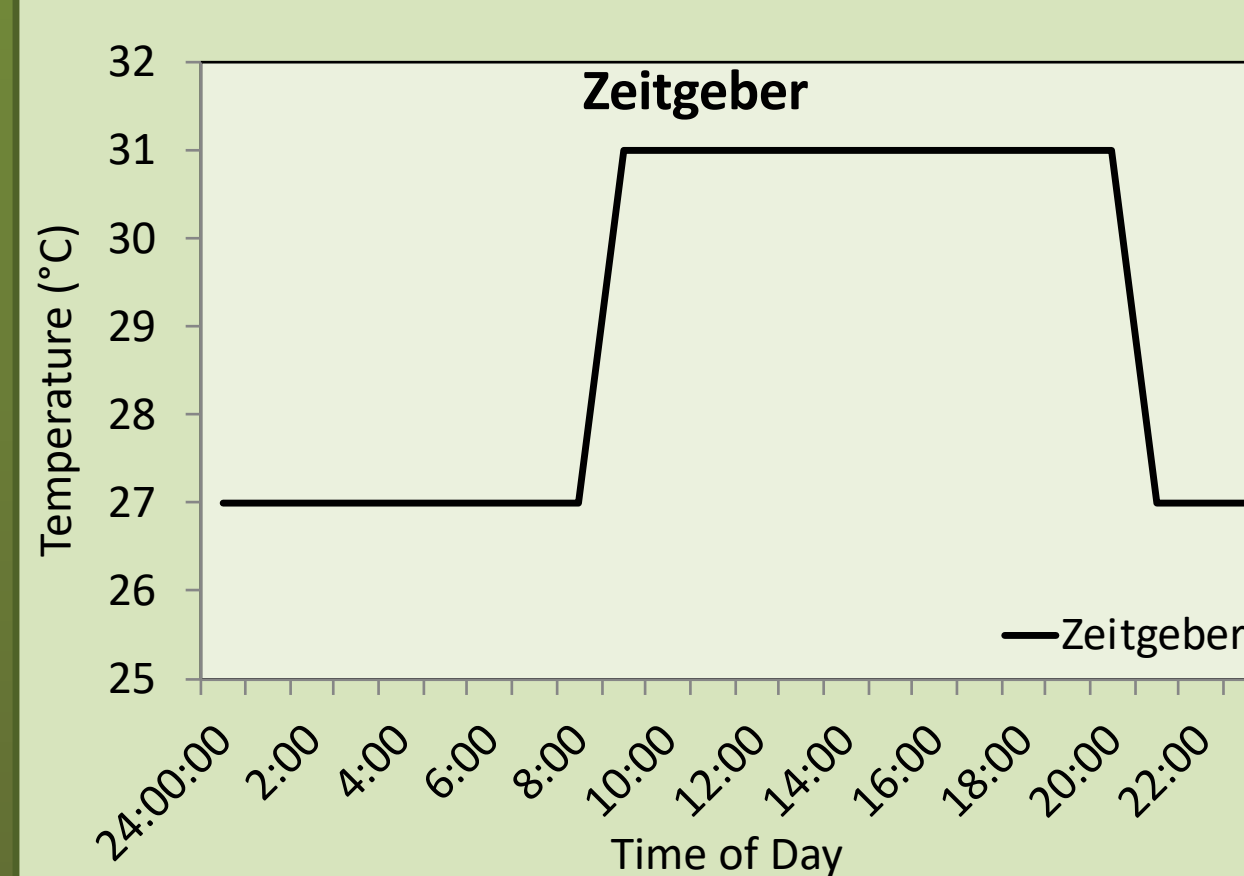
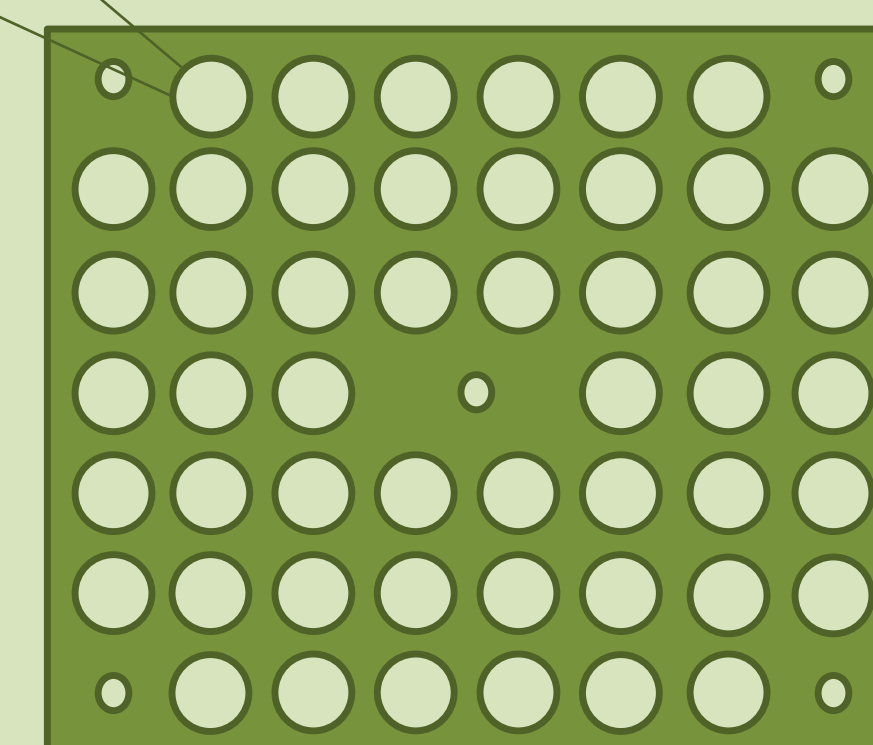
## Methods

- Straw selecting process
  - 2018 field season
  - All x-rayed
  - 6+ healthy brood cells
  - Total of 450 selected

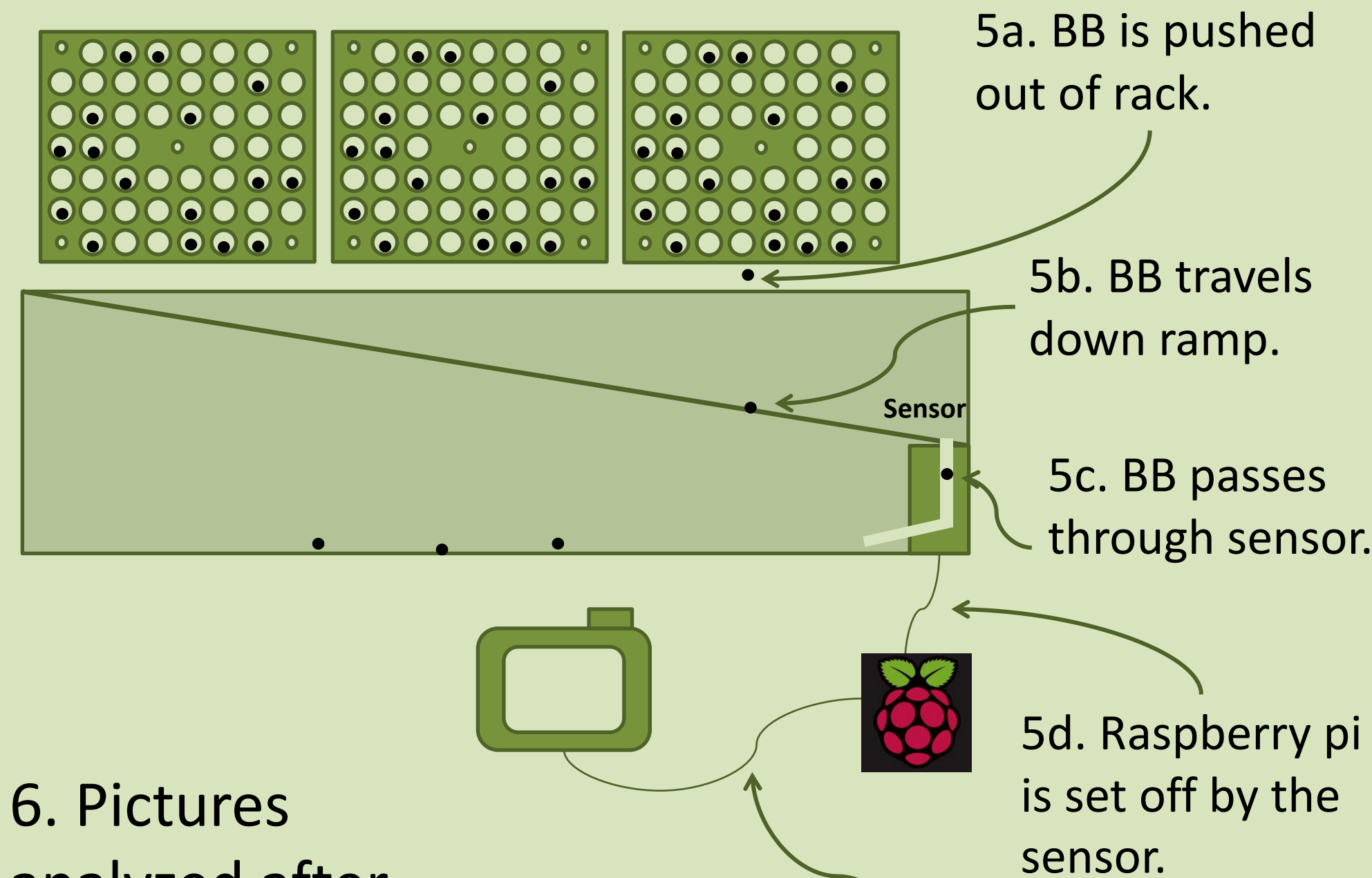


- Each brood cell was given an ID and placed into an Eppendorf tube along with an airsoft pellet.

- The Eppendorf tubes were placed into 3D printed racks with a small metal BB placed on top of the airsoft pellet.



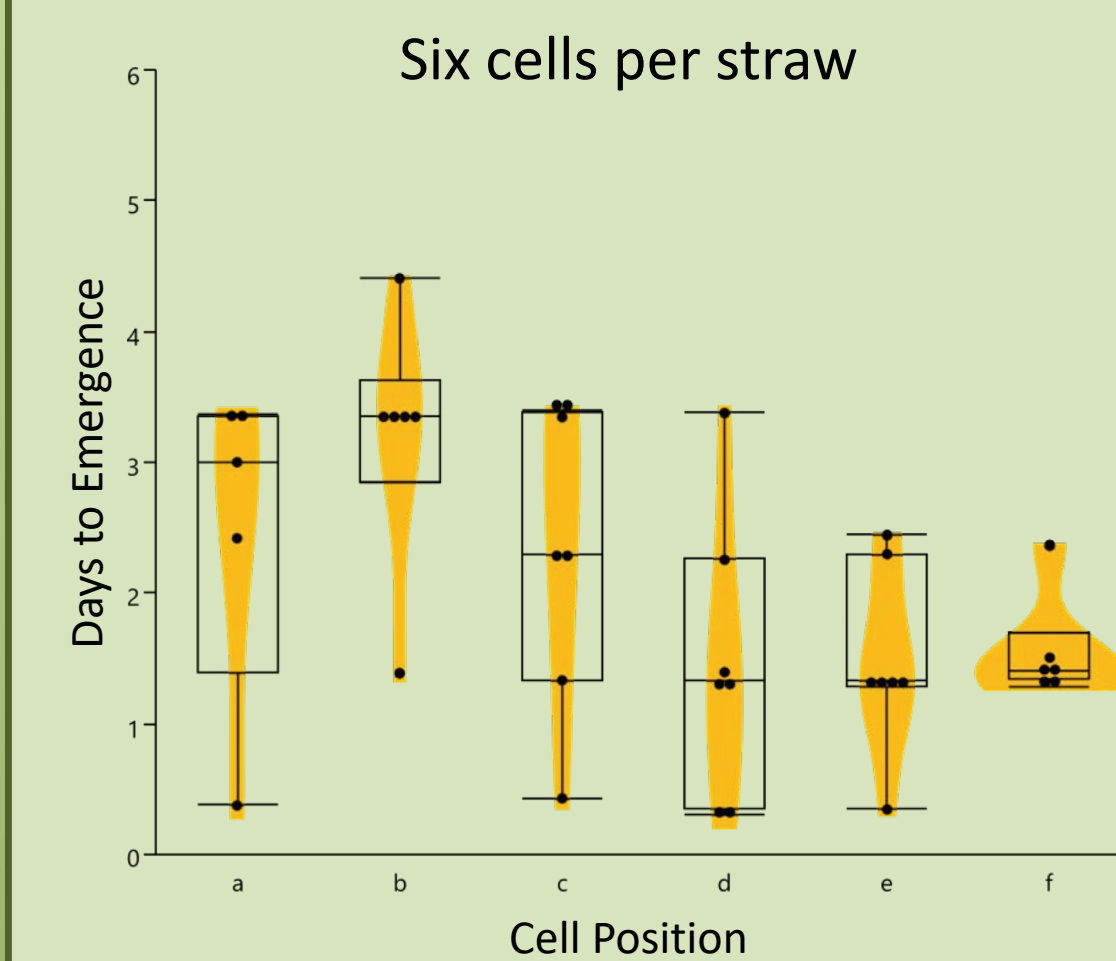
- The prepupal bees developed in an incubator with a 4°C temperature change (zeitgeber) to synchronize their emergence.



- Pictures analyzed after the bees were done emerging to show which bee emerged.

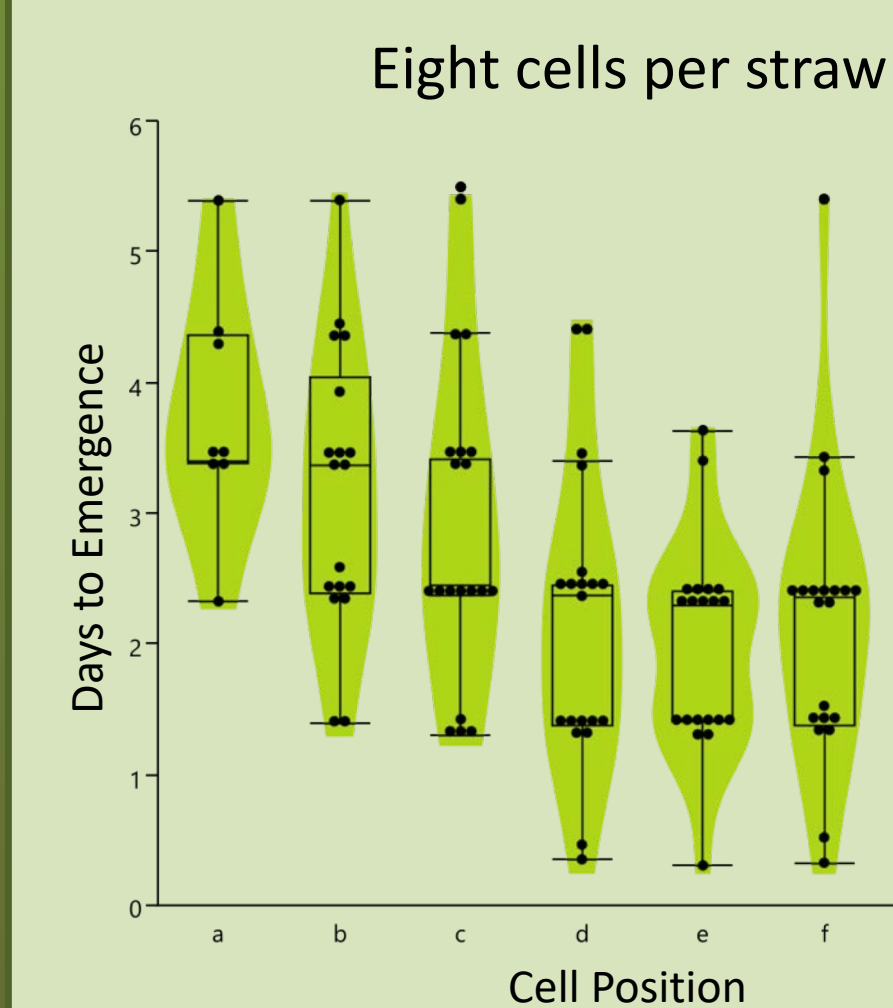
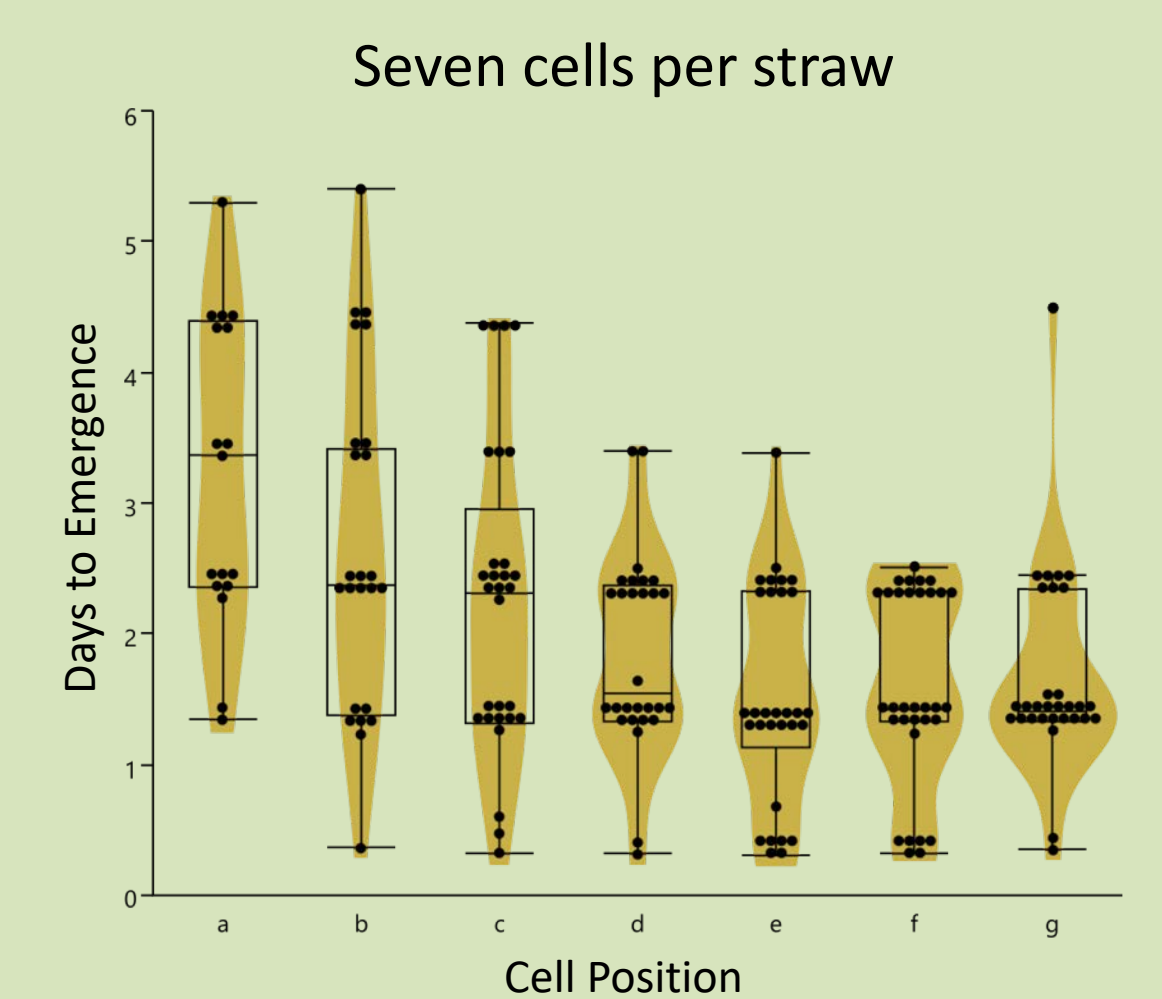
5e. Camera is triggered by the pi to take a picture stamped with date, time, and temperature.

## Results



**Figure 1:** Days to emergence varied by cell position ( $\chi^2=11.66$ ,  $p=0.0398$ ). Cell positions b & d ( $p=0.0314$ ) and b & e ( $p=0.0331$ ) had significantly different times to emergence.

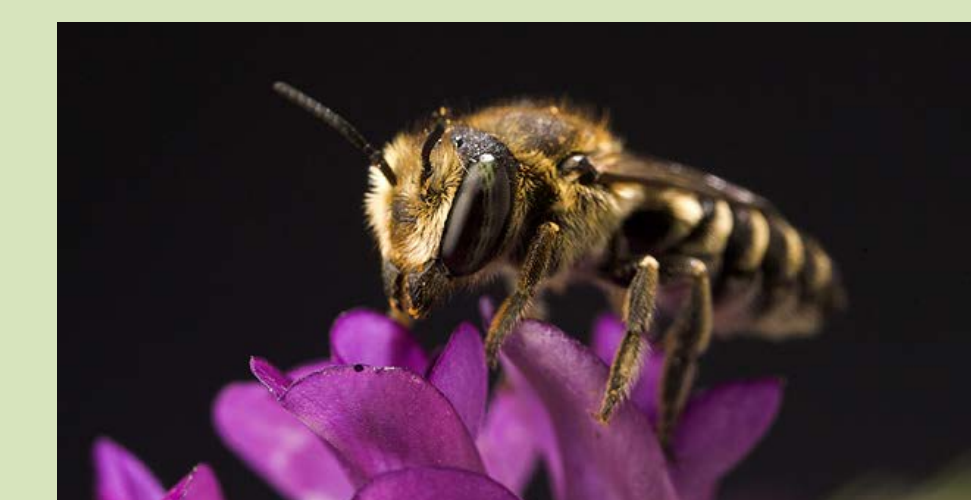
- Cell position affected the days to emergence ( $\chi^2=31.90$ ,  $p<0.0001$ ). Times to emergence varied between cells from the front of the straw to the cells in the back of the straw (post-hoc comparisons,  $p<0.05$ ).



**Figure 3:** Variation occurred between cell positions and their days to emergence ( $\chi^2=29.037$ ,  $p<0.0001$ ). Observed variations occurred between the front cells and the back cells (post-hoc comparisons  $p<0.05$ ).

## Conclusion

- Overall, results supported the predicted outcome of bees in the front cells emerging earlier than those in the back cells.
- For all straw lengths, differences were observed in days to emergence based on cell position.
- The variation in days to emergence could be due to unexpected sex differences.



## References

- Helm, B. R., Payne, S., Rinehart, J. P., Yocum, G. D., Bowsher, J. H., & Greenlee, K. J. (2018). Micro-computed tomography of pupal metamorphosis in the solitary bee *Megachile rotundata*. *Arthropod Structure & Development*, 47(5), 521-528. doi:10.1016/j.asd.2018.05.001
- Kemp, W. P., & Bosch, J. (2000). Development and Emergence of the Alfalfa Pollinator *Megachile rotundata* (Hymenoptera: Megachilidae). *Annals of the Entomological Society of America*, 93(4), 904-911. doi:10.1603/0013-8746(2000)093[0904:daeota]2.0.co;2
- Pitts-Singer, T. L., & Cane, J. H. (2011). The Alfalfa Leafcutting Bee, *Megachile rotundata*: The World's Most Intensively Managed Solitary Bee. *Annual Review of Entomology*, 56(1), 221-237. doi:10.1146/annurev-ento-120709-144836

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