

Florissant Formicids: Eocene to Modern Comparison

Meliah Dubus & Sarah Leventhal



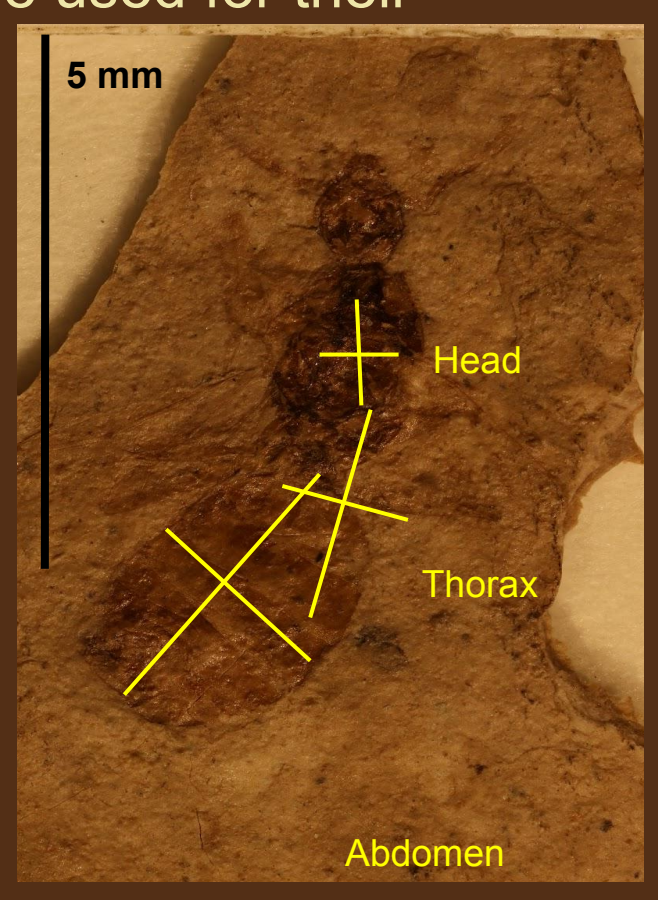
Introduction

- Ants with that are larger and are arboreal tend to have a higher heat tolerance. (Hays,2016; Baudier et al. 2015)
- Ants in urban areas tend to be smaller to be less noticeable by humans. (Ossala, et al., 2015)
- In my project I studied ants from the Eocene Epic (34-56 mya) and compared them to modern day ants of the same lineages to study how they have adapted to a changing climate.
- Climate change is affecting animal populations worldwide.
- Studying animals across time periods of climate change can help us understand and predict the one that we have entered.

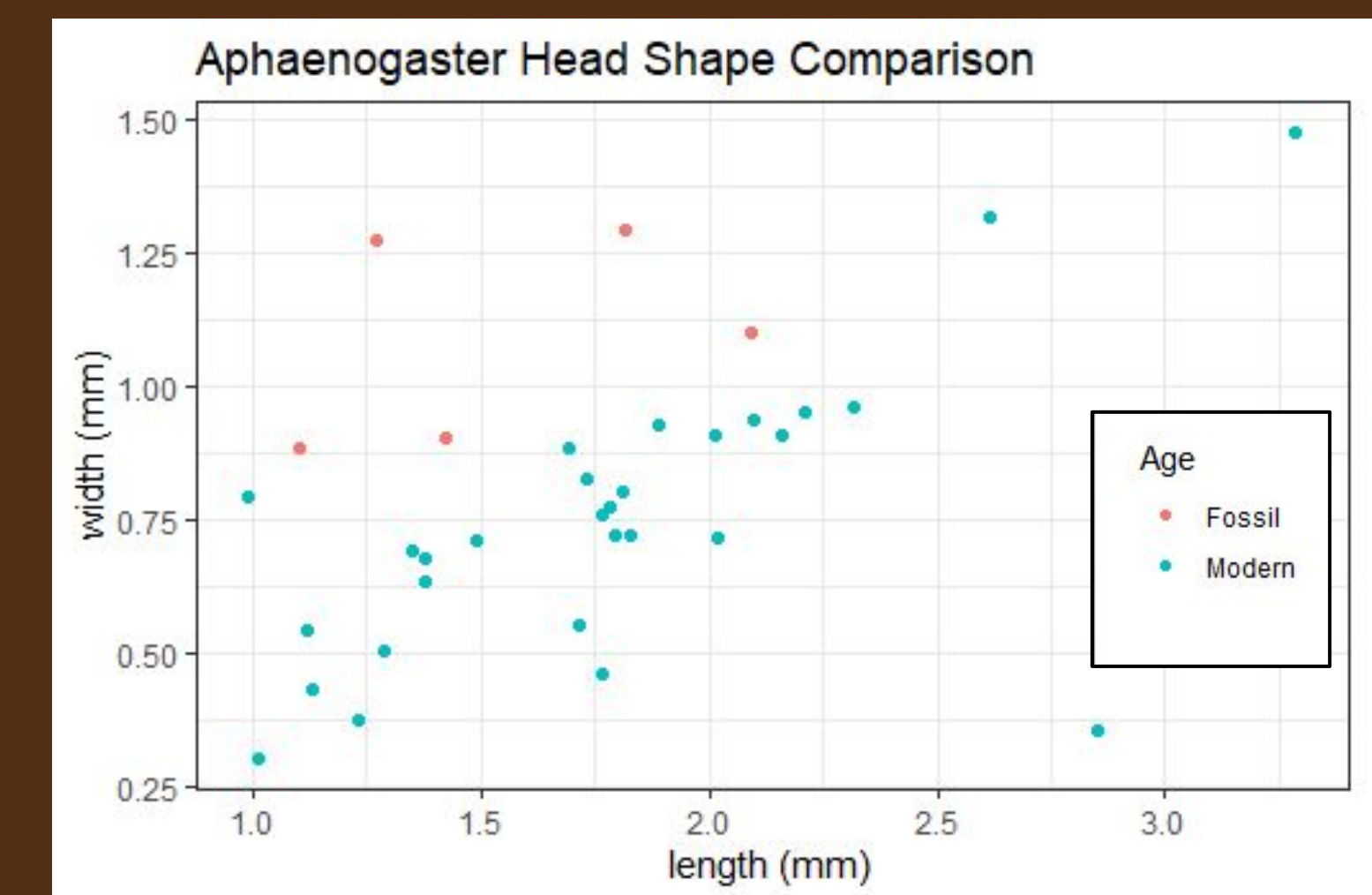
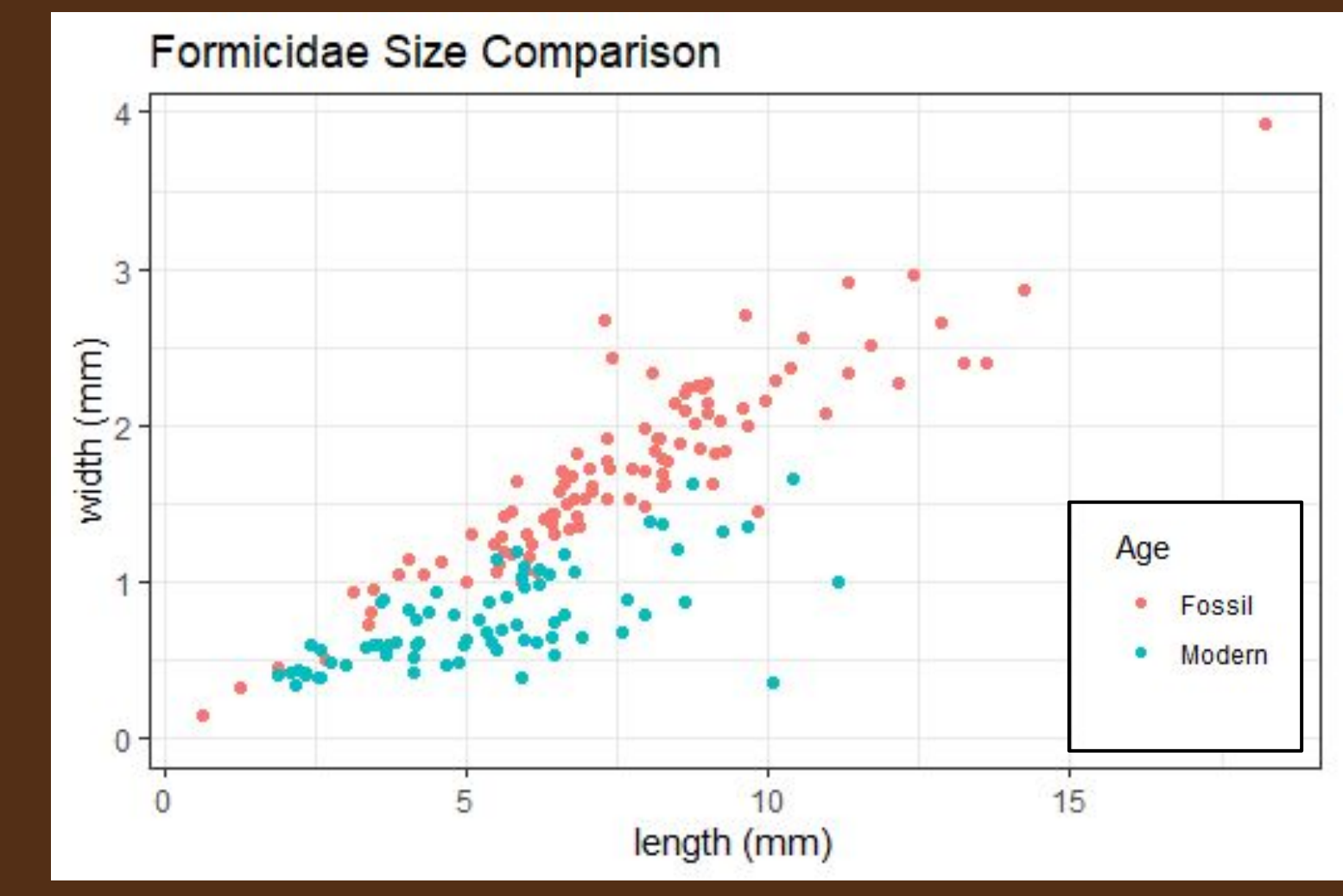
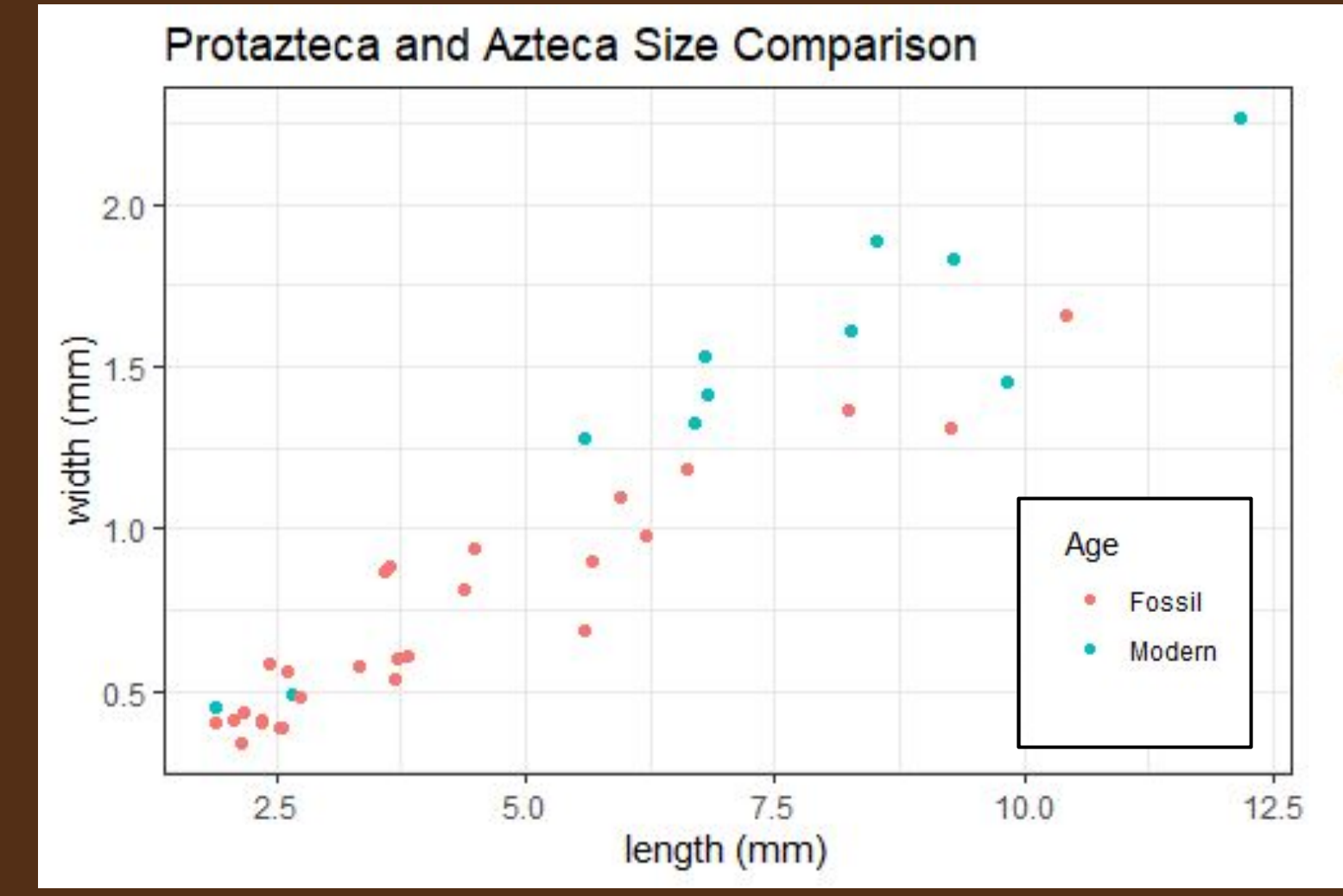
Cenozoic						
Paleogene			Neogene			
Paleocene	Eocene(56-33.9 mya)	Oligocene	Miocene	Pliocene	Pleistocene	Holocene (now)
GREEN HOUSE		ICE HOUSE				

Methods

- The digital databases of the CU Museum of Natural History and Symbiota Collections of Arthropods Network were used for their formicidae records.
- Helicon was used to digitize additional fossils, we used a Canon camera and a Stackshot rail to get highly focused images to add to CU's Museum Database.
- Head, thorax and abdomen dimensions were measured using Image J and converted to mm using a scale bar.
- Comparisons were made based on Hays(2016), and Baudier et al. (2015) observation of body size, climate, and microhabitat indications.
- Comparisons of dimensions were made using R studio.



Results



- The genus *Prozteca* has evolved into *Azteca*, has moved from Colorado to different areas of South America.
- The size of *Azteca* is on average 2.62mm less long and 0.67mm thinner and has a wider variation in their dimensions.

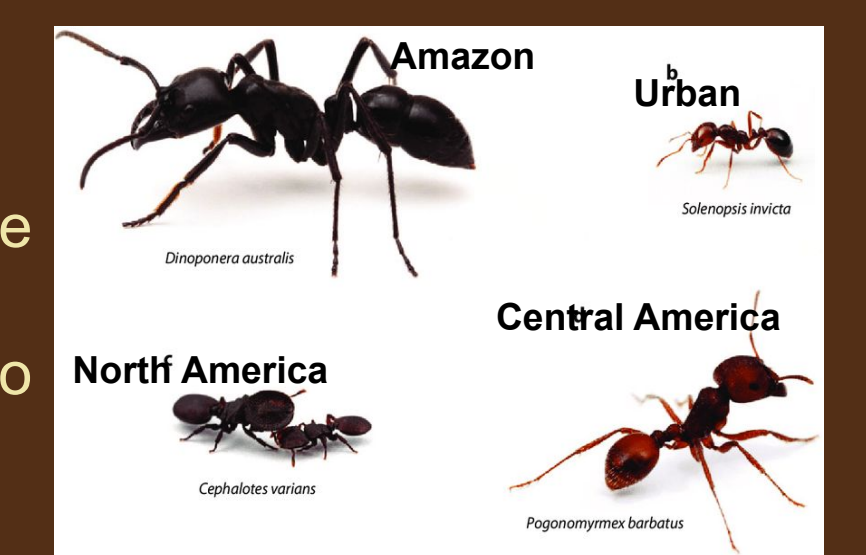
- The ants of the Eocene were larger by 2.21 mm in length and 1.47 mm in width on average.
- During the Eocene all of these ants lived in a tropical area. Now these lineages have diversified to deserts, deciduous forests urban areas, ect.

- *Aphaenogaster* head shape has changed from the time of the Eocene. Modern species have a 0.22mm longer head and a 0.34mm thinner head on average.
- During the time of the Eocene it is believed *Aphaenogaster* as a genus was arboreal. Now they live underground.

Discussion

Takeaways

- The decrease in size across genera indicates the global temperature and humidity decrease since the Eocene. Larger insects thrive in the tropics because of the abundant food.
- The smaller size also could be attributed to global urbanization. Smaller ants have an easier time surviving in urban environments due to human life. (Ossala, et al, 2015)
- The thinner and longer heads of the *Aphaenogaster* genus corresponds to their move underground to avoid harsh climate changes.
- As climate change and urbanization continue, ants may struggle because of conflicting environmental pressures.



Limitations

- Specimen are crushed in the process of fossilization so comparing them to the 3D modern ants is imperfect.
- Measurements are imperfect as ants are an organic shape. A sample was taken measuring 3 times for each measurement to test the variance. The variance was <1% for all measurements taken besides thorax width.

Future Work

- 9 weeks isn't enough time to study this. Further research, a larger sample size and analysis would lead to more meaningful data.
- I would also like to test the variance after being crushed
- I would like to study more about urbanization because my project didn't investigate it.

Acknowledgements

I would like to thank Jeffrey Schmidt, Alicia Christensen, Dana Stamo, Bec Bachelor and everyone else at RECCS for all their guidance. I would also like to thank Ann Reidl for helping me get this opportunity. And recognize NSF, CIRES and CU for the funding making this all possible.

References

Baudier, K. M., Mudd, A. E., Erickson, S. C., & O'Donnell, S. (2015). Microhabitat and body size effects on heat tolerance: implications for responses to climate change (army ants: Formicidae, Ecitoninae). *Journal of Animal Ecology*, 84(5), 1322–1330.

Hays, B. (2016, September 8). *Study: Climate dictates size and color of resident ants*. UPI. https://www.upi.com/Science_News/2016/09/08/Study-Climate-dictates-size-and-color-of-resident-ants/8281473351801/.

Ossola, A., Nash, M. A., Christie, F. J., Hahs, A. K., & Livesley, S. J. (2015). Urban habitat complexity affects species richness but not environmental filtering of morphologically-diverse ants. *PeerJ*, 3, e1356. doi:10.7717/peerj.1356