



Pleiotropic Constraints on Evolution: The Correlation of Cuticle Color and Geotaxis in *Drosophila simulans*



Addison Crews, Ashley March, Carter Dalili, Sarah N. Ruckman, and Kimberly A. Hughes

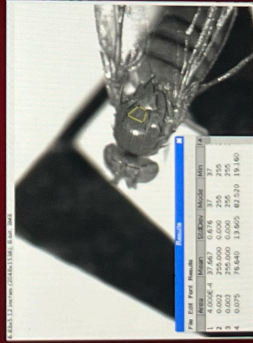
Introduction

- A key question in modern evolutionary biology is how predictive is adaptation. Pleiotropy (a single gene controls multiple phenotypic traits) may limit our ability to predict how organisms adapt, particularly in changing environments.
- Geotaxis is an organism's response to a gravitational shift. Negative geotaxis is the movement of individuals against gravity. Geotaxis measures movement ability with slower rates associated with a loss of motor development (1).
- Previous research has shown that organisms selected for color have altered aggressive behavior (2-3). We asked if other behaviors also became altered if we selected for color.

Hypothesis: If we select for color, we will find a change in geotaxis due to pleiotropy with the dopamine synthesis pathway.

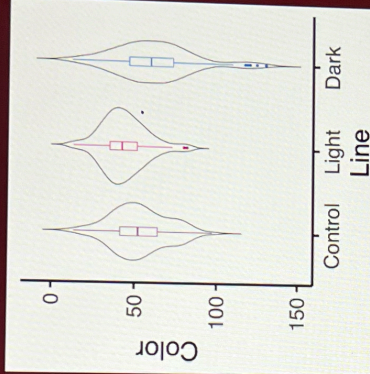
Methods

- To explore the genetic correlation between cuticle color and geotaxis patterns in *Drosophila simulans*, we selected for darker and lighter cuticles, with control groups maintained without selection.
- We conducted geotaxis assays by placing flies in a vertically sealed tube and timing their ascent to a predetermined mark three inches from the bottom.
- We then photographed each individual. Using ImageJ, we analyzed the photos for the mean color value associated with the fly.

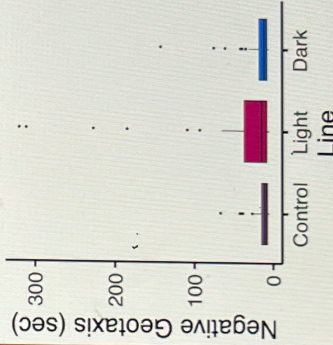


An example of an individual fly photo. This includes the mean grey scale values and the measured trident color.

Results



Using a beta regression, we found that each line was significantly different in color. Darker flies were significantly darker than light and control flies.



Using a linear model, we found no significant difference between lines. Color did not modulate geotaxis.

Conclusion

- There was no significant difference between lines and geotaxis. Color did not modulate geotaxis. This does not support our hypothesis.
- Color does not appear to limit geotaxis evolution.
- Future work will be done in additional species and other behaviors to determine if other traits are constrained by color.

References

1. Cao, W., Song, L., Cheng, J., Yi, N., Cai, L., Huang, F., & Ho, M. (2017). An Automated Rapid Iterative Negative Geotaxis Assay for Analyzing Adult Climbing Behavior in a *Drosophila* Model of Neurodegeneration. *Journal of Visualized Experiments*, 127.
2. Roulin A., & Ducrest A.-L. (2011). Association between Melanism, physiology, and behaviour: A role for the melanocortin system. *European Journal of Pharmacology*, 660(1), 226-233.
3. Takahashi A. (2013). Pigmentation and behavior: Potential association through pleiotropic genes in *Drosophila*. *Genes & Genetic Systems*, 88(3), 165-174

Acknowledgements:

This research is supported by the Hughes Lab and Saltz Lab in Rice University. Along with our fellow researchers, Paulina Montes Mendez, Katelyn McCaffrey, Sam Miller, Lauren Campbell, Nicholas Tan, Aidan Callender, Carys Delahanty, Lauren Kenny, Carlos Pereira, Erica Peters, and Zoe Tsiapalis.