

The Effects of Paternal Deprivation on Beak Coloration



Amanda M. Ayon, Angela K. Riley and Jennifer L. Grindstaff
Department of Integrative Biology
Oklahoma State University



Background

- For ornamented species, such as zebra finches, beak coloration is a key factor that is considered in mate choice.¹
- Females prefer male partners that exhibit redder beaks.¹
- The red pigmentation is derived from carotenoids in their diet, with processing dependent on several factors.²
- Zebra finches are a bi-parental species, like 80% of bird species.³
- Early-life stressors can have negative consequences in adulthood.^{4,5,6,7}

Question: Does paternal deprivation affect beak coloration?

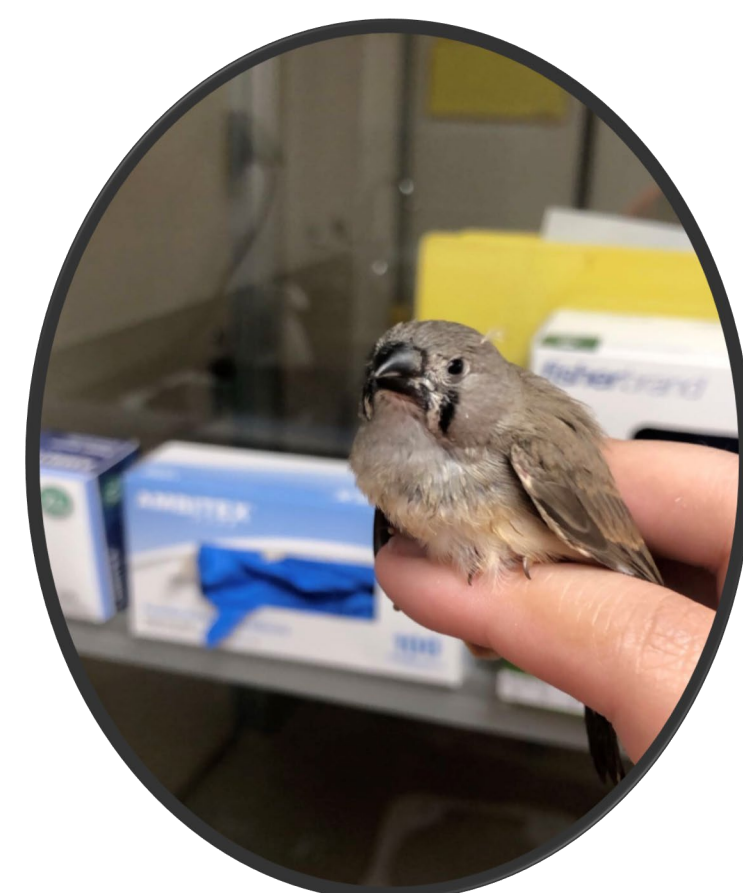
Methods

In order to test this question, we set up 3 treatment groups: early removal, late removal, and a control group:



Early Removal (E)

Father removed during nestling stage (day 0).



Late Removal (L)

Father removed when nestlings fledged (day 18).



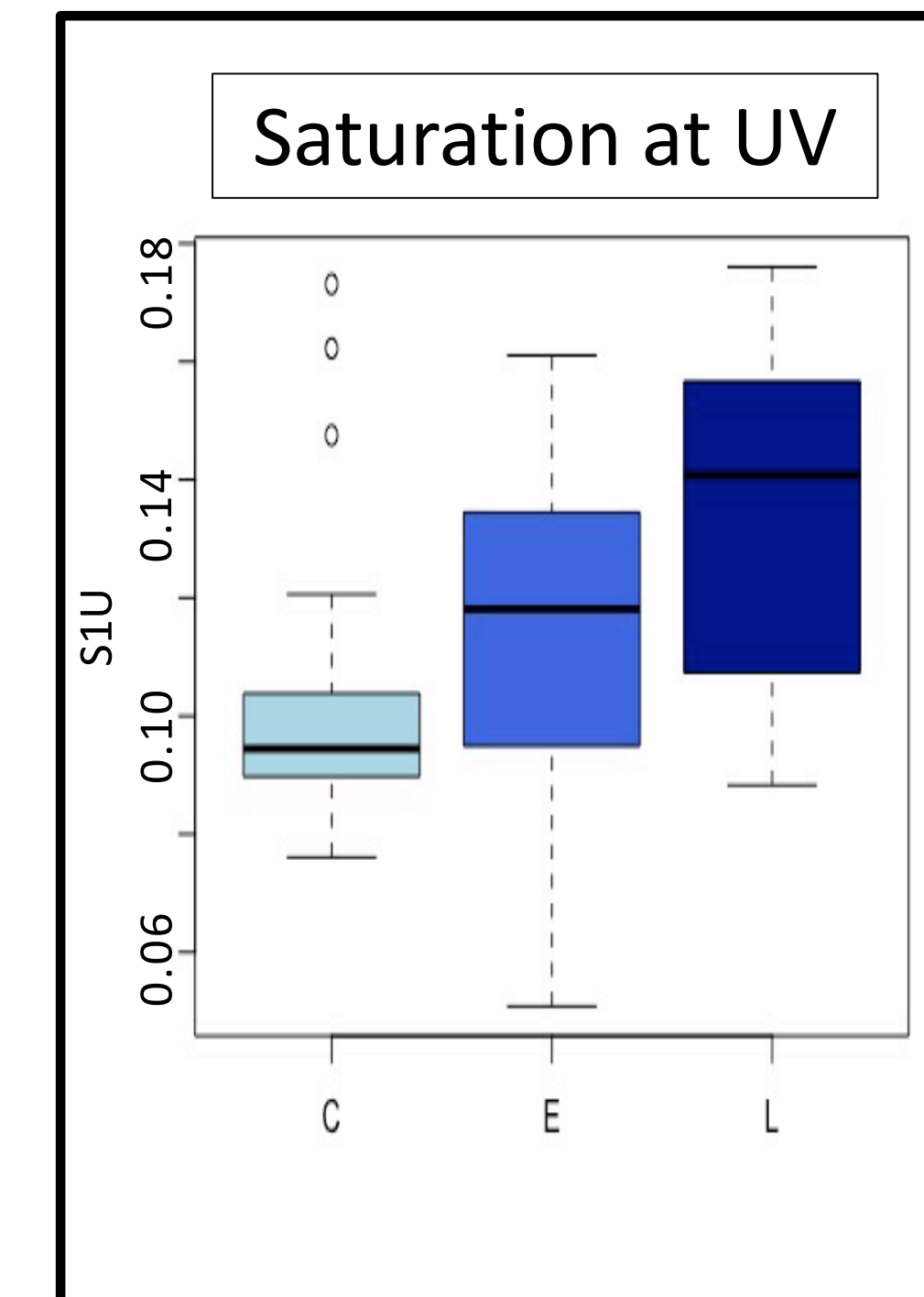
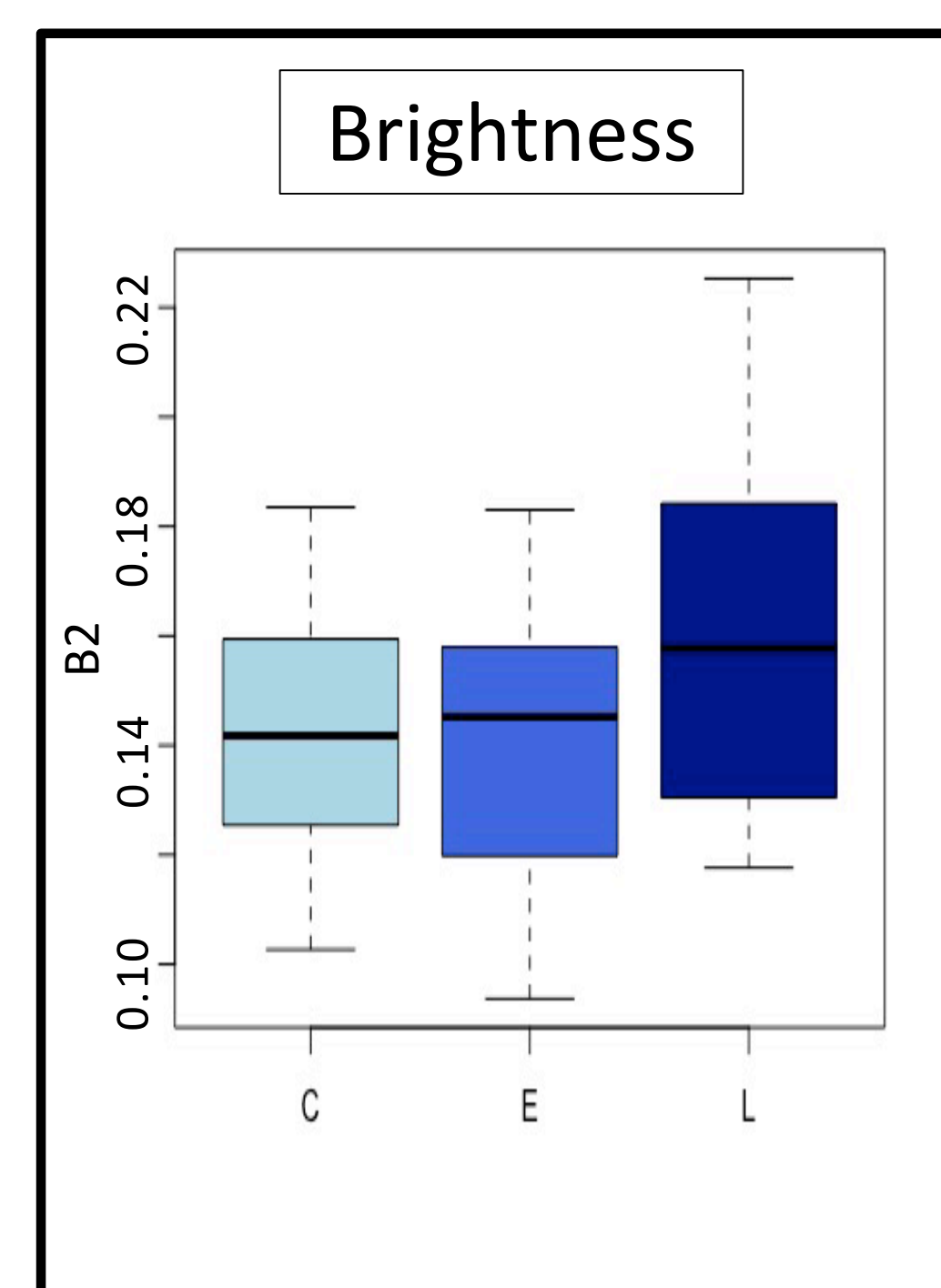
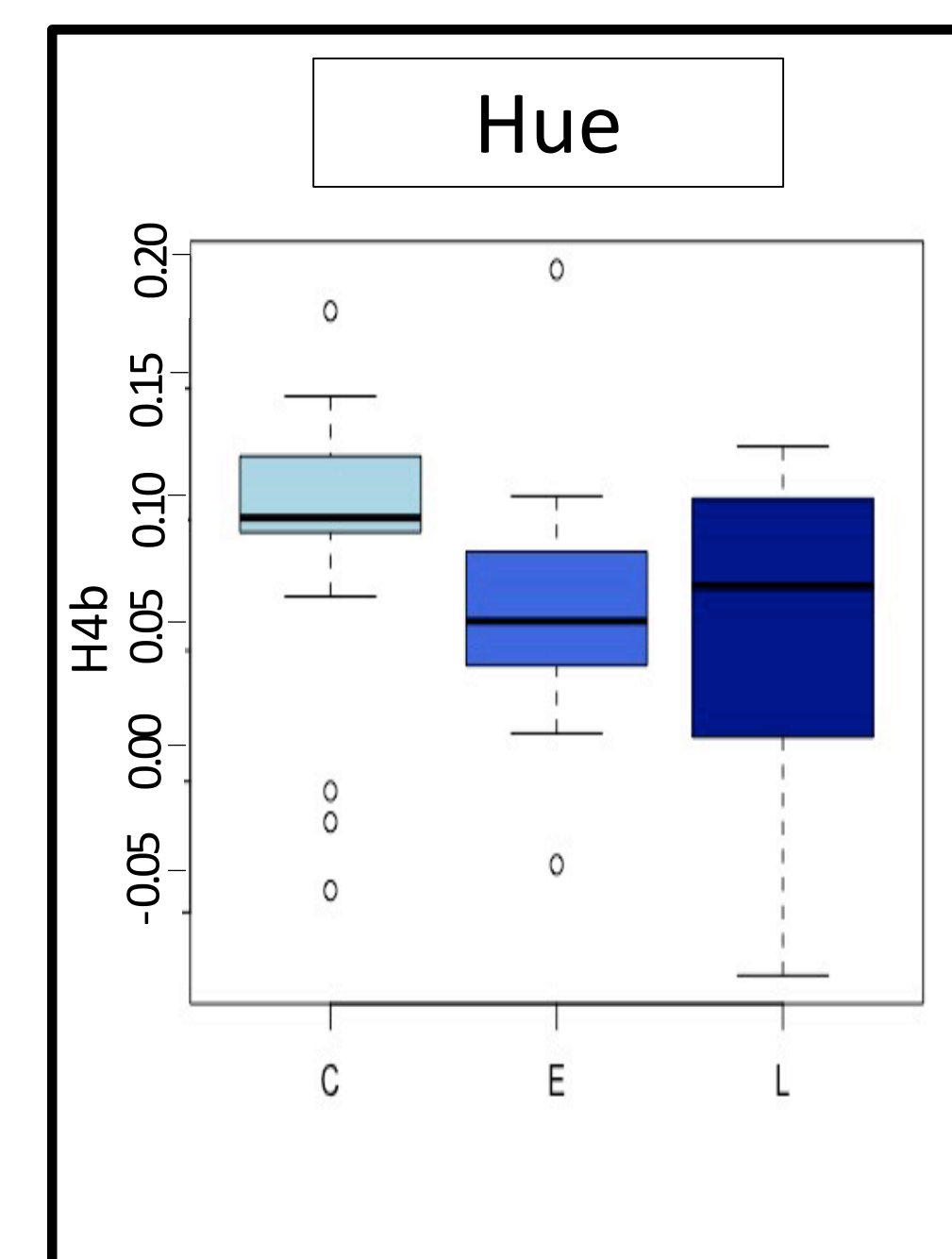
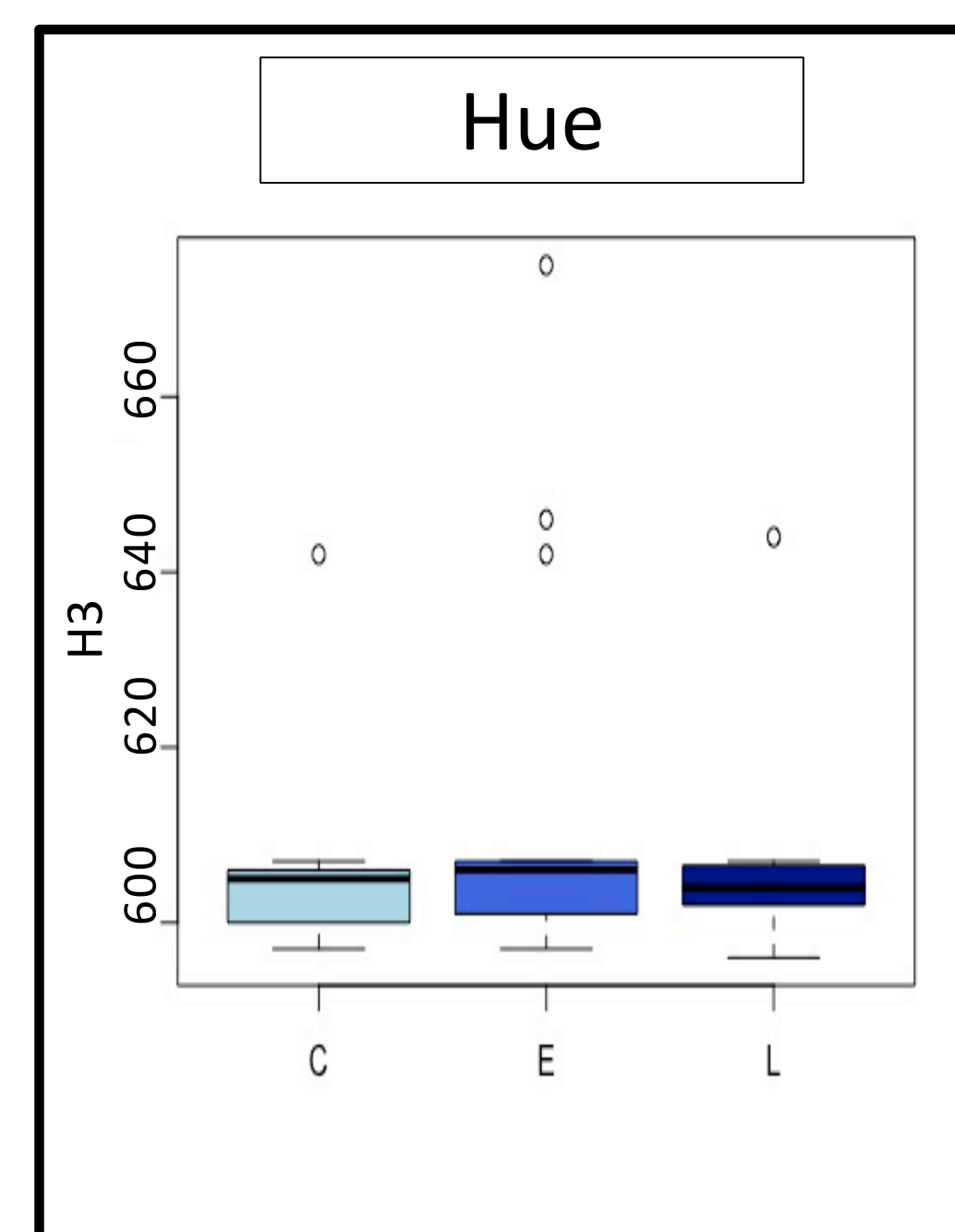
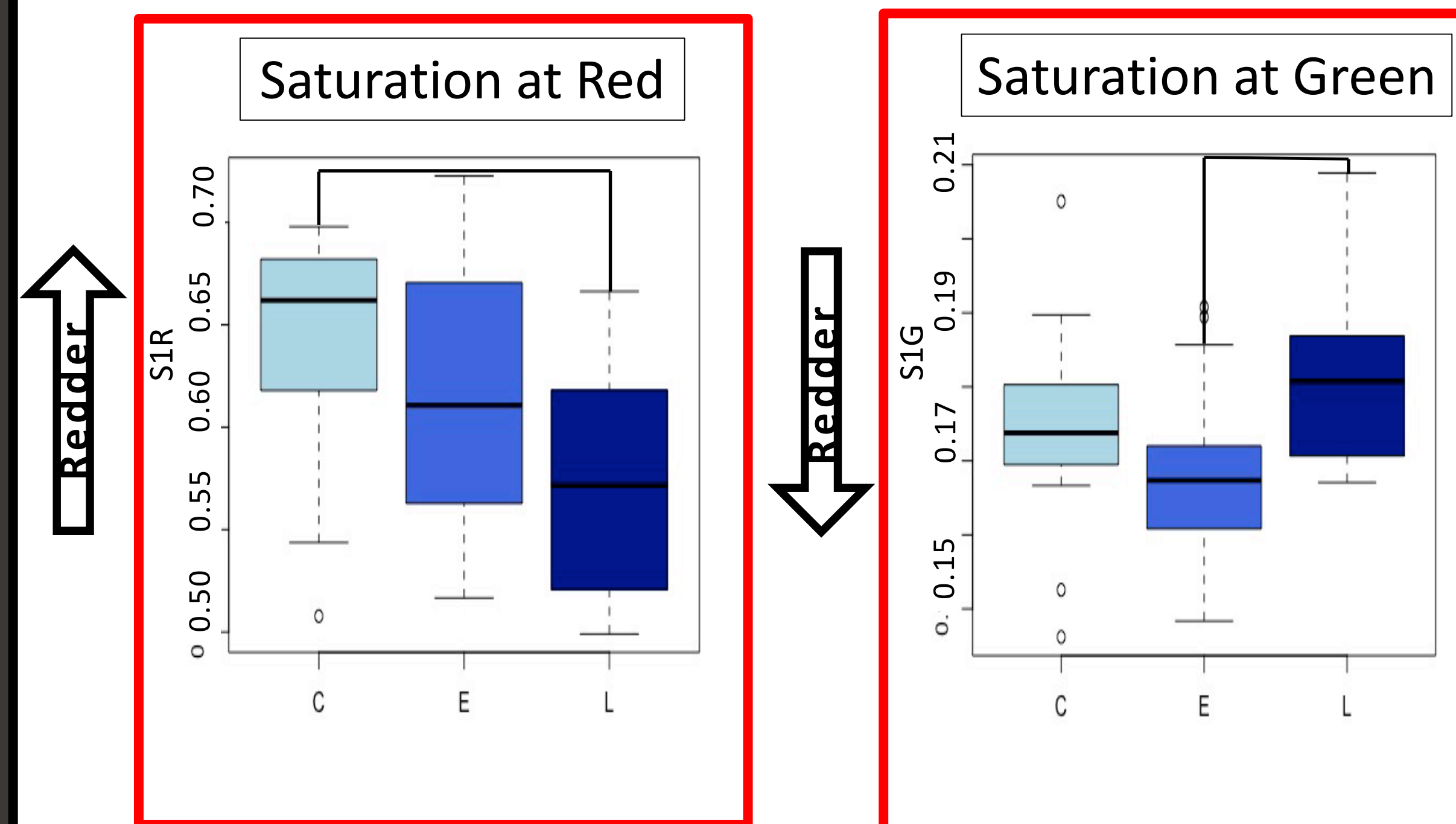
Control (C)

Father remained during nestling and fledging stages of offspring.

- Beak color measurements were taken from 49 adult male finches between the ages of ~1-3 years post-hatch.
- We used a portable spectrophotometer and took 4 measurements of the upper mandible for each bird.⁷
- Brightness, hue, and saturation at the red, green, and UV wavelengths, and hue were calculated with RCLR.^{8,9}
- Stats were ran using mixed models in SAS.



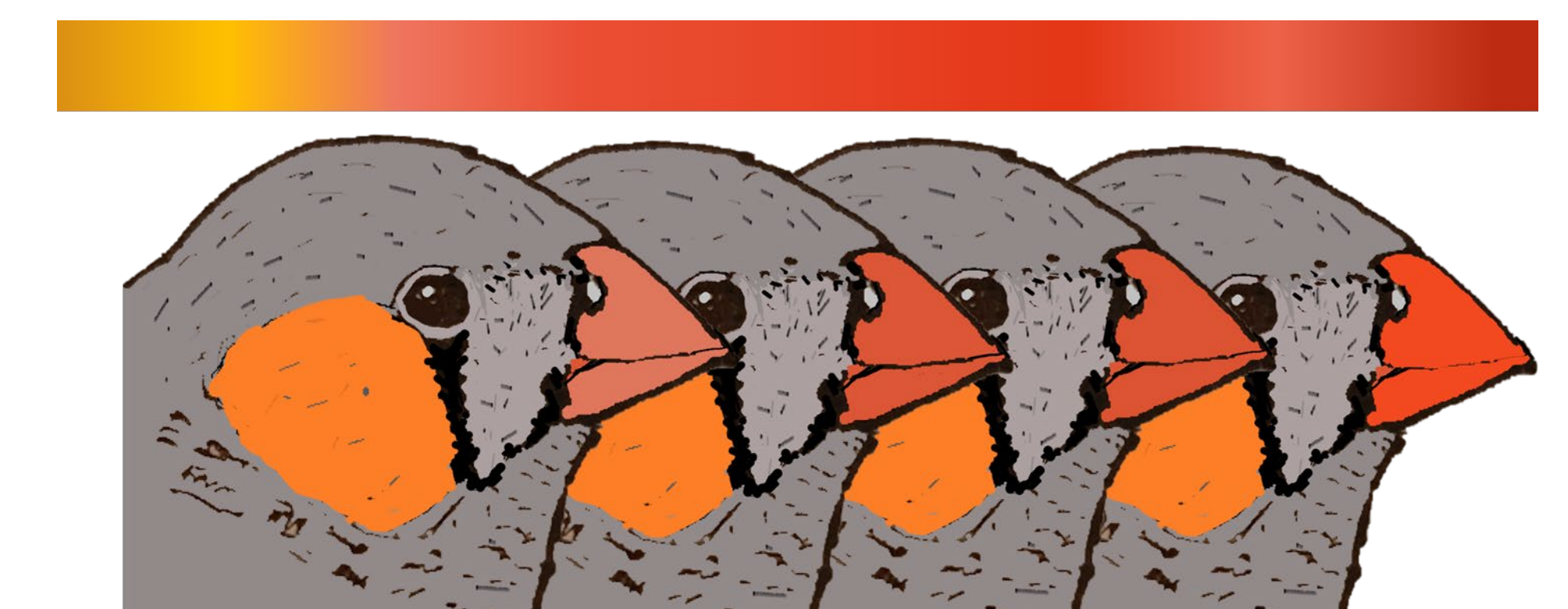
Results



Conclusions

Does paternal deprivation affect beak coloration?

- At the red spectra, offspring that experienced late paternal deprivation had beaks that were less red than control birds.
- At the green spectra, offspring that experienced late paternal deprivation exhibited beaks that were less red than early deprivation birds.
- It is possible that mothers are less able to compensate for the loss of a mate when it occurs in the middle of development.



Future Directions

- If we saw a significant difference in beak coloration within treatment groups, what else could paternal deprivation be affecting?
- In my future work, I will study how mothers might compensate for paternal deprivation.
- I would also like to see if paternal deprivation affects other factors, such as telomeres, across treatment groups.

References and Acknowledgements

We would like to thank the Grindstaff lab: Sierra Williams, Victoria Roper, Kiley Cox, and Hailey Freeman.

Contact info
Email: amanda.ayon@okstate.edu

1. Mirre J.P. Simons, Simon Verhulst, Zebra finch females prefer males with redder bills independent of song rate—a meta-analysis, *Behavioral Ecology*, Volume 22, Issue 4, July–August 2011, 755–762. 2. McGraw, K. J., Lee, K., & Lewin, A. (2011). The effect of capture-and-handling stress on carotenoid-based beak coloration in zebra finches. *Journal of Comparative Physiology A*, 197(6), 683–691. 3. Zann, R. A. (1996). *The zebra finch: a synthesis of field and laboratory studies* (Vol. 5). Oxford University Press. 4. Grindstaff, J. L., Hunsaker, V. R., & Cox, S. N. (2012). Maternal and developmental immune challenges alter behavior and learning ability of offspring. *Hormones and behavior*, 62(3), 337–344. 5. Banerjee, S. B., Arterbery, A. S., Fergus, D. J., & Adkins-Regan, E. (2012). Deprivation of maternal care has long-lasting consequences for the hypothalamic–pituitary–adrenal axis of zebra finches. *Proceedings of the Royal Society B: Biological Sciences*, 279(1729), 759–766. 6. Spencer, K. A., & Verhulst, S. (2007). Delayed behavioral effects of postnatal exposure to corticosterone in the zebra finch (*Taeniopygia guttata*). *Hormones and Behavior*, 51(2), 273–280. 7. Merrill, L., Naylor, M. F., & Grindstaff, J. L. (2016). Imperfect past and present progressive: beak color reflects early-life and adult exposure to antigen. *Behavioral Ecology*, 27(5), 1320–1330. 8. Montgomery R. 2014. RCLR, version 0.9.34. Queen's University, Kingston, Canada. (available at <http://post.queensu.ca/~mont/color/analyze.html>) 9. Montgomery R. 2014. Rfiles, version 0.8. Queen's University, Kingston, Canada. (available at <http://post.queensu.ca/~mont/color/analyze.html>). Images: Oklahoma State University 2020. Riley, A 2021.