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For Your Eyes Only: Do Visual System Differences Between Predators and Conspecifics Influence Perception of Lizard Body Coloration?

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Recommended Citation

Rojo, Andrés, "For Your Eyes Only: Do Visual System Differences Between Predators and Conspecifics Influence Perception of Lizard Body Coloration?" (2023). *Research Days Posters 2023*. 85.
https://orb.binghamton.edu/research_days_posters_2023/85

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For your eyes only: Do visual system differences between predators and conspecifics influence perception of lizard body coloration?

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Introduction

- Animal species vary in their ability to perceive colors and patterns, and color perception is optimized by evolution [1]
- Some species use "secret signals" to communicate with conspecifics while remaining inconspicuous to their predators [e.g., 2]
- The water anole (*Anolis aquaticus*) is a small species of lizard from Central America that uses rapid body color change to avoid predation via camouflage [3]
- We tested whether *A. aquaticus* body coloration would be perceived differently by conspecific anoles versus anole predators
- We predicted that *A. aquaticus* body coloration would be perceived as more conspicuous to conspecifics than to anole predators.

Methods

- *A. aquaticus* (n = 37) were captured in 2016 at Las Cruces Biological Station (Costa Rica), and each anole and its substrate was immediately photographed under standardized conditions
- We ran these standardized photographs through Quantitative Color and Pattern Analysis (QCPA) in the Mica Toolbox plugin [4] for ImageJ to create anole and avian predator visual models (Fig 1)
- For each visual system (anole or predator) we calculated the percentage of color overlap between the anole and the substrate upon which it was found (Fig 2)
- We used a linear mixed model to test whether color overlap differed between anole and predator visual models

Results

- Color overlap difference between anole and predator visual models was nearly significant (t = -1.901, df = 28, P = 0.067), but in the opposite direction
- When comparing an anole to its substrate, conspecifics perceived greater overlap (less conspicuousness) than avian predators

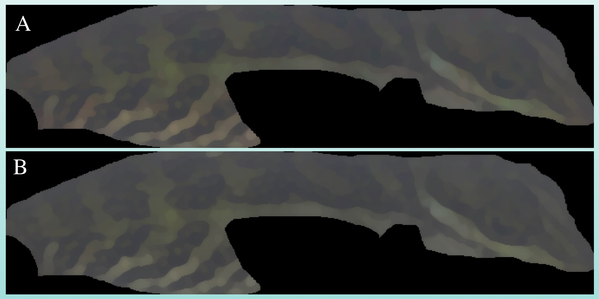

Figure 1. *Anolis aquaticus* (cropped to relevant body coloration areas) as seen by A) a relevant avian predator and B) a conspecific at a distance of 0.75 m.

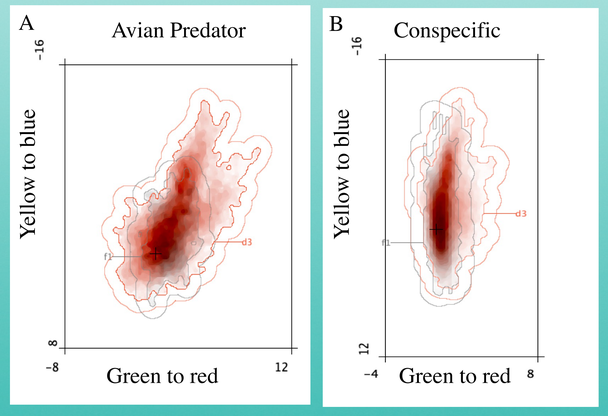

Figure 2. Example color maps representing the perceived color overlap between an anole (red cloud) and its substrate (gray cloud) for A) a relevant avian predator and B) a conspecific. Axes differ because range of color vision differs between species.

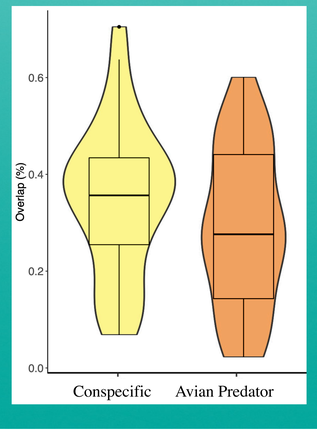

Figure 3. Violin plots of the distribution of overlap scores of the color maps for conspecifics (yellow) and avian predators (orange). Boxplot are overlaid on the violin plots to delineate quartiles

Discussion

- Avian predators of *A. aquaticus*, such as kingfishers and motmots, are possibly able to see a camouflaged anole better than their own conspecifics. However, this does not mean that camouflage is ineffective, but instead that anoles are not using "secret signals" using these particular body colors
- Other aspects of anole coloration, such as patternation, were not examined and could also provide crypsis against predation
- It is possible that anoles identify conspecifics or potential mates using a part of the body that was not accounted for in this experiment, such as the dewlap

Future Directions/ Conclusions

- Additional visual modeling, such as pattern analysis and edge disruption analysis, will be used to further examine differences in conspecific and predator visual perception of anoles.
- Location of capture and related "color phase" may further explain variation in these results; dark phase anoles may be perceived differently than light phase anoles by their conspecifics.
- Rapid coloration offers protection from predators [3], but may also provide other ways that anoles may communicate with their conspecifics.

References

1. Price 2017. Am Nat. 190: 157-170
2. Brandley et al. 2013. Evol. Ecol. 27: 1045-1068
3. Wuthrich, Nagel, Swierk. 2020. Am. Nat. 199: 277-290
4. Troscianko, Stevens. 2015. Methods Ecol. Evol. 6: 1320-1331.

Acknowledgements

We thank Binghamton University's Summer Scholars and Artists Program, the Biological Sciences Department, the Organization for Tropical Studies, and the NSF NAPIRE REU program. We are grateful to A. Nagel and other REU students for field assistance with photography.

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