



INDIANA UNIVERSITY

# Visual resolution of two species of *Sceloporus* lizards that differ in ventral coloration

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## INTRODUCTION

• For social communication, visual signals should evolve to match the visual abilities of the intended receivers

• For signals used during aggressive male-male interactions, sensory abilities of males may bias male signal properties [1,2]

• Males of most *Sceloporus* lizards have blue belly patches used to deter rival males [3] though some species have evolutionarily lost the patches [4] and exhibit the white-bellies similar to the females

• Following a change to the signal, what are the consequences for the receiver?

*S. virgatus*



*S. undulatus*



Diagram depicting sister taxa *S. undulatus* and *S. virgatus*. All females and *S. virgatus* males have white bellies while *S. undulatus* males have blue belly patches

## GOAL

Test for sex and species differences in visual resolution in *Sceloporus* lizard species that differ in male-specific ventral color

## METHODS

• Collected 12 *S. undulatus* (8 male, 4 female) from Lake Monroe, Indiana, and 11 *S. virgatus* (8 male, 3 female) from the Chiricahua Mountains, Arizona

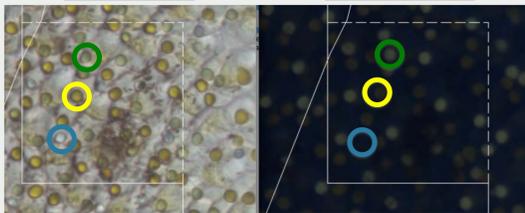
• Extracted and flattened retinas from both eyes (see 5 and 6 for details) and mounted on microscope slide, photographing under bright field and epifluorescent illumination

• *Sceloporus*, as in most diurnal lizards, have 4 oil droplet classes associated with 4 cone types (2 "yellow", 1 "green", 1 "colorless"; Ellis Loew, pers. comm), but unable to distinguish "yellow" double cones and single cones

• Counted and classified density of different oil droplet types corresponding to different types of photoreceptors

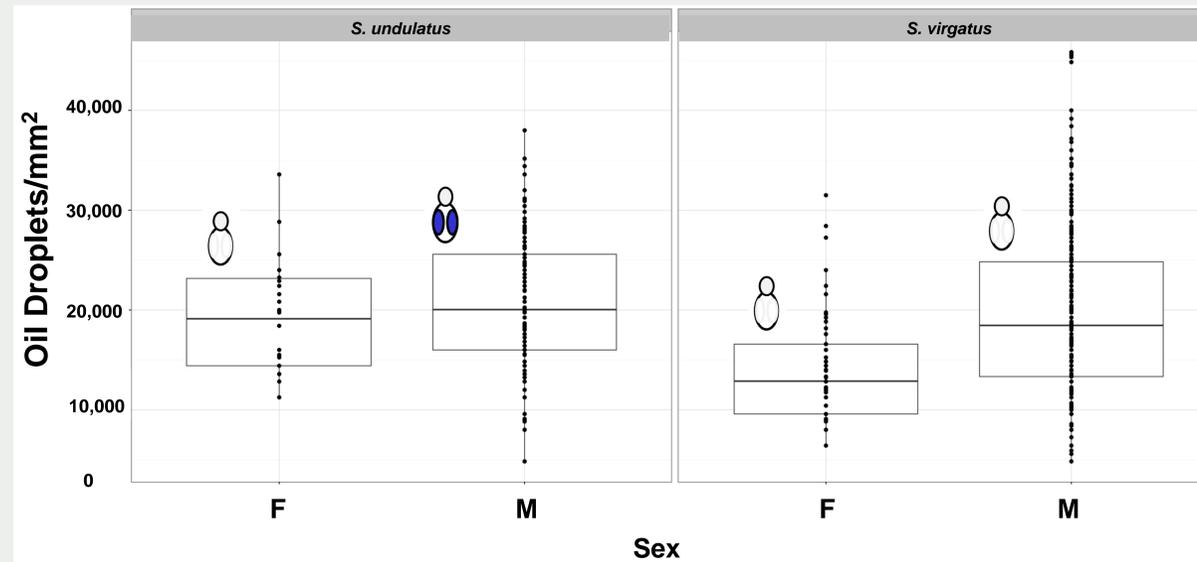
Bright Field

Epifluorescent



Retinal photographs identifying 3 types of oil droplets: Y-type (yellow), G-type (green), B-type (colorless)

## Sex differences in overall oil droplet density



Box plots showing overall density of retinal oil droplets. A two-way, repeated-measures, ANOVA detected a significant effect of Sex ( $F_{1,17}=6.275$ ,  $p<0.05$ ), but not Species ( $F_{1,17}=2.013$ ,  $p=0.17$ ), or their interaction ( $F_{1,17}=0.76$ ,  $p=0.40$ ).

## High correlations between oil droplet types

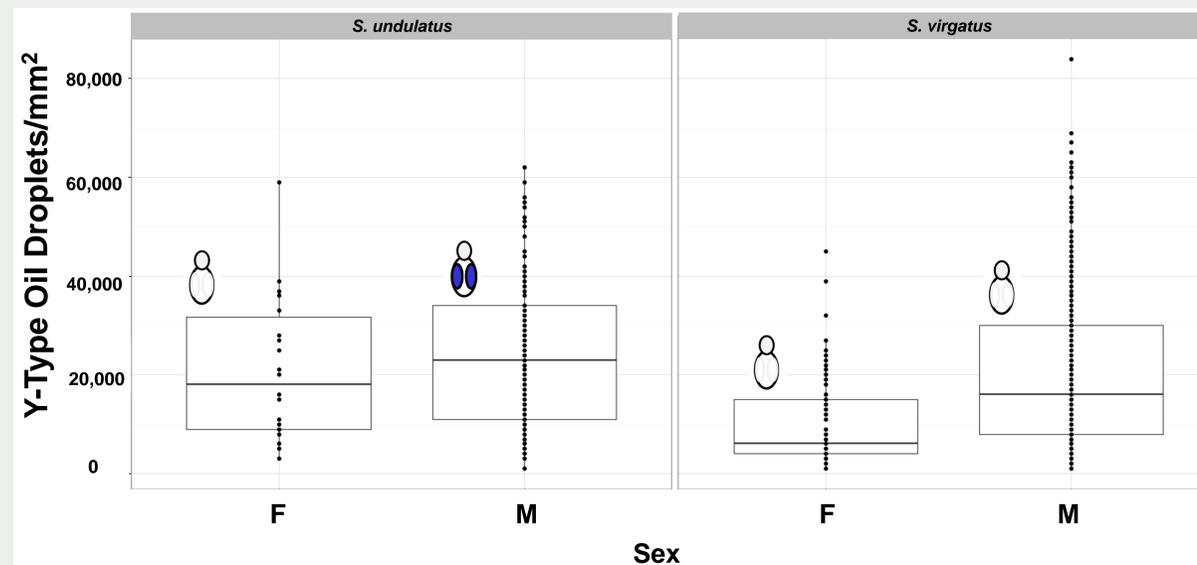
|                | Y-Type Density | G-Type Density | B-Type Density |
|----------------|----------------|----------------|----------------|
| Y-Type Density | 1.00           |                |                |
| G-Type Density | 0.82*          | 1.00           |                |
| B-Type Density | 0.78*          | 0.81*          | 1.00           |

Pearson's product-moment correlations for all oil droplet types. Results indicate high correlations between all three types ( $p<0.05$  in all cases).

## SUMMARY

- Males exhibited a higher overall photoreceptor density and a higher density of Y-type oil droplets compared to females, indicating a higher visual resolution
- Trend for *S. undulatus* to have higher photoreceptor density, though not significant
- *S. virgatus* females have a particularly low photoreceptor density

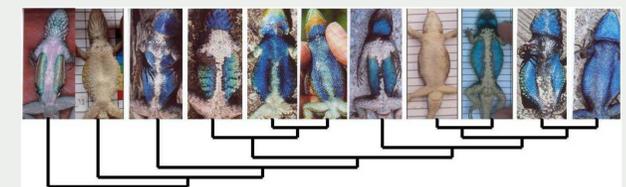
## Sex differences Y-type oil droplets



Box plots density of Y-type "yellow" oil droplets. A two-way, repeated-measures, ANOVA detected a significant effect of Sex ( $F_{1,17}=7.183$ ,  $p<0.05$ ), but not Species ( $F_{1,17}=4.035$ ,  $p=0.061$ ), or their interaction ( $F_{1,17}=0.677$ ,  $p=0.42$ ).

## CONCLUSIONS

- Our findings that there may be sex differences in visual resolution are consistent with previous work in *S. undulatus* indicating that males are better able to detect blue than females [7]
- High variability of oil droplet density in *S. virgatus* males perhaps due to relaxed selection?
- Blue belly patches are ancestral for the genus [4], and behavioral work indicates that *S. virgatus* responds appropriately to blue belly patches, despite not having any of their own [2]
- Further analyses will examine sex and species differences in different parts of the retina



**CITATIONS:** [1] den Hartog PM, Slabbekoorn H, ten Cate C (2008) Phil Trans R Soc B 363:2879-2889 [2] Quinn VS, Hews DK (2000) Proc R Soc Lond B 267:755-758 [3] Cooper WE, Burns N (1987) Anim Behav 35:526-532 [4] Wiens JJ (2000) Proc R Soc Lond B 266:1529-1535 [5] Ullmann JFP, Moore BA, Temple SE, Fernández-Juricic E, Collin SP (2012) Brain Behav Evolut 79:26-44 [6] Fernández-Juricic E, Ojeda A, Deisher M, Burry B, Baumhardt P, Stark A, Elmore A, Ensminger A (2013) PLoS ONE 8:e58985 [7] Nava SS (2009) Ph.D. dissertation Indiana University, Dissertations & Theses @ CIC Institutions, ProQuest. Web. 6 Jul. 2010

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