



Shell disease and carotenoid-based color expression in painted turtles (*Chrysemys picta*)

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Abstract

- Carotenoids are pigments found in plants
- Animals eat carotenoids to color stripes and spots
- Animals also eat carotenoids for immunological benefits
- Carotenoid-based stripe color often communicates condition-dependent (i.e. immunological) visual information because pigments cannot be used for both purposes at the same time.
- Plants (containing carotenoids) make up a large portion of painted turtle diets
- Painted turtle stripes and spots are colored by carotenoids (Steffen et. al. 2015)
- We show that shell disease (i.e. fungal infection by *Emydomyces testavorans*) increases forelimb stripe brightness
- We show that when shell disease and carotenoid deprivation are combined, forelimb chroma is reduced
- Stripe & spot color may advertise immunological health information and function as a condition-dependent indicator trait because it is altered by shell disease fungal infection
- This adds to other indirect evidence that painted turtle stripe and color may serve as a sexually selective visual signal.

Objectives

- To show how carotenoid-based stripe and spot color may be affected by health
- To show that carotenoid-based stripes and spots may function as a condition-dependent indicator trait for sexual selection

Methods



- **Reflectance Spectrometry:** Ocean Optics S2000 spectrometer w/ tungsten–deuterium light source & fiber-optic cable
- **Measure colorful stripes and spots before and after experiment**
- **Experimental diet:** turtles fed nutritious diets with moderate amounts of xanthophyll & beta-carotene (i.e. C+) or without xanthophyll & beta-carotene (i.e. C-)
- **Shell diseases noted & cared for throughout experiment**
- **Statistical analyses:** MANOVA, RBSDA (ANOVA & MANCOVA)



Figure 1 (left): a healthy painted turtle showing red forelimb stripes; (right): shell disease from infection by *Emydomyces testavorans*

Results

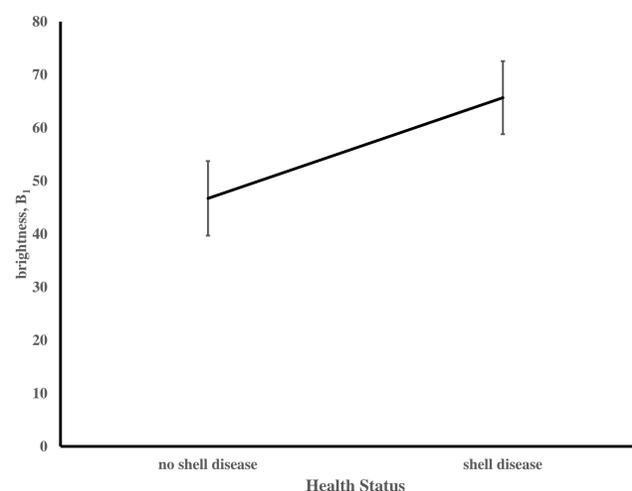


Figure 2. Shell disease increased forelimb stripe brightness. Error bars = S.E. $P < 0.05$.

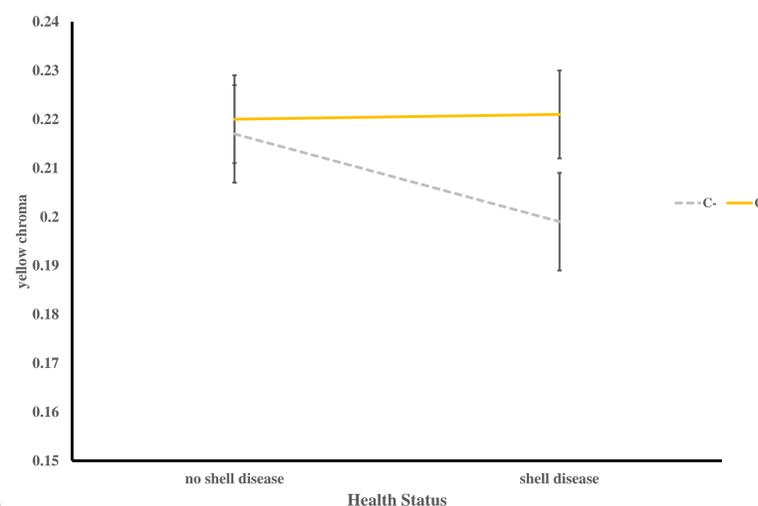


Figure 3. Shell disease interacted with experimental carotenoid diet. When shell disease & carotenoid deprivation (C-) were combined, forelimb stripe yellow chroma was reduced. Error bars = S.E. $P < 0.05$.

Conclusion

- **Shell disease (i.e. fungal infection by *Emydomyces testavorans*) increases forelimb stripe brightness**
- **When shell disease & carotenoid deprivation are combined, forelimb chroma decreases**
- **Increase in brightness and decrease in chroma are consistent with pigment loss in forelimb stripe**
- **This suggests that carotenoids can only be used for stripe / spot coloration or health, but not both.**
- **Painted turtle carotenoid-based stripe and spot color may function as an indicator trait, which functions in sexual selection.**

References

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- McGraw, K. J., & Ardia, D. R. (2003). Carotenoids, immunocompetence, and the information content of sexual colors: an experimental test. *The American Naturalist*, 162(6), 704-712.
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