Genetic Rescue in guppies: Do migrant males have unusual color patterns that lead to rare male advantages in the wild?

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Research Question

Do migrant male guppies have unusual color patterns that lead to rare male advantages in the wild?

Background

- The maintenance of genetic diversity is necessary for the conservation of small, inbred populations because diversity allows species to adapt to a changing environment (1).
- **Genetic rescue** is a human-mediated conservation method in which immigrant animals from one population are introduced to smaller populations to increase population sizes and conserve genetic variation (2).
- However, we don't know much about the underlying processes of genetic rescues.
- Trinidadian guppies (*Poecilia reticualta*) are an ideal system to assess what processes promote successful rescues because male guppies exhibit extreme color pattern variation, and this variation is maintained through female preference for novel color patters (2-7).
- In this experiment, guppies from a downstream location in a Trinidadian river were translocated upstream and allowed to migrate into pools with small guppy population sizes. Migrant and hybrid males had higher fitness than resident males and population sizes increased over time, which suggests genetic rescue indeed saved these populations (8).
- Here, we hypothesized that migrant and hybrid males have novel color patterns (preferred by females) and their level of novelty reflects their high fitness.

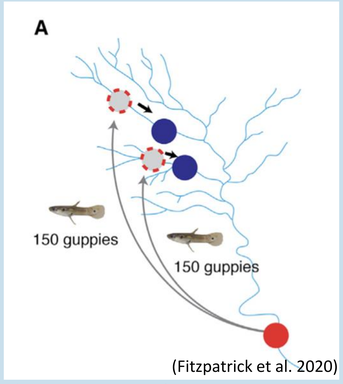

Figure 1: Guppy translocation

Methods

- We used images of resident, migrant, and hybrid guppies taken from the genetic rescue study and converted raw images to .tps files for landmarking in *tpsDig*.
- Seven permanent landmarks were placed near easily identifiable locations, and 55 were placed in between these landmarks. Landmarks were also placed on each of the guppy's color standards.
- We then imported images to *Colormesh* in R, where images were unwarped to a consensus shape and run through Delauney triangulation to determine consistent sampling locations across each photo (10).
- The RGB color values were measured from each of the sampling circles and these values were calibrated by from RGB value of the guppy's respective color standard.

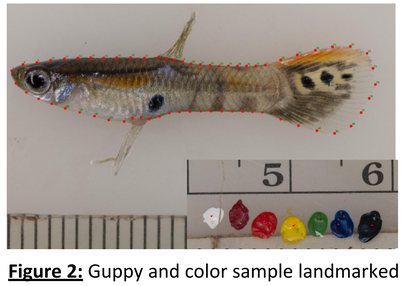

Figure 2: Guppy and color sample landmarked

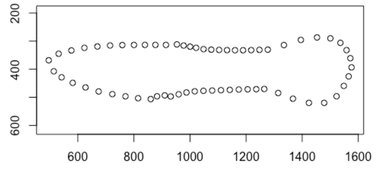

Figure 3: Guppy Perimeter

Figure 4: Delauney triangulation mesh

Results

- Anticipated results: hybrid and migrant male guppies will have rare/unfamiliar color patterns, which will be correlated with high fitness.

Figure 8: Unwarped images of resident, hybrid, and immigrant male guppies, respectively.

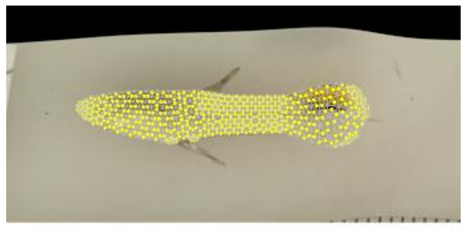

Figure 7: Delauney triangulation mesh on guppy

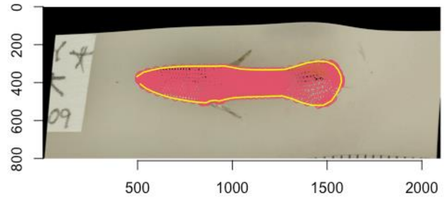

Figure 6: Guppy with color sampling points

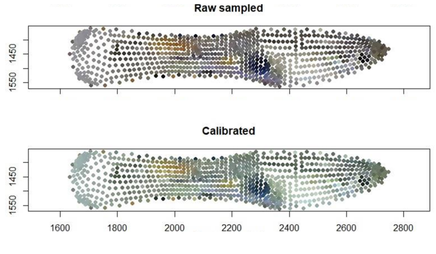

Figure 5: Color sampling procedure. Credit: J. Valvo & D. Aponte

Conclusion

- Color variation can be quantified by using Delauney triangulation and color sampling, using a program called *Colormesh.*
- From what is known about sexual selection in guppies, guppies with color patterns that differ from the norm can be expected to have a high degree of fitness.
- **Future Directions:** Quantified color data from this project will be combined with fitness data to further understand sexual selection and the magnitude of genetic variation within guppies.

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