Evolution of Complex Color Patterns in Male Trinidadian Guppies

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Hypothesis

Female mate choice can lead to a high level of genetic diversity in males of a population.

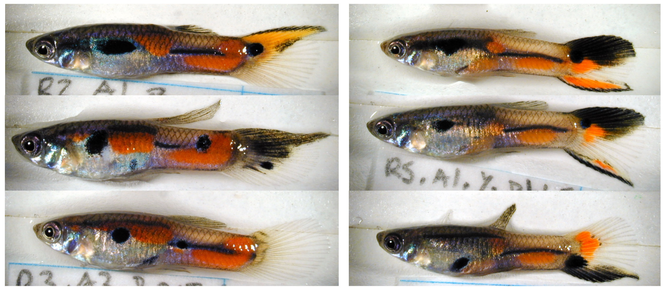
Introduction

- In biology, the color pattern of a species can provide insight into the species' function and evolution[1].
- Male *Poecilia reticulata*, also known as Trinidadian guppies, have highly variable and highly heritable color patterns, resulting in lineages that have distinct phenotypes known as IF lines.
- The high levels of genetic diversity may be due to negative frequency dependent selection (NFDS). When this type of selection is acting on the population, rare traits are favored and individuals expressing those traits are more likely to reproduce and pass on their alleles to their offspring.
- If NFDS is acting on the population, then there may be a rare-male advantage, meaning it is advantageous for males to have a rare color patten[2].

Methods

- Ten 300-gallon tanks were set up. The tanks were lined with gravel, a water pump was placed to aerate the water, and full spectrum metal halide lights were hung from the ceiling.
- 2,500 Trinidadian guppies were recruited from a lab stock population that began 10 years ago.
- 150 females, 92 IF9 males, and 8 IF10 males were placed in half the tanks. The other half contained 150 females, 8 IF9 males, and 92 IF10 males. See Figure 1.
- In 2 tanks, dividers separated the males and females. Reproduction in these tanks was controlled.
- After every generation, all the fish were caught, and males were identified by color pattern.
- After 10 generations, we ended the experiment and analyzed how the frequency of IF9 and IF10 had changed with each generation.

Results



Pattern A **Pattern B**

Figure 1: The fish above "Pattern A" and "Pattern B" express the IF10 and IF9 patterns, respectively.

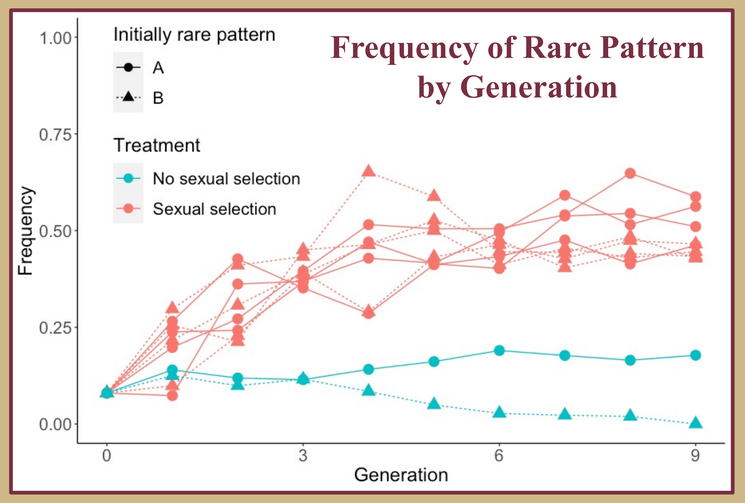


Figure 2: The frequency of the initially rare pattern increased with each successive generation before leveling off at around 0.5.

Figure 3: Tank Without Divider

Figure 4: Tank With Divider

Conclusion

- The ratio of male guppy IF lines leveled off to approximately 50% IF9 and 50% IF10. In the two control tanks, this trend was not observed.
- A generalized linear mixed model was run to see how a female's ability to choose her mate and the generation affect the frequency of the initially rare color pattern.
- This resulted in a p-value of less than 0.001.
- The treatment and generation have a significant impact on the frequency of the initially rare color pattern.
- The results of this study indicate that NFDS is at play in these populations.

Future Works

In future projects, the variability in color pattern of male guppies within an IF line over time can be analyzed, with size being adjusted for using a process called landmarking.

References

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2. Hughes, K. A., Houde, A. E., Price, A. C., & Rodd, F. H. (2013). Mating advantage for rare males in wild guppy populations. *Nature*, *7474*, 108–110.

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