



Female Mating Preference Tied to Negative Frequency Dependent Selection (NFDS)

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Introduction:

- Genetic differences matter because populations can be drastically altered over time through seemingly minor changes in frequency throughout a short period (Hughes et al 2013).
- In many species, we can see that individual organisms have numerous genetic differences from one another, and we don't fully understand why.
- One possible reason for this variation is the idea of negative frequency-dependent selection (NFDS) (Olendorf et al. 2006).
- NFDS means that rare phenotypes have an advantage.
- Female mating preference for males with rare traits is one possible cause of reduced genetic variation over time.
- In our study species, the Trinidadian guppy (*Poecilia reticulata*), we are diving into the potential reasoning behind female mate selection.
- Our prediction is that initially rare-colored males will increase in frequency over time due to biased female mate choice.
- This occurrence would show that genetic differences can accumulate within a species due to novelty in NFDS and female mating preference.

Methods:

- The fish gathered were lab stock descended from the Paria River population (Daniel et al. 2019).
- There were two different lines (Fig. 1) with distinct color differences. We used these differences to track frequency of each pattern over time.
- Once captured, fish were placed in 300-gallon tanks and fed Tetramin and Spirulina flake food.
- There were 10 different mesocosm populations; within each population were 100 males and 150 females.
- Two treatments were applied, one allowing for sexual selection and one not allowing for sexual selection.
- Plexiglass dividers were used for the non-sexual selection treatment to prevent females from choosing their mates (Daniel et al. 2019).
- Data was collected by photographing males to determine the color pattern they possessed.

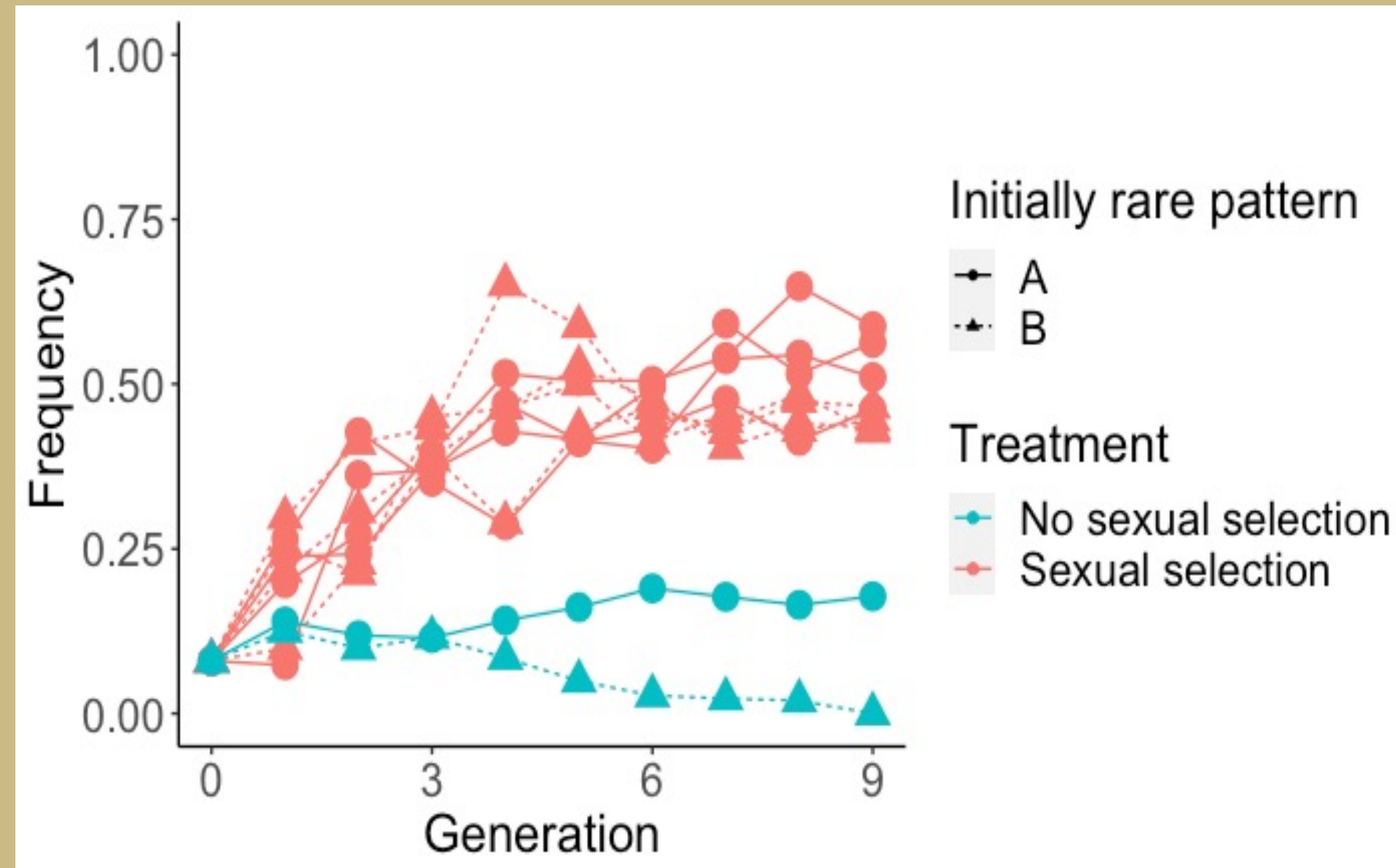


Figure 1. Two lines in each generation of mesocosm. Female mate choice was allowed (Red) but also prevented (Blue). Initially rare male color pattern denoted by symbol shape (Circle or Triangle). One half of populations allow A to be initially rare (8% A, 92% B); other half allow for B to be initially rare (92% A, 8% B).

Effect	P-Value
Line	0.112
Treatment	0.080
Treatment*Line	0.417
Generation	<0.001
Line*Generation	0.050
Treatment*Generation	<0.001
Treatment*Generation*Line	0.001

Table 1. Results from Generalized Linear Mixed Model (GLMM). Shows statistically significant relationships between Generation and Treatment, as well as Generation, Treatment, and Line combined.

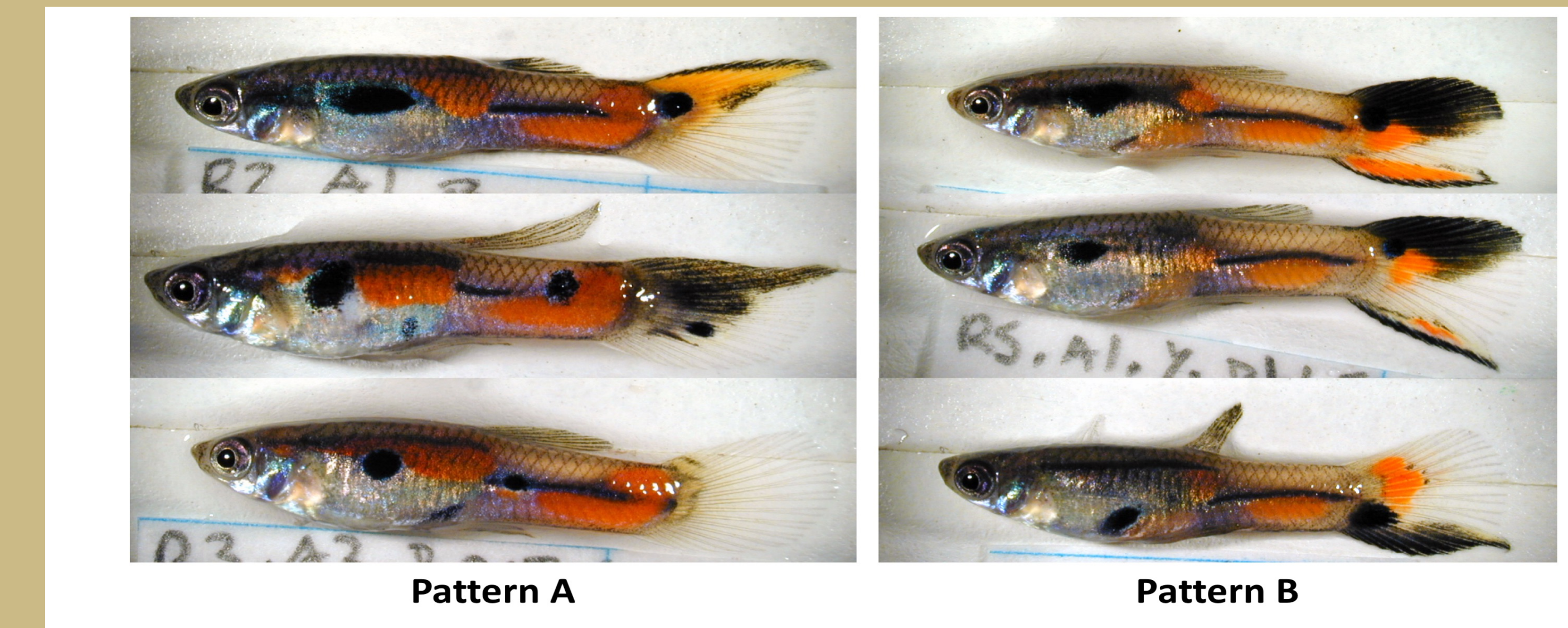


Figure 2. 3 Males with Pattern A & 3 Males with Pattern B

Conclusion:

- We have seen drastic frequency differences within the treatment allowing for sexual selection, pointing to NFDS being a prominent force within the samples.
- Future directions include using geometric morphometrics (Valvo et al. 2021), a set of mathematical approaches to measure morphology.

References:

- Daniel, M. J., et al. "Habituation Underpins Preference for Mates with Novel Phenotypes in the Guppy." *Proceedings of the Royal Society B: Biological Sciences*, vol. 286.
- Hughes, Kimberly A., et al. "Mating Advantage for Rare Males in Wild Guppy Populations." *Nature*, vol. 503.
- Olendorf, Robert, et al. "Frequency-Dependent Survival in Natural Guppy Populations." *Nature*, vol. 441.
- Daniel, Mitchel J., et al. "Mating Preference for Novel Phenotypes Can Be Explained by General Neophilia in Female Guppies." *The American Naturalist*, vol. 196.
- Valvo, Jennifer J., et al. "Using Delaunay Triangulation to Sample Whole-Specimen Color from Digital Images." *Ecology and Evolution*, vol. 11.

Acknowledgements:

I wish to show my appreciation towards the National Science Foundation, NSF, for funding this research project. I would also like to thank my UROP leaders, Natalie Storch and Gabriela Herrerias, for guiding my UROP experience. Lastly, I would like to acknowledge the other undergraduate students that I worked with to maintain the fish populations.