

Workshop on Microevolution: Reznick & the Guppies

by Michael Robinson (with contributions by Dana Krempels)

In this workshop you will examine & discuss the content and implications of two papers by David Reznick and colleagues on the evolution of life history characteristics in guppies (*Poecilia reticulata*). The goals of this workshop are (1) to improve understanding of microevolution and several concepts important to microevolution, (2) expose you to important components of the scientific literature, and (3) help you make mental connections between theoretical concepts as discussed in lecture and your text and biology in practice.

As always you must read these papers and this workshop BEFORE coming to your workshop meeting. Make sure you bring copies of the papers and this workshop. Do not fill out these sheets prior to workshop, however. Just be prepared. The papers to read are:

Reznick et al. (1990) Experimentally induced life-history evolution in a natural population. *Nature* 346: 357-359.

Reznick et al. (1997) Evaluation of the rate of evolution in natural populations of guppies (*Poecilia reticulata*). *Science* 275: 1934-1937.

Electronic copies of these are available online at the UM library. These papers discuss the evolution of life history traits. Life history is a term that describes demographic qualities of a species: for example, age-of-maturity, number of offspring in a clutch (a "clutch" is a batch of eggs laid by a single individual at one time), number of clutches in a life time, life expectancy.

To get a better handle on the biology here, you should start by reading the 1st paragraph (not the abstract) of the 1997 paper. Then proceed to the 1990 paper.

I. Understanding the Concepts and Terminology of Microevolution

1. Discuss the meaning of:

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| a. species | f. heritable traits (consider "nature vs. nurture") |
| b. population | g. adaptive, maladaptive, and neutral traits |
| c. gene pool | h. monogenic vs. polygenic traits |
| d. gene | i. directional, stabilizing and disruptive selection |
| e. allele | |

2. Discuss the nature of each of the following in terms its effects on the genetic composition of a population of organisms:

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| a. mutation | c. non-random mating | e. natural selection |
| b. migration | d. small population size | |

II. Discussion of Original Literature by Reznick, et al.

1. Why do you think Reznick *et al.* (from now on we'll just say Reznick) performed these studies? What were they trying to test or measure? What was their overall hypothesis and what results did they use to test this hypothesis? Specifically, list the data they measured and briefly describe the significance of each type of data.

2. In biological research, a **system** is the biological context in which the investigators are working. Why do you think Reznick chose this system (guppies and two fish predators in Trinidad)?
 - a. Why do you think Reznick chose this system?
 - b. What are the benefits of using this system?
 - c. What are the shortcomings of using this system (if any?)
 - d. What are the two predators? How do they differ and how is this important in the context of these papers?

3. In the 1990 paper, the authors mention two sites, a control and an experimental.
 - a. How did these sites differ?
 - b. What predictions regarding guppy life history would you make based on these differences?
 - c. Why? Is there any evidence (prior to this paper) to support these predictions?
 - d. The investigators moved 200 guppies from the control to the experimental site. Why? What would you predict should happen?
 - e. Can you spot any potential problems with moving only 200 fish?
 - f. Do you see any other problems with their methodology?
 - g. Do they address any of these problems? Do they address them adequately?

4. What were the results of the transplant study? Did the results support the investigators' predictions?

- a. Were there any results that did not support their predictions?
 - b. Overall, what would you conclude?
5. Reznick then collected fish from the wild and reared them in captivity to look at their offspring.
- a. Why? Think of a specific term discussed already.
 - b. If the investigators hadn't examined the captive-reared guppies, would your interpretation of their field study results have been different? How?
 - c. If, in the laboratory experiments, the guppies from the two sites had been completely the same in their life history traits, how would this have affected your interpretation of the results from the field transplantation?
6. Think about the genetics of these traits for the guppies. Are the traits you listed above likely to be mono- or polygenic? What might this mean in terms of natural selection?
7. What was the goal of Reznick's 1997 paper? Were they testing an hypothesis?
8. What is a Darwin?
9. What did they find regarding the rate of evolution in guppies? Was it equal between males and females? What is their explanation(s) for this? How do they come to this conclusion?

How did the rate of evolution compare to what is estimated from the fossil record? What is their explanation for the relationship between the rates they observed and observed from fossils?

10. Gould and Eldredge put forth the idea of **punctuated equilibrium**, in which bursts of evolution are followed by “species selection” (i.e., individual species either expand or go extinct). What implications might Reznick’s results have on our ideas about the rate of evolutionary change?

Final considerations:

What environmental factors did Reznick use to create different regimes of natural selection for the guppies? Could other factors have been involved, as well?

As the guppies evolved as predicted, what might you expect would happen to the predators? What implications might this have (if any) for interpreting the results?

If time allows, pick any species. Design a study that would be an independent test of life history evolution like Reznick’s. Which species would you use?

Would you use two predators or some other aspect of the environment? Describe your study.