[redacted] and [redacted]

"How water toxicity affects the size of *Poeciliidae* offspring"

Citation:

Riesch, Rüdiger, Martin Plath, Ingo Schlupp, Michael Tobler, and R. Brian Langerhans. "Colonisation of Toxic Environments Drives Predictable Life-history Evolution in Livebearing Fishes (Poeciliidae)." Ed. Jean-Michel Gaillard. *Ecology Letters* 17.1 (2014): 65-71. Print.

Intro:

In the 17th publication of Ecology Letters, Rüdiger Riesch and several colleagues including NCSU professor Brian Langerhans who recently was a guest speaker for our class, conducted research documenting the size difference in a fish family called *Poeciliidae* when they were raised in toxic sulfidic environments. The results revealed an interesting and highly predictable trend: the fish in sulfidic environments exhibited lower fecundity and higher body mass in their offspring.

Parts 4 and 5:

The paper we chose to review contained many of the concepts we talked about in class and even some that we haven't yet covered. The three topics we chose to highlight were life-history theory, phylogenetics, and convergent evolution.

First we'll start with life-history theory. According to Medanth, an anthropology and biology knowledge database, "Life-history theory defines the stages of gestation, infancy, childhood, adolescence, and adulthood and seeks to explain the difference of the timing of development, fertility, and death in living organisms." Many things help shape an organism's development such as mate availability, energy availability, energy requirements of the offspring, and many more. Even environmental factors help determine aspects of life-history. In the paper Dr. Riesch and his colleagues studied the life-history traits of fish in the Gambusia and Poeciliidae families, both of which give birth to live offspring. One such trait they looked at was body size. They charted a trend between water toxicity due to the presence of sulfide and body mass. Fish that had to survive in the more toxic waters had higher body mass at birth, giving them more surface area to diffuse the toxic sulfide. Another closely related trait they studied was fecundity, or ability to reproduce. They noted that as body size went up, fecundity went down. This, was an expected result that follows a well-established life-history trend: the larger and more energy-requiring your offspring, the fewer you will have. For example, humans (the vast majority of the time) birth one offspring at a time. Due to our slow development and high interdependence as children, it would be nearly impossible for mother to support many more than one offspring. Smaller, more independent organisms such as common house mice can produce up to 140 offspring per year with 3-14 offspring per litter!

In order to track the evolutionary ancestors of the fish species and their offspring, Dr. Reisch and his team employed the use of phylogenetics. A phylogenetic tree is a branched map showing the evolutionary relationships between multiple species by tracing their common ancestors back to divergent events. Dr. Reisch was able to determine how related the multiple species of live-bearing fish he used by comparing a

402 basepair long sequence of their DNA.

When the phylogenetic data was analyzed, Dr. Reisch saw an interesting pattern. The nine species came from two ancestral groups, or clades. However, the two groups were not separated by sulphidic water species and non-sulfidic. Each clade had some sulphidic-adapted fish and some not. This is an indicator of what is known as convergent evolution. The two clades evolved separately and in different locations, but they both evolved larger body mass to adapt to sulfidic environments. Convergent evolution is observed when two organisms that are not from an immediate common ancestor evolve to form similar traits. A good example would be the bluefin tuna and the dolphin. Both are aquatic species and both have a tail, a dorsal fin, and two more fins located towards the front of their body for directional use. However, a dolphin is more closely related to a giraffe than a tuna! Their aquatic traits developed completely independent from each other, but they phenotypically look similar! Dr. Reisch noticed the same trend with his live-bearing fish. Even though two fish that lived in sulfide-rich environments had very similar traits, they were not very closely related!

Implementing the elements in our presentation:

- Element 1-Title of project: The title is at the top of the paper
- Element 2-Full Citation: The citation is right below the title and labeled
- Element 3-Introduction: Labeled and right below the citation. Also contained in interview with Dr. Langerhans
- Element 4-Short explanation of 3 theory concepts from class: In the main body labeled with "parts 4 and 5"
- Element 5-Linking theory and paper: In the main body labeled with "parts 4 and 5"

Questions for Langerhans:

Would you mind giving a brief summary of the research you conducted and what you were attempting to learn from the experiment?

Why did you choose the family Poeciliidae?

How did you go about collecting the fish in the field?

Do you think your methods of capture could have provided any bias?

You mentioned in the paper two species, *Gambusia eurystoma* and *Poeciliidae sulphuraria* are endemic to sulphur-spring complexes and couldn't compare them to non-sulphidic habitats. Would it be out of the question to subject them to in-lab non-sulfidic conditions to see how growth rate compared?

Do you have any hypotheses surrounding *P. reticulata* being an outlier and having small body mass and high fecundity in a sulfidic environment?

If I understand the article correctly, the larger size is beneficial for the individual by giving them more surface area and mass to expel toxins?

Why was it necessary to construct a phylogenetic tree for the fish species?

Relevant links:
http://gambusia.zo.ncsu.edu/people.html
http://onlinelibrary.wiley.com/doi/10.1111/ele.12209/full
http://medanth.wikispaces.com/Life+History+Theory
http://archive.peabody.yale.edu/exhibits/treeoflife/convergent.html

Three topics:
Life-history Theory
Phylogenetic trees
Convergent Evolution

COMMENTS:

Hi [redacted] & [redacted],

The following feedback is in addition to the feedback I provided you guys a few days before the draft submission date.

1) Your intro was a little short and had some seemingly irrelevant information it (I'm still not sure what "17th publication of Ecology Letters" was referring to, I can assure you that this is not the 17th time the journal Ecology Letters has come out).
2) There were several typos where Dr. Riesch's name was spelled incorrectly. Please, be careful with things like that, this can be very uncomfortable once you present this to a more public audience.
3) The purpose of the section "Implementing the elements in our presentation" was not clear to me.
4) I missed the section on what you were actually planning on doing in your movie (conducting an interview, etc.), all I saw was a list of questions.
5) Whenever you cite a source (e.g. Medanth) you need to also provide a list of (full) references at the end of the paper so the reader knows your sources. For this class, I will only allow textbook references and original papers (including review papers) as sources. I will specify this in the rubric as well.
6) I think your theory concepts are ok, when it comes to life history theory, you should probably focus on the traits the paper talked about (e.g., offspring number & size)
7) Careful with explaining what exactly a phylogenetic tree is, the explanation you're offering is a little too specific. You can use a phylogenetic tree to trace common ancestors back to divergent events but that's already pretty specific and not how the authors used the tree in this paper.
8) Let's sit down and talk about your interview questions before you conduct the interview(s).

I highly encourage you to add another layer to your project in addition to the interview, like an animation for instance. The study really lends itself to some cool animations! And remember that you will be graded on creativity in your final movie and that this project sums up to 20 % of your final grade.

Think about this movie as telling a story. You are telling the story of the paper you chose.
Treat this movie as if you will show it to your grandmother and she needs to understand what has been done in the study you chose and why it matters!

Let me know if you have any questions about the things I commented on above. One of the goals of this class is to make you more comfortable with using the primary literature (and being able to interpret what you read and how to refer to/cite it correctly) I am well aware that this can be finicky sometimes but that's what I'm here for.

Next week I will provide a sign-up sheet so everyone can meet with me to discuss their project.

Best,
D. Magdalena Sorger