**Honors Project Proposal**

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# Assessing environmental variables across Plethodontid salamanders

ABSTRACT:

The majority of the 700 extant salamander species inhabit moist environments, such as under rocks, logs, and in leaf litter on the forest floor, or in aquatic habitats. Yet surprisingly, nearly 100 species have adopted an arboreal lifestyle. Life in trees can be ecologically challenging due to increased oxygen demands, mechanics of climbing, and the more variable temperature and humidity found in the canopy compared to on or under the forest floor. These difficulties are particularly salient for salamanders of the family Plethodontidae, as they lack lungs and are completely dependent upon cutaneous respiration. Yet, we have found that plethodontids have transitioned from terrestrial life to arboreal life in at least six independent lineages. Although morphology has responded to these changes in microhabitat, a distinct arboreal phenotype does not exist as it does in other vertebrate lineages It must be so that other influences are in play to explain the unequal distribution of diversity across North, Central, and South America, especially in the tropics. We suggest that climate may facilitate large clade dispersal and may explain some of the variation in terms of microhabitat use. We use ecological niche modeling to investigate specifically (1) if arboreal species live in different climatic niches compared to terrestrial species and (2) if these climatic variables sufficiently explain the distribution of arboreality across North America informing our larger question of how climate shapes microhabitat use in Plethodontid salamanders.

INTRODUCTION:

The majority of the 700 extant salamander species inhabit moist environments, such as under rocks, logs, and in leaf litter on the forest floor, or in aquatic habitats. Yet surprisingly, nearly 100 species have adopted an arboreal lifestyle, some of whom occupy bromeliads while others can be found mainly on tree trunks and branches or up in the canopy (McEntire 2016). Life in trees can be ecologically challenging due to increased oxygen demands, mechanics of climbing, and the more variable temperature and humidity found in the canopy compared to on or under the forest floor. These difficulties are exaggerated for salamanders of the family Plethodontidae, as they lack lungs and are completely dependent upon cutaneous respiration. Yet, we have found that plethodontids have transitioned from terrestrial life to arboreal life in at least six independent lineages. How these plethodontid lineages have colonized the arboreal habitat remains unclear. We hypothesize that investigating the environment around them, also known as their microhabitat, will give us insight into this perplexing ecological anomaly. A species microhabitat contains the range, climate, precipitation, vegetation, and other surrounding factors. One way to analyze the microhabitat in a more defined lens, is by looking at specific environmental variables that could affect their ranges. The variables I will be looking at are temperature, humidity, and precipitation. I will be looking at the environmental variables of microhabitat of the species in Plethodontidae that live an arboreal lifestyle and compare it to the species who live terrestrial, aquatic, and fossorial lifestyles. By characterizing the environmental factors each species experiences, we aim to uncover abiotic characteristics necessary for the evolutionary transition towards arboreality in Plethodontidae.

OBJECTIVE:

I will be assessing correlation between an arboreal lifestyle and the microhabitat of Plethodontid salamanders. In this study, since we are looking at correlation between species ranges, we might expect to see a few things based on previous knowledge. The first hypothesis is that geographically distinct arboreal species share similar climactic features such as humidity, precipitation, and temperature. Alternatively, more closely related species maybe have more similar habitats simply due to low dispersal rates. The second hypothesis is that specific environmental variables can be associated with specific clades in the phylogeny. If similar habitats arise because of low dispersal, then each clade should have an associated microhabitat and clades sharing a more recent common ancestor will have similar microhabitats. By analyzing the climatic variables across species ranges with various microhabitat types, we will be able to characterize the environmental components necessary for the unique arboreal lifestyle and attempt to discern how Plethodontid salamanders inhabit all types of niches.

METHODS:

To quantify the environmental factors in each species range, we selected our taxa based on the most recent molecular phylogeny for the group by Bonett and Blair (2017). I obtained occurrence data for each species in the phylogeny from the IUCN (2018), AmphibiaWeb (2018) or Vertnet (2018) database, from which I have constructed species range polygons. Microhabitat classifications were determined by other lab members from published literature and field accounts, and each species is classified as one of the following microhabitat types: arboreal, terrestrial, fossorial, aquatic, cave, or saxicolous (Baken and Adams, in prep). To obtain data on the environmental factors of interest, I retrieved (2.5 arc-minute resolution) data from the WorldClim/Bioclim (2018) database. Using the species range data and BioClim variables, I will extract the humidity, precipitation, and temperature patterns for each species. I will then use phylogenetically-informed ANOVA methods to test whether the environmental factors of interest correlate with microhabitat use. I will be using R statistical software (2013) to perform these analyses. The final product of my project will be summarized in a poster and paper.

# REFERENCES:

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