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Daniel M. Franz

University of Montana, Missoula, df106751@umconnect.umt.edu

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**Capstone: Difference in Physical Traits of Rocky Mountain Tailed
Frogs in Burned and Unburned Streams**

Dan Franz

Introduction

Rocky Mountain Tailed Frogs (*Ascaphus montanus*) are small amphibians that are found within forested streams in western Montana and northern Idaho (Figure 1). With anthropogenic climate change becoming more pressing, the proper management of our nation's forests is more important than ever. One factor in forests that needs to be managed and may be increasing with climate change is the occurrence of forest fires. Forest fire seasonal severity ratings (SSR) are estimated to increase anywhere from 10-50% in North America over the century (Flannigan, 2000). Increased fire frequency and severity will potentially result in a larger amount of habitat being affected by fire. It has been found that gene flow between populations of tailed frogs differs in previously burned areas, so this suggests that management techniques must take tailed frogs into account (Spear, 2010). Gene flow in the Rocky Mountain Tailed Frogs occurs along the riparian zones (not usually over land) and is limited by solar radiation. This indicates that gene flow will be altered and limited in a burned area because severe wildfire reduces the canopy cover in an area. We want to find out what kind of genetic variation is more prevalent in a burned area since gene flow becomes restricted, and populations become more divided.

Question 1

One factor we will be measuring is how the abundance of tailed frog tadpoles change in burned and unburned streams. Rocky Mountain Tailed Frogs live in small and cold forested streams. These streams stay cold due in part to the canopy cover of the forest (Rambo, 2008). It has been found that tadpole densities were greatly reduced in streams in areas that had been clear-cut (Dupuis, 1999). This is due to the severe and sudden reduction in canopy cover. On the other hand, buffered and old-growth streams had significantly higher densities of tadpoles. Just like clear-cutting, wildfire is a disturbance that severely reduces canopy cover upon the landscape. Based on this information, I hypothesize that tadpole abundance will be lower in the

burned streams because of the reduced canopy cover resulting in more intense solar radiation reaching the streams.

Question 2

Another factor we will be measuring is length of the tadpoles. It has been found that length of the tadpole is directly correlated with age class, indicating that longer tadpoles are older (Metter, 1967). According to Dupuis (1999), tadpole densities were smaller in streams with higher levels of sediment, detritus, wood, and rubble. During and immediately following a fire, things like detritus, woody debris, and other pollutants are increased in a stream because of erosion and falling ash (Neary, 2005). There is currently not enough information available on how length or stage of development is impacted by fire. Although Dupuis's study deals with abundance and not length or age, this information allows me to hypothesize that there will be longer (older) tadpoles in the burned stream. This would be explained by the fact that the added nutrients, debris, and pollutants in a burned stream most likely would negatively harm the younger tadpoles. The death of younger, weaker tadpoles would align with the decrease of tadpole abundance, and leave a higher proportion of longer (older) tadpoles.

Question 3

The last factor we will be measuring is if the color of the tailed frog tadpoles change in burn and unburned streams. Tailed frog tadpoles range in color from black to light brown, and can include fine black speckling (Dupuis, 1999). The color of tailed frog tadpoles has been found to almost always match or resemble the color of the substrate that they are found in (Adams, 2014). After fires, the color of the landscape is often altered due to ash from burned wood. A lot of this ash and burned detritus runs into the streams as well, so stream sediment is likely to be darker in a burned stream. Based on this, I would hypothesize that tadpoles will have a darker color in the burned streams. New tadpoles will begin to adapt to blend into their surroundings which are now darker than they had previously been due to the fire.

Methods

Study Area

Study sites will be chosen in the same relative area consisting of 6 streams in an unburned area, and 6 streams in a recently burned area. This area will be the Lolo Peak Fire burn area about 15 miles south of Missoula, Montana. The two sets of sampling sites consist of the same species and similar topography, yet on each side of Highway 12. Highway 12 marks one of the borders of the fire; north of Highway 12 is unburned, while the fire took place south of the road (Figure 2). The distinction between burned and unburned streams will be made based on how much of the watershed has been burned. The burned streams must have a 90% reduced canopy. Unburned streams must have at least 60% canopy cover. The unburned streams are not downslope from the burned streams in order to prevent any downstream influence the fire may have had. The streams consist of *Ascaphus montanus* tadpoles (Rocky Mountain Tailed Frog). We will be measuring and collecting samples in 10 m length sections of each stream that match our criteria for “burned” and “unburned.”

Data Collection

Population: At each site, tadpoles will be collected using a small aquarium fish net. Tailed frogs lay eggs in a string underneath boulders in streams, and that is where the tadpoles remain until they mature (Karraker, 1997). Rocks and boulders will manually be turned over in the streams, and the tadpoles will be caught once they detach from the rock. To quantify abundance of tailed frog tadpoles, the number of total individuals caught in each stream will be counted.

Tailed Frog Traits: To quantify differences of tadpoles in burned and unburned streams, body length will be measured with a ruler. Body length will be recorded in the field using the standard technique of tip of snout to tip of tail for males, and tip of snout to tip of “tail nub” in

females (Daugherty, 1982). Lastly, to be able to compare color differences of tadpoles in burned and unburned streams, color will be measured using a color wheel displaying different hues of black and brown. These data will be recorded by placing the tadpole in a small Tupperware or petri dish that has a ruler and a color wheel in it. Top-down photos will be taken in the field of each tadpole showing the ruler and color wheel in frame, so the data recorded in the field can be verified.

Habitat: Some other variables of each site itself will also be compared in order to determine what changes occur to the landscape after a fire. To quantify how fire impacts the tree cover of a forest, canopy cover will be measured at all 12 sites using a densiometer to determine percent of open canopy. In order to compare how stream composition changes after fire due to erosion and ash, a note will be made about the substrate in each stream. This will be a percentage of sand, pebbles, and rocks. The substrate composition note will also include woody debris in the stream.

Analysis

Once data has been collected, the results will be entered in Microsoft Excel. To test whether abundance of tadpoles differs in burned and unburned streams, tadpoles in each type of stream will be added together and averaged in order to find the average amount of tadpoles in the two types of streams. To test whether fire impacts length of the tadpoles, body lengths for the two sets of 6 sites will be compiled and averaged. These values will be graphed with a 95% confidence interval in order to determine whether the differences in values are statistically significant or not. To test whether tailed frogs respond to the darker color of a recently burned stream, color will be compared by assigning numerical values to each hue on the color wheel, and then finding the average of each population's color (Figure 3). The darker colors are a higher number, so if the average of all the tadpoles in the burned areas is much higher, it will give us insight about the difference of color in both types of streams.

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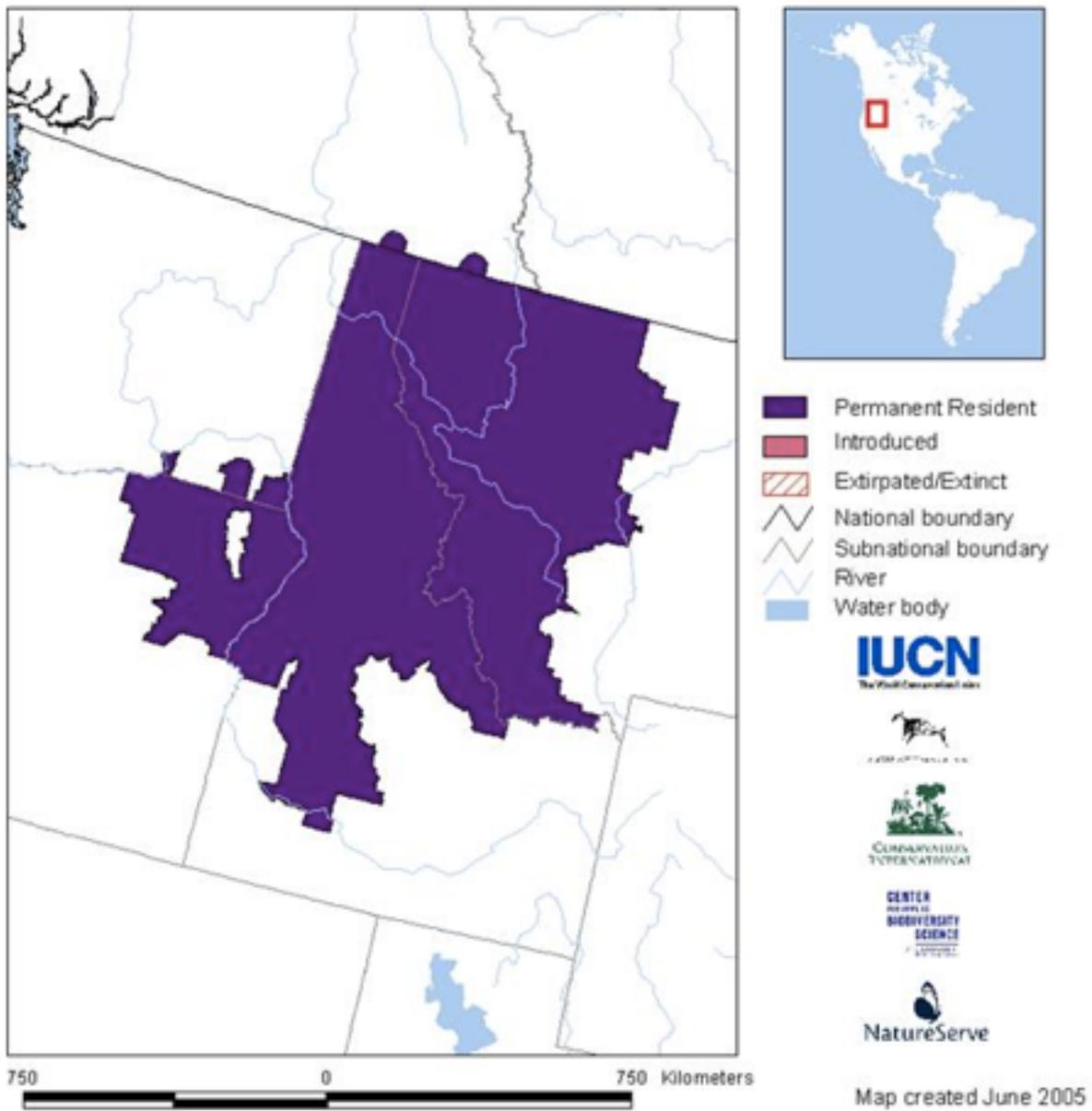


Figure 1: Range of Rocky Mountain Tailed Frog Habitat. Credit: Montana Field Guide (<http://fieldguide.mt.gov/speciesDetail.aspx?elcode=AAABA01020>)

Lolo Peak Fire Progression

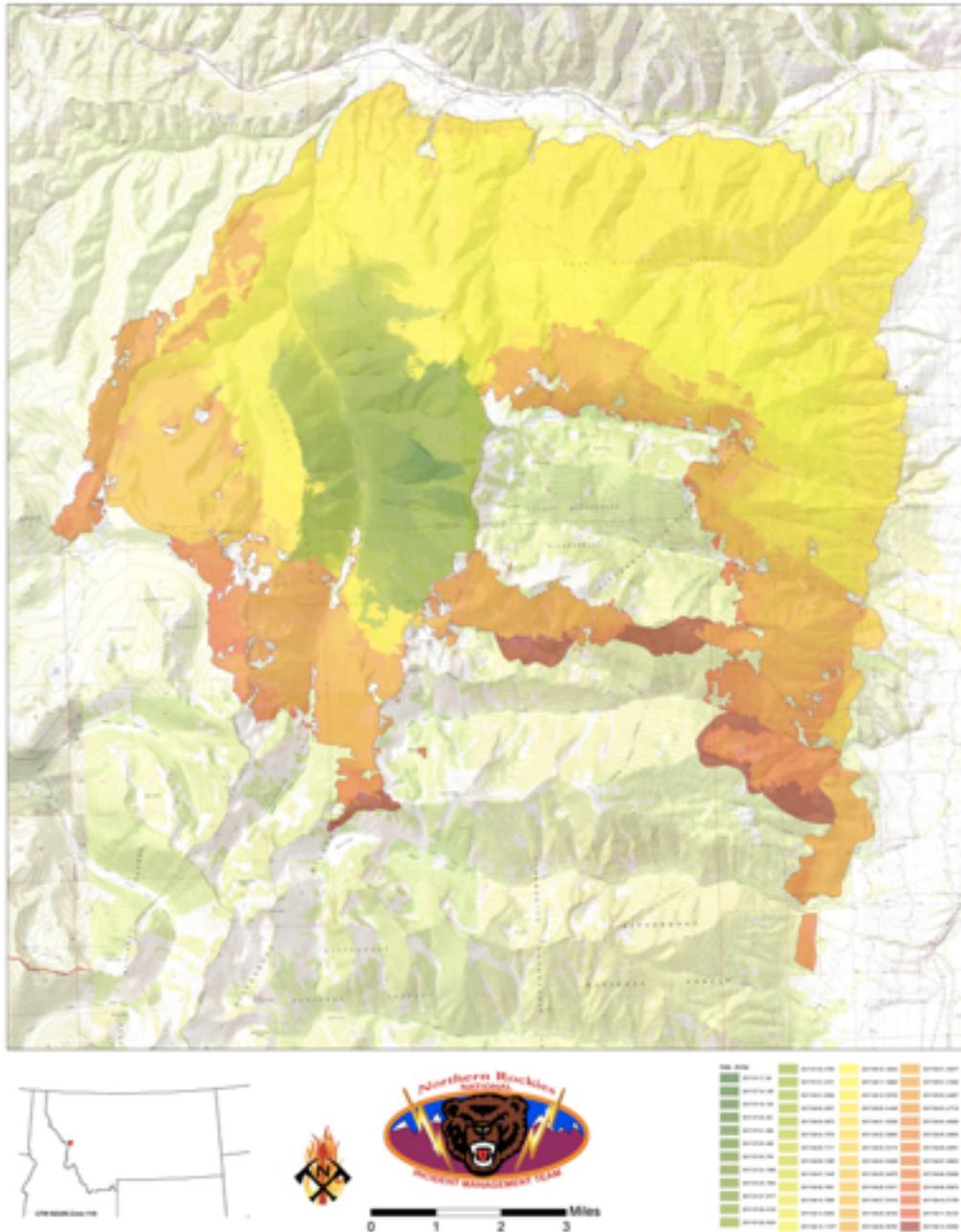


Figure 2: Map of the Lolo Peak Fire in September of 2017. Credit: Inciweb (<https://inciweb.nwcg.gov/incident/map/5375/11/74601>)

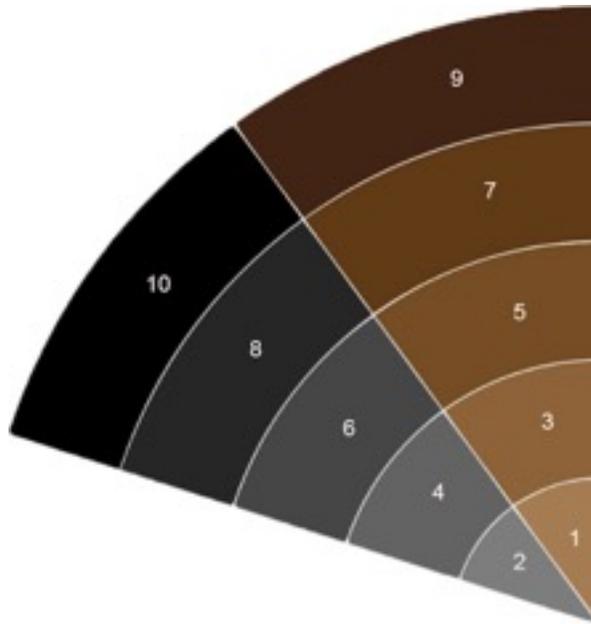


Figure 3: Black and brown color hue wheel that will be used in the Tupperware dishes to measure color of tailed frog tadpoles. Numbers have been assigned in ascending order based on how dark the color is.