

The Effects of Controlled Fire on Amphibians

Prepared for

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April 28, 2008

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Dear Dr. Brucker:

The following research report was written to fulfill the requirements of assignment 15 in the English 2053 Technical Writing course. The topic of this research report covers the effects of controlled fire on amphibians. I chose the topic due to my interest in the subject area. With the increasing use of controlled fire as a wildlife management tool, the effects of fire must be considered for all organisms. I will be conducting an undergraduate research project next year that covers the same topic, and this research paper should provide the needed background information for a proficient experiment.

I provide the reader with basic information on why fire is used and how it affects amphibians. Amphibians are extremely sensitive organisms. They require moist micro-habitat which causes them to be susceptible to many environmental hazards such as global warming, drought, as well as fire. Fire affects many other things within the environment of amphibians. Therefore, fire can directly or indirectly have negative effects on amphibians.

Sincerely,

Stuart C. Brasel

Stuart C. Brasel

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ABSTRACT

Amphibians are sensitive organisms which require a cool, moist, and low-light micro-habitat. Controlled fire is a common forest management tool and causes serious concern on amphibians. Fire reduces soil moisture due to a decrease in vegetation near the ground level which increases daily temperature fluctuations. Fire also negatively effects the primary food source if amphibians (arthropods) which in turn, negatively effects amphibians. Amphibians have been found to be significantly more abundant in un-burned habitat vs. burned habitat. Amphibians play the role as indicators for habitat destruction due their intense sensitivity, and if the knowledge if amphibians increases, then it will only improve the scientific world.

INTRODUCTION

Description and History of Fire and Amphibians

Amphibians are sensitive organisms that feed mostly on arthropods. Amphibians also require a low-light, cool, moist micro-habitat. They are usually found beneath decomposing logs, rocks, or other objects that provide favorable habitat. If these objects are removed, then amphibians lose the required necessities for survival.

Fire can damage the habitat of amphibians by removing the objects that amphibians take shelter under. Fire has been and will continue to be a commonly used management tool for scientists because many species of trees require fire for the germination of seeds (Gomez-Gonzales, Sierra-Almeida, and Cavieres 2008). Fire creates species diversity within ecosystems of temperate regions by opening the understory and ground cover within a forest. The forest consists of five layers, or strata (Fig. 1). These five layers are listed from top to bottom: first, the emergent canopy which consists of trees emerging from the strata below; second, known as the crown layer or upper-canopy which consists of the majority of leaf mass and absorbs the most solar radiation for photosynthesis; third, the mid canopy which consists of immature trees; fourth, the lower canopy or understory which consists of small shrubs, tall herbaceous plants, and tree saplings; lastly, the ground cover consists of herbaceous plants and small woody vegetation. Each stratum absorbs a portion of the solar radiation from the sun. Fire tends to reduce the vegetation available in the lower canopy and ground cover which in turn, increases the amount of solar radiation reaching the forest floor. The increase in solar radiation will increase the temperature on the forest floor. Fire will also reduce the amount leaf litter on the forest floor. The reduction of leaf litter and increase of solar radiation within the forest will reduce the soil moisture. Fire has a negative effect on arthropods which is the primary food

source for most amphibians. Amphibians require micro-habitat that is cool and moist.

Therefore, fire should negatively affect the abundance of amphibians. Fire is essential

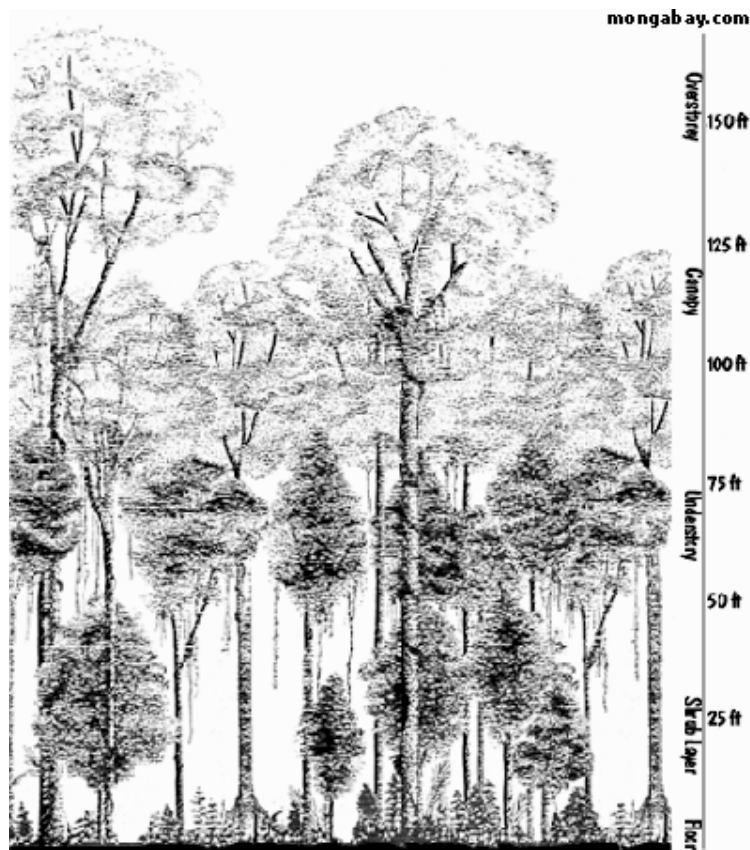


Figure 1. The five strata of a forest ecosystem.

Source: Will McWhinney, *Grammars of Engagement* (2002), www.asc-cybernetics.org/2002/canopy_levels.gif

for many species of vegetation such as the long-leaf pine (*Pinus palustris*) (Campbell, Hanula, and Outcalt 2008). However, it can be detrimental to other more fire-sensitive species such as amphibians.

Statement of Purpose

The purpose of this report is to address the concerns with the effect of controlled fire on amphibians. In attempt to explain the information, many sources were located and interpreted to provide a reasonable answer.

Target Audience

The primary audience consists of Dr. Carl Brucker and interested faculty. The secondary audience includes future students in the English 2053 course or anyone interested in the topic.

Scope

The report covers one major topic: the effect of controlled fire on amphibians. However, many indirect effects of controlled fire on amphibians are addressed.

CONTROLLED FIRE

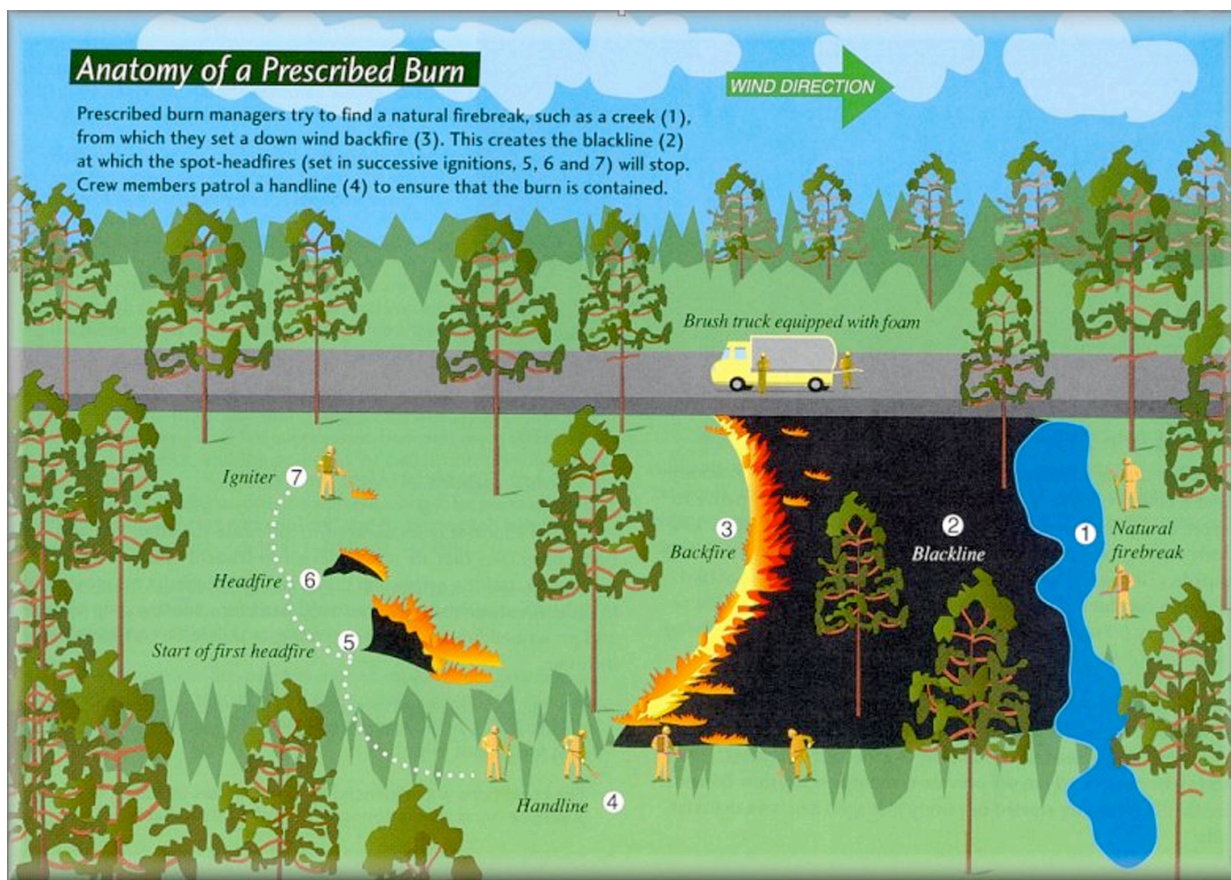


Fig. 2. Diagram of a typical prescribed fire.

Source: 2004 Clemson University Public Service Baruch Institute of Coastal Ecology and Forest Science, retrieved 28 April 2008 from the world wide web:

www.clemson.edu/rxfire/pfcglossary.htm

As stated previously, controlled fire is used as an important management tool. Controlled fire is also known as prescribed fire. A controlled fire is one that has been planned for some period of time. Usually, someone has already placed a fire line around the planned burn area. These fires are used to reduce fire fuels such as dead leaf litter. The threat of wildfire is reduced when fire fuels have been reduced. Prescribed fire is also used in oak-hickory forests in the eastern U.S. to improve the oak-hickory regeneration by thinning out the abundance of understory trees. Although fire is useful for many reasons, scientists must pay close attention to other more sensitive species.

Design of Controlled Fire

All prescribed fires are designed similarly (Fig. 2). First of all, a natural fire break is chosen such as water and a road. Next, a back fire is lit to create a “black line,” or area that has been set on fire against the wind to increase the distance from the head fire to the natural break which will help prevent a chance that the fire will jump the natural fire break. Then, fire crews are strategically placed to create hand lines or lines that are manually cut to prevent fire escape. Finally, a person with a flare or drip torch will walk along igniting the head fire which burns with the wind. Controlled fires tend to happen during the dormant season of temperate regions. The dormant season is recognized as the period when trees are not in leaf and small herbaceous plants are not growing on the forest floor. This period of time ranges from early November to late March. During this time, amphibians are found to have their highest activity.

Effects on Amphibians

Amphibians require moisture in their environment due to partial oxygen exchange through their skin. Amphibians do not have complex respiratory systems like most mammals



Figure 3. Post-fire organic layer reduction.

Source: Estimating Increased Erosion and Sediment Delivery Caused by Wildfires, B.E. Drake, 2005. Retrieved on 28 April 2008 from the world wide web:

www.crwr.utexas.edu/.../FinalReport_Drake.htm

and therefore send blood to the skin to be oxygenated. This phenomenon is possible due to the moist skin which allows for efficient oxygen exchange. If this moisture is taken away from the environment, then amphibians will be forced to leave the habitat and could potentially die. Soil moisture is directly related to the amount of organic material on the ground layer. However, the fires remove most of the organic material which decreases soil moisture (Fig. 3). Also, most amphibians are nocturnal and reside under decomposing logs during daytime hours. The fires remove these shelter sites as well. In ecosystems that receive persistent fire regimes, amphibians have been found to have significantly less abundance (Table 1) with the many-ribbed salamander and slimy salamander being more abundant in sites that have not been burned within ten years (Pilliod et. al. 2003). Amphibians, especially frogs, are known as explosive breeders because they will migrate to breeding pools shortly after a rain and call to attract mates. The breeding pools are very crucial in the life of amphibians. Fire can affect the breeding pools as well. However, fire is beneficial for some and harmful for others around breeding pools. The dusky

Species	# of Sightings	
	In Burned Site	In Un-Burned Site
Many Ribbed Salamander	24	11
Slimy Salamander	35	15
Leopard Frog	12	3
Green Tree Frog	8	2
Total	79	31
% of Total Sightings	72%	28%

Table 1. Number of sightings in Un-burned sites vs. Burned sites.

Source: "Fire and Amphibians in North America." Forest Ecology and Management, 178: 163-181.

gopher frog reacts positively to fire regimes. The more open the canopy of the forest is, the longer the photoperiod, length of sunlight, on the body of water which means more fluctuation in daily water temperature Thurgate and Pechmann (2007). However, southern leopard frogs react negatively to fire regimes. They require a more shaded environment around the breeding pools.

Effect on Arthropods

Arthropods are insects and amphibians rely on them for a primary food source. Arthropods feed on vegetation and organic material found in the soil. Fires reduce the vegetation and organic material within the soil temporarily which negatively affects the arthropod abundance. With arthropods acting as the primary food source of amphibians, a decrease in abundance could only negatively affect amphibians.

CONCLUSION

Amphibians are sensitive organisms that can play important roles as indicator species for habitat destruction. Fire is a commonly used management tool that can be harmful to amphibians in any habitat. Scientists must take into consideration the affect that fire has on these sensitive organisms. A possible option would be to increase burn intervals. Nevertheless, fire has a negative effect on amphibian abundance.

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