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Effects of UV Light on Local Stream Frog Behavior

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Abstract

Amphibian declines have been well documented throughout the world. Several studies have examined whether UV radiation from the sun is a possible contributing cause to declining populations. In Southern California, two closely related species of treefrogs, *Pseudacris hypochondriaca* and *Pseudacris cadaverina*, coexist in many perennial streams. *P. hypochondriaca* is primarily nocturnal while *P. cadaverina* is known to bask in direct sunlight. The purpose of the study is to determine how the two different species of frogs will react under different types of light emitted by a portable flashlight. The light was emitting either UV radiation or visible light, or was turned off as it was slowly brought toward the frog. When the frog jumped from its resting position, the light was held stationary and the distance from the light to the original frog perch was recorded. Our results suggest that both species are more sensitive to the UV light than to the light that was turned off or the visible light. Frogs jumped much sooner when presented with UV even the light was farther away from them. There appeared to be no differences in the sensitivity of the two species to the UV light. Our results suggest that both species of tree frogs are sensitive to UV. This sensitivity may be due in part to the large levels of UV that reach streams after wildfires. Wildfires are a natural part of these ecosystems and the removal of tree canopy by wildfire may create periodic strong selection on riparian animals to avoid increased levels of UV radiation.

Introduction

Scientists have observed noticeable declines in amphibian populations in the last 20 years (Pounds, 2001). Causes of declines are complex and scientists suspect that single causes are rare. Recent declines in amphibian populations can be attributed to a variety of reasons, including potential increase in UV-B as a result of ozone depletion (Palen and Schindler, 2010). This depletion has been implicated with anthropogenic activity (Collins and Storfer, 2003). Increases in UV radiation, especially UV-B (290-320 nm), have detrimental effects on amphibians, which lack feathers and fur for protection from UV damage (Tietge et al., 2001).

In addition, frequent wildfires in the Santa Monica Mountains have removed shade canopies increasing the exposure of these native amphibians to light, and therefore increased UV (Anzalone and Kats, 1998). The Baja California tree frog (*Pseudacris hypochondriaca*) and California tree frog (*Pseudacris cadaverina*) are closely related native species in the Santa Monica Mountains. The Baja California tree frog exhibits nocturnal behavior and the California tree frog exhibits diurnal behavior. Recent studies suggest that UV-B may increase embryonic mortality in some amphibians at higher altitudes and latitudes (Anzalone and Kats, 1998). In this study, we sought to determine if these two species of frogs were behaviorally sensitive to UV radiation as adults and to determine if there were interspecific differences pertaining to UV-B sensitivity. Studying the effects of UV-B sensitivity of amphibians provides better insight into amphibian behavior and their adaptation to increased UV-B exposure.

Methods

Study Sight and Collection

We examined sensitivity to UV-B radiation in two species of local frogs in streams in the Santa Monica Mountains (Los Angeles Co., California) in the winter and spring of 2010. We surveyed the Arroyo Sequit, which is part of the Santa Monica Mountain stream system. We examined the behavior of juveniles and adults in the field. After experimentation, specimens were released.

Examining Effect of UV-B

When a frog was located we captured it and placed it on a flat surface. When the frog was stationary, a Streamlight Twintask UV model ® was placed 1 meter directly above the frog, (we constructed an apparatus to maintain relatively constant ambient UV during experimentation.). The flashlight was lowered at a constant vertical velocity until the frog jumped. The distance between the end of the flashlight and the frogs starting position was then measured. This procedure was repeated with each frog, randomizing the order of exposure to visible light, UV-B radiation (.11 μ w/cm² at distance of .2 meters), and with the flashlight turned off as a control.



Figure 1. *Pseudacris cadaverina*



Figure 2. *Pseudacris hypochondriaca*

Results

Both species of frogs reacted significantly different when they were exposed to UV-B radiation compared to when they were exposed to visible light or control situations (Fig. 3). There was a larger distance between the flashlight and frog when it was emitting UV-B than with visible light or no light at all.

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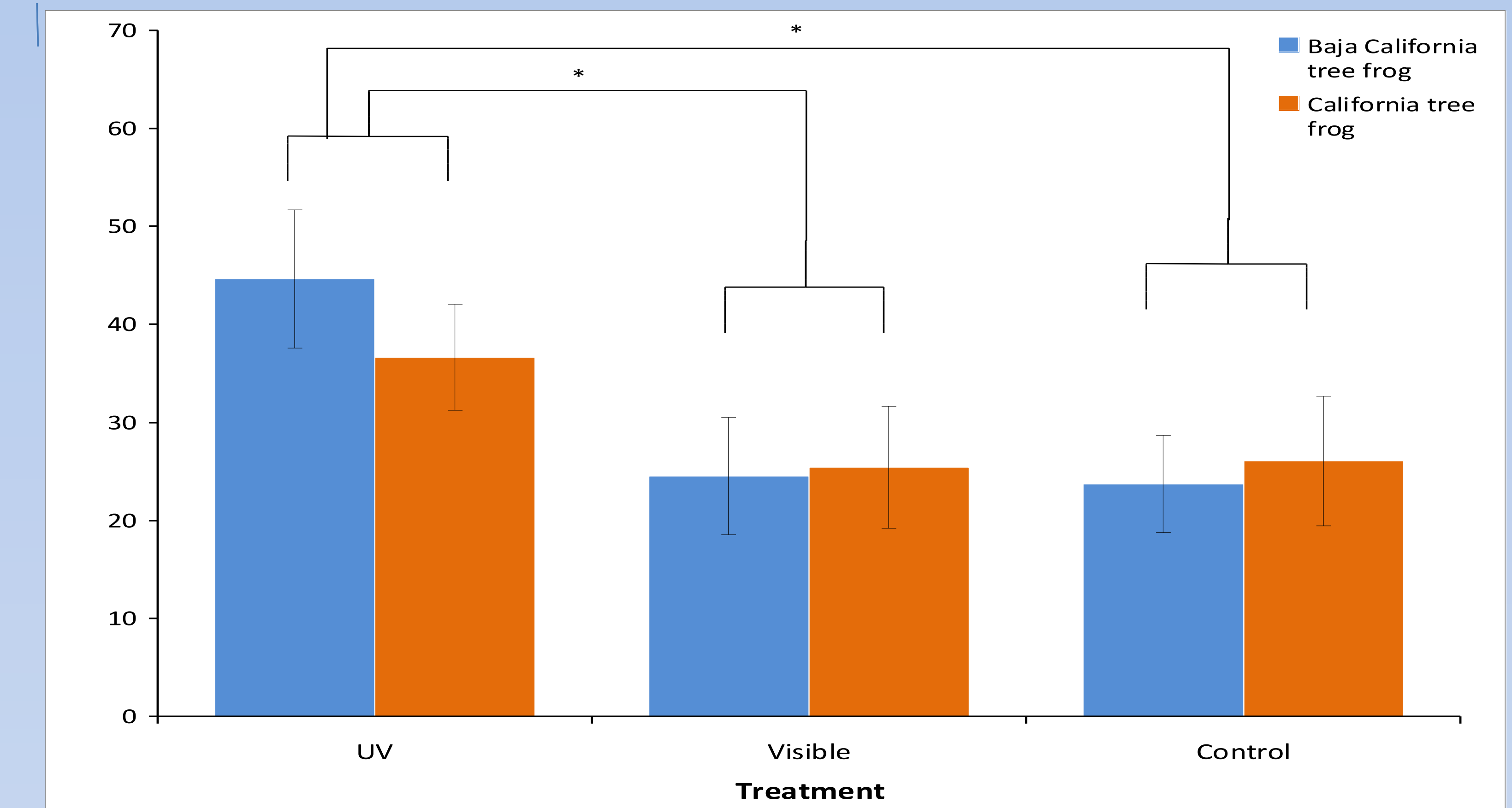


Figure 3. Shows the response of *P. hypochondriaca* and *P. cadaverina* to different light treatments. The analysis from a 2-way ANOVA indicate that there was a significant difference in the response between UV and visible light and UV and no light (control), respectively ($p < 0.05$). Although there was not a significant difference between the species in their response to UV, the results suggest that *P. hypochondriaca* may be more sensitive to UV than *P. cadaverina*. *denote statistical significance.

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Species	1	74.004	74.004	.103	.7492
Treatment	2	6406.795	3203.398	4.446	.0139
Species*Treatment	2	608.122	304.061	.422	.6568
Residual	111	79965.820	720.593		

Table 1. Displays the results of the analysis of a 2-way ANOVA conducted in the study. Based on the p-values, there was not a significant correlation between species. In addition, there were not significant differences found between the interaction of species and treatment. However, the analysis did reveal that there was an significant difference amongst the response to varying light ($p < 0.05$).

Conclusion

1. Both species were more sensitive to UV-B than they were to visible light or control treatments.
2. There was a tendency for Baja California tree frogs to be more sensitive to UV-B than California tree frogs.
3. Loss of canopy due to wildfire might make frogs more susceptible to UV-B (Anzalone and Kats, 1998). In particular, adult Baja California tree frogs may be less able to tolerate UV-B than California tree frogs.

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