Understanding range limits of a vulnerable desert amphibian, *Anaxyrus exsul*, with a severely restricted habitat

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Introduction

Populations of the black toad (Anaxyrus exsul) are limited to desert springs within a single valley in the White-Inyo Range of California (*1*). All reported native populations occur in an area of about 24 km-sq. in Deep Springs Valley (Figure 1), giving it one of the smallest documented ranges of any amphibian.

Most of the known black toad habitat is located on actively grazed land. Although disturbance and grazing can be beneficial to desert spring vertebrates (*1, 2*), we know little about habitat preferences of this species. How, then, can we develop an ecologically informed management plant that will allow students and community members at Deep Springs College to become more successful stewards of the black toad? With this goal in mind, we sought to address the following questions:

- Where in Deep Springs Valley are black toads found, and where do they breed?
- What are the physical and chemical attributes that characterize black toad habitat?
- How does active clearing of vegetation influence water temperature and toad usage?
- How do water sources containing toads differ from other local sources that are toad-free?

Materials and Methods

From February through July of 2011, we mapped and monitored populations of *Anaxyrus exsul* in Deep Springs valley. We measured pH, instantaneous temperature and specific conductance (SPC in microsiemens/cm normalized to 25°C) with a YSI ProPlus meter.

We experimentally manipulated vegetation in a pond within a cattle exclosure at the Antelope Springs site. In late February, we divided this pond into seven 30 ft. plots and experimentally cleared either the eastern or western subplot using a randomized design (Figure 2). With HOBO dataloggers, we measured near-surface water temperature within each of the 14 subplots at 10 minute intervals throughout the toad breeding season, and for each day we calculated the mean, minimum and maximum temperature.

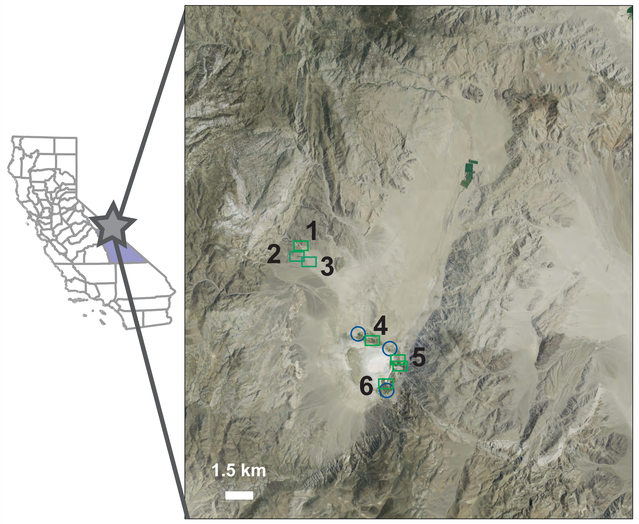
Black Toad Habitat is Alkaline and Rich in Electrolytes

Site	pH Range	SPC Range
Sam Spring	7.89 to 8.37	346 to 435
Antelope Springs	7.10 to 8.18	431 to 520
Bog Mound Springs	7.80 to 8.62	460 to 534
Corral Springs	7.35 to 8.00	563 to 1642
Buckhorn Springs	8.83 to 8.93	1296 to 1335
Seep Pond	9.77	>85,000

First Egg Strings Observed: March 9
First Tadpoles Observed: March 31

- Toads were observed in shallow, slow-moving waters.
- Toads were not observed in the highly saline, alkaline seep ponds that occur at the edge of Deep Springs Lake.
- In some cases, toad-free springs or water sources were near toad-containing springs with similar physical characteristics. The reasons for toad absence in these areas is unclear.
- For the first time, we observed and documented toad breeding at Sam Spring (through the occurrence of adults and tadpoles).

Figure 1. Black Toad Habitat in Deep Springs Valley



1 Sam Spring
2 Antelope Spring Pond
3 Antelope Spring Stream
4 Bog Mound Spring
5 Corral Spring
6 Buckhorn Spring

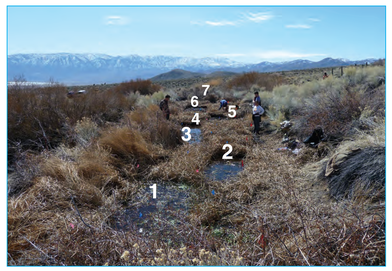
Water Sources

without toads

with toads

Vegetation Clearing at Antelope Springs Increases Daily Temperature Range

Fig. 2 Experimental Plot at Antelope Springs



- ANOVA revealed a significant effect of plot, date and clearing treatment on daily temperature mean and range.
- Clearing increased mean temperatures mildly (~0.8 °C) but nearly doubled the and daily range (from <4° to >7.5°).
- Plots in areas of greater flow had more consistent and warmer temperatures.
- Vegetation clearing requires yearly maintenance; by July 19th treatment plots were no longer well-distinguished.

Fig. 3 Effect of Clearing on Temperature

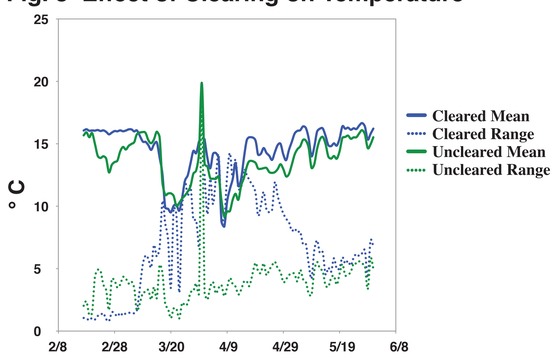
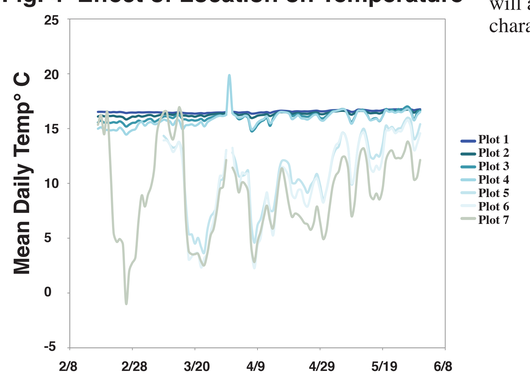


Fig. 4 Effect of Location on Temperature



Different Habitats for Different Activities

Different kinds of habitat appear to be preferred for different toad activities. Toads called almost exclusively from vegetated regions, but most amplexing individuals were observed in open areas.
Toads appear to prefer disturbed habitats for breeding.
Tadpoles often congregate in shallow water margins that, while usually warmer, may be at higher risk of drying especially in cattle-grazed areas.

Cattle Impact at Bog Mound Spring

Breeding Toads

Future Research

- What is the age structure of the black toad population?
- Where and when does most mortality occur?
- Are toad growth rates influenced by water characteristics such as specific conductance, pH and temperature?
- What is the influence of cattle on water turbidity and toad hatching success?
- Do introduced carp compete or otherwise interfere with breeding toads? How do toads move between different habitat types across seasons and between years?

Eggs Silted by Cattle

We hope to address these questions in the future through the use of tagging and mark-recapture studies in the toad habitats. With these data, we will continue to evaluate grazing and management strategies that can maintain healthy populations of the black toad. Because we are able to fully characterize the habitat of this narrow-range species, our findings will also have implications for other studies that seek to use habitat characteristics to define species range limits.

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