

Field Update on American Bullfrog (*Lithobates catesbeianus*) Control Measures and the Effect on Foothill Yellow-legged Frog (*Rana boylei*) Observations in Sherlock Creek, Mariposa County, California

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Control of American Bullfrogs (*Lithobates catesbeianus*) in California, and other regions of the west, has been shown to be effective in that bullfrog populations can be controlled (Adams and Pearl 2007, Kamoroff et al. 2020, Alvarez and Wilcox in press), and control can have positive effects on native species (Doubledee et al. 2003, Witmer et al. 2015, Alvarez and Wilcox, in press). Bullfrogs eat an enormous array of prey items, including native anurans, and are reported to be a conservation concern for declining species (Bury and Whelan 1984, Adams and Pearl 2007).

With the recent listing under the Federal Endangered Species Act (ESA), populations of Foothill Yellow-legged Frogs (*Rana boylei*) are under increased attention and factors contributing to their decline are being investigated (USFWS 2021). Confounding effects that contribute to declines should be considered in a management context, and if possible, addressed. This may include hydrologic conditions, potential dumping, mining, or construction activities, and the presence of non-native predatory species (Thomson 2016). Bullfrogs are known predators of Foothill Yellow-legged Frogs (Wilcox 2017) and may contribute to their decline locally or regionally. In the context of the known feeding behavior of bullfrogs, their presence has to be considered a potentially detrimental aspect of occupied habitats.

We surveyed a 1.6 km section of Sherlock Creek, upstream of its confluence with the Merced River, in Mariposa County California, with Foothill Yellow-legged Frogs being the focal animal. This population is considered endangered under ESA (USFWS 2021). Our goal was to determine if they were extant, and if so, were factors present that might be negatively impacting their population. Our surveys included a daytime component and a nighttime component, and each survey covered the same area of creek. Recent work by Alvarez et al. (in press) has shown that nighttime surveys are far more efficient at detecting the presence and numbers of Foothill Yellow-legged Frogs, when extant.

In 2022, we conducted two day and night surveys and found six Foothill Yellow-legged Frogs present during all surveys combined. Sub-adult and adult Foothill Yellow-legged Frogs were noted. We also detected nine adult bullfrogs (no larvae or subadults)

sympatric with Foothill Yellow-legged Frogs. Eight of the nine bullfrogs were lethally removed from the site and stomach contents were examined. No Foothill Yellow-legged Frogs were detected in the stomach contents of frogs removed during our survey efforts.

In 2023, we returned to the same section of the creek and conducted similar surveys in a similar method throughout the same reach of the creek. We detected an increase in Foothill Yellow-legged Frogs from 2022 and a decrease in bullfrogs. In 2023, we found 1 larva, and 175 subadult and adult Foothill Yellow-legged Frogs (Figs. 1 and 2), while we found and lethally removed five adult bullfrogs (100% of those observed; no larvae or sub-adults) sympatric with Foothill Yellow-legged Frogs, all of which were lethally removed. Moreover, bullfrogs were found only on the extreme lower reach of the section of creek we surveyed.

Surveys and control efforts to detect both Foothill Yellow-legged Frogs and bullfrogs were conducted in the same portion of the same stream course, by the same individuals, during approximately the same time of year and time of day. We observed an increase in Foothill Yellow-legged Frogs from one year to the next (i.e., 6 to 175; 2,816% increase), following removal of bullfrogs from Sherlock Creek.

We found previous reports for the site, including in 1980, when a single Foothill Yellow-legged Frog was collected (MVZ 175103), and from anecdotal reports on the site from 2015, which included only a single Foothill Yellow-legged Frog and 132 bullfrogs. Additional surveys at Sherlock Creek from 1998, 2005, and 2008-2010 did not quantify numbers consistently, but did suggest persistence of the Foothill Yellow-legged Frogs in lower numbers (7-10 individuals; BLM, unpublished data).

We acknowledge that the time frame that we conducted our work was brief, and the time for recovery of the Foothill Yellow-legged Frog may not reflect long-term trends in the population. We also acknowledge that other factors could have contributed to a suppression of bullfrogs in the creek reach, including high winter water flows or factors that were not witnessed and could not be quantified.

Our experience with bullfrog control would suggest to us something similar to that we see in other locations; bullfrogs are highly susceptible to population

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Fig. 1. Foothill Yellow-legged Frog larva in Sherlock Creek observed during the second year of bullfrog control, in 2023, Sherlock Creek, Mariposa County, CA.



Fig. 2. One of 175 foothill Yellow-legged Frogs present at Sherlock Creek, Mariposa County, California, in 2023, following bullfrog control activities at the site.

control, and local populations crash with sustained control efforts (Alvarez and Wilcox, in press). Further, when the number of individuals is low or very low, removal of the majority or all of the bullfrogs appears to have a positive impact on the potential prey base that remains.

We share these data as a brief update on an ongoing task of reducing or eliminating bullfrogs in Sherlock Creek for the benefit of Foothill Yellow-legged Frogs. We believe that in a short time we are seeing the benefits of control on this stretch of creek and will continue our efforts. We recommend, if possible, a more systematic study be conducted to determine the effort required to create a rebound in potential prey base in bullfrog occupied systems. Until that work is conducted, we feel that lethal control can have a positive impact on this endangered species.

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