

Diet Comparison of Invasive American Bullfrogs (*Lithobates catesbeianus*)

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Background

The American Bullfrogs (*Lithobates catesbeianus*) is an invasive species to California and eats a variety of species including endangered vertebrates. Bullfrog populations can be found in waterways in the central valley and the foothills of the coastal mountains of northern California. However, the composition of invertebrate and vertebrate species that form their prey base may vary between these regional populations.

Of particular concern is the influence of an invasive crawfish, the swamp crawfish (*Precambarus clarkii*). Swamp crawfish are often found in the same waterways as bullfrogs in northern California. Although these invasive species are often thought to have negative impacts on native species in these environments, where they occur together they may have actually disrupt the impact on native forms.

We hoped to demonstrate that the diets of bullfrogs were different between populations found in the central valley environment and the coastal foothill environment. In addition, we hypothesized that when swamp crawfish made up a large portion of the diet of bullfrogs, this would reduce predation pressure on the native vertebrates in those cases.



Figure 1. Map of sampling localities (in red) from central valley and foothill regions of northern California

Table 1. Sampling localities in central valley and foothill sites in northern California

Sampling Site	#	Type
Robbins, CA	13	Valley
Sutter, CA	2	Valley
Yuba City, CA	8	Valley
Napa, CA	2	Foothill
Pleasanton, CA	9	Foothill
Windsor, CA	24	Foothill
Total	58	

Research Objectives

- To determine if bullfrog diets varied between populations found in the central Valley and those found in the costal foothills of northern California.
- To determine if consumption of invasive crawfish is associated with reduced consumption of vertebrate taxa

Methods

- Bullfrogs were collected from six sites, three in the Coastal range foothills and three in California Central Valley (Table 1, Figure 1)
- Frogs were collected using a pool gig at night with head lamp (Figure 2)
- Snout to vent lengths were measured for each frog
- Stomachs were removed in the lab, and preserved in jars with 70% ethanol for later use
- Stomach contents were examined under a dissecting scope to determine taxa present
- Contents sorted into categories including: bullfrog, chorus frog, bird, fish, terrestrial arthropod, aquatic insect, swamp crawfish
- Data were also converted to examine categories of total vertebrates, total invertebrates, total native species, and total non-native species
- We ran an analysis of variance to examine differences between locality types and a general linear model with site as a random variable to examine the impacts of crawfish on vertebrate consumption.



Figure 2. a) Student Nayeli Lozano collecting samples using a pool gig and b) a pool gig apparatus.

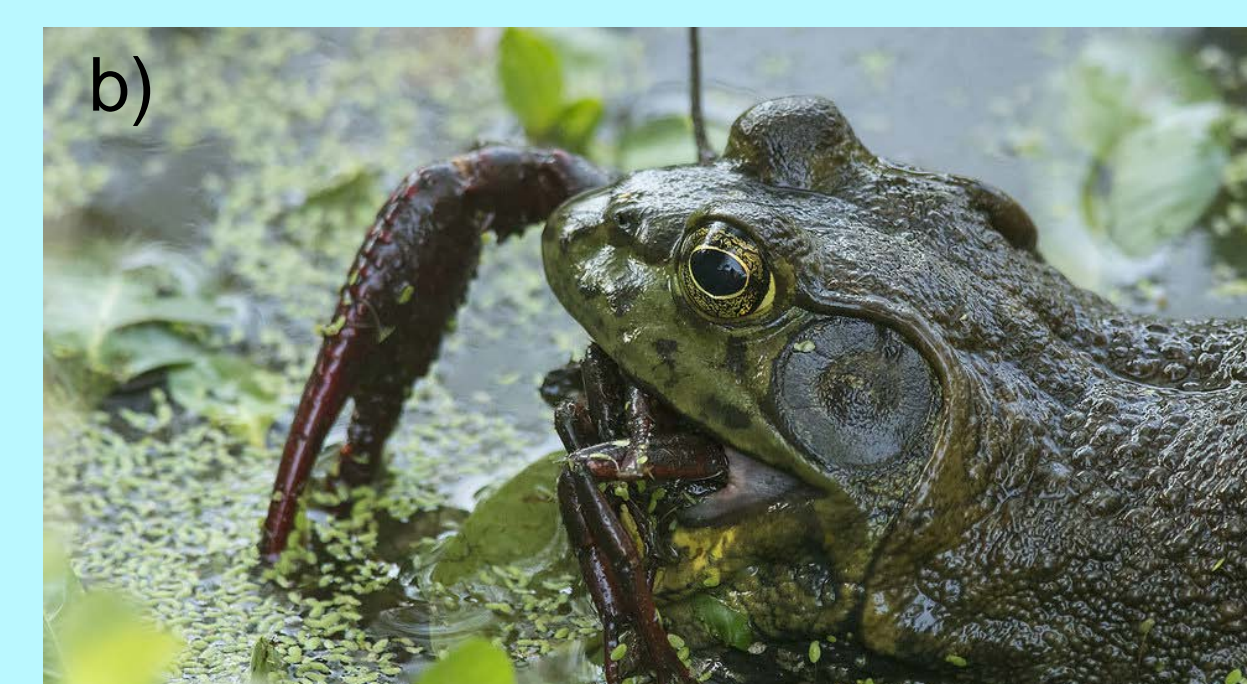
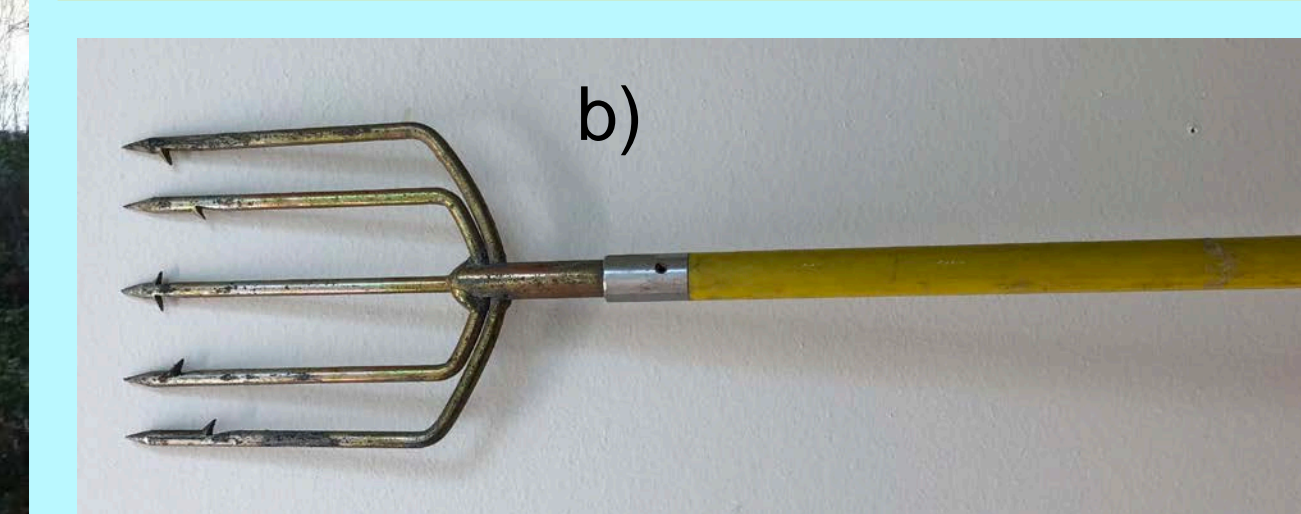


Figure 3. a) Student Nayeli Lozano sorting prey from bullfrog stomachs and b) bullfrog eating a crawfish

Results

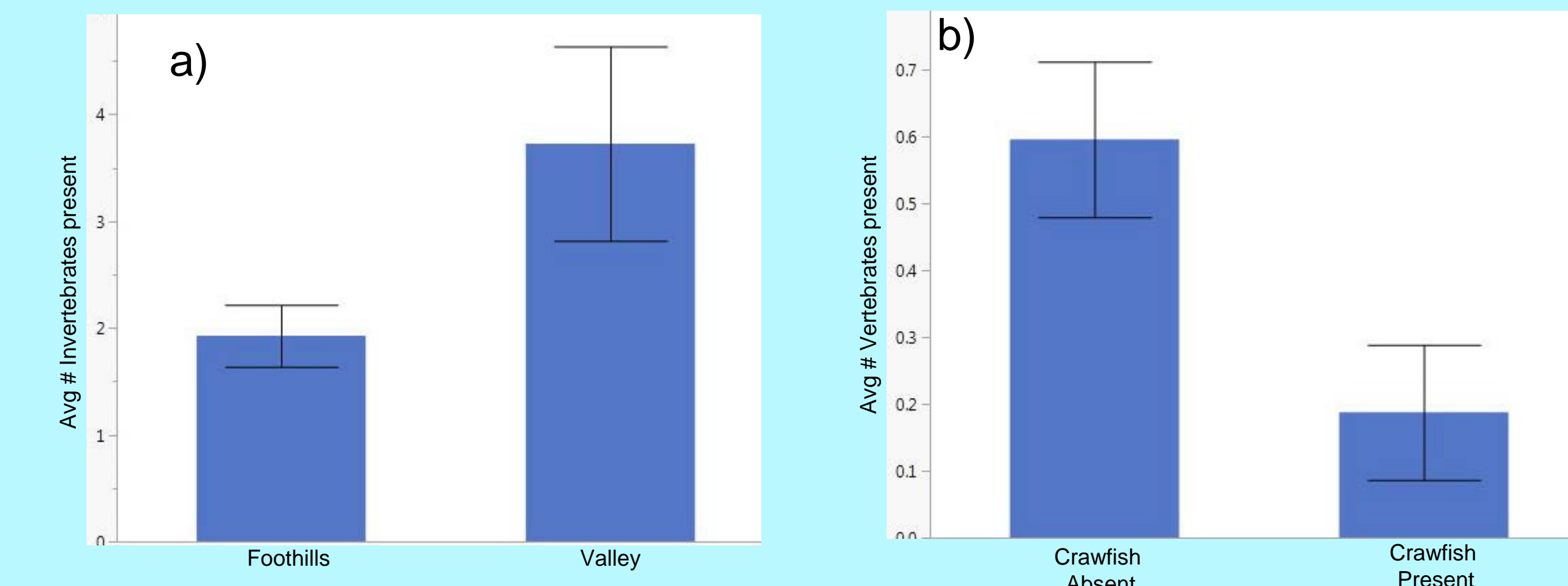


Fig 4: a) graph showing that invertebrates were found in the diet of the valley frogs significantly more than in foothill frogs ($F_{1,1}=5.4325$, $p=0.0231$) and b) graph showing that when crawfish were present in the diet, the average number of vertebrates present was significantly less than when no crawfish were present ($F_{1,1}=5.5977$, $p=0.0213$) with site set as a random effect.

Discussion

- The preliminary results suggest that bullfrogs that live in central valley populations (with similar habitats) consume a greater number of invertebrate species than those in the foothill habitats
- Habitat descriptions of sampling sites should be examined to identify whether there are specific habitat or climate characteristics that account for the general differences seen here.
- When bullfrogs are consuming invasive crawfish, they appear to be less likely to consume native vertebrate species
- Larger sample sizes should be collected to allow more detailed taxonomic analysis of diet type variation among sites with different habitats and prey communities
- Additional sampling to determine availability of crawfish relative to consumption of native species is needed

Acknowledgements

We would like to thank the Koret Foundation for support of this project. We would also like to thank Dave Cook and Sharon Kahara for their assistance in obtaining samples.