

# Prey Preference as a Function of Native versus Introduced Prey Types in Neonate Gartersnakes (Colubridae: *Thamnophis*)



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## Abstract

Two species of gartersnakes, *Thamnophis hammondi* and *T. sirtalis*, live sympatrically where several species of prey have been introduced into their geographic range. These introductions could present novel challenges (e.g., unique chemical defenses) for the snakes and may influence their predatory responses. We presented neonate snakes of both species with chemical cues on cotton swabs in a random order from the following prey types: 1. adult *Pseudacris regilla* (Pacific Treefrog; native); 2. adult *Lithobates catesbeianus* (Bullfrog; introduced); and, 3. adult *Xenopus laevis* (African Clawed Frog; introduced). We used distilled water and cologne as visual and olfactory controls, respectively. We recorded the total number of tongue-flicks and latency to attack. Following five daily consecutive presentations, all neonates were fed exclusively white cloud minnows (*Tanichthys albonubes*) for two weeks, and again presented with the chemical cues. Both snake species preferred the native Pacific Treefrog to the introduced prey types in both the naïve and biased trials, with the number of attacks on the Pacific Treefrog being greater than those on other prey types. Only *T. hammondi* showed a preference for cues from the African Clawed Frog. A stronger response to cues from African Clawed Frogs was also elicited by *T. hammondi* for naïve versus biased presentations. Our study indicates that *T. hammondi* may have developed an innate predatory response to the African Clawed Frog, and these predators may be a useful resource in eradication efforts of this invasive anuran.

## Introduction

- The innate predatory behaviors of snakes can be modified to establish a bias towards a single prey type<sup>1</sup>.
- The predatory response in adult *Thamnophis hammondi*, a dietary generalist, is similar for a variety of prey types, including both native and introduced species<sup>2</sup>.
- The recent introduction of the African Clawed Frog (*Xenopus laevis*) to the geographical range of *T. hammondi* may present a novel challenge due to the toxic secretions from the integumentary glands<sup>3</sup>.
- Adult individuals of *T. hammondi* readily consume *X. laevis* without impairment of locomotor function<sup>4,5</sup>. This behavior has been observed in only this species of *Thamnophis*.

## Purpose

Our study compared neonate predatory responses between two gartersnake species, and assessed whether or not these responses could be biased by repeated initial consumption of a single prey type.

## Methods

- We paired female *T. hammondi* with males to produce 3 clutches of neonate subjects in 2009. In the same season, we collected gravid *T. sirtalis* females from a local population and obtained 3 clutches of neonates of this species.
- Following birth and the first shed, neonate snakes of both species were presented with chemical cues on cotton swabs in a random order from the following prey types: 1. adult *Pseudacris regilla* (Pacific Treefrog; native); 2. adult *Lithobates catesbeianus* (Bullfrog; introduced); and, 3. adult *Xenopus laevis* (African Clawed Frog; introduced). Distilled water and cologne were used as visual and olfactory controls, respectively.
- We recorded the total numbers of tongue-flicks and latency to attack and used these values to calculate the tongue flick-attack score (TFAS), which has been shown to reliably predict predatory interest<sup>6</sup>. Following 5 consecutive presentations of cues, all neonates were fed exclusively white cloud minnows (*Tanichthys albonubes*) for two weeks. We then repeated the presentation of the same chemical cues. We detected differences in TFAS using an ANOVA with post-hoc tests and Bonferroni corrections. Means are reported  $\pm$  1 SE.

## Results

- Both *T. hammondi* and *T. sirtalis* preferred the native Pacific Treefrog to introduced prey types, with TFAS means of  $21.55 \pm 0.56$  ( $p < 0.0001$ ) and  $13.54 \pm 0.33$  ( $p < 0.0001$ ), respectively (Figs. 1, 2).
- The mean TFAS for African Clawed Frogs ( $5.77 \pm 0.56$ ) was also higher only in *T. hammondi* ( $p = 0.0001$ ), whereas responses to the other chemical cues did not differ (TFAS means of  $3.08 \pm 0.56$ ,  $1.33 \pm 0.89$ , and  $2.29 \pm 0.56$  for Bullfrog, cologne and water, respectively; Fig. 1).
- Responses from *T. hammondi* to chemical cues to the African Clawed Frog were higher in naïve trials ( $8.85 \pm 0.74$ ) as compared to the biased trials ( $2.69 \pm 0.85$ ;  $p < 0.0001$ , Fig. 1)
- For *T. sirtalis* only, the Pacific Treefrog elicited higher TFAS during the biased trials ( $14.84 \pm 0.58$ ) as compared to naïve trials ( $12.23 \pm 0.32$ ;  $p < 0.0041$ , Fig. 2).
- Attacks were only observed when snakes were presented with chemical cues from Pacific Treefrogs, and the number of attacks by the snakes was greater in biased trials (Fig. 3).

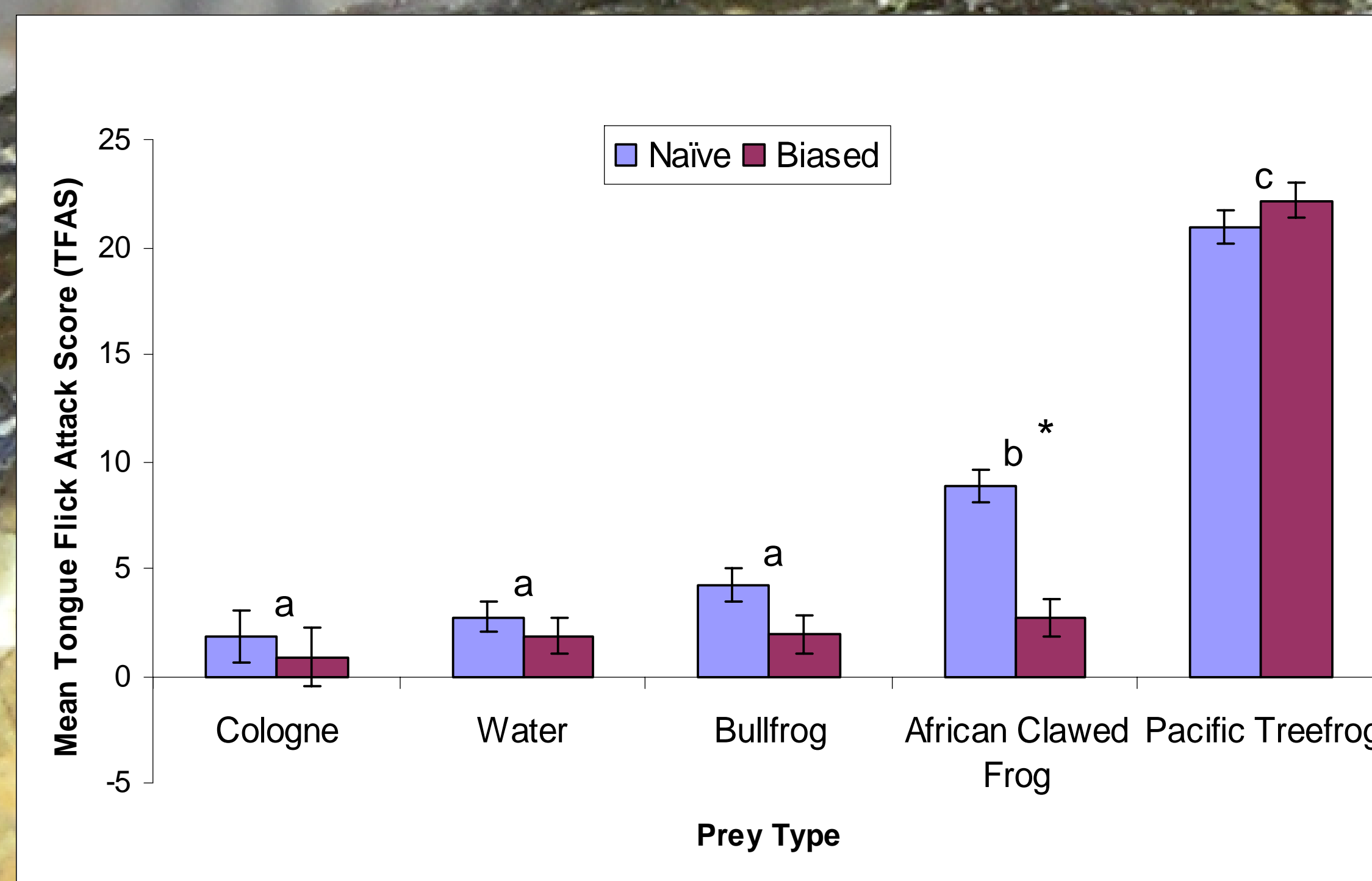


Fig. 1. Mean TFAS elicited by *T. hammondi* for all prey types in both naïve and biased trials. Subscripts of the same letter denote no significant difference between prey types and asterisks denote a significant difference between naïve and biased trials for a single prey type.

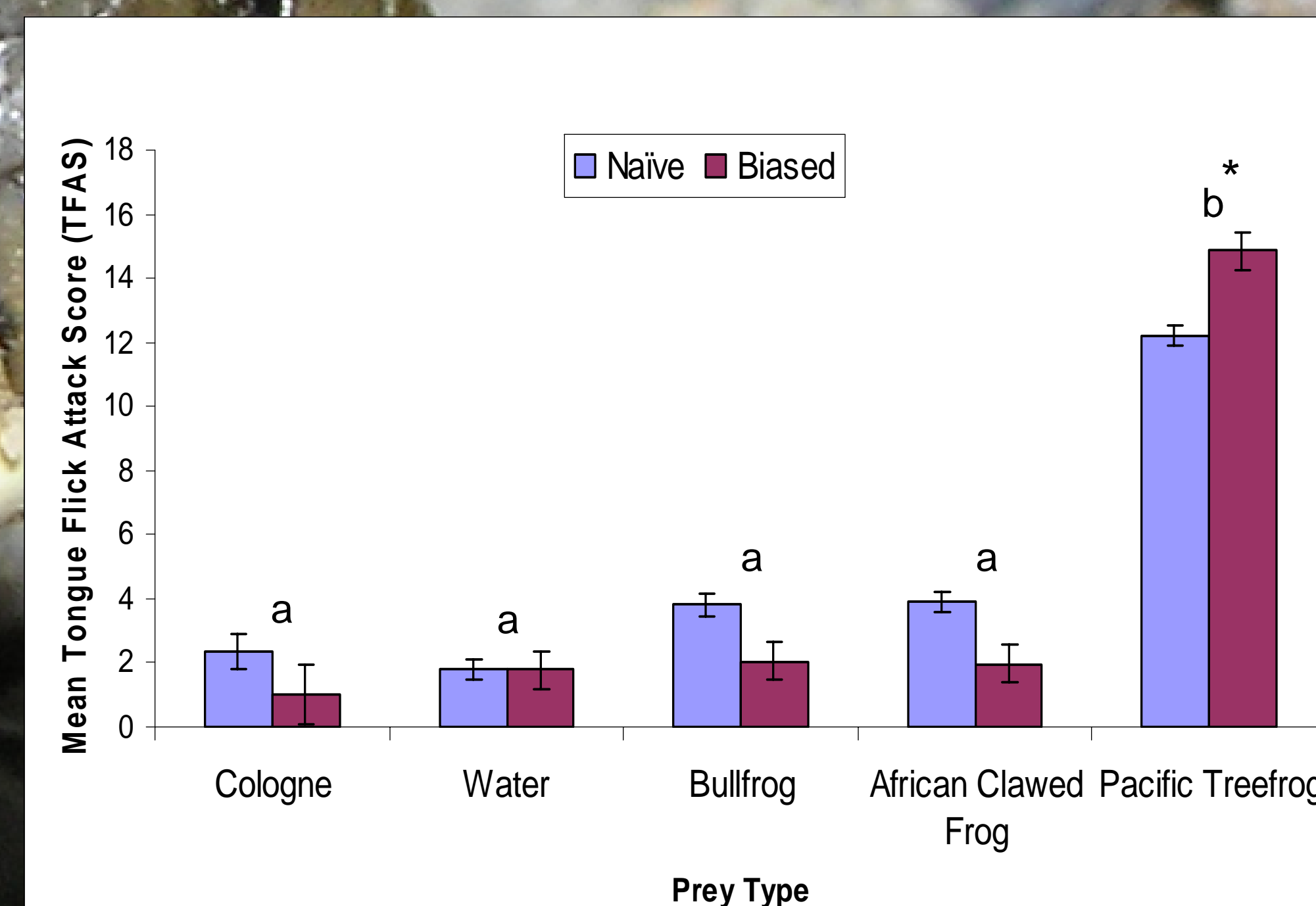


Fig. 2. Mean TFAS elicited by *T. sirtalis* for all prey types in both naïve and biased trials. Subscripts of the same letter denote no significant difference between prey types and asterisks denote a significant difference between naïve and biased trials for a single prey type.

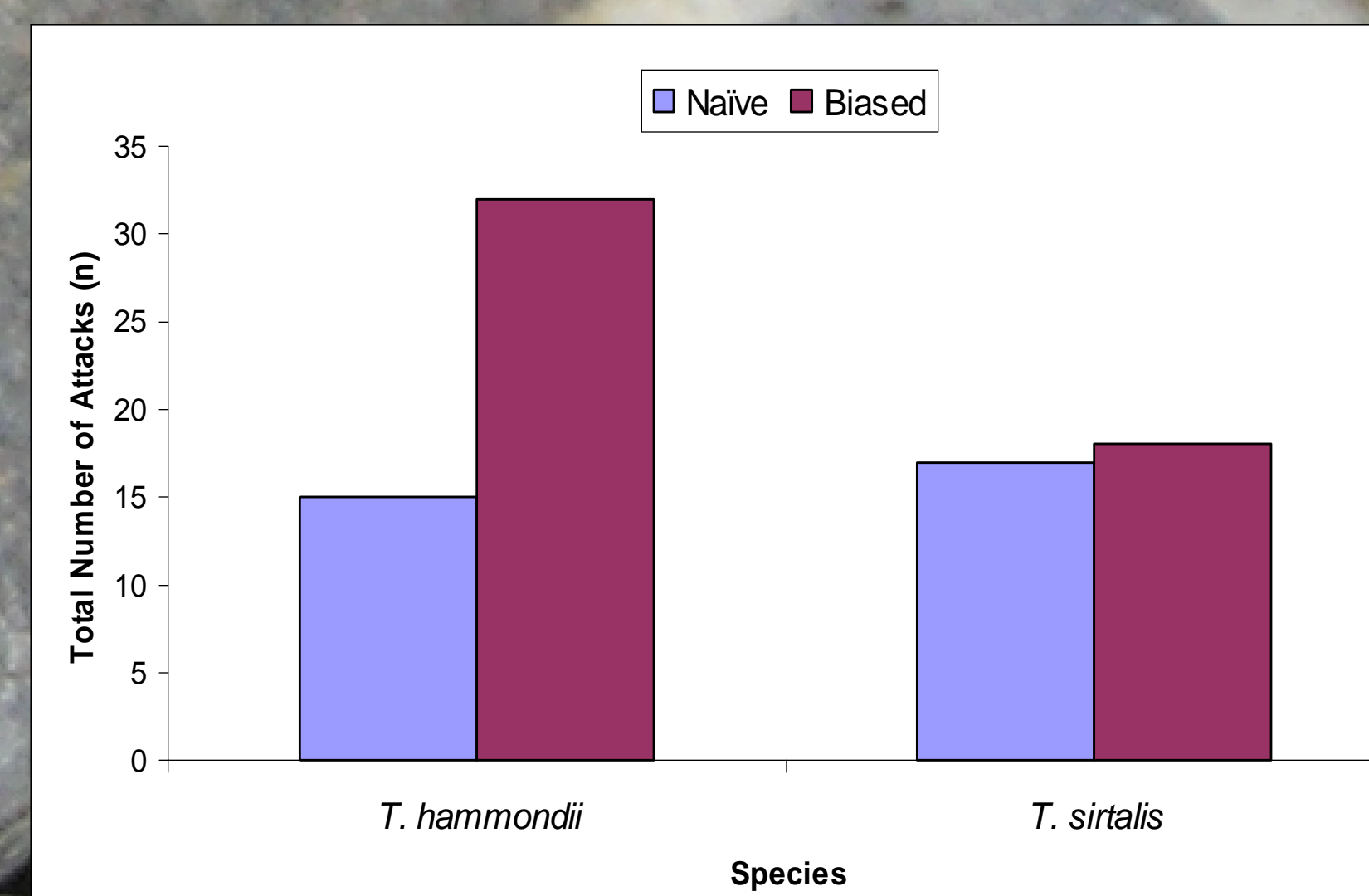


Fig 3. Total number of attacks elicited by *T. hammondi* and *T. sirtalis* for the Pacific Treefrog in naïve and biased trials.

## Discussion

- Gartersnakes responded with greatest vigor to cues from the native prey species. For *T. hammondi*, the similarity between naïve and biased trials involving cues from Pacific Treefrogs indicates an innate preference for this native prey type.
- The decreased response to cues from the African Clawed Frog in *T. hammondi* when fed fish indicates the development of a bias for this particular prey species.
- We suggest that *T. hammondi* has an innate predatory response to the African Clawed Frog (seen in the neonates), which is consistent with responses in adult snakes<sup>6</sup>.
- This response is species exclusive, as a similar pattern was not observed in *T. sirtalis*. We suggest that the diversity of prey species has increased for *T. hammondi*, a species of conservation concern.
- Given that populations of African Clawed Frogs pose unique threats to the diversity in aquatic habitats<sup>7</sup>, *T. hammondi* might serve as a useful resource in eradicating this introduced anuran.



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