



# Interactions between diet and behavior in the death-feigning snakes *Heterodon nasicus* and *H. platirhinos*

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## Abstract

Hognose snakes are well-known for their peculiar defensive behavior of death-feigning. However, the full significance of this behavior is far from clear. Many of these snakes' predators are carrion eaters, and the rapid onset of death-feigning suggests that it is involuntary. Furthermore, several authors have suggested an interaction with the bufotoxin-rich diets of these toad specialists. Paratoid gland secretions of Bufonid toads include many of the same endogenous stress hormones produced by the endocrine system, so a complex but as-yet unelucidated interaction between diet and behavior may be partially responsible for the origin of the death-feint. Finally, in order to be maintained over evolutionary time, death-feigning must confer at least a slight survival advantage.



*Heterodon nasicus* defensive behaviors: a) hood-spreading, b) burrowing, c) death-feigning

## Introduction

- Habituation in captivity causing loss of the death-feigning behavior has made it difficult to study the circumstances under which hognose snakes death-feign (1,2).
- Human presence has been used as a proxy for predator threat in other studies of snake behavior (11).
- Numerous anecdotal observations have suggested that *H. nasicus* death-feigns less readily than *H. platirhinos*, but no study of this contrast has been performed (9).
- Additionally, *H. nasicus* feeds on a wide variety of prey types, including amphibians, small mammals, lizards, and eggs of birds and chelonians, while *H. platirhinos* is an amphibian specialist with a strong preference for toads, which are toxic to most snakes (5). The diets of both species are still poorly known (9).
- Diets of snakes, which feed infrequently, are difficult to determine via stomach content and fecal analyses (10).



Sand prairie habitat in Carroll County, Illinois

- Stable isotope analysis of carbon and nitrogen is a technique for determining animal diets at small spatial scales (6,10). Lab validation experiments must be performed to ascertain expected isotopic shifts between predator and prey (8).

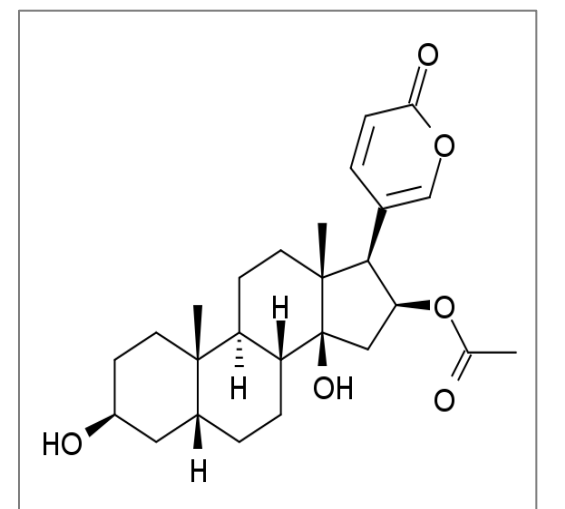
## Proposed Methodology

- Develop and apply an ethogram of defensive behaviors of hognose snakes.
- Collect tissue samples from hognose snakes and their prey at 3 sites in Illinois and analyze via mass spectrometry for C12:C13 and N14:N15 ratios.

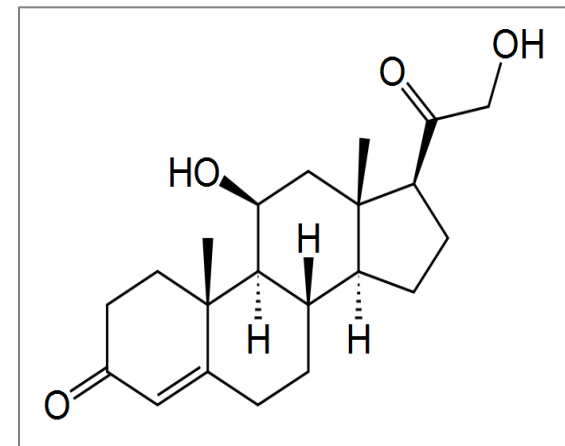
## Top-down - Predators



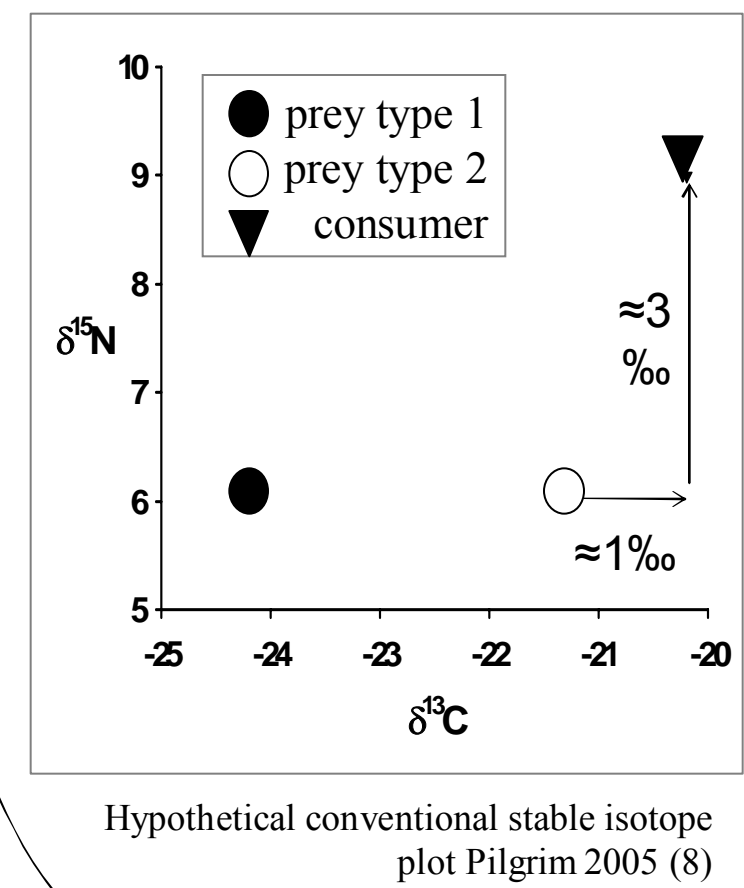
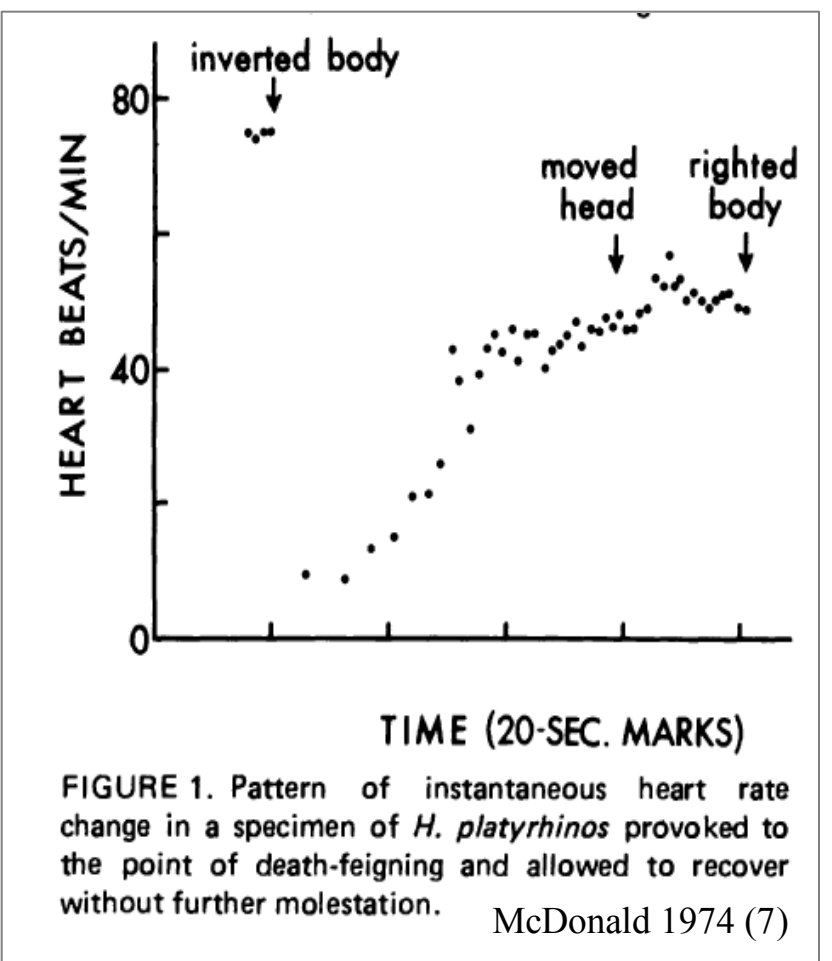
**ETHOGRAM**  
(A) Invert  
i. Part of body  
ii. Full body  
(B) Mouth open  
(C) Tongue extended  
i. Stationary  
ii. Moving  
(D) Hood spread  
(E) Voiding cloaca



A bufodienolide toxin



An endogenous steroid hormone

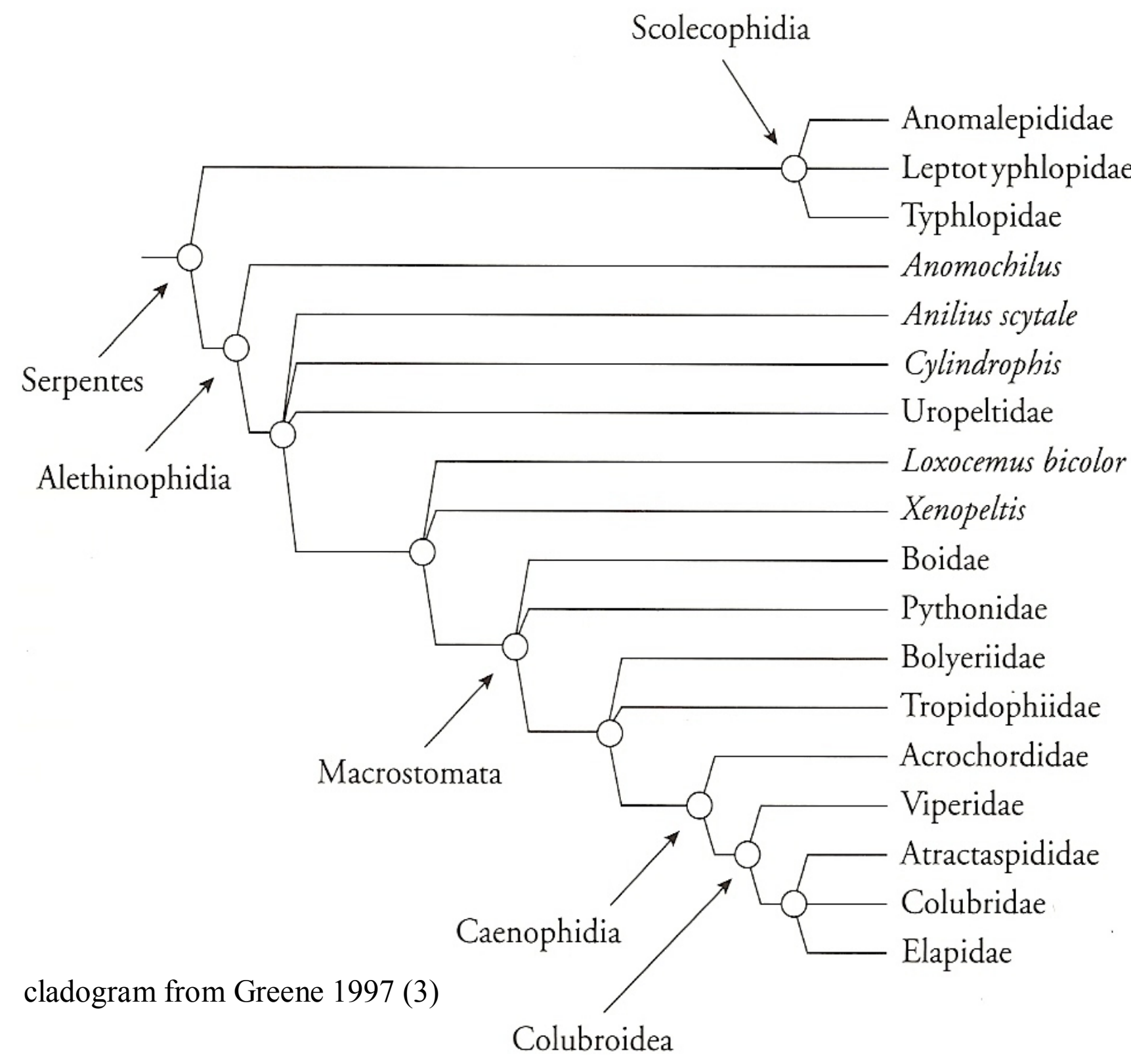


## Bottom-up - Prey

## Further Evidence

Several other snake species in the families Elapidae, Viperidae, Natricidae and Xenodontidae exhibit both bufophagy and death-feigning but are unrelated to *Heterodon* (4). One species, *Rhabdophis tigrinus*, is known to sequester bufotoxins for defensive secretion from nuchal glands, and to transfer such sequestered toxins from mother to offspring (3).

Many of these species also possess enlarged adrenal glands (7), known to play a role in detoxification and regulation of stress hormones. In *Heterodon*, these are sexually dimorphic and present at birth (12,13), as is the death-feigning behavior (1).



*Naja haje* death-feigning



*Rhabdophis tigrinus* with *Bufo* prey item



*Causus rhombeatus*, a bufophagous viper



*H. platirhinos* eating *Acris crepitans*  
opistoglyphous dentition visible



*Xenodon rhabdocephalus*



*Hemachatus haemachatus*

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