



A Comparative Dietary Analysis of Two New Jersey Pine Barrens Snake Species

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Eastern kingsnakes (*Lampropeltis getula getula*) and northern pinesnakes (*Pituophis melanoleucus melanoleucus*) are large, predatory snake species that inhabit the New Jersey Pine Barrens. An important component of a predator's niche and its community relationships is diet composition. However no prior studies have been conducted to compare the diets of these two snake species. To gain a better understanding of the diets and ecological niches of both species, scat and stomach samples from twenty-nine eastern kingsnakes and twenty-nine northern pinesnakes were examined and the prey identified. The prey identified in the *L. g. getula* samples consisted of nine snakes, seventeen mammals, one bird, one bird egg, and one squamate egg. Prey of *P. m. melanoleucus* consisted of twenty-three mammals, eight birds, six bird eggs, and no snakes or other reptiles. Both *L. g. getula* and *P. m. melanoleucus* consumed prey types in unequal proportions. Shannon's diversity indices indicated that the species had similar diet breadths and evenness (*L. g. getula*: $H' = 2.085$, $J' = 0.870$; *P. m. melanoleucus*: $H' = 1.946$, $J' = 0.936$). The Morista Index of niche overlap indicated the diets were dissimilar in prey content ($C = 0.20$). The prey species consumed by both snakes differed markedly, *Lampropeltis g. getula* consumed several snake species and a few small rodents, while *P. m. melanoleucus* consumed primarily small rodents, rabbits, and birds. Differences in diet may function to minimize interspecific competition between these two coexisting snake species.



INTRODUCTION

- Both eastern kingsnakes (*Lampropeltis getula getula*) and northern pinesnakes (*Pituophis melanoleucus melanoleucus*) are large snake species of special concern status that reach the northern end of their native range in the New Jersey Pine Barrens (Burger and Zappalorti 2011 and Wund et al. 2007)
- A comparative dietary analysis has not been conducted on eastern kingsnakes and northern pinesnakes
- Analyzing species' diet is essential to understanding species ecology and for making effective conservation efforts to protect both snake species and their environment
- Main Objectives:
 - To determine whether *L. g. getula* and *P. m. melanoleucus* consume their prey categories in equal proportions
 - To analyze diet breath (concerning diet) of the two species and determine the diet overlap between them

MATERIALS & METHODS

- Twenty-nine (29) scat and stomach samples were collected from wild eastern kingsnakes and 28 scat samples were collected from wild northern pinesnakes in the New Jersey Pine Barrens from 1989-2020
- Samples were examined microscopically for various identifiable remains such as scales, teeth, jaws, hair, claws, feathers, and eggs
 - Remains were compared to study skins and sample skulls
 - Scales were compared to a snake-shed key and to fluid-preserved specimens in lab
- Chi-squared goodness of fit tests were performed to determine if there was a preference for prey types. Categories included mammals, birds, snakes, bird eggs, and reptile eggs
- A Chi-squared test for association was used to compared the diets of the two species
- Shannon-diversity index was used to determine diet breadth. A t-test was conducted between the two species indices to determine whether diets breaths were significantly different.
- Simplified Morista Index of niche overlap was used to determine diet overlap

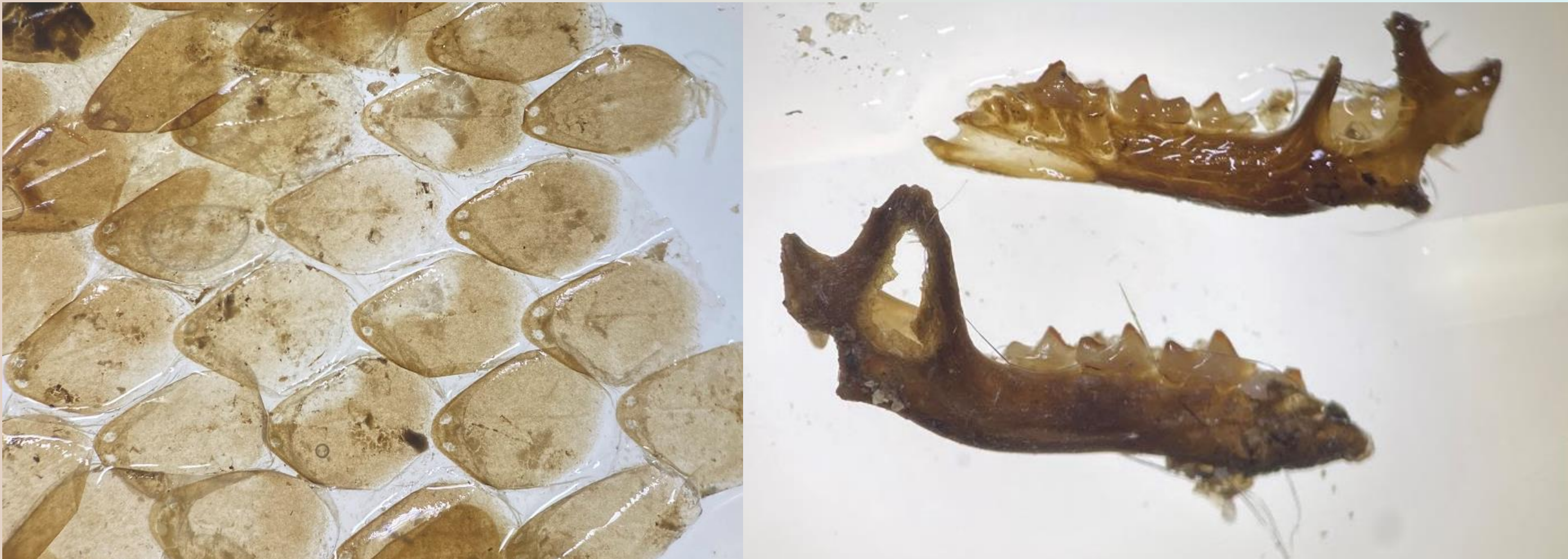


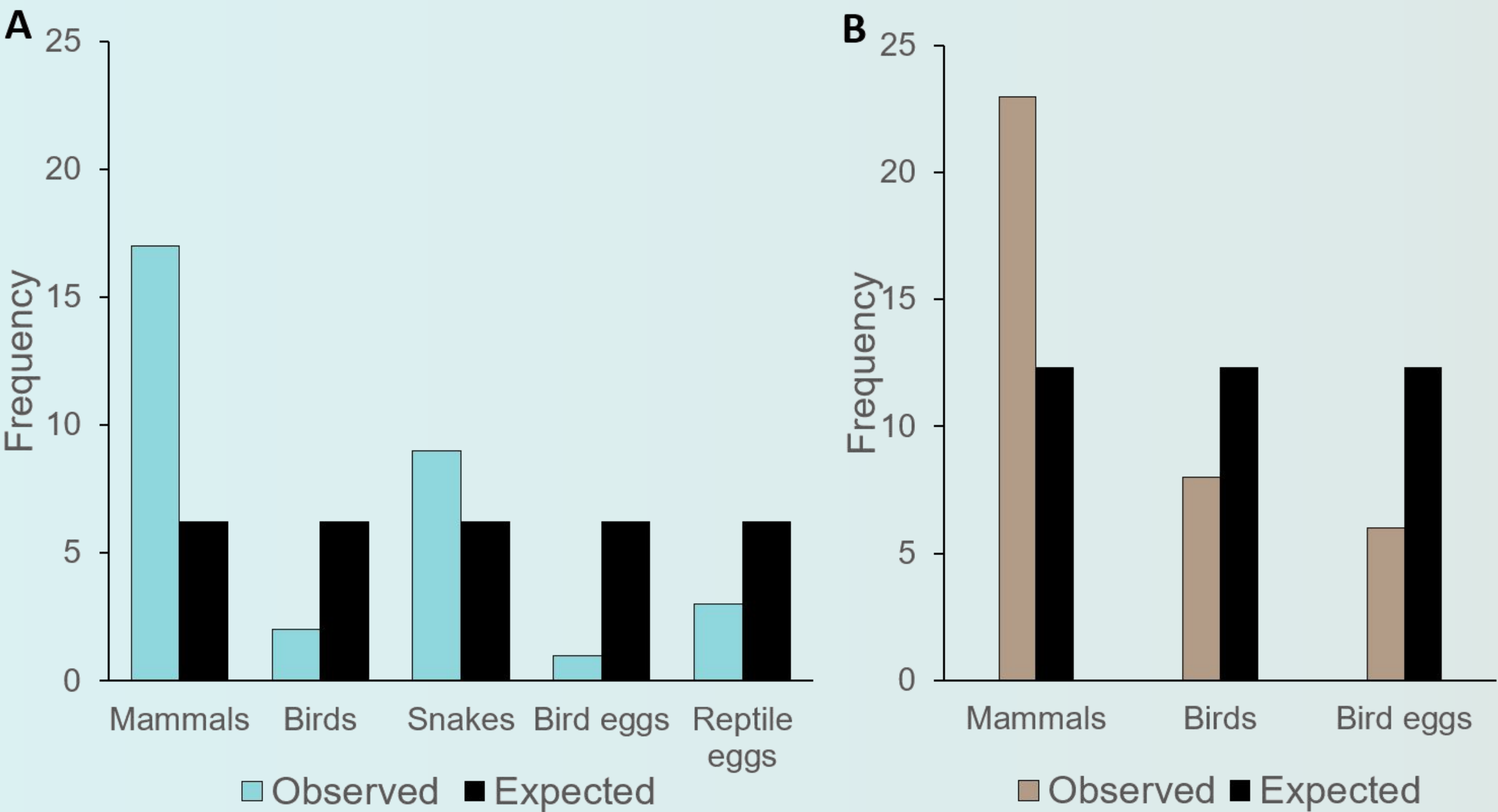
Figure 1. (Left): Remains of a corn snake, *Pantherophis guttatus* in an eastern kingsnake scat sample next to (right) the skeletal remains of a masked shrew, *Sorex cinereus* in a pinesnake sample. Both are under a dissecting microscope.

RESULTS

Table 1. Prey in the *Lampropeltis g. getula* and *Pituophis m. melanoleucus* scat samples.

Prey Species	Eastern Kingsnake		Northern Pinesnake	
	Number	%	Number	%
Snakes	9	29.0	0	0.0
<i>Pantherophis guttatus</i> (red cornsnake)	2	6.5		
<i>Coluber c. constrictor</i> (northern black racer)	1	3.2		
<i>Thamnophis sp.</i> (garter/ribbbon snake)	1	3.2		
<i>Storeria occipitomaculata</i> (redbelly snake)	2	6.4		
<i>Diadophis punctatus</i> (ringneck snake)	1	3.2		
<i>Carphophis a. amoenus</i> (worm snake)	2	6.5		
Eggs	4	12.9	6	16.2
Reptile (unknown species)	3	9.7		
Bird (unknown species)	1	3.2	6	16.2
Birds	1	3.2	8	21.6
Mammals	17	54.8	23	62.2
Microtine rodents	5	16.1	5	13.5
<i>Sorex cinereus</i> (masked shrew)	9	29.0	1	2.7
<i>Condylura cristata</i> (star-nosed mole)			2	5.4
<i>Peromyscus leucopus</i> (white-footed mouse)			6	16.2
<i>Sylvilagus floridanus</i> (cottontail rabbit)			6	16.2
Undetermined	3	9.7	3	8.1

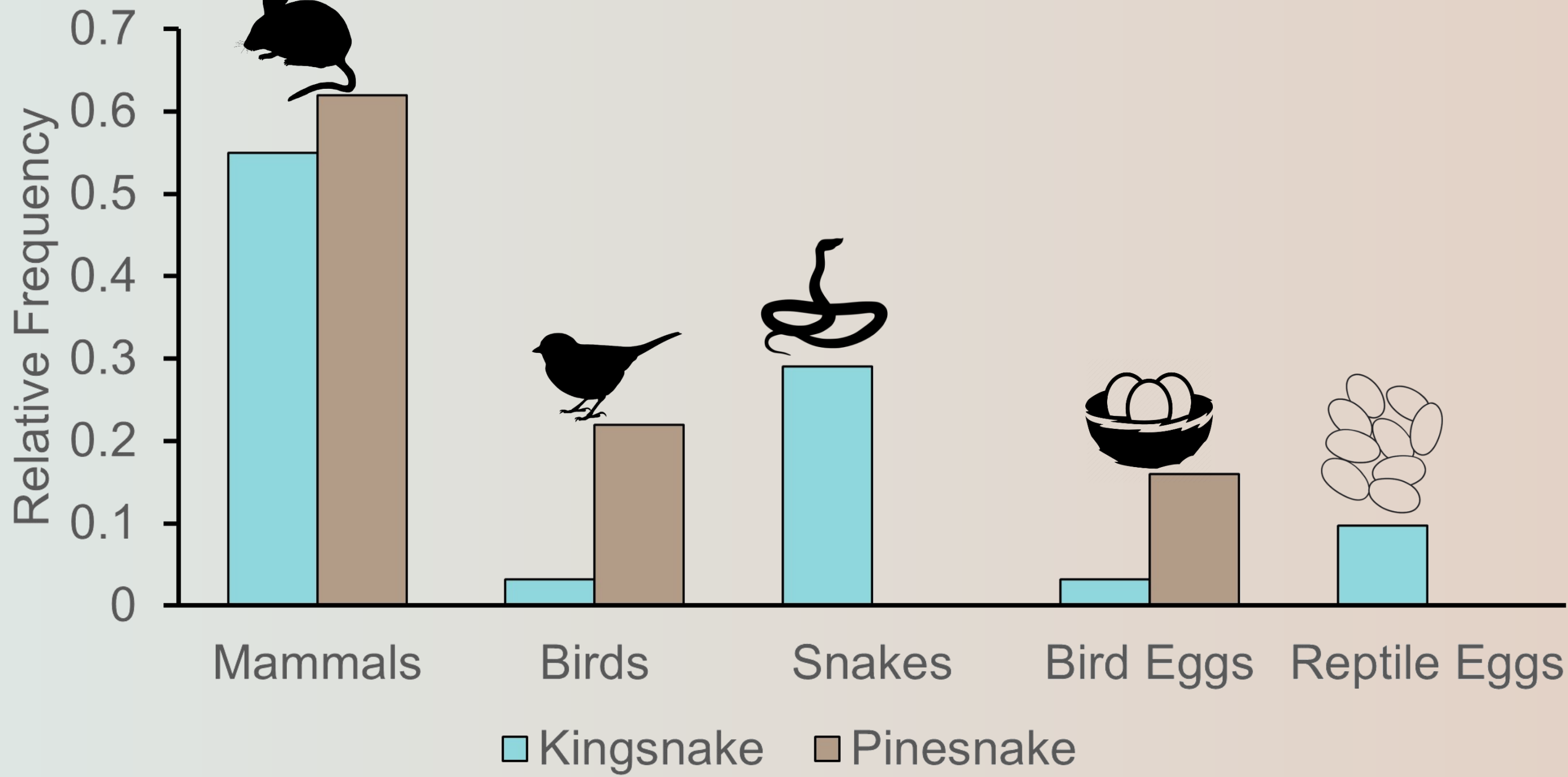
Figure 2. The observed diet of eastern kingsnakes (A) and northern pinesnakes (B) compared to the expected condition of no prey category preference.



- L. g. getula* did not consume prey groups in equal proportions ($X^2_4 = 30.45$, $P < 0.001$)
- P. m. melanoleucus* did not consume prey groups in equal proportions ($X^2_2 = 14.00$, $P < 0.001$)
- Both snake species displayed an increased frequency of mammal consumption compared to other prey types

RESULTS

Figure 3. The observed diet composition of both snakes.



- Kingsnakes and pinesnakes had different diet compositions when prey groups were collapsed *to meet assumptions of the chi-squared association test ($X^2_2 = 30.45$, $P < 0.001$)
- Kingsnakes frequently ate snakes and reptile eggs while pine snakes ate birds and bird eggs

Table 2. Shannon diversity and Simplified Morista Index.

	Diet Breadth and Overlap	
	Diversity (H')	Evenness (J')
Kingsnake	2.085	0.870
Pinesnake	1.946	0.936
Morista (overlap)	0.200	

- There was similar diet breath in both species despite different prey groups being consumed ($t_{43} = 0.855$, $P = 0.3973$)
- Simplified Morista Index was 0.200, indicating low overlap among prey types

DISCUSSION

- The species display an unequal consumption of prey categories with high evenness among the specific species consumed. This could reflect prey preference of the snakes or the actual prey availability in their specific habitats
- Future research could be determining prey availability in the habitats the snakes occupy to determine whether the snakes are opportunistically feeding or preferentially selecting prey
- The limited overlap between the two species diets indicate they do not likely compete with one another for food resources

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