Morphological differences between three common Dominican snake species

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Abstract

The island of Dominica is home to a wide array of herptofauna including four snake species. Of these, only *Boa nebulosa, Liophis juliae juliae,* and *Alsophis antillensis* were included in the study. We captured, measured, and photographed a total of 16 snakes in order to compare morphological differences between the species. Our results indicate that there are indeed significant morphological differences between the three species, specifically in regards to *A. antillensis,* which possesses a proportionally smaller and narrower head than either *L. juliae juliae* or *B. nebulosa.* Additionally, a great deal of intraspecies variation in coloring and patterning exists, specifically among *A.antillensis* and *L. juliae juliae.*

Introduction

Dominica is commonly referred to as the "Nature Island of the Caribbean" because of the extremely high biodiversity found on the island. More specifically, the island is home to an impressive array of herptofauna including three species of frogs, ten species of lizards, and four species of snakes. The smallest of the four snake species is the Burrowing Thread Snake or Worm Snake *(Typhlops dominicana*), which rarely reaches more than a foot in length and can most often be found burrowing beneath leaf litter and topsoil. *T. dominicana* inhabits primarily coastal dry forest and scrub and is a Dominican endemic (Evans and James 1997). The largest snake species found on the island is the Clouded Boa (*Boa nebulosa),* which can reach lengths of over ten feet. Boas are largely nocturnal as well as arboreal, making encounters with them rare on the island except when they are seen crossing roads (Evans and James 1997). *B. nebulosa* was also recently identified as a Dominican endemic. Two species from the family Colubridae are also present on the island. The smaller of the two is the Julia's Ground Snake (*Liophis julae*

juliae) locally referred to as "Kouwês jenga" which reaches an average adult size of roughly two feet. *Liophis* exhibits a black and white or black and yellow checkered pattern; although at higher elevations they may appear almost entirely black (James 2004). *Liophis* is found primarily at higher elevations where wetter conditions prevail. As its name would suggest, *L. juliae juliae* is primarily a terrestrial species. By far the most common snake species on the island is the Lesser Antillean Racer (*Alsophis antillensis)* which is a slender snake capable of reaching lengths over three feet. Locally known as kouwès nwé, this racer is colored black (although a brown morph exists) with white or yellow bands running diagonally across the length of the back at intervals (Quick 2001). *Alsophis* is far more common in drier areas of the island such as the western coast, specifically Cabrits National Park. *A. antillensis* is also a largely terrestrial species. Our goal was to survey the morphological differences between *B. nebulosa, L. juliae juliae, and A. antillensis* over a period of three weeks at various locations throughout the island.

Materials and Methods

Upon capturing a specimen we first recorded the specific location as well as habitat type. Next, we measured snout to vent length (SVL) in centimeters using a flexible tape measure in order to contour to the curves of the snake's body. Next, head length was measured from the base of the skull to the tip of the snout in centimeters using a dial caliper. Head width at the widest point was also measured in centimeters using the caliper. Next, a series of photographs was taken to document variations in pattern and coloration. We captured images from three different angles for each specimen: overall, close up of pattern, and underbelly. Any unique features (i.e. injuries) were also photographed. Notes were taken on any unique aspects of the snake or the capture location. Lastly, we took the log of the SVL, head length, and head width

data to minimize the effect of body size and used Principle Component Analysis to examine patterns of morphological differences between species.

Results

We captured a total of 16 snakes over a period of 12 days. Specimens were captured from eight different locations and three distinct habitats. Figure 1 lists the specimens we collected, in order of date/time found, and summarizes the data which we collected from each individual.

Date/Time	Species	Location	Habitat	SVL	Head Length	Head Width	Notes
5/21/2013 3:06pm	Boa	Springfield West	Secondary forest	130	5.2	3	Missing tip of tail
5/24/2013 1:06pm	Alsophis	Cabrits, Douglas Bay Battery	Dry forest	60	1.9	0.9	Missing tip of tail
5/24/2013 2:22pm	Alsophis	Cabrits, Entrance	Dry forest	62	2.1	1.1	Under rock
5/24/2013 3:00pm	Alsophis	Cabrits	Dry forest	48	2	1.1	On trail
5/25/2013 9:12am	Liophis	Springfield West	Secondary forest	37.8	1.4	0.8	On trail
5/28/2013 11:30am	Liophis	Springfield West	Secondary forest	32	1.5	0.7	Under rock pile
5/30/2013 10:27am	Alsophis	Cabrits, Fort Entrance	Dry forest	54	1.85	1	N/A
5/30/2013 10:30am	Alsophis	Cabrits, East Trail	Dry forest	64	2.54	1.35	Completely patterned
5/30/2013 10:30am	Alsophis	Cabrits, East Trail	Dry forest	53.5	1.9	1.15	Missing tip of tail
5/30/2013 10:35am	Alsophis	Cabrits, East Trail	Dry forest	55.8	1.94	1.05	Missing tip of tail
5/30/2013 11:03am	Alsophis	Commandant's Quarters, Cabrits	Dry forest	54.4	2.05	1.17	Brown color morph
5/30/2013 11:55am	Liophis	Commandant's Quarters, Cabrits	Dry forest	27	1.35	0.71	Juvenile
5/30/2013 12:35pm	Alsophis	Commandant's Quarters, Cabrits	Dry forest	58.5	1.9	1.13	N/A
5/30/2013 2:10pm	Alsophis	Cabrits, Entrance	Dry Forest/Coastal	51	1.68	1	Old wound approx. mid-body
5/30/2013 4:05pm	Boa	Batalie Beach	Dry Forest/Coastal	134	5.1	3.75	Approx. 20' up in tamarind tree
6/2/2013 11:30am	Boa	Castle Bruce	Littoral Forest	191	7.45	6.2	Found in road

Figure 1: Visual representation of all data collected in the field.

Discussion

Morphology

Figure 2 explains that 98.229% of the morphological variance between the three species can be explained simply by overall body size. Additionally, a further 1.389% of the variation can be explained by shape, accounting for over 99% of total variation.

As seen in Figure 3, principle component one is positive of the same order of magnitude, showing that size is the main factor affecting morphological differences between the three species. Principle component two shows a strong shape difference between the three species.

Figure 4 compares the morphologies of the three snake species we observed. The *x*-axis represents overall size, while the *y*-axis has head size weighted heavily on the negative side of the axis and SVL on the positive side**.** These results allow us to compare morphology regardless of size and/or coloration. *B. nebulosa* exhibited a large head in relation to SVL, as did *L. juliae juliae.* On the other hand, *A. antillensis* possesses a rather small and especially narrow head in comparison to SVL. These results are somewhat surprising considering that both *A. antillensis* and *L. juliae juliae* are both members of the family Colubridae. Consequently, one would expect them to exhibit similar morphologies when in fact *L. juliae juliae* possesses a head/SVL ratio more similar to that of *B. nebulosa.* However, it should be noted that regardless of morphologies *A. antillensis* and *L. juliae juliae* appear quite similar to the naked eye (i.e. body size, coloration, etc…)

Coloration/Patterning

While there is obviously a great deal of interspecies variation in coloring/patterning, *A. antillensis* and *L. juliae juliae* in particular exhibit a large amount of intraspecies variation. As shown in Figure 5, *L. juliae juliae* found at higher elevations exhibit an almost entirely black appearance, while those found at lower elevations display a black and white/yellow checkered pattern.

Similarly, the horizontal patterning on *A. antillensis* varies greatly from snake to snake, possibly fading with age (Daniells et al 2008). As illustrated in Figure 6, some individuals displayed only anterior patterning which faded gradually towards the tail, while others displayed patterning along the entire length of the body. Additionally, a specimen exhibiting a brown coloration was found.

The boas captured displayed very little change in coloration/pattern, disregarding one specimen who was preparing to shed and subsequently appeared very dark and without pattern.

Conclusions

As expected, a large portion (~98%) of the morphological differences between *B. nebulosa, A. antillensis,* and *L. juliae juliae* can be explained simply by overall size. However, much of the remaining variation is due to intriguing differences in head size/SVL ratio. Surprisingly, the two species from the family Colubridae (*A. antillensis* and *L. juliae juliae*) differ substantially in morphology. While *A. antillensis* possesses a very small and narrow head in proportion to SVL, *L. juliae juliae* exhibits a comparatively broad head more similar to that of

B. nebulosa. Furthermore, marked differences in intraspecies coloration occur, specifically among *A. antillensis* and *L. juliae juliae*.

While 16 specimens were adequate to run the type of analysis which we performed, it is likely that the collection of more snakes would result in even more significant results. Specifically, it would be interesting to include *T. dominicana* in the study in order to perform a complete survey of all snake species present on the island.

Total Variance Explained

	Component	Initial Eigenvalues[a]			Extraction Sums of Squared Loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Raw	1	.874	98.229	98.229	.874	98.229	98.229
	2	.012	1.389	99.618	.012	1.389	99.618
	3	.003	.382	100.000			
Rescaled	1	.874	98.229	98.229	2.945	98.152	98.152
	2	.012	1.389	99.618	.043	1.440	99.592
	3	.003	.382	100.000			

Extraction Method: Principal Component Analysis.

a. When analyzing a covariance matrix, the initial eigenvalues are the same across the raw and rescaled solution.

Figure 2

Component Score Coefficient Matrix[a]

	Component	
	1	2
lnSVL	.296	3.828
lnHL	.283	-.906
lnHW	.430	-2.881

Extraction Method: Principal Component Analysis.

Component Scores.

a. Coefficients are standardized.

Figure 3

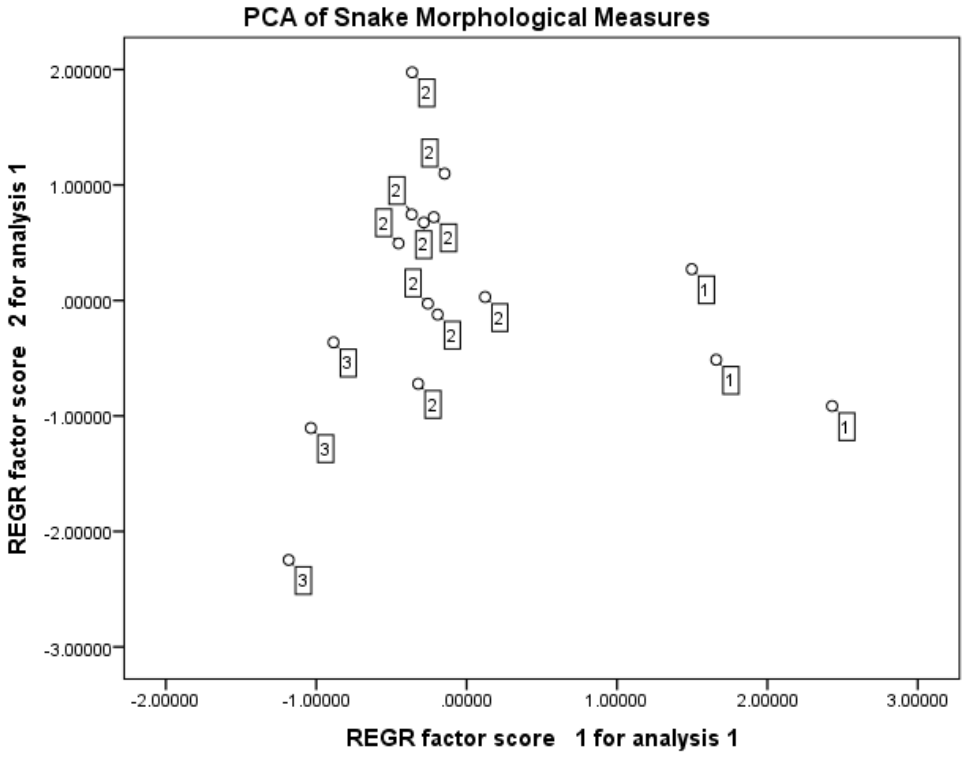

Figure 4: *B. nebulosa* (2), *A. antillensis* (2), *L. juliae juliae* (3)

Figure 5: Comparison of *Liophis* pattern found in low elevation dry forest (left), and high elevation secondary rainforest (right.)

Figure 6: Variations of *Alsophis* pattern and coloration. Common partially patterned variant (left), fully patterned variant (middle), brown variant (right.)

Works Cited

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