Sexual Dimorphism in Anolis Oculatus

Kaitlyn N. Forks

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Department of Wildlife and Fisheries Science
Texas A&M University

Abstract

The purpose of this study was to examine morphological differences in male and female *Anolis oculatus*. 10 male and 10 female Anoles were caught, measured, marked and released in various locations on the island of Dominica in the Lesser Antilles of the West Indies. Anoles captured were sexed and compared on a basis of eight variables: sex, skull length, skull width, snout to vent, tail length, hind limb, dewlap length, and dewlap width. After utilizing principal component analysis software, the following general trends were found, males are on average larger, have wider dewlaps, and slightly longer skulls. Females have longer tails and larger hind legs.

Introduction

The island of Dominica is home to one endemic species of anole, the *Anolis oculatus*. Many *Anolis sp.*, including *A. cristatellus*, the invasive species on the island, and those across seas like the *A. carolinensis*, express morphological differences between sexes. The most visually apparent sex related characteristic is the male's exaggerated dewlap. It is a common misconception that only the males bear this colorful extension of cartilage and skin. Both sexes actually exhibit dewlaps. In addition to being useful for attracting mates, male *Anolis sp.* are known to extend their dewlaps and bob their heads in order to establish territories. Patterns in sexually related morphology can be useful in the study of mating and dominance behavior among *Anolis spp.*

Materials and Methods

All specimens were caught by hand. Anoles were typically found in the buttresses of large *Ficus sp.* and on trunks of various fruit bearing trees including cacao and mango. Most specimens were captured on the Massacre Trail (Big Fig) or in the surrounding areas, Mt. Joy and the Archbold Tropical Research and Education Center. Two specimens were recorded at Batalie Beach. Once captured, eight morphological measurements were taken using a digital caliper.

Snout to vent was measured from the tip of the snout to the anal scale. Tail length was measured from the anal scale to the end of the tail. If the tail was damaged, it was recorded in the notes. Hind limb measurements were measured on

the right hind leg from the base of the thigh to the knee. The dewlap was measured lengthwise from where the beard was connected to the throat on either side. Width of the dewlap was taken by pulling the dewlap outward to its maximum extent and measuring from the base of the throat at the greatest width present. Skull length was measured from the tip of the snout to behind the skull plate, which is indicated by scales. Skull width was measured laterally, in line with the characteristic spot on top of the *A. oculatus'* head.

Specimens captured at locations that were visited more than once were marked with a sharpie. A small black X was placed under their right forelimb on the ventral side to discourage data bias. All specimens were sexed based on the evaluation of two primary characteristics. Sexually mature males exhibit large black spots on their backs and two distinct post anal scales, which are not present in females. The presence of a post anal bulge indicating a hemipenis and an exaggerated dewlap were used as confirmation test if the specimen was evaluated as a male. The lack thereof was used as confirmation of a female specimen. After data was collected, all eight variables were compared using Principle Component Analysis.

Results

Table 1. Morphological Measurements of All Specimens

M/F and Specimen #	Skull Length	Skull Width	Snout Vent	Tail Length	Hind Leg	Dewlap Length	Dewlap Width	Location	Notes
F 2	18.72	7.81	50.02	92.6	13.14	9.54	1.97	Mt. Joy	
F 4	12.54	3.44	40.98	80.45	7.14	8.32	1.44	Big Fig	
F 6	15.83	7.75	52.72	88.32	11.53	9.3	1.52	Batalie	
F 10	17.72	9.36	50.4	91.47	13.54	10.5	3.12	Big Fig	
F 11	14.03	8.27	46	83.2	11	10.88	2.43	Big Fig	
F 13	16.4	7.86	48.18	52.61	11.79	11.1	2.2	Big Fig	
F 14	25.72	12.17	75.11	128.23	20.65	31.1	12.48	Big Fig	Outlier
F 15	18.54	9.69	51.8	97.58	15.1	15.8	4.4	Big Fig	
F 16	7.5	9.61	52.53	103.82	13.7	15.9	3.57	Big Fig	
F 19	16.97	9.63	49.47	97.68	14.53	14.5	4.25	Big Fig	
M 1	21.85	12.3	60.89	107.8	12.14	23.89	11.36	Station	
M 3	9.93	5.14	30.33	54.91	5.8	9.89	6.73	Station	
M 5	24.11	13.66	77.54	112.06	11.53	23	19.67	Batalie	Damaged tail
M 7	17.09	10.91	59	108.14	16.1	22.47	13.68	Station	
M 8	19.24	9.61	52.73	102.53	13.01	19.52	7.21	Station	
M 9	15.6	8	41.09	72.63	10.1	10.1	1.72	Big Fig	
M 12	14.31	8.38	43.8	83.2	11.57	14.71	0.73	Big Fig	
M 17	21.31	10.35	58.48	114.63	14.74	20.9	20.95	Big Fig	
M 18	17.19	9.35	43.21	92.43	12.53	13.6	11.15	Big Fig	Small red parasite
M 20	18.73	8.78	46.7	94.47	12.66	15.98	13.26	Big Fig	

Table 2. Total Variance Explained by the Seven Extracted Factors in Principle Component Analysis

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.213	74.477	74.477	5.213	74.477	74.477
2	.680	9.707	84.184	.680	9.707	84.184
3	.398	5.692	89.875	.398	5.692	89.875
4	.257	3.674	93.550			
5	.205	2.925	96.475			
6	.148	2.119	98.594			
7	.098	1.406	100.000			

Extraction Method: Principal Component Analysis.

Table 3. Weights of Principal Component Analysis

Component Matrix[a]

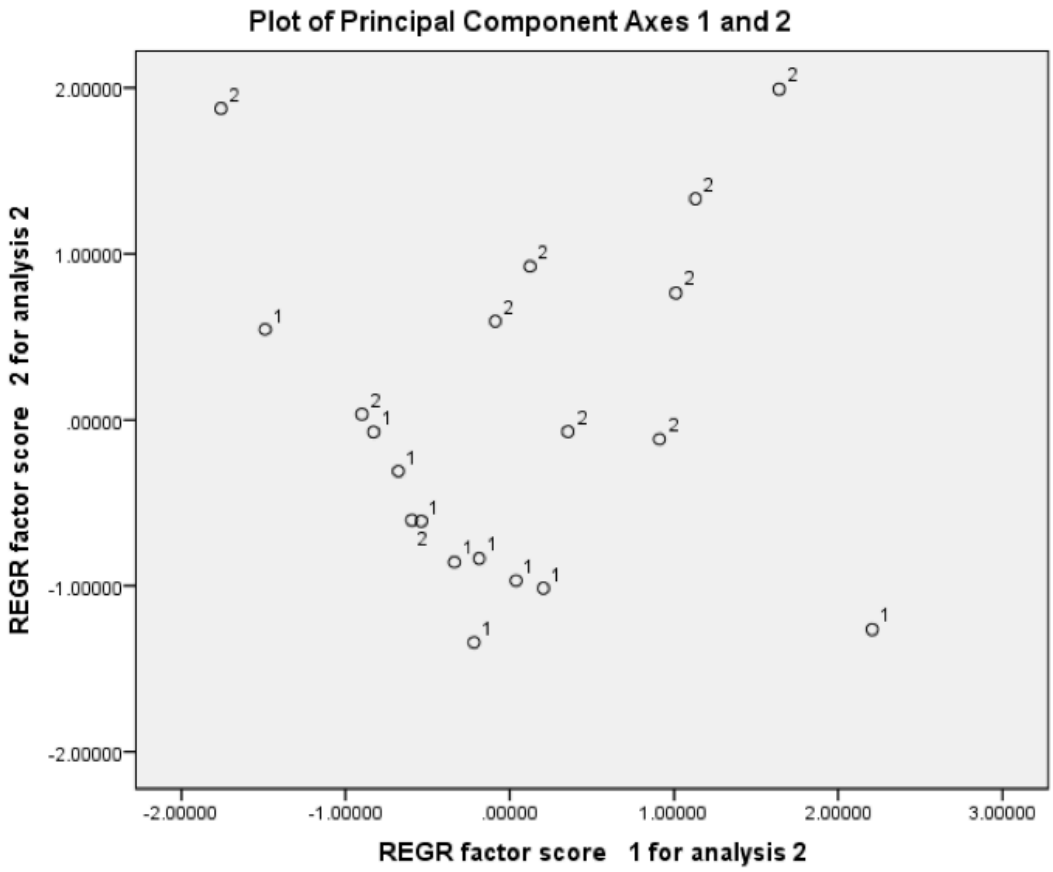
	Component		
	1	2	3
Skull Length	.826	.131	.515
Skull Width	.914	-.021	.013
Snout Vent	.922	-.044	.110
Tail Length	.894	-.152	-.240
Hind Leg	.790	-.531	-.037
Dewlap Length	.924	.067	-.172
Dewlap Width	.753	.592	-.180

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

Table 2 shows that Components 1 and 2 have 84% total variance, meaning that they capture most of the variance in the data. Table 3 shows the weights of each variable in relation to the first 3 principal components.

Figure 1. Principal Component Plot



In Figure 1 male specimens were given the label of 2, while female specimens were given the label of 1. The plot comparison in Figure 1 illustrates the general trends of each sex.

Figure 2. Male and Female Dewlap Comparison

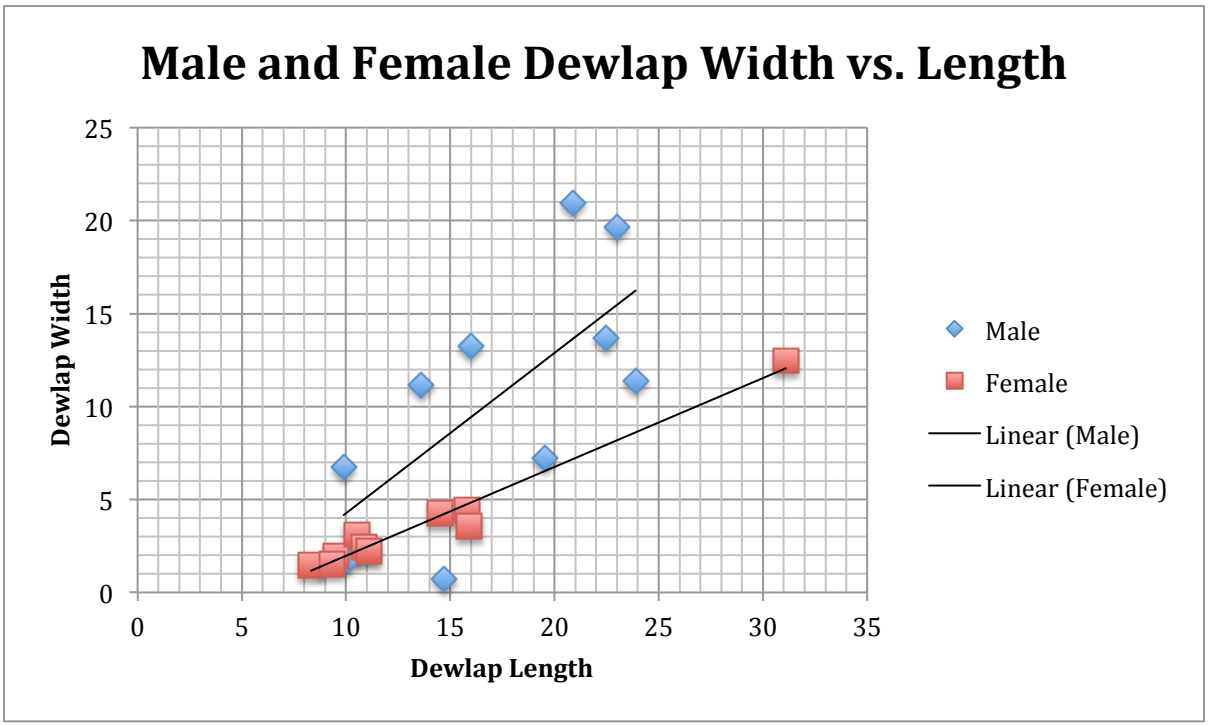


Figure 2 illustrates the direct relationship between dewlap length and dewlap width. Males and females are portrayed as separate trend lines for comparative purposes.

Discussion

Size was the first principal component and each variable shows positive correlation, indicating that *Anolis sp.* exhibit no irregular allometry. As size of specimen increases, so do the various parts.

Dewlap width was the second most significant component and the most easily visualized expression of sexual dimorphism. Males have much wider dewlaps in relation to length (Fig. 2). The exaggerated dewlap is theoretically related to the attraction of mates and defense of territory.

From the data we can derive a few less pronounced morphological differences. Males have slightly longer skulls. This could be because males participate in territorial and dominance behaviors, while females have no need for these aggressive morphological features. Females also displayed larger hind limbs and longer tails. This is potentially related to the females' biological duty to lay eggs. The time limitations and the existence of some outliers, which may skew the data, mean that these less significant trends may be the result of a small sample size.

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