Sexual Dimorphism in *Monophyllus plethodon*

Travis Pruitt

Dominica Summer Study Abroad 2012

Texas A&M University

Dr. Thomas Lacher

Dr. Jim Woolley

Abstract

Twenty *Monophyllus plethodon* were caught and their weight, forearm length, hind foot length, and ear length were recorded. These measurements were then analyzed in a statistical program. The purpose of my study was to show whether or not the bat species *M. plethodon* exhibited sexual dimorphism. After analysis of the data, I have concluded that slight sexual dimorphism is exhibited in the species.

Introduction

Sexual dimorphism, or the differences in morphology within a species between males and females, is exhibited in many different species (Encyclopædia Britannica, 2012). These differences can be extreme such as the differences in many bird species (Encyclopædia Britannica, 2012). The males usually have brighter more colorful feathers than the females who have a more dull appearance. Some species can exhibit very subtle differences. One gender can be just slightly smaller on average than the other. The purpose of this study was to expand on Devra Hunter's work in 2001 by focusing on whether or not only one certain species of bats, *Monophyllus plethodon*, exhibited sexual dimorphism.

Monophyllus plethodon, or the Lesser Antillean Long-tongued Bat, is a nectivorus bat that is found mainly in the Lesser Antillean islands. It is in the family Phylostomidae or the New World Leaf-nosed Bats. This family of bats occupies a wide range of foraging niches from feeding on insects and small vertebrates to feeding on nectar and fruits. Vampire bats are also included in this family so blood feeding is yet another niche this family occupies. The nectarous bats can be distinguished from the other bats in the family just by the morphological traits that had developed for nectar feeding. These traits include an elongated snout and tongue. The canine teeth of nectarous bats are the only teeth that are large and strong while all the other teeth are small, rootless, and rounded making them unsuitable for chewing. The lower incisors are absent while the upper incisors are pushed to the sides. This makes an opening for which the tongue can be extended for feeding. The tongue itself is also designed for nectar feeding. In addition to its length, it is densely covered with large filiform papillae. These papillae form a sponge-like layer on the tongue, which sucks up the nectar by capillary action. The nectar is then squeezed out by pressing the tongue against the palate. (Neuweiler, 2000)

Materials and Methods

To catch *M. plethodon*, I used a mist net that were 6 meters in length. To set up one net we put bamboo poles in 6-inch holes and then tied to two stakes in the ground for stability. These bamboo poles held up the bat net. We set up one net around 6:00 in the afternoon on June 4 some distance away from the Stinking Hole on the Middleham Falls Trail in Morne Trois Pitons National Park. We opened the net around 6:30 and then waited for the bats to come out. As soon as the bats flew into the net we got them out and placed them in a sock with a clothespin to close it. Once twenty bats were caught, we took down the net. From there we measured the weight of the bats, their right forearms, right ears, and right hind foot. These measurements were organized in a spreadsheet and put into a SPSS statistical program in which T-tests and a Principal Components Analysis were conducted.

Results

Of the twenty bats that were caught, eight were male and twelve were female. All eight of the males were weighed however one of the males escaped before I could measure his forearm, hind foot, and ear. The measurements I collected can be seen below in Table 1.

Table 1: Bat Measurements

Bat #	Date	Species	Age	Sex	Sex Code	Sock Weight	Bat/Sock Weight	Bat Weight	Forearm	Hind Foot	Ear
1	4-Jun	*Monophyllus plethodon*	Adult	Male	1	35	48	13	-	-	-
2	4-Jun	*Monophyllus plethodon*	Adult	Male	1	16	29	13	41	7	9
3	4-Jun	*Monophyllus plethodon*	Adult	Male	1	24	38	14	40	9	11
5	4-Jun	*Monophyllus plethodon*	Adult	Male	1	23	40	17	42	7	9
7	4-Jun	*Monophyllus plethodon*	Adult	Male	1	38	51	13	41	8	11
9	4-Jun	*Monophyllus plethodon*	Adult	Male	1	28	42	14	41	9	12
12	4-Jun	*Monophyllus plethodon*	Adult	Male	1	34	50	16	42	9	11
18	4-Jun	*Monophyllus plethodon*	Adult	Male	1	35	49	14	42	8	10
4	4-Jun	*Monophyllus plethodon*	Adult	Female	2	32	47	15	41	9	9
6	4-Jun	*Monophyllus plethodon*	Adult	Female	2	53	67	14	41	8	10
8	4-Jun	*Monophyllus plethodon*	Adult	Female	2	20	35	15	41	8	11
10	4-Jun	*Monophyllus plethodon*	Adult	Female	2	-	-	14	42	9	11
11	4-Jun	*Monophyllus plethodon*	Adult	Female	2	21	36	15	42	8	10
13	4-Jun	*Monophyllus plethodon*	Adult	Female	2	31	46	15	44	9	9
14	4-Jun	*Monophyllus plethodon*	Adult	Female	2	28	42	14	42	9	11
15	4-Jun	*Monophyllus plethodon*	Adult	Female	2	30	43	13	41	10	11
16	4-Jun	*Monophyllus plethodon*	Adult	Female	2	38	53	15	41	9	11
17	4-Jun	*Monophyllus plethodon*	Adult	Female	2	24	39	15	42	9	10
19	4-Jun	*Monophyllus plethodon*	Adult	Female	2	32	47	15	41	9	9
20	4-Jun	*Monophyllus plethodon*	Adult	Female	2	37	51	14	41	10	11

The mean weight for the males was 14.25 g ± 1.5 g (Table 2). The mean weight for females was 14.5 g ± .7 g. For the forearm averages, the males had an average of 41.29 mm ±.8 mm while the females had an average of 41.58 mm ± .9 mm. The males had an average hind foot length of 8.14 mm ±.9 mm. The females' average hind foot length was 8.92 mm ± .7 mm. The mean ear length for the males was 10.43 mm ± 1.1 mm, and for the females was 10.25 mm ± .9 mm.

Table 2: Comparison of Mean Values between Males(1) and Females(2).

	SexC	N	Mean	Std. Deviation	Std. Error Mean
Weight	1	8	14.25	1.488	.526
	2	12	14.50	.674	.195
Forearm	1	7	41.29	.756	.286
	2	12	41.58	.900	.260
HF	1	7	8.14	.900	.340
	2	12	8.92	.669	.193
Ear	1	7	10.43	1.134	.429
	2	12	10.25	.866	.250

After running the T-tests, I found that, for weight, the t value was .513. It had 18 degrees of freedom and a p-value of .614. The forearm shows a t-value of .734, 17 degrees of freedom, and a p-value of .473. The hind foot showed a t-value of 2.146, 17 degrees of freedom, and a p-value of .047. The last characteristic, the ear, showed a t value of .387, 17 degrees of freedom, and a p-value of .703. The t-test for equal variances was used in all cases. These values can be seen in Table 3 below. Only hind foot length differed significantly, being larger in the females.

Table 3

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig (2-tailed)	Mean Differenc	Std. Error Differenc	95% Confidence Lower	Upper
Weight	Equal Variances Assumed	4.029	0.06	-0.513	18	0.614	-0.25	0.487	-1.273	0.773
	Equal Variances Not Assumed			-0.446	8.94	0.666	-0.25	0.561	-1.52	1.02
Forearm	Equal Variances Assumed	0.084	0.775	-0.734	17	0.473	-0.298	0.405	-1.153	0.557
	Equal Variances Not Assumed			-0.771	14.589	0.453	-0.298	0.386	-1.123	0.528
Hind Foot	Equal Variances Assumed	1.652	0.216	-2.146	17	0.047	-0.774	0.361	-1.535	-0.013
	Equal Variances Not Assumed			-1.979	9.926	0.076	-0.774	0.391	-1.646	0.098
Ear	Equal Variances Assumed	0.88	0.361	0.387	17	0.703	0.179	0.461	-0.794	1.151
	Equal Variances Not Assumed			0.36	10.138	0.726	0.179	0.496	-0.925	1.282

After the t-tests, I ran my data through a principal components analysis. This analysis explained the amount of variance of each component for all the bats. The results can be seen in Table 4 below. The first two components explain 72.5 percent of the variability in morphology among all bats.

Table 4

	Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Raw	1	1.626	48.771	48.771	1.626	48.771	48.771
	2	0.79	23.702	72.473			
	3	0.551	16.523	88.997			
	4	0.367	11.003	100			
Rescaled	1	1.626	48.771	48.771	1.853	46.332	46.332
	2	0.79	23.702	72.473			
	3	0.551	16.523	88.997			
	4	0.367	11.003	100			

Once I got those principal component values, I extracted the data and put them in a components matrix, which can be seen below. This table shows the weight of all four variables on each of the principal components.

Component Matrix[a]

	Raw		Rescaled	
	Component		Component	
	1	2	1	2
Weight	.798	.481	.782	.472
Forearm	.512	.292	.608	.347
HF	-.421	.558	-.507	.672
Ear	-.741	.402	-.784	.425

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Finally, I plotted each bats score on the first factor, which explained 48.8 percent of the total variance, against its sex code. This can be seen in Figure 1 below. I also plotted each bats' first two factors against each other. This graph can be seen below in Figure 2.

Figure 1

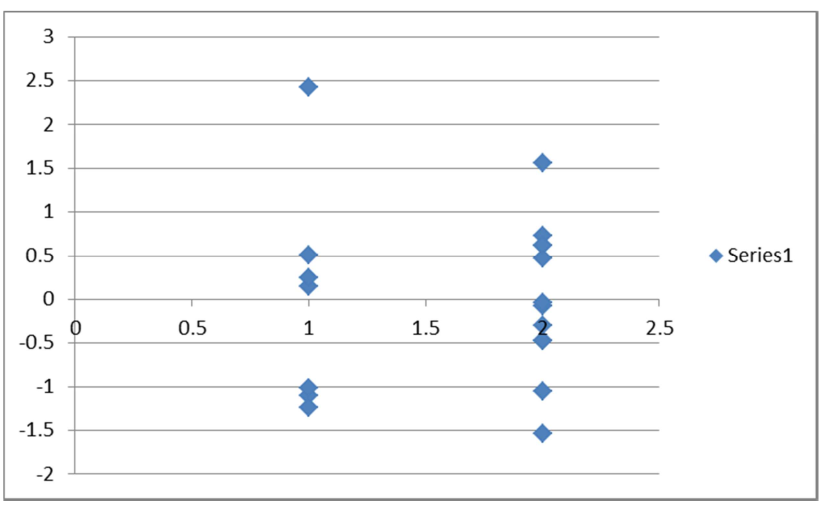
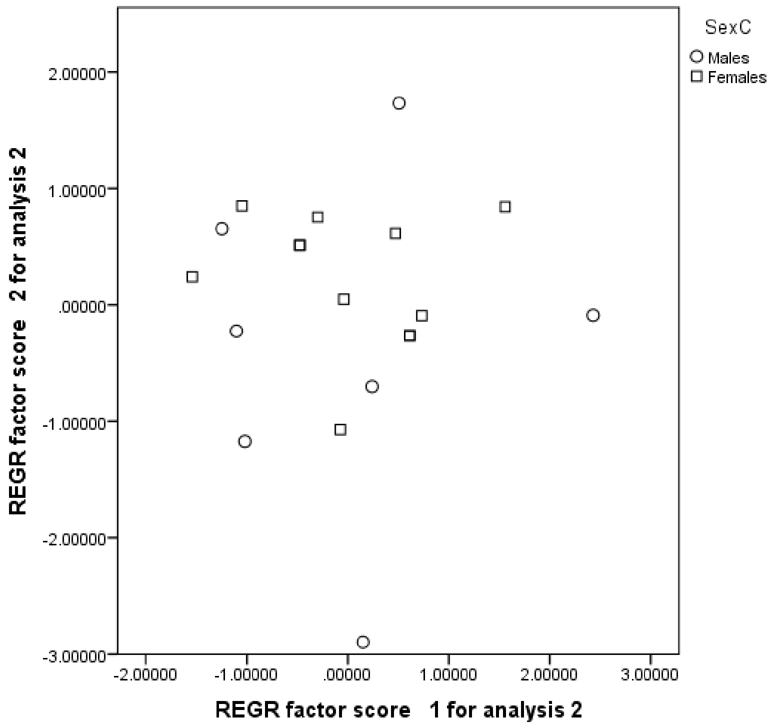


Figure 2



<u>Discussion</u>

At first glance at the measurements I had taken, no sexual dimorphism seemed to be apparent. However, after running the data through the two statistical tests, I have concluded that there is slight sexual dimorphism exhibited in *Monophyllus plethodon*. The first evidence of the sexual dimorphism can be seen in Table 3. The hind foot's t-value is much higher than the other characteristics. This suggests that males on average will have a smaller hind foot. No other characteristic seemed dimorphic until the characteristics were analyzed together in the principle component analysis test. The first component, which was weight, had a 48.771% of variance suggesting that it is also a dimorphic trait since it was not 25% of the variance between all the bats. In the components matrix table, we see that the variance was not just due to size because component 1 had both positive and negative values. We can also see this in both Figure 1 and Figure 2. In Figure 1, we can see that males tend to have smaller values while the females have bigger values. Also in Figure 2, the males were more densely plotted in the negative values of the x-axis. This was the result of the smaller hind feet of the males. The females were clustered more around the positive side of zero on the x-axis because they were slightly heavier than males.

My analysis of the data has revealed that females tend to be bigger in weight, forearm, and hind foot. The males are usually smaller except in the ears where they tend to be bigger than the females. These dimorphic trends can be explained by the biology of the bat. Females have to carry the fetuses, and so must have a larger size. To support this larger size, the females must also have larger wings thus larger forearms. In addition, it can be inferred that because of their larger size, they need larger hind feet to support themselves while resting upside down. There does not seem to be any obvious reason for the males to have larger ears, though this difference is not significant. Further research would be required to explore this farther.

While *Monophyllus plethodon* exhibits sexual dimorphism, the degree to which it is exhibited is very small. It was only after putting the data in a statistical program that it became apparent. This can be partially explained by aerodynamics. There cannot be drastic changes in the overall form of a bat or else it will not be aerodynamic and will not be able to fly very well. This fact has kept any changes in the form of the bat to a very small almost negligible.

Acknowledgements

I would like to take the time to thank everyone who helped me collect and analyze my data. Thank you to DJ, Kathy, Andrea, Catherine, and Juliet for helping collect bats and holding them for measurements. I would also like to give a special thanks to Dr. Lacher for helping set up the nets and for attempting to help me get a sense of my statistical data.

Works Cited

"sexual dimorphism". *Encyclopædia Britannica. Encyclopædia Britannica Online.* Encyclopædia Britannica Inc., 2012. Web. 10 Jun. 2012 <http://www.britannica.com/EBchecked/topic/537133/sexual-dimorphism>.

Neuweiler, Gerhard. *Biology of Bats.* New York: Oxford University Press, Inc, 2000. Print