Flight speeds of *Artibeus jamaicensis* and *Monophyllus plethodon*

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Abstract

*Flight speeds were found for the Jamaican fruit bat (*Artibeus jamaicensis*) and Long-tounged bat (*Monophyllus plethodon*) during the 2008 Texas A&M University Study Abroad Program to Dominica. Bats were captured at the Checkhall River and from Tou Santi cave. An approximately 2.25 x 1.35 x 19 meter flight tunnel was constructed from the concrete frame of a burnt down dormitory. The mean speeds were analyzed based on sex and species, and compared to the forearm length. It was found that* A. jamaicensis *have a mean flight speed of 15.41 km/h and* M. plethodon *fly at an average speed of 13.02 km/h. Only in* M. plethodon *was there a notable difference between the sexes (males had longer forearms).*

Introduction

Although about 20% of the world's mammals are bats, there is still much to learn about these unique creatures. While most research completed concerns their behaviors, habitats, and morphology, much is still unknown about their flight speeds. Though there have been more investigations as of late (e.g., Akins *et al.*, 2007; Hopkins *et al.*, 2003; Sanchez-Hernandez *et al.,* 2006), many species have yet to be studied. Hopkins *et al.* (2003) and Akins *et al.* (2007) analyzed Neotropical bats, and Sanchez-Hernandez *et al.* (2006) looked at vampire bats. Our research looks at two species of Dominican bats, *Artibeus jamaicensis* and *Monophyllus plethodon*.

Materials and Methods

On 25 May 2008, we set up two mist nets (one long, one short) near the Bee House due the proximity to water. We used bamboo rods as the posts and staked them into the ground. After leaving the nets open for about an hour and fifteen minutes, we returned to the nets to find a *Sturnira lilium* was caught. He was freed from the nets, weighed, and released. This gave us useful experience in handling the bats.

The next day, we started to build our flyway. For the location, we used the old dormitories of the Archbold Tropical Research Educational Center. The dimensions were perfect. The hallway was 7'10" high, 4'5.5" wide, and 63' long (approximately 2.35 x 1.35 x 19 meters). All plants were cleared from inside the tunnel, and we swept the floors of debris. Two strong ropes were tied from one end of the hall to the other in the top corners of the hallway. Then, a truckers hitch knot was used to tighten the ropes as much as possible. Two 40 ft x 20 ft tarps were draped over the ropes creating a tunnel. To reduce sagging, the centers of the main ropes were secured to the roof. Because we used two tarps, duct tape was used to eliminate gaps between the two. In addition, to hold the tarp down, rocks were placed along the entire length of the tarp on the portions overlapping the ground.

That night, we caught another *Sturnira lilium* at the Bee House. We took him out of the net by hand, and placed him into an open plastic bag. We walked up to our flyway and used this bat for a trial run to get an idea on how to improve our methods. It was decided that with every run, we would use four people. Person one would handle and release the bats. The other three were timers whom sat at intervals of 20 ft, 40ft, and 60ft. Each timer used a standard stopwatch to time, and each person had a headlamp with a white light on. The timers crouched as low as possible to try to avoid any interference in bat flight.

To record the data, we formatted a table. For each bat, we recorded the date, time of night, weather, species, bat number (assigned), sex, weight (using a Pesola scale), and the time it took the bat to fly to 20ft, 40ft, and 60ft.

Data Sheet							
Date:			Weather:				
Species	**Bat Number**	**Sex**	**Weight**	**Time of Night**	**Time at 20 ft.**	**Time at 40 ft.**	**Time at 60 ft.**

Figure 1: Sample data sheet that was used each night to record the data

A picture was taken of each bat. Someone held the bat with the left wing spread out while a picture was taken of the aerial view. These pictures were then loaded onto a computer. ImageJ was used to find the wing area (cm^2) and forearm length (mm).

Since there seemed to be a scarcity of diversity and number of bats being caught at the Bee House, the nets were taken down. On 29 May 2008 we set the short mist net by the Checkhall River, and one *Sturnira lilium* was captured that night. Because the time at the 60 ft marker was unable to be recorded, this bat was not used in our data. From that point, it was decided that only bats with complete data sets would be considered in our results. To maintain constant methods, individual bats were released after being tested once.

The next night, four individual *Artibeus jamaicensis* were captured in the net. During the night's tests, three out of the four bats pulled a U-turn and flew out the entrance of the tunnel instead of flying the entire length. From that point on, a short tarp was used to close off one end of the tunnel. When the bats use their echolocation, they would find the only way out would be straight ahead of them. This made a big difference in the rest of our flight runs as fewer bats switched directions in flight.

On 31 May 2008, the large mist net was placed across the river in an area that was shallow enough to walk through. We figured that this would catch a greater number of bats per night because it was actually over the river. This night we caught five *Artibeus jamaicensis* and one *Pteronotus davyi.* This was the first night that we used socks to hold the bats. This gave them more air, and it seemed to make a big difference in the energy level of the bats. All but one bat flew perfectly that night.

The following night, the weather conditions were great and bats were out by the masses. Twenty individuals of *Artibeus jamaicensis* and two *Sturnira lilium* were captured. We only had 15 socks, and so the remaining 7 bats were placed in open plastic bags. Once at the flyway, we saw that the two *S. lilium* and two *A. jamaicensis* were dead. All of these individuals had been placed in plastic bags. Though the bags were left open, the plastic sealed off the opening suffocating these animals. Many of the other bats were weak from being placed under too much weight. One such *A. jamaicensis* died the next day despite efforts to nurse it back to health all night. At the end of the night, nine sets of solid data were collected and the rest of the bats were set free.

On 2 June 2008, 24 specimens of *Monophyllus plethodon* and 4 *Natalus stramineus* were captured on the edge of Tou Santi, on the trail to Middleham Falls, as they emerged from the cave also known as Stinking Hole. Insect sweep nets were used to collect the bats. Then they

were removed by hand and placed into socks. On the final two nights, eight *A. jamaicensis* were caught (three on 04 June 2008, and five on 06 June 2008).

In summation, five species were captured and flown for data. For the purposes of this paper, only the *Artibeus jamaicensis* and *Monophyllus plethodon* data were analyzed.

Total Collected	**Species**	**Sex Ratio (Female:Male)**	**Bats with Complete Data Sets**
37	*Artibeus jamaicensis*	12:7	19
24	*Monophyllus plethodon*	9:9	18
4	*Natalus stramineus*	4:0	2
3	*Sturnira ilium*	0:3	0
1	*Pteronotus davyi*	1:0	1

Table 1: Summation of bats captured

Results

Flight speeds and forearm length for a total of 37 bats were recorded. Sex and species of the bats were compared.

We found that with the *Artibeus jamaicensis,* there was no significant difference in forearm length between males and females ($t=1.01$, $df=17$, $p=0.32$). In terms of flight speeds the *A. jamaicensis* also had no significant difference between the males and the females ($t=1.22$, $df=17$, $p=0.24$). On the other hand, the *Monophyllus plethodon* showed some differences in forearm length. The males have a significantly larger forearm length than females ($t = 2.36$, $df=16$, $p=0.03$). In terms of flight speeds, the *M. plethodon* are marginally nonsignificant between males and females ($t=1.89$, $df=16$, $p=0.08$).

When comparing the two species some differences should be noted. *A. jamaicensis* are highly significantly faster than *M. plethodon* with sexes pooled ($t=3.65$, $df=35$, $p=$less than 0.001). The mean flight speed of the *M. plethodon* is 13.02 km/h ±0.48. For the *A. jamaicensis*, the mean flight speed is 15.41 km/h ±0.44. There was no relationship found between forearm length and flight speed for either species (see Figure 2 & 3).

Species	Sex	n	Forearm Length (mm) Mean ± SE	Flight Speed (km/h) Mean ± SE	Flight Speed (km/h) Range
Artibeus jamaicensis	F	12	67.07 ± 0.97	15.82 ± 0.53	13.95-19.03
	M	7	65.59 ± 0.92	14.71 ± 0.77	13.41-19.14
	Total	19		15.41 ± 0.44	13.41-19.14
Monophyllus plethodon	F	9	43.41 ± 0.64	13.88 ± 0.71	10.58-17.10
	M	9	45.9 ± 0.84	12.2 ± 0.56	9.23-13.77
	Total	18		13.02 ± 0.48	9.23-17.10

Table 2: Forearm lengths & flight speeds of *A. jamaicensis* and *M. plethodon*

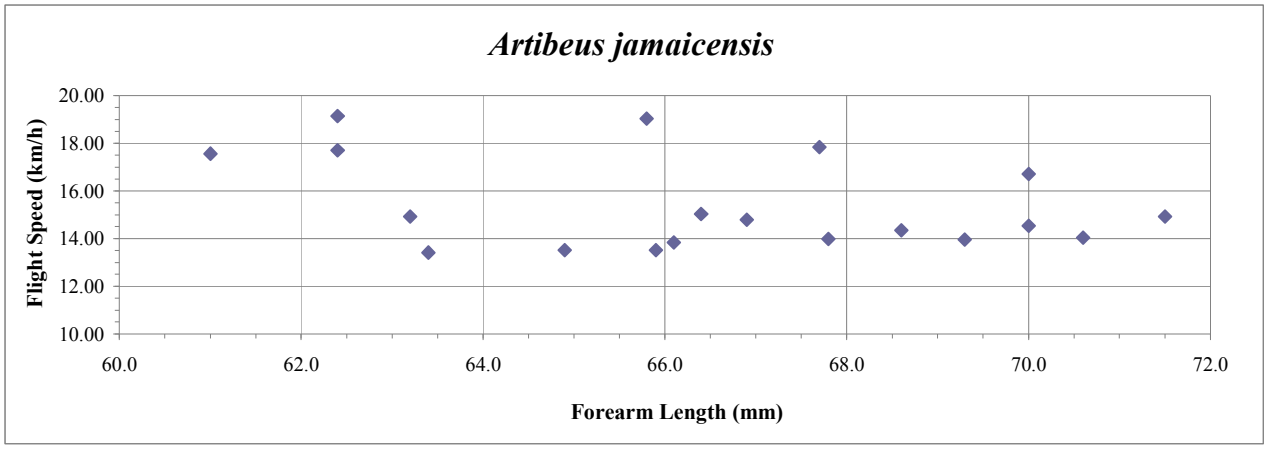

Figure 2: Forearm length (mm) VS flight speed (km/h) of *A. jamaicensis*

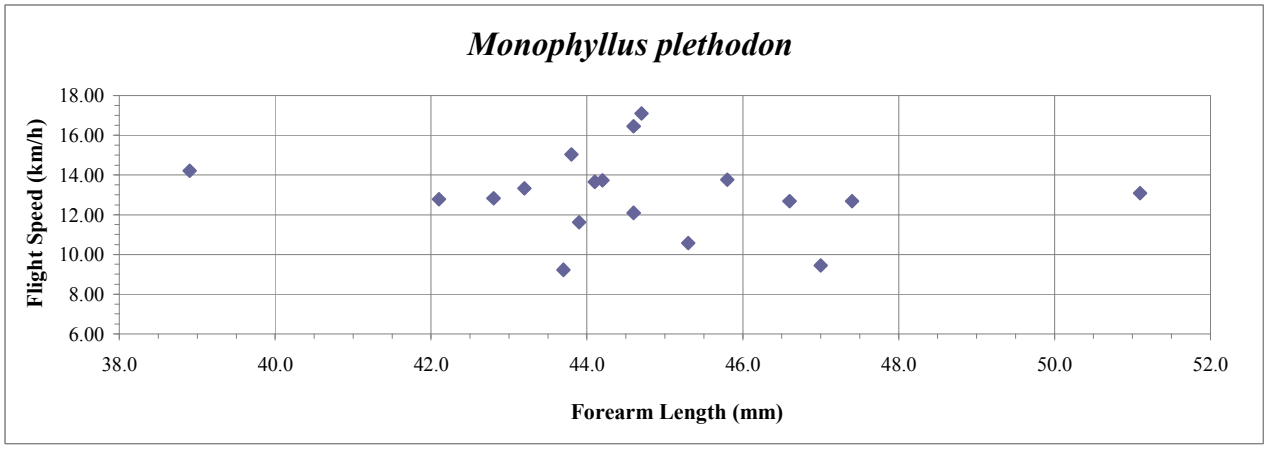

Figure 3: Forearm length (mm) VS flight speed (km/h) of *M. plethodon*

Discussion

As Hopkins *et al.* (2003) pointed out, this report does not give definitive flight speed. The measurements that we recorded were the flight speeds of bats in a closed tunnel. This information does not take into consideration flight speeds of long-distance flights, the speed of bats when foraging, or when in a dive and with a tail wind. Also, human error must be taken into consideration. When timing with handheld stopwatches, there will be a small amount of human error.

The diet of *A. jamaicensis* consists mostly of fruits, but they also eat insects. *M. plethodon* feed mainly on nectar. The higher flight speed in *A. jamaicensis* may be in part caused by the need to catch insects from the air. Nectar eaters simply hover when feeding and do not require high flight speeds.

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Appendix A

The completed bat tunnel

Placing caught bat into sock

Night's collection at Stinking Hole

Example picture of wing

Timing bat flight

Natalus stramineus perched in tunnel