BAT SPECIES DIVERSITY OF THE PERUVIAN NEOTROPICAL RAINFOREST

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INTRODUCTION

Biology

The family Chiroptera includes two extinct suborders, Megachiroptera (Old World fruit bats) and Microchiroptera (echolocating bats) (Schutt personal. comm. 2003). Containing over 1100 species and varying greatly in size, Chiroptera (bats) is the second largest order of mammals in the world (Schutt personal. comm. 2003). They are widely distributed, inhabiting most of the world s tropical and temperate regions (Jenkins, 2000). Bats of the neotropics are important when considering mammalian biomass, totaling 39% within Peru (Emmoms & Feer, 1990). Bats are the only mammals capable of independent flight (Simmons, 1997), having true wings that are made of thin, strong membranes supported by elongated fingers (Pearson & Beletsky, 2001). Like birds (Fenton, 1983), bat bodies have been modified through evolution to conform to the needs of energy-demanding flight, having a large heart, low body weight, and a high metabolism (Schutt personal. comm. 2003).

Behavior

Bats are nocturnal and usually spend the daylight hours roosting in caves, rock crevices, trees, or manmade structures such as houses and bridges (Simmons, 1997). They are highly social animals often roosting and foraging in groups (Schutt personal. comm. 2003). Some bats are solitary, while others are found in colonies that may include over a million individuals. Interspecies interaction within roosts and feeding is also common (Simmons, 1997). Feeding normally begins at dusk and diets consist of a variety of invertebrates, fruits, nectars, and small vertebrates (Emmons & Feer 1990). Bats heads come in a variety of sizes and shapes, where some may have elongated muzzles while others have broad, short faces. The way in which the face is oriented may also effect how echolocation is used by some species (Fenton, 1992). Their breeding behavior is very diverse, including monogamy, polygamy, and promiscuity, taking place either seasonally or during any time of year (Pearson & Beletsky, 2001).

OBJECTIVES

This study hopes (1) to document the diversity of bat species within the Peruvian neotropical rainforest, (2) to determine what factors can influence diversity, (3) to determine the frequency of each sex, and (4) to demonstrate if light introduction affects overall bat collection.

MATERIALS AND METHODS

Bat specimens were collected using nylon mist nets (Avinet, 33mm mesh with 4 sleeves (Figure 1) ranging in size (2.6m, 6m, & 9m). Net heights were adjusted and manipulated using aluminum poles. Collection areas were selected by finding flyway zones, waterways, and possible roosting grounds to maximize species diversity encountered. Areas were classified as disturbed or undisturbed regarding the amount of human influence on forest vegetation (Figure 2). Light was introduced via halogen headlamps for 30-second intervals every night during collection. Once caught the bats were placed in cottage bags for later field measurements of the forearm (FA), tail length (T), hind foot (HF), body length (BL), ear (E), tragus, (Trag), weight (Wt), and calcar (Calc). They were then sexed, and identified to genus and species.

Figure1. Illustrates Josh and Bill retrieving a bat at the Los Amigos waterhole

Figure2a-d. Images of areas where bats were collected; a (above),

b. Manipulated areas of collection at Los Amigos (disturbed);;

c. Area of collection at Boca Manu, Peru (disturbed)

d. Natural causeway within the rainforest. (undisturbed)

RESULTS

A majority of all the species were collected from the neotropical rainforest (Table 1), with bats collected ranging in size and structure. A higher diversity of bat specimens were collected at disturbed areas, whereas areas such as the water hole of Los Amigos were limited to those bats specialized for higher maneuverability with in the rainforest. This ability to move through thick vegetation was due to the smaller size and weights of the bats. Bats under 30 grams were found at a relatively equal frequency to bats 30 grams and greater in disturbed areas, where in undisturbed areas, the bats under 30 grams dominated (Figure 3). There was little difference with regards to frequency of sexes encountered. (Figure 4). Light did not appear to have any effect on the number or type of species collected; bats were entangled in the mist nets whether light was introduced or not.

Table 1. Indicates the number of species encountered within the Peruvian rainforest

Genus* and *species	**Common Names**
Myotis sp.	Little brown bat
Molossus sp.	Mastiff bat
Glossophaga soricina	Common long-tongued bat
Sturnira lililum.	Yellow-shouldered fruit bat
Phyllostomus hastatus	Spear-nosed bat
Carollia perspicillata	Short-tailed fruit bat
Mimon crenulatum	Hairy-nosed bat
Artibeus Jamaicensis	Large fruit-eating bat
Phylloderma stenops	Pale-faced bat
Micronycteris sp.	Little big-eared bat
Peropteryx leucoptera	Doglike sac-winged bat
Saccopteryx sp.	White-lined sac-winged bat
Rhinophylla pumilio	Little fruit bat

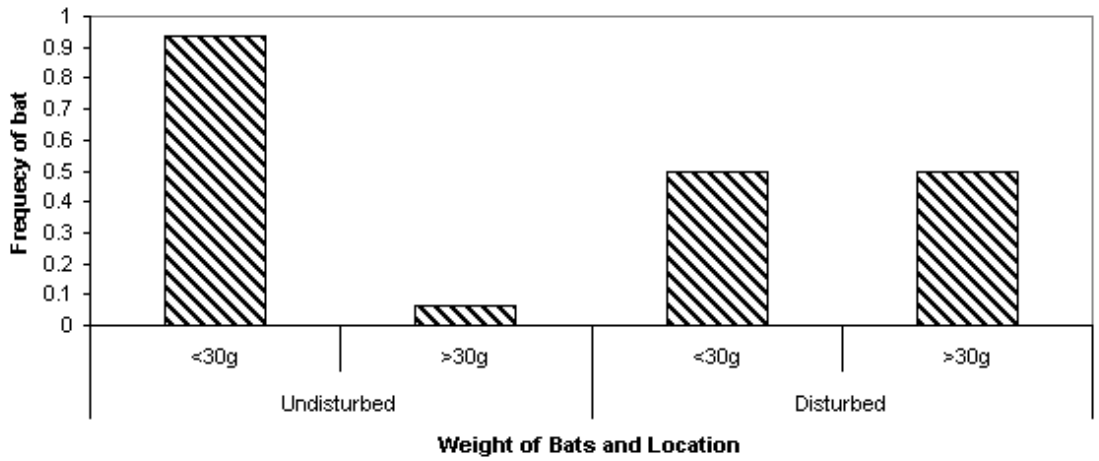


Figure 3. Illustrates the frequency of species encounterd in disturbed areas (ex.waterhole) vs undisturbed areas (ex. stream)

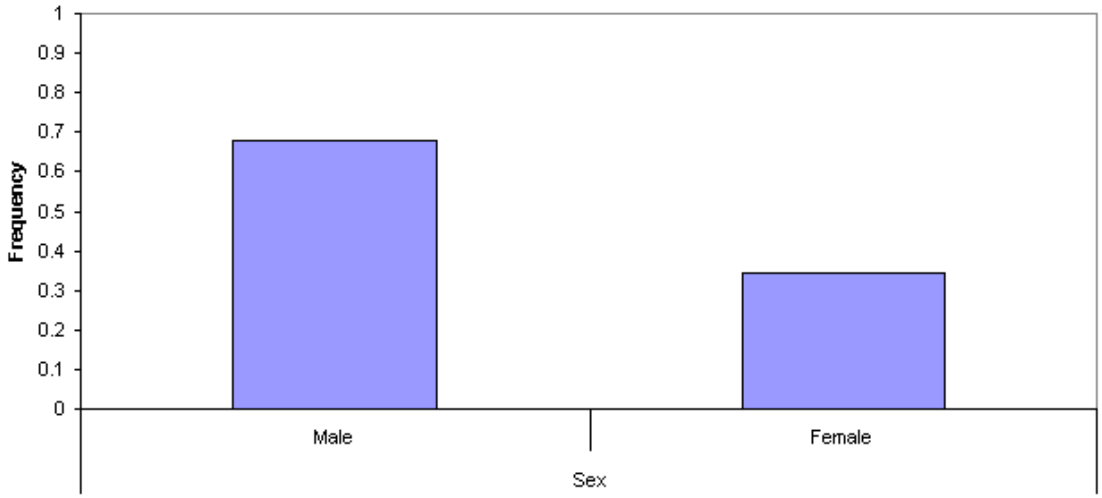
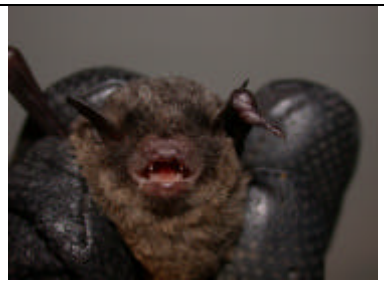


Figure 4. Indicates capture frequency of sex (Male or Female).
P-value -0.163 *Variance* -0.146

a. *Sturnira lilium,* collected 14Jan03

b. *Rhinophylla pumilio*, collected 14Jan03

c. *Phyllostomus hastatus*, collected 14Jan03



d, *Myotis nigricans,* collected 11Jan03

Fig 5a-d. Demonstrates a variety of bat specimens collected on various nights

DISCUSSION

Considering 170 of the 431 species of mammals in Peru are bats, and all vary in size, the number of species encountered within the Peruvian rainforest were not great in numbers (Table 1). Being able to capture and focus on all the species encountered can further help in understanding more about these organisms niches with in the rainforest. Size and weight of the bat was determined by their ecological niche in the habitat.

The null hypothesis would imply that all species would be found in every environment, yet the results tell us there is a definite body size differentiation between habitat areas. Bats come in a variety of sizes ranging in weights roughly between 3g and 190g. A high number of *Myotis* and *Sturnira* sp. (20-32g) were found within the same area, probably due to the different niches they fill. *Sturnira* sp. is fruit and nectivores, and *Myotis* sp. are insectivores (Emmerson & Feers, 1990). Since the water hole was a disturbed area, it is not surprising to find a variety of species and sizes there. Due to the larger size of some of the bats, it makes them less maneuverable in heavily wooded areas, minimizing the amount of area they can travel in, and the amount of times captured. If a smaller bat s habitat were being analyzed, it can be concluded that they can inhabit both areas, but dominate those that are minimally disturbed because of smaller body size and higher maneuverability.

A major misconception about bats is that they are blind. This idea originated from the fact that bats are able to successfully maneuver in the dark and often have small eyes. On several occasions, bats would come within centimeters of the nets and fly right over them. Experiments on several species of bats have also shown that they are able to distinguish patterns even at low light levels (Hill and Smith, 1984). Working with this idea, light introduction would seem to be an important factor when trying to capture these creatures in an attempt to disorient them, as though someone where shining a bright light into ones eyes. Light introduction could also be a factor in attracting more insects, and more insects would bring more insectivores. Nonetheless, light introduction didn t seem to play a major role when trying to attract these animals. Weather played a small part, but capture was a matter of the bats being unable to see the nets and getting entangled in them, making for a successful batting night.

Species numbers, as well as overall numbers, decreased when the weather was bad (cloudy or rainy). On the nights when the moon was in full view and the sky humidity free, collecting was the most productive.

When analyzing the primary data and results, it seemed as though males would be the dominant sex, but after multiple nights and computations, there was no dominant sex pattern demonstrated (Figure 5), due to the random fact of probability. Between the two sexes, there is a fifty-fifty chance of catching either sex.

CONCLUSION

Bat biology and ecology are an important factor within the neotropical rainforest. They are pest controllers and seed dispersers, and have an overall positive effect on the habitats they reside in. The overall collection experience was a great success. Multiple species and multiple samples of some species of bat were captured and easily identified, allowing for the perfection of collection techniques. To further enhance the experiment, more research would be needed for a full understanding of sex and species diversity in collections for different times of the year. In general, the biology of bats is a very interesting topic and hopefully everyone can enjoy the experiences that I took part in.

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