2016

Leaf Characteristics and Structural Diversity of Bat Tents in Costa Rica

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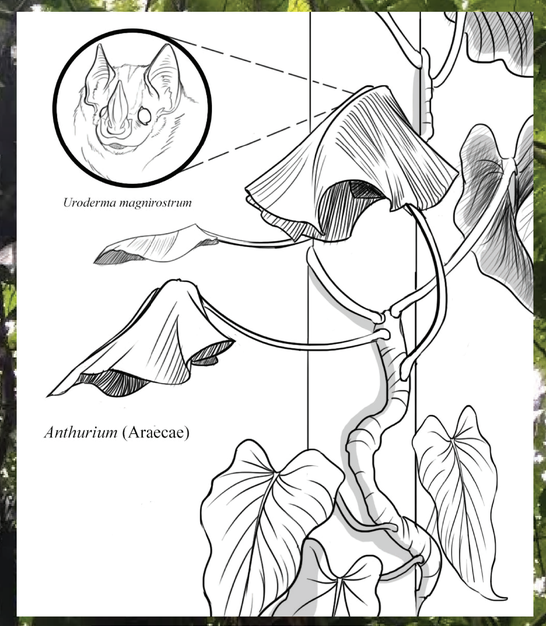
Introduction

The tent-making bats of Costa Rica are a prime example of the unique capabilities of species to adapt and survive in the neo-tropics. A great amount of research has been conducted on the many different bat species that participate in this tent-making, and scientists are still unclear as to why they perform this phenomenon. Some hypothesize that it could be a selective form of courtship display by males (Stoner 2000), although it has also been observed that females can construct these tents (Rodriguez-Herrera 2006). Another common suggestion is that tent construction has been favored as a form of protection from predators, but there is still great debate over this since constructing these tents is very costly to the bats. It is also still not known just how many types of tents these bats can make and if they are specific to the environment they live in. In order to further understand these creatures and their impact on the environment, it is essential to continue to observe these species in the wild and gather more information about variety of tents they are constructing. For my study, I wanted to see if I could find characteristics in tent leaves that could possibly be linked to why these bats are choosing these plants as tents to roost in. I also wanted to be able to see how many different types of tents were these bats creating in such a specific area of the tropics.

Methods

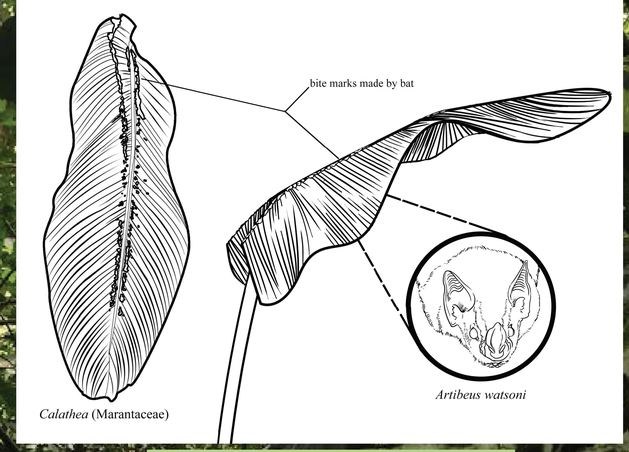
All measurements and observations were conducted at two locations in Costa Rica: The Children's Eternal Rainforest Biological Station at Pocosol (Northern central Costa Rica), and Hacienda Baru Lodge at Hacienda Baru (on the coast) during March, 2016. These areas consisted of both old-growth and new growth forests. Identification consisted of walking the trails at both sites and looking for leaves with tent-like alterations. This could include symmetrical bends in the leaf or visibly consistent bite marks. I was also assisted by a local bat specialist who helped me in identifying these tents. Once one was identified, we measured and observed specific characteristics of the leaf, which were (**1**) species of plant; (**2**) location; (**3**) height of tent from ground; (**4**) length of leaf; (**5**) width of leaf (left side from edge to rachis, center space between the left and right fold, right side from edge to rachis) and any additional observations. A tape-measure reel was used for gathering measurements of bat tents. I also used a climatographer to measure the angle of elevation of the plant, which helped to measure the height of tents that were to tall to measure or had bats occupying the tents.
Mist-netting was performed in order to provide concrete evidence of tent-making species being present in these field sites. Mist-netting of bats was conducted at both sites, with the nets being opened at approximately 6pm every evening and then closed around 8pm. We made sure to vary in net location every night in order to obtain a broader range. Whenever a bat was caught, we would then measure its weight, tarsus length, determine its gender, and use the Timm guide to determine the species.

Map of Costa Rica with study sites marked

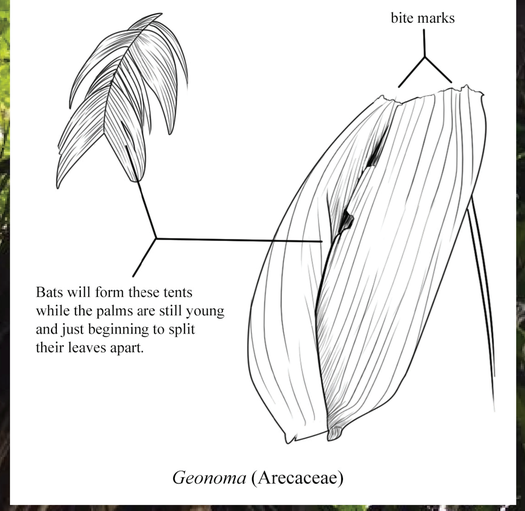


Apical tent type found in Pocosol

Photo of roosting *Artibeus watsoni* in Baru



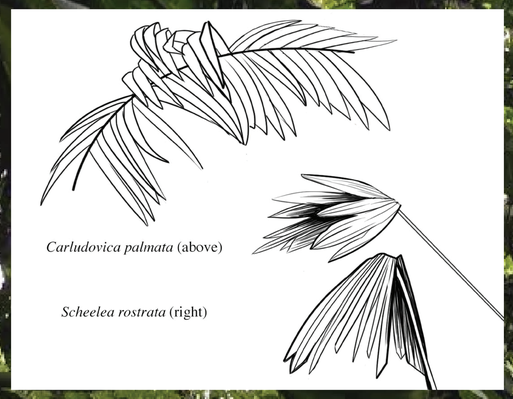
Boat tent type found in main Baru forest



Tent type found at old growth forest in Baru

Results

Two main plant species were found to exhibit bat tents. At Pocosol, 5 tents of the genus *Anthurium* (family Araceae) were found. All of these exhibited an **apical** tent shape (Kunz et al.). In Hacienda Baru's main trail site, 14 more tents were found, with 12 of these being of the genus *Calathea* (family Marantaceae) and two being of the same species found in Pocosol. The *Calathea* tents all exhibited a **boat shape** (Kunz et al.).
On average, the *Anthurium* species in Pocosol were 2.674 m off the ground, and the average length of these tents were 48.15 cm. In Hacienda Baru, the average height from the ground for the *Calathea* was 2.779 m, with their length being 113.27 on average.
While at Baru, we also visited an old growth forest where 4 more types of tents were discovered in species Carludovica Palmata (family Cyclanthaceae), Scheelea Rostrata (family Arecaceae) and a *Geonoma* species (family Arecaceae).
Through mist-netting we discovered 11 species of bats in Pocosol, and 8 in Hacienda Baru (Shaw). Out of this list we found two common tent-making species: *Uroderma magnirostrum* and *Artibeus watsoni*.



Pinnate and palmate tent types found at old growth Baru forest

Discussion

In Pocosol only one type of leaf was found being used as bat tents, and all the tents found there were relatively in close proximity to each other or even on the same plant. These tents are likely being made by the same bat or group of bats, since having more than one tent could help them to have more places to hide if one roost is found by a predator (Kunz et al. 1994).

The tent type at Pocosol were apical tents, which are made when bats partially chew on either side of the midrib which causes them to droop downwards thus inverting the leaf (Kunz 1995). Most likely the abundance of the Anthurium species throughout the forest made it more favorable. The tents were never found higher than 3 meters off the ground, confirming previous studies of these bats prefer to roost in lower areas. It was found that when measuring the width of these tents on average they were fairly symmetrical in their cut. The most fascinating discovery at Pocosol was finding a group of three tents on one plant, because it was able to visually show the progression of tent-selection. This further confirms previous research that states that bats make more then one main tent throughout the season (Chaverri et al. 2007). While mist-netting at Pocosol, we caught the tent-making bat species *Uroderma magnirostrum*, which helped to clarify that there were tent-making bats in the area even though we did not find any roosting.

In Baru, I was significantly more successful in finding tents, and the same pattern of having bats select a singular species followed me here. I was also even able to find four or five bats roosting in one of the tents. This time, bats were creating a boat tent, which are made by the bat biting both sides of the leaf down the midrib, which causes the leaves to slightly collapse downward (Kunz 1995). It also appears that these bats a selecting based on the same pressures at Pococsol: choosing an abundant plant that still is simple enough to construct a tent on. Most boat tents all had the lateral cut, although one leaf was found with more of a v-shaped cut into the Calatea plant. V-shape cut is distinctive in *A. watsoni* (Stoner). While mist-netting in Baru we again caught tent-making bats, and the ones we caught were also the same species found in the roosted tent: *Artibeus watsoni*.

The older growth Baru forest showed the most divesity in tent types, contrasting the previous two sites of study having only one type each. Here, I found 4 other tent types, spread througout the forest. What is most interesting is just how unique each type of tent was from one another, raising further questions such as whether or not these are all being made by different bat species. It would be ideal to have further research done as to why they will specifically make one tent form over another, and if there is species overlap occurring. Knowing more about home range size can increase our knowledge of the vulnerability of a species to habitat degradation or to direct exploitation.

Acknowledgements

I would like to thank Dr. Federico A. Chinchilla Romero and Dr. Jeff Norris for assistance with data collection, identification of flora and fauna while Costa Rica, and for the lending of field equipment. I would also like to thank Kylie Shaw for her assistance in mist-netting and cataloguing the bat species we caught, as well as the professors in this course for teaching me so much about tropical biology and for mentoring me during this entire process: Dr. David Johnson and Dr. Ramon Carreno. Lastly, I would like to thank Ohio Wesleyan University for providing financial support for this amazing opportunity to participate in this course and to travel to Costa Rica.

All illustrations were made by me in Adobe Photoshop, and all references used for these drawings were provided by photographs I took during my time in Costa Rica

Literature Cited

Chaverri, G., Quiros, OE., Kunz, TH. 2007. Ecological Correlates of Range Size in the Tent Making Bat Artibeus Watsoni. Journal of Mammology. 88(2):477-486
Foster, M. S. and R. M. Timm. 1976. Tent-making by Artibeus jamaicensis (Chiroptera: Phyllostomatidae) with comments on plants used by bats for tents. Biotropica 8(4):265–269
Foster, RB., Cerda I., Vandermeer, J. 2001. Atlantico Sur – Herbs, Climbers, Epiphytes. Field Guides: The Field Museum. Web.
Kunz, TH., Fujita, MSa., McCracken, GF. 1994. Convergence in Tent Architecture and Tent-Making Behavior Among Neotropical and Paleotropical Bats. Journal of Mammali an Evolution. 2(1):57-78
Rodriguez-Herrera, B., Medellin R.A., Gambo-Rios, M. 2006. Tent building by female Ecto phylla alba (Chiroptera: Phyllostomidae) in Costa Rica. Acta Chriopterologica. 8(2):537-571
Stoner, KE. 2000. Leaf Selection by the Tent-Making Bat Artibeus Watsoni in Asterogyne Martiana Palms in Southwestern Costa Rica. Journal of Tropical Ecology. 16(1):151-157
Timm, RM., LaVal RV. 1998. A Field Key to the Bats of Costa Rica. Center of Latin American Studies. No.22: 1-30