Guest Editorial

Bats: Magnificent and Mysterious

It is indeed an honour to be granted the opportunity to write in the Living World Journal on a topic I hold dear. In this guest editorial, I highlight the importance of bats in our ecosystems, reflect on the diversity of bats in Trinidad and Tobago, highlight some of the research taking place in Trinidad and Tobago, and advocate for continued research into these marvellous creatures.

Whenever I am given the opportunity to present on the importance of bats, I start by asking the audience what they believe to be the importance of birds. Depending on the audience, I may get a few people answering that their plumage or songs are appealing. With some prompting, finally, members of the audience speak of pollination, seed dispersal, and insect control. Bats are the night shift for these services. One study on the pollination services of new world phyllostomid bats found that they pollinate the flowers of 360 species of plants of 159 genera and 44 families. Another study found that neotropical bats disperse the fruits of at least 549 species of plants of 191 genera and 62 families. Their role in maintaining our forest ecosystems is profound, and is well demonstrated by the cover photo where a Common Tent-making Bat, *Uroderma bilobatum* is dispersing a Ficus fruit. With respect to fruit dispersal, bats are cited as essential for recolonisation in forest clearings since many of the seeds they disperse are adapted for growth in disturbed areas. These early successional plants include those of the Jumbie Candle, *Piper sp.* and Bois Canot, *Cecropia peltata*. Bats are especially good at helping to repair fragmented forests since they are described as mobile foragers, traversing these open areas and dispersing seeds into forest patches. Without insectivorous bats, the food resources we as humans depend upon would likely be more expensive. It has been estimated, for example, that the value of bats to agriculture in the continental United States is $22.9 billion/year with respect to insect control, thereby reducing the need for pesticide applications. In Thailand, a single species of bat has been found to prevent the loss of about 2900 tonnes of rice per year. The benefits of bats in the control of insect populations may also extend to their consumption of mosquitoes and other vectors of disease, which means they have a critical role to play in human health as well.

In light of the many ecosystem services provided by bats, the Minister of Agriculture, Land and Fisheries, Senator the Honourable Clarence Rambarrat, has recognised the importance of these creatures, going so far as to join the Trinidad and Tobago Bat Conservation and Research Unit (also known as Trinibats) on an evening of mist netting at the Asa Wright Nature Centre in the Arima Valley on October 12th, 2018. The bats cooperated fully this evening, with 185 bats of 19 species being captured and safely released back into the night. This was the largest catch rate for the entire 2018 Trinibats expedition, and we were able to highlight a wide array of feeding guilds to the Honourable Minister. Bats comprise over 20% of the world's mammalian fauna, and 70% locally. In Trinidad and Tobago there are roughly 70 species of bat, and this list is likely to grow given the fact that molecular techniques used to differentiate species have not been conducted on most of the species present. Using such techniques, the only endemic species of mammal in Trinidad and Tobago was recently found in Tobago, Sir David Attenborough's Myotis, *Myotis attenboroughi*. The rich diversity we are fortunate to have in Trinidad and Tobago can be discussed in several ways. In terms of Family diversity, there are nine families of bat, with the Phyllostomidae dominating with five subfamilies and 38 of the roughly 70 species. Each of these families have their own unique characteristics. The Emballonuridae, for example, are characterised by having glandular sacs on their wings, used to mark their territories and attract mates. The Thyropteridae, consisting of one species, Spix's Disk-winged bat, *Thyroptera tricolor* is adapted to roost in the rolled up leaves of heliconia and banana using suction cups on its heels and thumbs. In terms of size, the smallest bat in Trinidad is the Riparian Myotis, *Myotis riparius,* with a forearm between 32-38mm, while the largest is the Spectral Bat, *Vampyrum spectrum*, with a forearm between 98-110mm.

Perhaps the best way to illustrate our bat diversity, however, is by feeding guild. The Spectral Bat is the largest bat in the New World, and the largest carnivorous bat in the world, feeding on birds and small mammals. There are several gleaning animalivores, such as the Little Big-eared Bat, *Micronycteris megalotis.* These can find and consume insects perched on a leaf in the dark within forested habitats, no easy task. Nectar feeding bats, such as Geoffrey's Hairy-legged Bat, *Anoura geoffroyi*, have spectacular acrobatic displays, hovering at flowers for short periods while they stick out their long tongues to consume the nectar therein. Large generalist fruit bats like the Great Fruit-eating Bat, *Artibeus lituratus*, can be seen dispersing a wide array of fruit, including Figs, Hog Plum, and Sapodilla. There are also several species of high and fast flying insectivorous bats, such as the Ghost-faced Bat, *Mormoops megalophylla*, that fly above the canopy

feeding on moths, beetles and flies. There is one species of bat which specialises on fish, the Greater Fishing Bat, *Noctilio leporinus*, extending its long feet with large sharp claws to gaff fish at the water's surface. Finally, in Trinidad we possess two of the three species of vampire bat, the Common Vampire Bat, *Desmodus rotundus*, which feeds on mammalian blood, and the White-winged Vampire Bat, *Diaemus youngi*, which feeds on avian blood.

The diversity of bats we see in Trinidad and Tobago makes this a fertile ground for research. The William Beebe Tropical Research Centre at Simla in the Arima Valley was used by Dr Donald Griffin in the 1960s to conduct some of his seminal work on echolocation in bats, helping uncover the feeding ecology of the Greater Fishing Bat. It was Dr Griffin who coined the term "echolocation" in 1944 to describe the method used by microbats navigate and forage in the dark. The reproductive ecology of bats has also been the subject of very interesting and ongoing research. Seba's Short-tailed Fruit Bat, *Carollia perspicillata,* has been used as a model organism to help understand some of the serious problems found in human pregnancy. They are ideally suited to this task since they usually carry a single embryo in a simplex uterus, similar to that seen in humans. In understanding the reproductive ecology of this species, scientists such as Dr John Rasweiler IV have helped us understand some of the processes which lead to implantation of human embryos. Some of the pioneering work on paralytic rabies was carried out in Trinidad, where the link between bats and this form of the disease was made in 1931 during a multi-species rabies epidemic which killed 73 people, and thousands of livestock. Today, research continues on mimicking the anticoagulant properties of enzymes in the saliva of the Common Vampire Bat. Though the Vampire Bat has a sordid history in Trinidad, it is hoped that in harnessing the special properties found in their saliva humans may benefit from novel drugs for stroke victims. The community of bats we find in the forests of Trinidad have themselves been shown to be indicators of forest health, with gleaning animalivores having higher abundance in primary forests.

Throughout the world, bats continue to perform their tasks under cover of darkness. They perform many ecosystem services which we take for granted, have spectacular adaptations to perform these tasks, and continue to be important subjects of research. More recently, research on their behavioural and feeding ecology continues with the University of the West Indies (UWI), in conjunction with Trinibats. Research on the efficacy of batbox use in Trinidad is ongoing, where the use of bat boxes in attracting bats and alleviating bat human conflict is the focus. Bat boxes have been installed at the Asa Wright Nature Centre, along with bat acoustic recorders, in keeping with the pioneering work carried out in Trinidad on echolocation. A comprehensive treatise of the bats of Trinidad and Tobago has also been published by Geoffrey Gomes and Fiona Reid, an essential companion to novices and experts alike. Trinibats continues in our efforts to educate the public of the importance of bats, encouraging research and conservation. Beyond the research carried out by the UWI, Trinibats, and other entities, in more recent times we are pleased to see the removal of most bat species from the vermin list in the Conservation of Wildlife Act. Support from the Government of Trinidad and Tobago and the Minister of Agriculture, Land and Fisheries in the protection of roosting habitat for bats is also vital. One such location which houses a massive population of bats is the old World War II bunker in Cumuto called the "Icehouse". We do hope that structures such as these will be protected in perpetuity for these bats. Bats deserve our respect and protection. I hope that I've highlighted their importance, and the need for their continued protection.

Luke Rostant, PhD
Department of Life Sciences,
The University of the West Indies,
St. Augustine, Trinidad
lvrostant@gmail.com