THE GREATEST MIGRATION IN AFRICA

Unlocking the Mysteries of the Straw-Colored Fruit Bat

BY HEIDI V. RICHTER AND ALLYSON WALSH

Perhaps the greatest migration in Africa takes place every year at Kasanka National Park in Zambia – where 8 million fruit bats appear as if out of noowhere, stay for two months, and then disappear – like ghosts on the wind. Unraveling this mystery is a challenge undertaken by researchers at the University of Florida and Lubee Bat Conservancy.

A theatrical whoosh of flapping wings and a matter of fact announcement by Changwe "Madam, our international bats have arrived," heralds the annual arrival of close to 8 million straw-colored fruit bats to a remote swamp forest in Zambia. On the first night, three bats fly off into the October sunset, wings beating slowly and rhythmically, not quite in unison. These bats appear to be scouting out the terrain, looking for the best feeding sites. As if by mutual agreement, the next night a few hundred bats leave the roost in their nightly search for food. Over subsequent nights the numbers swell and swell, until the branches of trees are crammed with bats and the evening sky is speckled with dispersing bats as far as the eye can see. At their peak they number between 5 and 10 million, packed in an area smaller than New York City's Central Park, but it is difficult to accurately estimate the precise number. At the very least, it is one of the largest remaining migrations of mammals in the world, worthy of scientific scrutiny. Where do the bats come from? Why do they congregate is such large numbers at a single small site? How big a role do they play in shaping the African landscape? Is their survival at this site threatened? Until now, conservation scientists have not been able to say.

Kasanka National Park, home to this mega- roost of straw-colored fruit bats (*Eidolon helvum*), is a Zambian national park that is privately managed by the U.K. based Kasanka Trust. At Kasanka the bats roost in an area of "mushitu" or evergreen swamp forest. This may be because its dense understory and dual canopy structure mimics that of tropical forests, the bats' primary equatorial habitat. In Zambia, increasing deforestation has dwindled mushitu to the point where this forest habitat is now considered endangered. Kasanka may offer a unique complement of protected roosting and foraging areas, therefore making it critical bat habitat, and an ideal flagship study site for examining the key role these fruit bats play in shaping African landscapes.

At 80 cm, straw-colored fruit bats have the largest wingspan of any bat on the African continent, yet they weigh only 250 – 320g. The high energetic demands of flight require a lot of fuel, so these bats go in search of fruit each night in the surrounding miombo woodland. While the fruits provide sugar for energy, these bats also forage on leaves and nectar to supplement their diet, pollinating flowers of multiple plant species as they forage. Fruit bats can eat up to 2.5 times their weight in fruit each night. Five million fruit bats staying for a period of 10 weeks at Kasanka can potentially consume 262 *million* kg of fruit during their stay each year. With a gut transit time of about 20 minutes, that translates into the dispersal of myriads of fruit seeds.

In most of Central Africa, straw-colored fruit bats feed principally and selectively on figs – a food source that is limited in this region. At Kasanka, the bats feed primarily on the fruits of waterberry (*Syzygium sp.*), mupundu (*Parinari curitellifolia*) and wild loquat (*Uapaca sp.*) trees. The nearby villagers often see the bats in their mango and banana trees as well, but the bats do not eat enough of these fruits to be considered a pest. In this regard they are lucky, since they avoid the persecution fruit bats face where they are considered nuisance species. While fruit bats are eaten in parts of Western and Northern Zambia, in Central Province, where Kasanka is located, the local villagers will not consider eating the bats, believing even the idea to be disgusting.

The practice of the chitemene system of farming, or slash and burn, is responsible for a large amount of regional deforestation. While one might expect the bats to be foraging mainly in the protected woodlands of the national park, this long held assumption may not be true. At 420 km^2, if all 5 million bats foraged in the park, Kasanka would have to hold almost 12,000 bats per square kilometer. Surprisingly, observations of the bats indicate that most of them fly outside of the park into the surrounding farmlands to feed. It may be that people spare the edible fruit trees when clearing their fields, or that some fruiting tree species have a growth advantage when regenerating in deserted fields. Regardless of the cause, it appears that on most nights the majority of bats fly a minimum of 15 km, and up to 50 km or more, to feed.

Rainfall in Zambia is seasonal, and coinciding with this rainfall researchers have found a strong seasonal peak in the fruit supply during the time the bats are at Kasanka (Richter and Cumming, 2006). It seems likely then that the bats are migrating to the area to exploit these fruit resources. One day, around Christmas, the bats simply disappear into the night, not to be seen again for at least another nine months. After witnessing the vast size of the colony, it is hard to imagine that so many animals can disappear, their whereabouts unknown until they return the next year. It may be that this large colony separates into smaller satellite colonies, explaining why a colony this size has not been reported elsewhere in Africa. Alternately, the colony could migrate to unsettled or more rural areas in Africa, where it has remained undiscovered.

Until now, there has been little research into the causes and consequences of migrations by African fruit bats, despite their potential significance for pollination, seed dispersal and ecosystem enrichment. The heavy weight of satellite transmitters and inability of small bats to carry these during flight has prevented scientists from following such long-distance movements. Last year however, an exciting technological breakthrough in the miniaturization of satellite telemetry tags permitted us to steer the direction of our research towards answering some of the basic questions about migration at a landscape scale. With funding from the National Science Foundation, four lightweight transmitters with microminiaturized solar panels and rechargeable batteries were secured, and we began the first satellite telemetry study of fruit bat movement patterns in Africa.

Prior to deploying the transmitters for the first time in the field, it was vital we maximize the likelihood that the transmitters would remain on the bats long enough for us to discover the bats' migratory routes, stopover and roost sites, and the countries they cross or reside in when their migration was over. There was little room for error, since the high cost of transmitters and data collection meant we only had four collars to use in the pilot project. It was crucial we develop an attachment technique that could withstand up to two years (the life of the transmitter) on a bat. Bats are very agile, flexible animals that can easily remove a collar that is not tight enough. They also have strong jaws as well as sharp teeth and claws, and what they cannot reach to chew on, we discovered their roost mates will.

The Lubee Bat Conservancy, located in Gainesville, Fla., worked with the University of Florida Department of Wildlife

Ecology and Conservation to develop and test various collar designs. Using captive straw-colored fruit bats, we were able to identify appropriately sized transmitters that would not hamper the bats' ability to conduct their daily functions of foraging and flight. We were able to develop a leather collar for attaching the devices that reduced irritation to the collared bats. Watching how the bats chewed on the devices also allowed us to work with the manufacturer of the transmitters, Microwave Telemetry, to reinforce the transmitters at their weakest points. This cross organization collaboration resulted in strong transmitters, secure collars and minimal harm to the animals involved in the study. Without the availability of captive animals at an AZA member facility, access to a research environment, and animal keepers to monitor the bats' reactions to the collars and transmitters, this project undoubtedly would not have been successful.

The satellite tracking has been working for several months now, and we have collected both local and long distance movements of the fruit bats, first as they foraged locally and more recently along their migration route. The data are currently being analyzed within a Geographic Information System (GIS) framework, combining satellite images and measurements of habitat productivity to model foraging and migration behavior in the species. Initial results suggest that the bats are most likely following the rains, and the synchronized seasonal burst in fruit production. This leads them on a path north to south, following the Intertropical Convergence Zone (ITCZ) weather pattern, migrating thousands of kilometers across Africa. This is only the opening chapter, and we expect this project to mature into a long-term study and provide answers to the many mysteries that surround this fruit bat colony in Africa.

Fruit bats do not receive as much attention as Africa's high profile safari mammals, and yet we are beginning to discover they play a large role in seed dispersal and pollination for many ecologically and economically important African plant species (Fujita and Tuttle, 1991; Taylor and Kankam, 1999). Chronic neglect by biologists, indifference by conservationists and a tradition for eating bats in some areas of Africa, means that convincing reasons are needed to conserve African fruit bats. This project will begin to provide data about one of the greatest migrations in Africa – and help place the importance of this migration in the context of continued sustainability of African ecosystems and continued provision of forest goods and services to local communities in Zambia and other African countries. Through exploration and scientific discovery, we hope to provide the data and management recommendations to place fruit bats that cross borders freely more firmly on the wider African conservation agenda.

Studies of the bats at Kasanka were initiated by Dr Graeme Cumming and graduate student Heidi Richter of the Department of Wildlife Ecology and Conservation at the University of Florida. Dr. Cumming is now affiliated with the University of Capetown, South Africa. Dr. Allyson Walsh is a Courtesy Associate Professor at the Department of Wildlife Ecology and Conservation, University of Florida, and is also the Director of the Lubee Bat Conservancy, an AZA member facility located in Gainesville.

References

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Tribute to Pamela Mizell Poppell Thomas

It is with great sadness that the Lubee Bat Conservancy announces the loss of our team leader and dear friend Pamela Thomas. Pam passed away on April 30th, 2006 after a year long struggle with cancer. She started work at Lubee on September 27, 1999, and was the cornerstone of our animal keeping department for close to seven years. Pam's love of her job shone through in everything she did and to all the people that she worked with. She was devoted to the care of the bat collection at Lubee, and knew each bat by name and character. Pam Thomas was a trusted friend, a leader to the staff, a mother of three sons, a loving wife, and a source of inspiration to all that knew her. Her joy for life and love of nature lives on through her incredible wildlife photographs and in our memories. Pam was truly an extraordinary person, and she will be missed by all who knew her.

Photo Caption: Pam Thomas training visiting keeper Victor Alm from Oakland Zoo.