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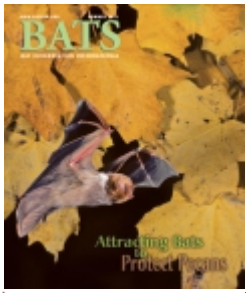

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Sanctuaries in Dwindling Rainforests
Proving the bat-conservation value of forest fragments
Matthew Struebig

The rainforests of the Malay Peninsula are said to be the oldest in the world. Spared by Ice Age glaciers, these forests have been in place for perhaps 130 million years. And they host a remarkable diversity of animals and plants. Flying mostly unnoticed among the tigers, monkeys and Asian elephants that attract conservation headlines are at least 120 species of bats â€“ more than a quarter of them on the IUCN's Red List of threatened species, mostly because they are losing habitat in the ancient forests. Malaysia clearly is a critical target for bat conservation.

Tropical forests are disappearing worldwide at an alarming rate as they are cleared for timber, agriculture, ranches and towns. Southeast Asia is no exception. Great expanses of the region's rainforest have given way in recent years to timber, rubber and oil-palm plantations that have fueled rapid economic development. Malaysia and Indonesia supply more than 80 percent of the world's palm oil.

Bats and other wildlife increasingly must survive in modified landscapes, often depending on scattered, isolated fragments of undisturbed forest. Their success can depend on our understanding of the size, conditions and connections they require in these sanctuaries â€“ and on our willingness to use that knowledge.

The good news is that responsible companies and government agencies are very much aware that the adverse environmental impacts of their activities can come at a price in unwelcome public attention and in reduced sales. A number of oil-palm producers are learning this lesson and making active commitments to minimize damage.

One way agricultural interests can limit their impact on biodiversity is to retain forest fragments and to connect them by preserving wooded corridors in and around the plantations. Unfortunately, while this subject has been studied in considerable depth in the New World tropics, we know very little about the biodiversity responses to rainforest fragmentation in Southeast Asia.

To begin filling that information gap, I studied how insect-eating bats utilize forest fragments in Malaysia and the potential impacts on bat communities. As part of my postgraduate work at Queen Mary University of London, and with support from a Bat Conservation International Student Research Scholarship, I wanted to characterize how bat communities and populations were affected by the size and isolation of these fragmented habitats. My goal was to inform management decisions concerning the fate of forest remnants in oil-palm plantations.

After 18 months of fieldwork and a Ph.D. thesis, I have achieved this goal.

I focused on a 1.4 million-acre (560,000-hectare) landscape of forest and rubber and oil-palm plantations that surround the protected Krau Wildlife Reserve in central Pahang on the Malay Peninsula.

This reserve has what is probably the best-known bat fauna in the Old World tropics. Its Kuala Lompat Research Station, for example, supports the greatest diversity of insect-eating bats of any single site in the world â€“ more than 50 confirmed species known within just 1.1 square miles (3 square kilometers).

The Krau Reserve is also the research site for the Malaysian Bat Conservation Research Unit (MBCRU), which promotes research and conservation of Malaysian bats. It is directed by biologists Tigga Kingston of Texas Tech University, a member of BCI's Science Advisory Committee, and Zubaid Akbar of Universiti Kebangsaan Malaysia.

In collaboration with bat geneticist Stephen Rossiter of Queen Mary University, my study expanded the MBCRU's conservation research efforts beyond the boundaries of the protected area. I visited 27 forest fragments, sampling bat diversity using harp traps set across trails, streams and old logging skids.

Often, the hardest task was just reaching the scattered patches of forest. Ten of the bulky traps, along with field equipment, camping provisions and field assistants, had to be hauled atop a four-wheel-drive vehicle. Access roads were frequently blocked, washed away or simply nonexistent, so we covered many miles on foot in the tropical heat. I was extremely fortunate to have the help of field assistants from local villages, plus volunteers from Malaysia, the United Kingdom, Ireland and Poland.

We captured a total of 2,857 bats representing 28 species of insectivorous bats. These included rare species such as Peters' trumpet-eared bat (Phoniscus jagorii) in medium-sized patches surrounded by rubber plantations. The threatened bronze tube-nosed bat (Murina aenea) was found at a single large fragment of around 5,000 acres (2,000 hectares). But most fragment inhabitants, however, were generalist cave-roosting species, especially Blyth's horseshoe bat (Rhinolophus lepidus) and the fawn roundleaf bat (Hipposideros cervinus).

Not surprisingly, we found overall that small fragments hosted few bat species, while larger ones (of more than about 865 acres [350 hectares]) supported bat assemblages that were very similar in composition to those of the undisturbed forest of the reserve. The fragments' isolation from each other and from intact rainforest seemed to have little influence on species diversity.

Bat species that typically roost in foliage or tree cavities were more heavily impacted by fragmentation than cave-roosting species. This stands to reason, since small forest fragments are known to lose their large trees, removing critical roosting opportunities for forest bats.

Species that roost in caves, on the other hand, were relatively abundant in forest patches, probably because these bats often commute to foraging habitats from distant roosts. By recapturing banded bats, we confirmed that some cave-roosting bats commuted more than 6 miles (10 kilometers) between fragments.

One forest species that appears particularly susceptible to the effects of forest fragmentation is the papillose woolly bat (Kerivoula papillosa), which roosts in the hollows of standing trees. These populations exhibited significant local declines among fragments. On return to the United Kingdom, I conducted genetic analyses of samples from 322 individuals to determine any impacts of forest fragmentation on population genetic structure. Populations from small fragments showed reduced levels of genetic diversity,

suggesting potential inbreeding effects from population fragmentation and/or that gene dispersal (through contact with other populations) was limited.

We also discovered an intriguing "karst effect" while working at Gunung Senyum, a small forest reserve on limestone karst with ample caves. After several weeks of trapping, it became clear that this large roosting resource was having a significant influence on bat communities elsewhere in the landscape.

The dominant bat species at the Senyum caves gradually declined in abundance as we moved away from the reserve. In their place, forest-roosting species became more abundant, and overall diversity increased.

This pattern was evident out to six miles (10 kilometers) from the caves, suggesting that cave sites may help boost bat levels in surrounding forest fragments. In other words, managing fragments in isolation may not be enough: losing a cave complex, through mining activities for example, could result in diminished diversity across the landscape.

This research culminated in a set of recommendations to help land managers conserve bat diversity in modified landscapes. These included a list of bat species that are especially sensitive to the fragmentation process, along with evidence that even relatively small and degraded forest patches can be useful in conservation. Following my research, I served as an environmental consultant in Indonesia and was able to propose guidelines, backed by solid, hard-earned data, for designing landscapes that include bat conservation along with modifications for agriculture.

Working with industry and organizations such as BCI has taught me that even basic information, if based on solid scientific research, can make a real difference in winning land-use changes that are critical to safeguarding biodiversity in the tropics.

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