

Bats and EIDs

By **Tigga Kingston**/ Special To The Tab
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Gently, I reach into the holding bag and pull out the first of the night's catch. 65 million years of evolutionary perfection - a beautiful trefoil horseshoe bat (*Rhinolophus trifolius*). Her grayish-fawn fur is long and fluffy and she has yellow ears, elbows and knees and tan-colored wings.

With over 1,100 species, bats account for 20 percent of mammals and are found on all continents except Antarctica. In the wet tropics bats comprise more than half the mammal species, and in South America over 100 species can coexist at a single locality. This species richness is matched by unparalleled ecological diversity- bats eat fruits, nectar, leaves, insects, small terrestrial vertebrates, and fish. Despite popular myths, there are only three species of vampire bats, restricted to Central and South America.

Tragically, nearly a quarter of all bat species are threatened by extinction, mainly due to habitat loss, hunting, disturbance at roost sites and pesticides. Conservation has been greatly impeded by a lack of understanding of these animals. Demonized and feared across cultures for centuries, shrouded in myth and prejudice, bats now face another challenge to their unfairly tarnished image - their role as natural wildlife reservoirs in the emergence of new and sometimes fatal infectious diseases.

In 2005, scientists identified three horseshoe bat species (genus *Rhinolophus*) from China as the probable natural wildlife reservoir for the SARS (severe acute respiratory syndrome) virus. SARS first emerged in China in 2002, infected about 8,000 people around the world in 2003 and killed more than 750 people; the cost to the global economy was more than \$50 billion. SARS is one of several infectious diseases that emerged in the last decade in which bats have been identified as the probable wildlife reservoir. In the late 1990s, Nipah virus spilled over from pigs to humans in Malaysia, resulting in the death of 108 people. Old World fruit bats in the genus *Pteropus* (flying foxes) appear to be the original hosts of Nipah virus, the related Hendra virus, and probably Ebola virus.

From a conservation perspective, this would seem to be the final nail in the coffin of bat public relations. The health and economic impacts of Emerging Infectious Diseases are a global concern, and it is critical that outbreaks are controlled and minimized, but we must protect bats while addressing these diseases.



The bat being held in Tigga Kingston's hand is a *Hipposideros diadema*, or diadem leaf-nosed bat.

Large-scale culling programs - often the first response of beleaguered governments- are the last thing biologists and conservationists wish to see. Bats are a major and unique component of global biodiversity, and provide critical ecosystem and economic services as pollinators, seed dispersers and predators of insects. For example, in the Old World, more than 500 economically important products are derived from these plants pollinated or dispersed by bats - including favorites such as durian, petai, mango, banana, guava, figs, carob, cashew, avocado, dates, jackfruit and papaya. The durian trade alone is worth in excess US\$1.5 billion annually.

Insectivorous bats consume a least half their body weight in insects every night. In a six month period, a single colony of Mexican free-tailed bats may consume over 2,450 metric tons of insects, which include the most damaging agricultural and forestry pests.

Ethical and conservation issues aside, eradication of host species is ineffective in managing disease. Seventy years of aggressive campaigns to eradicate vampire bats (sometimes deploying draconian methods such as poison gas or blasting) did little to control bovine rabies in South America but resulted in the destruction of millions of bats of many species. Eventually, ecological and behavioral research led to selective control methods that are now proving effective. Policy must be based on solid research.

In the wild, host bat species show little signs of infection by the viruses they harbor. These viruses have been present in bat populations for 1000s -maybe millions - of years, but have only emerged recently. Understanding why bat-borne viruses are emerging now is the key to predicting and minimizing future outbreaks.

Although bats can pass some diseases directly to humans, such as rabies, in many cases (including, Hendra, Nipah and SARS) there is no direct transmission of the virus from bats to people. The viruses usually infect an intermediate "amplifier" host that is in contact with both bats and humans. In SARS this host was the masked palm civet. These are naive hosts with little or no resistance to the pathogens, resulting in rapid replication of the virus. This promotes transmission to other individuals of the same species, and can lead to genetic modifications that enable the virus to jump to humans. In most cases transmission to humans has occurred only among people closely associated with an amplifier host. In China wildlife traders and restaurant owners were the first to become infected with SARS, which reached epidemic proportions because of human-human transmission.

Historically bats had very little contact with spillover hosts, certainly not enough to sustain an infectious virus. Civets are generally solitary; it was the unnatural aggregations in crowded wildlife markets supplying the wildlife meat trade in South China that enabled them to become potential hosts. Neither pigs nor horses are native to Australia and farm pigs in Malaysia are far removed from their wild boar relatives, so all these represent naive hosts. Intensive farming practices then promote the rapid spread of pathogens within local populations.

Introducing domestic livestock into remote areas, coupled with intensive animal husbandry practices, have created opportunities for these diseases to emerge. In the live markets of China, bats and bat products are widely sold for food and traditional medicine, bringing them into direct contact with other wildlife traded for meat such as civets. The outbreak of Nipah virus in Malaysia was similarly precipitated by human actions. Fruit bats throughout South East Asia and Australia have declined dramatically due to hunting and habitat loss; these stressors have led to changes in foraging behavior that can directly impact viral dynamics while bringing bats into close proximity with people and livestock. Pig consumption of fruit pulp spat out by the bats seems to be the

route by which infected saliva and urine passed from bats to pigs in Malaysia, and the mode of transmission from bats to horses is probably similar. Infectious diseases have emerged due to human actions that affect the availability of amplifier hosts and the ecology of reservoir hosts. These diseases will not be controlled by controlling bats, but the risks could be minimized if links between reservoir species and spillover hosts are broken. In the short term, trade in wild animals for medicine and food increases the risks, and it is clear that domestic livestock should not be housed near fruit bat feeding trees. In the long-term, research on the interaction between host ecology, species-species transmission and human modification of the environment are the most likely means by which the emergence of new infectious diseases will be controlled.

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