Bats and Viruses

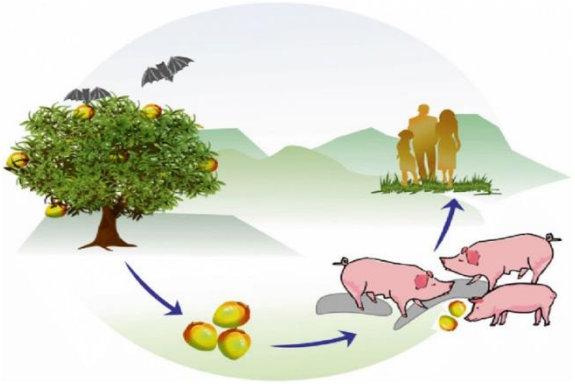
Zoonotic viruses – those transmitted from animals to humans – and viruses transmitted through contaminated food, have been the cause of several dangerous outbreaks and pandemics, particularly in Asia, where there are a high number of emerging infectious diseases due to the rich biodiversity of the region, and the growing human populations. Bats in particular are a natural host of many viruses, and the study of them has led to the discovery of many viruses, including coronaviruses, Nipah, Ebola and SARS. One of the overlooked drivers of these viruses spreading to animals and humans is human activity itself.

Nipah?

Nipah is a deadly disease with a death rate ranging from 40% to 75%, and no treatment. It is in the WHO'S top ten list of pathogens with epidemic potential, posing the greatest risk to human health. Nipah has a long incubation period, so has ample opportunity to spread between people before an infected host becomes aware they are ill, and can infect a wide range of animals through direct contact or by eating contaminated food.

Two outbreaks of Nipah, in Bangladesh and India, were linked to drinking date palm juice that had been infected by bats who had urinated in the date palm plantations nearby. From monitoring fruit bats via GPS, scientists have been able to identify several situations where there is similar risk – not just areas where fruit trees are grown (some bats have been monitored travelling up to 100km to certain forests) but also countries, for example Cambodia and Thailand, where bat faeces is commonly sold for popular fertiliser.

Moreover, the destruction of bat habitats has been directly linked to specific Nipah infections. The first documented outbreak, in Malaysia in 1998, was concluded to have been due to forest fires and local droughts forcing bats out of their natural habitat and towards fruit trees grown on the same farms as pigs. Under stress, bats have been shown to 'shed' more viruses. The combination of being forced to relocate and being in close contact with a species they do not normally interact with led the virus to move from bats, to pigs, and to farmers.



What makes the situation even more worrying is that Asia, out of all the continents, experiences one of the highest rates of biodiversity loss. In Thailand, agricultural lands amounted to 23% in 1960 of total land area vs. 40% since 1985, and similar trends have been identified in Cambodia, Vietnam, Indonesia, and many other South East Asian countries.

So is human activity is to blame for the movement of the bats?

To a large extent, yes – for several reasons. Deforestation has taken away bats' habitats. Rather than reducing numbers of the species, this has either pushed them into different locations or forced them to live in the changed environment, or both; this is because anthropized (converted by humans) environments often provide acceptable habitats for bat species, meaning that while their original habitat is destroyed, the bats survive with closer proximity to humans, and may also be encouraged to spread further afield.

In addition, anthropized environments actually result in greater biodiversity, because unlike highly selective natural environments, they accept a wide range of bat species. This can result in a higher concentration and biodiversity of bat-borne viruses. Bats are also more likely to spread to busy human areas, because lights attract large numbers of insects, which are easy prey for insectivorous bats.

However, it is important to bear in mind that the emergence of a disease is impossible to predict, and there is no evidence of the coronaviruses within bat populations being directly at the origin of infection in humans. The emergence of MERS was not attributed to deforestation but to the close vicinity of camels and people. On the other hand, the MERS virus found in Taphozous bats living in ruins might have been involved – and there has certainly been a large amount of evidence illustrating the complex dynamics of virus circulation between bats and wild or domestic animals prior to the viruses crossing to humans.

Whatever the case, it is clear that human activity is certainly one significant cause of increased risk of virus transmissions.

What questions remain?

Can we just get rid of bats? No! While this would raise huge ethical concerns, bats also play hugely important ecological roles, including pollinating hundreds of plant species and being part of disease control for other animals and humans (for example, they reduce malaria by eating mosquitoes).

What can farms do? Knowledge of risks and appropriate health and safety practices to prevent bat-to-human and animal-to-human transmission should be instigated, such as decreasing access to the sap of fruit trees, via protective coverings. Fruits with signs of bat bites should be discarded, and fruits should be thoroughly washed and peeled before consumption. Surveys have shown the market sellers in Bangladesh and India were mostly unaware bats could even carry diseases. In addition, pig feed should be protected against bats, and pigs should be kept in sheds (where possible) in areas where fruit bats are present.

Why are certain countries, despite being incredibly high risk, not experiencing outbreaks of certain viruses? This could be luck, or because different types of fruit bats are carrying different viruses or forms of viruses, or to do with humans interacting differently with the bats in each country! More research could help us to avoid outbreaks.

OTHER EXAMPLES:

Evidence indicates that alpha CoVs from the bat Hipposideros caffer ruber shared common ancestors with human HCoV-229E and that a related virus infected captive alpacas. Another related virus infected camels. Furthermore, HCoV-NL63, found in 9.3% of samples from people hospitalized for respiratory diseases displays sequence similarities with the bat CoV ARCoV.2, whereas HCoV-NL63 can replicate in cell lines derived from the lungs of tricolored bats.

MERS-CoV is closely related to both bat CoV HKU4 (found in Tylonycteris bats) and bat CoV HKU5 (found in Pipistrellus bats).

Lyssaviruses are bat-borne and infect wild and domestic mammals and humans. The best known virus from this family is rabies, but other lyssaviruses like Australian Bat Lyssavirus (ABLV), Lago virus or Duvenhage virus also represent a threat.

ABLV and Duvenhage virus are examples of bat-borne viruses directly transmitted to humans by bats, though these cases are rare.

Sources: https://forestsnews.cifor.org/63478/human-deforestation-activities-link-bats-to-ebola-outbreaks?fnl=

https://www.who.int/news-room/fact-sheets/detail/nipah-virus

Afelt, A., Frutos, R. and Devaux, C., 2018. Bats, Coronaviruses, and Deforestation: Toward the Emergence of Novel Infectious Diseases?. Frontiers in Microbiology, 9.