Human intrusion on fruit bat habitats raises exposure risk to Hendra virus in Australia

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Black flying fox (*Pteropus alecto*). Credit: James Nilson

There is a rising risk of human and domestic animal exposure to deadly Hendra virus (HeV) carried by fruit bats in Eastern Australia due to

human intrusion into their habitats, human proximity to woodlands and vegetation loss, a new study reveals.

Reported today in *Scientific Reports* by researchers from the University of Sydney, University of Melbourne and State University of New York, the study traces how pressures such as expanding human populations, urbanisation and forest fragmentation altered the shape and size of the habitats of pteropid fruit bats (flying foxes) in the decades between 1980 and 2015.

In recent years, bats from the Pteropodidae family have been pinpointed as 'natural reservoirs' of several emerging zoonotic viruses, such as Hendra virus (HeV), Nipah (NiV) and Ebola, which can cause death in humans.

Pteropid fruit bats carry HeV without becoming ill. Research has shown the black flying fox (*Pteropus alecto*) and the spectacled flying fox (*Pteropus conspicillatus*) harbor the infectious HeV and can shed HeV particles in their urine.

Their suitability as reservoirs has been linked to their capacity for flight, adaptability to different food sources, population structure, longevity and immune function.

"Pteropid fruit bats are essential pollinators and seed distributors in tropical and subtropical forests," says Dr Michael Walsh of the University of Sydney's Marie Bashir Institute for Infectious Diseases and Biosecurity, who led the study.

"Human-caused changes in their habitat exemplify the precarious balance between ecosystem integrity and human public health.

"The opportunity for the transmission of animal-borne viruses to human

populations arises when these changes in natural habitats create new configurations of ecosystems and animal populations that subsequently generate increased or unprecedented contact between human, domestic animal and wildlife communities."

Hendra virus was first identified during the first recorded outbreak of the disease in the Brisbane suburb of Hendra, Australia, in 1994. The outbreak involved 21 stabled racehorses and two human cases.

This newly emerging infectious disease made several further sporadic occurrences between 1994 and 2010 until in 2011 an unprecedented number of 18 distinct 'spillovers' more than doubled the number of known incidents.

A spillover event is defined as transmission of a pathogen such as HeV from a reservoir such as such as a pteropid fruit bat to a domestic animal such as a horse. It also includes pathogen transmission from an infected domestic animal such as a horse to a human.

As of August 2017, there have been 60 known outbreaks of Hendra resulting in the death of 102 horses, all occurring in the north-eastern coastal region of Australia.

To date, seven humans have contracted HeV in spillover events arising from the care or autopsy of ill or dead horses. Of those who tested positive for HeV, four died of the disease, including two veterinarians.

"The epidemiology of HeV spillover events indicates that expanding suburban communities may draw foraging flying foxes from nearby forest ranges into encroaching residential and community gardens and thereby, closer to horses," Dr Walsh says.

The researchers did two sets of analyses to assess whether an expansion

of the HeV reservoir was associated with an increasing trend in spillover risk.

First, they modeled changes in 1713 geo-located sightings of pteropid fruit bats *P. alecto* and *P. conspicillatus* at three different time points between 1980 and 2015 in response to factors such as climate, topography, and human migration in the preceding decade.

They found that rainfall, altitude, temperature, and human migration were highly associated with decadal changes in the ecological niche (as measured by sightings) of the black flying fox and the spectacled flying fox.

"The predicted habitat suitability for HeV reservoir pteropids expands geographically southward along the eastern coast of Australia from the earliest period in 1980-1989 to the latest in 2000-2015," Dr Walsh says.

"These changes predict that southeastern Queensland and northeastern NSW show consistently high habitat suitability, while advancing toward and beyond Sydney. There is also a corridor along the northern coast of the Northern Territory that shows a high degree of predicted habitat suitability."

In their second analysis, the researchers assessed whether HeV infections in horses and humans (spillover incidents) between 2000 and 2015 were associated with decadal changes in the ecological niche (as measured by sightings) of *P. alecto* and *P. conspicillatus* from 1980 to 2015.

They found a high association between the two, meaning the inter-decadal expanding reservoir niche of pteropid fruit bats was highly associated with a concurrent increasing trend for risk of HeV infections in humans.

Furthermore, the risk of HeV infection increased threefold as the ecological niche expanded along the coast in Queensland and NSW during the first two decades under study (1980-1999) and increased further still as habitat suitability continued to change from 2000-2015.

"The shared history between HeV spillover and the ecological niche of flying foxes notwithstanding, reservoir habitat suitability alone was insufficient to describe the spatial dependence of HeV spillover," says Dr Walsh.

"The human footprint, proximity to woody savanna, and vegetation loss were additional components of the landscape required to adequately describe the spatial dependence of spillover across eastern Australia."

The findings supported the researchers' hypothesis that the risk for HeV infection in Eastern Australia between 2000 and 2015 was associated with changes in the ecological niche of pteropid fruit bats in the decades between 1980 and 2015.

Furthermore, this risk was highly associated with human intrusion into their habitats, human proximity to woodlands and vegetation loss.

Provided by University of Sydney

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