



BATS- WILL SOCIO-ECOLOGICAL CHANGE MAKE THEM OF GREATER PUBLIC HEALTH SIGNIFICANCE IN THE FUTURE?

RELEVANCE TO CFEZI

The CFEZI assesses the risk and reduces the impact of infectious diseases in Canada. Key functions include developing tools to identify, predict and adapt to the impact of climate change on existing and emerging disease patterns and to understand the links between human, animal and ecosystem health. Bats are being increasingly recognized as important reservoirs of zoonotic viruses, but most attention in Canada has focused on their role as sources of rabies virus. Socio-ecological changes that can be expected with urbanization, habitat change and climate change coupled with recent findings of a coronavirus in Manitoba bats suggest that attention should be placed on better understanding human-bat interactions and the bat virome in Canada. There is no indication that the zoonotic disease risks from bats in Canada are changing at this time but emerging science indicates we can anticipate increasing risk of viral spill-over from bats to other species, including people, with a changing Canadian environment.

BACKGROUND

Bats are a source of emerging infections in people. Nipha, Hendra and Ebola viruses have been linked to bats and bats have been implicated to play a role in SARS and Middle-East respiratory syndrome (1,2). But in Canada, discussion of the public health implications of bats is largely restricted to rabies. There are three key reasons why it may be unwise to assume this situation will not change.

First, a coronavirus has been detected in the intestines of hibernating little brown bats (*Myotis lucifugus*) from Manitoba, as well as in the lungs of some of these individuals (3). The virus was classified as an alphacoronavirus, a group that includes zoonotic viruses. The bat appears able to maintain this coronavirus infection through 4 months of hibernation as an apparently non-pathogenic infection.

Second, white-nose syndrome (WNS) may down-regulate anti-viral responses in bats persistently infected with little brown bats coronavirus and increase the potential of virus shedding (4). Although relatively resistant to viral infections, North America bats have been decimated by the introduction of the fungus (*Pseudogymnoascus destructans*) which causes WNS. WNS is endemic in all provinces east of Manitoba and was recently detected in a colony of Manitoba bats. While there is no reason to expect zoonotic transmission of this coronavirus, the viral burden of Canadian bats is understudied, and this study (4) shows how a spreading epidemic fungal disease could affect viral shedding and therefore spillover of the coronavirus into other species.

Third, the risk of viral spill over is affected by the unique life history of bats as well as the nature and frequency of contact with people (5). Human–bat interactions are increasing as people encroach into bat habitats, and bats are use artificial structures, such as houses, as roosts. Misra et al (6) concluded that “climatic and socio-economic changes in the coming years may lead to more frequent contact between bats and humans and domestic animals, increasing the chance of spillover of bat viruses and the emergence of new infectious diseases”.

Bats are unique in their propensity to host zoonotic viruses (7). While most attention has been directed towards tropical ecosystems, fatal zoonotic bat virus have emerged in temperate countries as well, such as the bat lyssavirus in Europe (8). Other alphacoronaviruses, a SARS-like-coronavirus, MERS-like-coronavirus, and Ebola-like filovirus (Lloviu virus) have also been detected in European bats (9). Bats are known to be sources of salmonellosis and yersiniosis, histoplasmosis, cryptococcosis and blastomycosis which can be acquired by contact and ingestion of fecal material from infected animals. The significance of bats as sources of human infections in Canada for the former zoonoses is unknown.

SOCIO-ECOLOGICAL CHANGE AND SPILLOVER

Climate change

Climate influences the biogeography of bats, their access to food, timing of hibernation, reproduction and development, frequency and duration of torpor and rate of energy expenditure (10). Each of these factors can influence bat pathogen infection dynamics (5, 11). Rising temperatures already have changed habitats and shifted the distributions of many animal species, introducing the possibility of species and pathogens from central America or southern US moving northward toward Canada. Changing migration patterns of bats, (which could result from climate change) have also been implicated as a factor in spillover risk (12)

Habitat change

Land-use changes, such as agriculture land use and forestry, can affect co-occurrence and contact between bats and recipient hosts (11). Increased use and residence times of bats in urban areas has been associated elsewhere will spillover risk (12) suggesting a role for urbanization in disease emergence (12).

Concurrent stressors

The implications of the spreading epidemic of white-nose syndrome have been mentioned above. High levels of immunocompromising chemical contaminants, often pesticides, have been found in North America bats (13, 14).



OPPORTUNITY

In response to the WNS epidemic, Environment and Climate Change Canada supports a pan-Canadian network of bat health and conservation specialists. The goals of the National White-nose syndrome Response Program (Coordinated by the CWHC) is to establish an inter-agency network and coordinator position, build and expand its network and active participation, facilitate the development of monitoring programs and mitigation guidelines, facilitate disease surveillance and population recovery, and improve mitigation and communication. The CWHC serves as the principle means for WNS and other bat disease surveillance. Provincial diagnostic labs and the CFIA access bat samples as part of their rabies investigations. CWHC associates and staff are involved in several research projects designed to better understand WNS and are key contributors to virus discovery research in Canadian bats. The network and samples generated via this network provide an opportunity to supplement WNS surveillance to undertake additional testing to establish and periodically monitor changes in zoonotic pathogens in bats as well as to survey how socio-ecological stressors are changing spill-over risk.

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