BEYOND FOREST BOUNDARIES: EMERGING WILDLIFE VECTOR-BORNE DISEASES AT THE VETERINARY–PUBLIC HEALTH INTERFACE

***Aishwarya Dash & **Vaibhav Rathod**

* Student 3rd Year BVSc & AH, Institute of Veterinary Science & Animal Husbandry Siksha 'O' Anusandhan, Bhubaneswar-751003, **Student 5th year (internship) BVSc & AH,Krantisingh Nana Patil College Of Veterinary Science, Shirwal-412801

DOI: https://doi.org/10.5281/zenodo.21237138

ABSTRACT

Vector-borne diseases (VBDs) represent a significant and growing threat to global public and animal health. These diseases are transmitted by hematophagous arthropods, including mosquitoes, ticks, sand flies, fleas, and biting midges, which serve as vectors for a wide range of viral, bacterial, and protozoal pathogens. Wildlife species play a pivotal role in the ecology and epidemiology of many VBDs by functioning as natural reservoirs, amplifying hosts, and sentinels of pathogen circulation. Increasing anthropogenic activities, habitat fragmentation, biodiversity loss, urban expansion, globalization, and climate change have intensified interactions among wildlife, domestic animals, vectors, and humans, thereby enhancing opportunities for pathogen spillover and disease emergence. The movement and distribution of wildlife populations can further influence vector abundance and pathogen transmission dynamics across ecosystems. Understanding the complex relationships between wildlife hosts, vectors, pathogens, and environmental factors is critical for predicting disease outbreaks and implementing effective prevention and control measures. This review highlights the ecological significance of wildlife in the maintenance and spread of vector-borne diseases and emphasizes the importance of integrated surveillance, interdisciplinary research, and the One Health approach in mitigating the risks posed by these diseases to human, animal, and ecosystem health.

KEYWORDS: Vector-borne diseases, wildlife reservoirs, zoonoses, disease ecology, climate change, pathogen transmission, One Health, emerging infectious diseases.

INTRODUCTION

Vector-borne diseases are a highly dynamic share of emerging infectious diseases globally. Wildlife populations maintain an extensive bio-respository of zoonotic agents that can be transmitted through vectors to domestic animals and humans. Many zoonotic diseases, including Lyme disease [*borrelia burgdorferi]*, West Nile fever [*Flaviviridae]*, and tick-borne encephalitis [*Flaviviridae*], involve wildlife hosts in their transmission cycles. Progressive encroachment of suburban developments into ecosystems has heightened the risk of pathogen spillover events.

WILDLIFE AS RESERVOIRS OF VECTOR-BORNE PATHOGENS

Free-ranging fauna frequently act as competent, asymptomatic maintenance hosts, sustaining subclinical pathogen replication within natural biotopes while ensuring a persistent infectious source for feeding vectors

Major Wildlife-Associated Vector-Borne Diseases

1. Lyme disease, also referred to as Lyme borreliosis, is a bacterial infection transmitted through the bite of infected ticks. In the United States, the disease is primarily caused by *Borrelia burgdorferi*, while several other *Borrelia* species are responsible for infections in Europe and Asia. It is one of the most common tick-borne illnesses and can affect multiple organ systems if not identified and treated promptly.

The disease typically develops in three phases: early localized infection, early disseminated infection, and late-stage disease. During the initial stage, patients often experience symptoms such as fatigue, fever, headache, muscle aches, and a distinctive expanding skin rash known as erythema migrans, which may appear as a "bull's-eye" lesion. As the infection spreads, it can involve the nervous system, heart, and joints, leading to complications including neurological disorders, cardiac abnormalities, and inflammatory arthritis.

2. West Nile disease is a vector-borne viral infection transmitted primarily through the bites of infected *Culex* mosquitoes. Wild birds act as the main reservoir hosts, maintaining and amplifying the virus in nature,

while humans and other mammals are considered incidental hosts. The disease plays an important role in wildlife health, affecting numerous bird species and occasionally causing illness in horses and other animals.

Following transmission, the virus replicates in the host and may spread through the bloodstream to various organs. In severe cases, it can invade the central nervous system, leading to inflammation of the brain and spinal cord. Although most infections are mild or asymptomatic, neurological complications can occur, highlighting the importance of vector surveillance and disease prevention in both wildlife and human populations.

3. Tick-borne encephalitis (TBE) is a viral vector-borne disease caused by the tick-borne encephalitis virus and transmitted primarily through the bites of infected ticks. The disease is endemic in many parts of Europe and Asia, where wildlife species, particularly small mammals and ticks, play a key role in maintaining the virus in nature. Human infections occur most frequently during periods of high tick activity.

After transmission, the virus can spread to the central nervous system, causing inflammation of the brain and surrounding tissues. Clinical manifestations range from mild meningitis to severe encephalitis, which may be accompanied by neurological deficits or paralysis. Some patients may experience long-term neurological complications that affect daily functioning and quality of life.

Diagnosis is confirmed through the detection of virus-specific antibodies in blood or cerebrospinal fluid. As there is no specific antiviral therapy for TBE, treatment is mainly supportive. Vaccination remains the most effective preventive measure, particularly for individuals living in or traveling to endemic regions.

4. Rift Valley fever (RVF) is a mosquito-borne viral zoonotic disease caused by the Rift Valley fever virus. The disease primarily affects domestic livestock such as sheep, goats, and cattle, where it can cause significant losses due to high mortality in young animals and widespread abortions. Wildlife and mosquito populations contribute to the maintenance and transmission of the virus in endemic regions of Africa and the Arabian Peninsula.

Humans become infected through mosquito bites or direct contact with infected animals and their tissues. Clinical manifestations range from a mild flu-like illness to severe complications, including hemorrhagic disease, liver involvement, eye disorders, and neurological symptoms. Pregnant women may also face an increased risk of adverse pregnancy outcomes.

FACTORS INFLUENCING THE EMERGENCE OF WILDLIFE VECTOR-BORNE DISEASES

Climate Change

Changes in temperature, rainfall patterns, and humidity can significantly influence vector survival, reproduction, and seasonal activity. As climatic conditions become more favorable, vectors such as mosquitoes and ticks may expand into new geographic regions, increasing the risk of disease transmission.

Habitat Modification

Deforestation, agricultural intensification, urbanization, and land-use changes disrupt natural ecosystems and alter interactions among wildlife, vectors, livestock, and humans. These disturbances can create new opportunities for pathogen transmission and disease emergence.

Wildlife Trade and Animal Movement

The legal and illegal movement of wildlife can facilitate the spread of pathogens and their vectors across geographic boundaries. Translocation of infected animals may introduce diseases into previously unaffected regions, posing risks to both wildlife and human populations.

Biodiversity Changes

Reductions in biodiversity can disrupt ecological balances that naturally regulate vector populations and pathogen circulation. In some cases, the loss of species diversity may increase disease transmission by favoring competent reservoir hosts and vectors.

Globalization and Human Activities

Increasing international travel, trade, and human encroachment into wildlife habitats enhance opportunities for contact between humans, animals, and vectors. These interactions contribute to the emergence and spread of vector-borne diseases on a regional and global scale.

One Health Approach to Control

The One Health approach emphasises the interconnected nature of human, animal, and environmental health. As wildlife-associated vector-borne diseases arise from complex interactions among pathogens, vectors, wildlife hosts, livestock, and humans, their effective control requires a coordinated and multidisciplinary strategy.

Key elements of this approach include:

- Integrated surveillance systems that monitor disease occurrence in wildlife, livestock, vectors, and human populations.
- Regular assessment of vector distribution, abundance, and pathogen circulation to identify emerging health threats.

- Habitat management and targeted vector control measures to reduce opportunities for disease transmission.
- Public education and community engagement programs that promote awareness and preventive practices.
- Collaboration among veterinarians, physicians, ecologists, entomologists, and public health experts to strengthen disease prevention, detection, and response.

By fostering cooperation across multiple sectors, the One Health approach enhances disease surveillance, improves outbreak preparedness, and supports the sustainable management of wildlife-associated vector-borne diseases.

CONCLUSION

Wildlife-associated vector-borne diseases represent a significant and growing challenge for global public health, veterinary medicine, and ecosystem stability. Wildlife species act as natural reservoirs for many pathogens, while arthropod vectors such as mosquitoes and ticks facilitate transmission between wildlife, domestic animals, and humans. As a result, these diseases exist at the interface of multiple ecological systems and cannot be effectively understood in isolation.

In recent years, environmental changes including deforestation, urban expansion, climate variability, and habitat fragmentation have altered the natural balance between hosts and vectors. At the same time, increasing human encroachment into wildlife habitats and intensified contact with domestic animals have created new opportunities for pathogen spillover. These combined factors have contributed to the emergence, re-emergence, and geographic expansion of several vector-borne diseases worldwide.

Effective management of these diseases requires a strong focus on understanding wildlife reservoir dynamics, vector ecology, and environmental drivers of transmission. Strengthening surveillance systems, improving early detection methods, and enhancing risk assessment are essential for timely intervention and outbreak prevention.

In this context, the One Health approach provides the most comprehensive and sustainable strategy for control. By integrating human, animal, and environmental health disciplines, it promotes coordinated surveillance, interdisciplinary research, and collaborative response systems. This integrated framework not only improves disease prevention and control but also supports long-term protection of biodiversity and ecosystem health, ultimately reducing the global burden of wildlife-associated vector-borne diseases.

REFERENCES

World Health Organization (WHO). Vector-borne Diseases. Geneva: WHO; 2025.
Gubler DJ. Vector-borne diseases. Rev Sci Tech. 2009;28(2):583–588.
Ostfeld RS. Lyme Disease: The Ecology of a Complex System. Oxford University Press; 2011.
Kilpatrick AM, LaDeau SL, Marra PP. Ecology of West Nile Virus transmission and its impact on birds. BioScience. 2007;57(8):681–692.
Jones KE, Patel NG, Levy MA, et al. Global trends in emerging infectious diseases. Nature. 2008;451:990–993.
Karesh WB, Dobson A, Lloyd-Smith JO, et al. Ecology of zoonoses: Natural and unnatural histories. The Lancet. 2012;380(9857):1936–1945.
Centers for Disease Control and Prevention (CDC). Vector-Borne Diseases and One Health. Atlanta, USA.
Otranto D, Dantas-Torres F. The prevention of canine vector-borne diseases. Parasites & Vectors. 201
https://share.google/6GpVWFIw3g7iOVUZh
Lyme Disease Gwenn L. Skar; Marissa A. Blum; Kari A. Simonsen.Author Information and Affiliations
West Nile Virus Michael B. Clark; Timothy J. Schaefer.Author Information and Affiliations
Tick-borne encephalitis: A review of epidemiology, clinical characteristics, and management Petra Bogovic [1], Franc Strle [1]
Rift Valley fever: biology and epidemiology, Daniel Wright [1,2,*], Jeroen Kortekaas [3,4], Thomas A Bowden [5], George M Warimwe [1,6]

Cite this article:

Aishwarya Dash & Vaibhav Rathod. (2026). Beyond forest boundaries: emerging wildlife vector-borne diseases at the veterinary–public health interface. Vet Farm Frontier, 03(06), 27–29. https://doi.org/10.5281/zenodo.21237138