

Emergence or re-emergence of vector-borne diseases

Is climate one of many factors?



The blue tit, a potential West Nile virus reservoir in Europe.
G. Balança/CIRAD

Diseases transmitted by insect vectors have a major impact on human and animal health, and on the economy of societies. Because of the way in which they are transmitted, these diseases, whether or not they are zoonotic, are particularly sensitive to climate change. The biological processes involved are complex. CIRAD and its partners have been working for several years to develop models that enable a clearer understanding of these phenomena and can identify the periods and/or zones most at risk.

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Understanding the mechanisms and environmental conditions that are behind the emergence of vector-borne zoonoses is a major issue for improving control and prevention methods. The two examples below illustrate the major progress made through work by CIRAD and its partners.

Rift Valley fever

Rift Valley fever (RVF) is a “climate-sensitive” disease that is a major threat in most of Africa. It is caused by a Phlebovirus and transmitted to ruminants and man by mosquitoes (primarily *Aedes* and *Culex*). It has a dramatic sanitary and economic impact: in ruminants, mass abortions among gestating females and high mortality/morbidity in young animals; in man, there are several serious forms (notably encephalitis and a haemorrhagic form); and it can bring animal trading to a complete standstill. Senegal is currently one of the most severely affected countries in Africa. In this world region, no correlation has yet been established between extreme rainfall episodes and the occurrence of epizootics, unlike what has been observed in Kenya. However, CIRAD and



Temporary pond where the main mosquitoes that carry RVF in Senegal proliferate: in the dry season (top) © A. Tran/CIRAD; in the rainy season (bottom). © V. Chevalier/CIRAD

its partners have observed that major RVF epidemics were seen in years with simultaneous population peaks of the main two vector species, *Culex poicilipes* and *Aedes vexans*, those peaks being a direct consequence of specific, now well-described rainfall patterns. This work (entomological and serological studies, modelling) is being continued under the Vmerge project.

West Nile fever

West Nile fever (WNF), which is also transmitted by mosquitoes of the genus *Culex*, is caused by a Flavivirus. The reservoir hosts are wild birds, primarily passerines. Humans and horses can be infected, but are considered to be “epidemiological dead-ends”. In Europe, the virus has been seen in the Mediterranean since the 1960s, without any marked impact on human or animal health. However, the incidence of neurological cases in humans and horses increased sharply in the 2000s, particularly from 2010 onwards. A recent study by CIRAD and its partners showed that abnormally high temperatures, particularly in the month prior to epidemics, helped to trigger them by increasing vectorial competence and reducing the length of the gonotrophic cycle (the time between sucking blood and laying eggs). The statistical model developed can be used to generate predictive maps of the risk of transmission, which are already being used to optimize surveillance and target the most at-risk zones.



Culex mosquito, a West Nile fever vector. © CIRAD

The climate is not the only culprit

Although it often plays a role, the climate and its variations have very seldom been the only factor in the emergence of vector-borne diseases in recent decades. The concurrence in time and space of hosts – birds or ruminants – and vectors, and their ability to pass on or harbour pathogens are crucial. Reservoir distribution and density, the seasonality and geography of migration, landscape structure and the trophic preferences of the vectors present will have to be taken into account in future in order to fine-tune forecasts and reduce the impact of these diseases on health and the economy.



The starling, a potential West Nile virus reservoir in Europe. © G. Balança/Cirad

Partners

Europe: ANSES, Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail, France; ECDC, European Centre for Diseases Prevention and Control, Sweden; IRD, Institut de recherche pour le développement, France.

Africa and Middle East: ISRA, Institut sénégalais de recherches agricoles, Senegal; University of Haifa, Department of Geography and Environmental Studies, Israel.

Vmerge project: <http://www.vmerge.eu>

> For further information

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See also: <http://publications.cirad.fr>