ONE HEALTH ATLAS

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Mapping the areas at risk for transmission of a vector-borne disease (West Nile fever)

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West Nile virus (WNV), responsible for West Nile fever (WNF), is a widespread arthropod-borne virus of the genus Flavivirus. The transmission cycle of WNV is an enzootic cycle between mosquitos and birds (Figure 1). Humans and horses are considered incidental hosts. While most human infections are asymptomatic and mild cases present only flu-like symptoms, more severe cases (encephalitis, meningoencephalitis or meningitis) can occur. In Europe, the circulation of WNV has been confirmed episodically since the 1960s, but during the particularly hot summer of 2010, a very large number of human cases of WNF was reported in areas previously free of the disease. Since then, there have been annual outbreaks, suggesting an endemic transmission cycle and thus a resurgent public health problem, including safety of the blood supply.

In order to identify the environmental determinants of WNF in Europe, a One Health approach has been proposed in order to consider all factors likely to impact the presence and abundance of mosquito vectors and avian hosts. Using a statistical approach, the relationship between WNV infection status (infected or uninfected) and several environmental factors was studied at the district level (Figure 2).

Results showed that the best model to explain the infected/uninfected status of human WNF cases by district includes July temperature and early June water index anomalies, WNV circulation in the previous year, presence of wetlands, type of avian migration route, and human population. All of these factors are positively and significantly correlated with the probability of infection. These results highlight the role of water areas in the risk of WNV transmission in Europe and the relevance of a water index derived from satellite imagery to detect water areas above seasonal averages in June, which may favour high mosquito densities during the summer months and virus transmission to humans in late summer and early fall.

Maps of the probability of WNV infection by district can be produced annually based on this model (Figure 2). Built using 2001–2011 epidemiological data, the model successfully predicted the occurrence of WNV human and horse' cases in the following years, demonstrating the predictive capacity of such an approach. Thus, it could be used to assess the risk of WNV infection in the future under different climate change scenarios.

References

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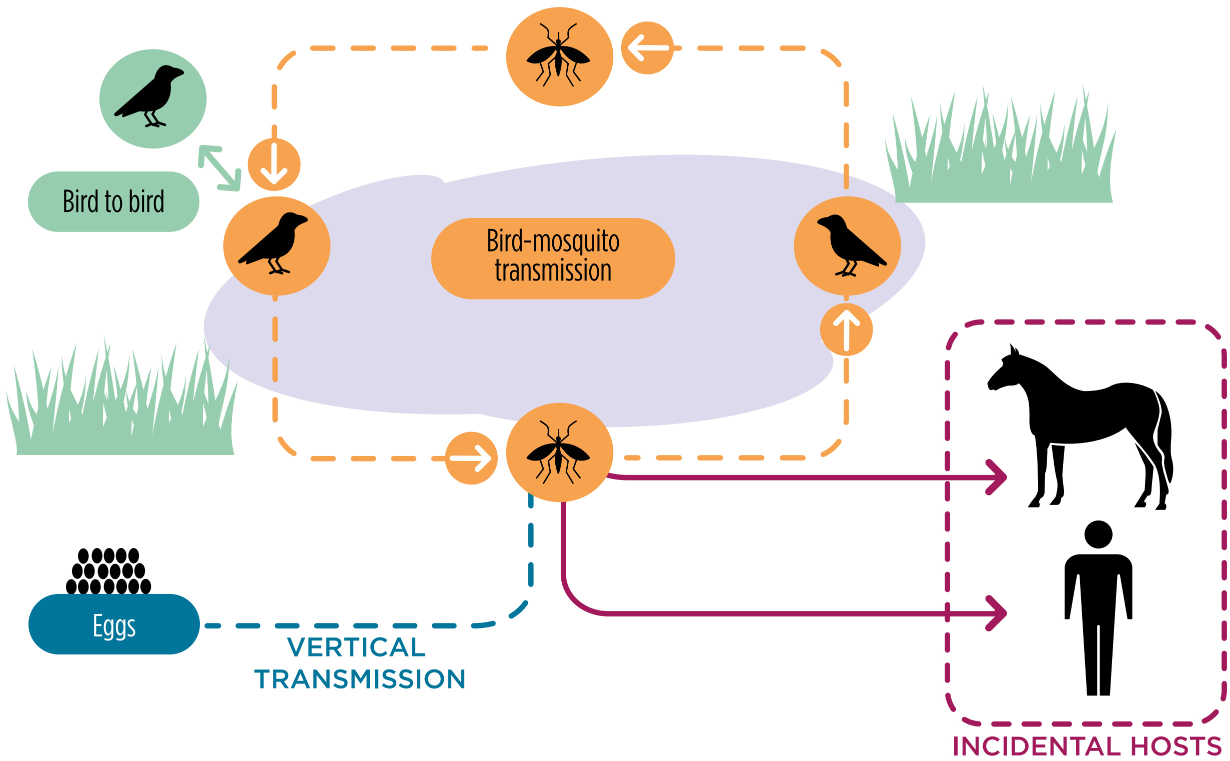

Figure 1. Schematic representation of the West Nile virus transmission cycle.

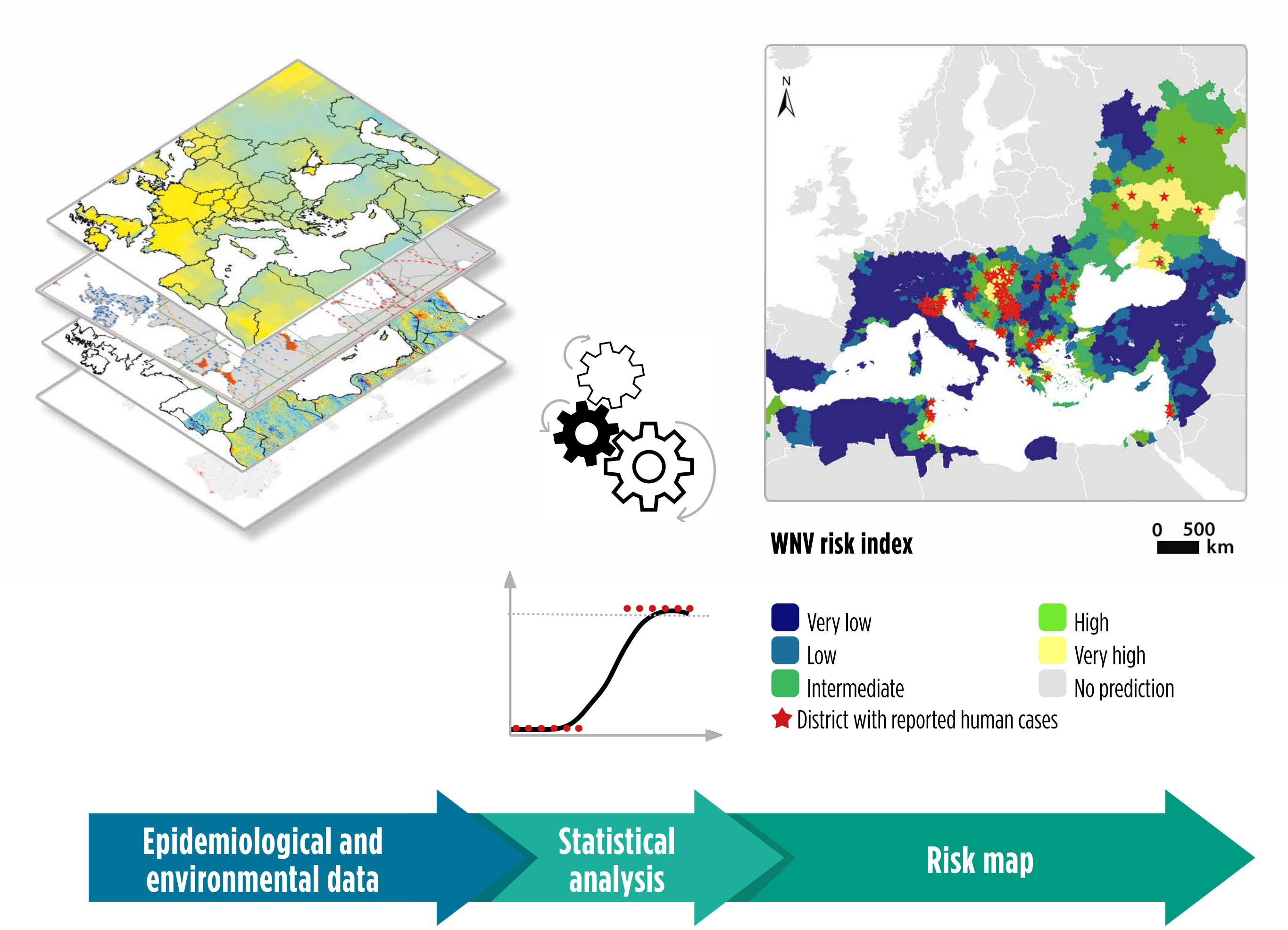

Figure 2. General framework for mapping West Nile virus (WNV) transmission risk areas in Europe based on environmental and meteorological indicators.