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Understanding the dynamics of West Nile virus in Emilia-Romagna, Italy

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West Nile Virus (WNV) has been identified for the first time in Italy in 1998, and more continuously since 2008 with a total of 173 neurological human cases between 2008 and 2015.

Still the circulation of the virus appears to have been episodic with most cases concentrated in a few years and a few hotspots shifting in different years.

The region Emilia Romagna, which is one of the most affected areas, has set up since 2009 a systematic program of mosquito and corvids (known to be among the most competent bird species for WNV) trapping and testing. Data collected through this program have been analysed through a mathematical model in order to understand the main drivers of the observed dynamics.

The analysis has mainly been based on an SIR (for competent birds)-SI (mosquitoes) model, with an environmentally driven population model, validated on independent data [1], for mosquito dynamics, and a simple population model for bird dynamics, in which the free parameters were the mosquito biting rate and the host-vector ratio.

Our results showed that simplest models with constant mosquito feeding behaviours are incompatible with the observed seasonal patterns of infected mosquitoes and birds. On the other hand, including a seasonal shift in mosquito feeding behaviour, as proposed in [2] and confirmed also for Italy in [3], makes model outputs much more consistent with observed data. Other improvements of the model allow for the age structure of the bird population, or for the presence of other untested competent bird species. Finally, multi-year simulations of a spatially-structured model show a qualitative agreement with observed patterns of spatial spread.

Our findings can be of particular interest for public health policy makers, as they provide important insights on WNV dynamics in order to improve surveillance, and risk assessment of WNV in the area.

References

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