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Wetlands Management and risk for West Nile Virus Circulation in Camargue, Southern France

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West Nile Virus (WNV) is a flavivirus transmitted between mosquitoes (mainly the genus Culex) and wild birds. Horses and humans are incidental hosts and can develop severe neurological disorders. During last decades, the number of WNV cases reported in Europe has increased dramatically. Large outbreaks of increased clinical severity have been reported in parts of Russia, Southern and Eastern Europe. In the Camargue area, WNV outbreaks have been reported in 2000, 2004 and more recently in 2015. We hypothesize that the management of Camargue wetlands could play a key role in the emergence of outbreaks in this area during recent years.

WNV transmission requires competent vectors, receptive hosts, and environmental parameters which allow contact between the vectors and the different hosts. The Rhône Delta is known for its landscape of wetlands and its wealth of different bird species. It is also a region where mosquito populations are very abundant. Recent observations have shown that environmental changes, mainly resulting from anthropogenic practices, have had an impact on inter-annual variations in the wetlands and consequently on the abundance of mosquitoes. Water is provided either by rainfall or by a very tight canal network diverted from the river Rhone. Water management is under the control of individual field owners and dependent on its various uses (grazing, rice culture, hunting reserves). This specific management of water resources could play a role in the circulation of WNV in the area.

Non-vaccinated horses (n = 1159 from 134 stables) were sampled in 2007 and 2008 in the Camargue area and a serological test was performed to identify a possible contact with the WNV. Environmental variables related to water resources and management were collected through fifteen Landsat images. Areas with open water and flooded vegetation and their variations within a year and between years (2007-08) were quantified for buffers of 2 km radius around the stables. Mean percentages of areas of open water and flooded vegetation, as well as variations in these percentages between 3 periods were calculated. The 3 periods were defined according to our knowledge on WNV circulation and epidemiology in the area, i.e. November to February (winter), not at risk period for WNV circulation; March to July (spring), mosquito-birds WNV cycle period; and August to October (autumn), WNV outbreak period.

Results of logistic regression demonstrated that horses' serological status was significantly associated with the variations of open water areas between the not at risk and the mosquito-bird cycle periods, as well as between the mosquito-bird cycle and the outbreak periods. WNV spillover was found more intense in areas where water level decreased strongly from winter to spring and from spring to autumn. These results could help decision-makers to target risk-based surveillance on high-risk areas.

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