Investigation into Usutu and West Nile viruses in ticks from wild birds in Northwestern Italy, 2012-2014

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SUMMARY
To assess the potential role of ticks as carriers of West Nile virus (WNV) and Usutu virus (USUV), we tested 1721 ticks from 379 wild birds in Northwestern Italy between 2012 and 2014. Ticks were analyzed in pools using a pan-flavivirus real-time RT-PCR and positive pools were subjected to RT-PCR for USUV and WNV genome detection. All the tested samples resulted negative, suggesting that Ixodes spp. ticks, at least in our study area, are not competent vectors and not even exploitable sentinels for USUV and WNV.

USUV, WNV, Ixodes ricinus, Ixodes spp., Flavivirus

Usutu virus (USUV) and West Nile virus (WNV) are emerging pathogens belonging to the family Flaviviridae, genus Flavivirus. Their natural cycles involve ornithophilic mosquitoes and wild bird species (Hubálek 2008). Although mosquitoes are considered the primary vectors for WNV, evidence of tick-borne transmission has been documented (Lawrie 2004).

We conducted a study to investigate the potential role of ticks as carriers and spreaders of WNV and USUV. Birds were captured using mist nets in the frame of ringing campaigns in the Scrivia river valley (province of Alessandria, Piedmont region). Between March 2012 and November 2014, ticks were systematically collected from migratory and resident birds, removed with tweezers, preserved in 70% ethanol and identified using morphological keys (Manilla 1998, Cringoli et al., 2005). RNA was extracted from ticks grouped in pools according to species, stage, host and season, with a maximum number of 20 ticks per pool. All Ixodes spp. ticks were analyzed by PCR. The presence of flaviviruses was investigated by using a pan-flavivirus real-time polymerase chain reaction (Johnson et al., 2010). Positive pools were subjected to one-step reverse transcription-PCR (RT-PCR) assays with USUV and WNV specific primers (Weissenböck et al., 2004; Chaskopoulou et al., 2011) and sequencing analysis.

Overall, 1723 ticks were collected on 381 birds belonging to 14 species; of these, 7 were short-distance and 7 long-distance migrants (Table 1). The large majority of ticks (91.9%) were collected on blackbirds (Turdus merula). Ticks were identified as Ixodes ricinus (96.1%, 1 adult, 1478 nymphs, 177 larvae), Ixodes frontalis (2 adults, 2 nymphs), Ixodes acuminatus (3 adults) and Hyalomma spp. (2 nymphs); 58 Ixodes spp. specimens (51 nymphs, 7 larvae) could only be identified at genus level as they were damaged. Blackbirds (n=300) hosted 70.7% of collected larvae and 94.6% of nymphs. A total of 159 pools were analyzed in real time RT-PCR for the presence of flaviviruses. Nineteen pools were positive with low mean Ct values (30.6±2.7). The flavivirus positive pools were then tested by specific PCR for USUV and WNV and resulted negative. Sequencing of pan-flavivirus positive samples was attempted but we did not obtain a readable chromatogram, probably due to the low virus copy numbers.

Results of this study support previous observations that blackbirds play an important role in the dispersal of immature stages of I. ricinus ticks and, in perspective, of their associated pathogens (Mannelli et al., 2005). WNV has been repeatedly isolated from ticks of Ixodidae and Argasidae families in Russia, Israel and Kenya (L’vov et al., 2002; Lwande et al., 2014; Mumcuoglu et al., 2005), and some studies suggested that selected tick species might play a role in the circulation of WNV (Anderson et al., 2003). Moreover, vector competence studies have shown the capacity for some tick species (Orihthodoros moubata, Orihthodoros erraticus, Orihthodoros maritimus, Argas arboereus and Hyalomma marginatum) to acquire WNV from infected animals and subsequently to transmit the virus to uninfected hosts (Vermeil et al., 1960; Abbasy et al., 1993; Lawrie et al., 2004; Formosinho and Santos-Silva, 2006), suggesting a potential reservoir role of ticks for WNV. However, whether or not Ixodid ticks are vectors of WNV has not been investigated in depth (Lawrie et al., 2004).

Even if the circulation of USUV and WNV has been reported in wild birds and mosquitoes in Northwestern Italy, including our study area (Victoriano et al., 2015a), none of our tick pools tested PCR positive for the two viruses. We may speculate on the reasons for the negative results. Firstly, our previous serological study of USUV and WNV involving more than 900 birds of 88 species and 14 different orders in the Scrivia river valley highlighted a low seroprevalence of both viruses (Victoriano et al., 2015b). Moreover, only few mosquito pools were found USUV and WNV positive in Alessandria province in 2013-2015 (http://sorveglianza.izer.it/emergenze/west_nile/emergenze.html). Accordingly, the negative results found in ticks may simply mirror the limited circulation of both viruses in the study area.

Key words: USUV, WNV, Ixodes ricinus, Ixodes spp., Flavivirus.
area. Secondly, Lawrie et al. (2004) reported that *I. ricinus* ticks can be infected after feeding upon WNV viremic hosts, but are unable to maintain the virus. Indeed, they did not find any evidence of WNV infection in nymphs one month after engorgement, suggesting that *I. ricinus* do not support the replication of the virus, and are not competent vectors for WNV. By extrapolation, *I. ricinus* ticks are also unlikely to be competent vectors of USUV, although this hypothesis will need experimental confirmation.

The role of *Ixodes pacificus*, as a possible vector of WNV was investigated in California by Reisen et al. (2007). In that experiment, they investigated the ability of the tick to become infected with the WNV NY99 strain while feeding on viremic song sparrows (*Melospiza melodia*), to maintain the infection transstadially, and then to transmit WNV to song sparrows. The study results indicated that *I. pacificus* ticks were not able to transmit WNV experimentally. Interestingly, a second experiment by Anderson et al. (2003) demonstrated that *Ixodes scapularis* larvae can acquire WNV from viremic mice but virus titers decreased rapidly in the days following completion of feeding. Larvae were able to pass the virus transstadially, but naive animals fed upon by nymphs did not become infected. Then, vector competence of *I. scapularis* was not demonstrated.

Our study has limitations in that the experiment was conducted in a single ringing station, and basically involved a single dominant tick species. However, Mancini et al. (2013) did not detect USUV and WNV in *Hyalomma* nymphs and a few *I. ricinus* immatures from wild birds in Central Italy. In conclusion, our negative results and the available literature point towards the conclusion that *Ixodes spp*. ticks are not competent vectors and not even exploitable sentinels for WNV and possibly USUV. However, experimental studies focusing on USUV are necessary to confirm this conclusion. Studies in other Italian locations with higher WNV and USUV prevalence are necessary to verify variations in the relative role of different ticks as sentinels or vectors. Moreover, based on our results, further research would be necessary to clarify the presence of other flaviviruses in ticks from Piedmont.

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**References**


