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FIRST RECORDS OF *Aedes koreicus* (DIPTERA, CULICIDAE) IN THE FRIULI VENEZIA GIULIA REGION (NORTH-EASTERN ITALY)

PRIMI REPERTI DI *Aedes koreicus* (DIPTERA, CULICIDAE)
IN FRIULI VENEZIA GIULIA (ITALIA NORD-ORIENTALE)

Abstract - *Aedes koreicus* (EDWARDS, 1917) (Diptera, Culicidae) is an alien mosquito native to East Asia. In Europe, the species was first found in 2008 in Belgium and, subsequently, it was reported from Italy (regions Veneto and Lombardy and province of Trento), Switzerland, Russia and Germany. This species has similar biology and behaviour to the invasive Asian tiger mosquito *Ae. albopictus* (SKUSE, 1894). *Ae. koreicus* was detected in Friuli Venezia Giulia region in September 2015 in two sites in the Pordenone province, close to the border to Veneto where the species was reported since 2011. Unlike *Ae. albopictus*, which is widespread especially in the plain urban area of Friuli Venezia Giulia, *Ae. koreicus* seems to be better adapted at higher altitudes. Therefore, the spread in the hilly and mountain areas of Friuli Venezia Giulia is likely. The species is a supposed vector of arboviruses and filariae infecting humans and animals.

Key words: Invasive mosquito species, Alien species, Establishment, Vector-borne diseases.

Riassunto breve - La zanzara *Aedes koreicus* (EDWARDS, 1917) (Diptera, Culicidae), originaria dell'estremo oriente, è stata rinvenuta per la prima volta in Europa nel 2008 in Belgio e successivamente in Italia (Veneto, Lombardia e Provincia autonoma di Trento), Svizzera, Russia e Germania. *Ae. koreicus* presenta biologia e comportamento simili a quelli di *Ae. albopictus* (SKUSE, 1894), la nota zanzara tigre. Il primo rinvenimento di *Ae. koreicus* in Friuli Venezia Giulia è avvenuto nel settembre 2015 in due comuni della provincia di Pordenone, confinanti con le località venete nelle quali la specie risulta insediata dal 2011. A differenza di *Ae. albopictus*, diffusa soprattutto nelle aree urbane di pianura del Friuli Venezia Giulia, *Ae. koreicus* sembra adattarsi meglio a quote maggiori. Pertanto, potrebbe diffondersi aggiungendosi alla molesta zanzara tigre in pianura, ma soprattutto sostituirsi ad essa nelle aree pedemontane e montane della regione. È una specie sospettata vettore di arbovirus e filarie all'uomo e agli animali.

Parole chiave: Zanzara invasiva, Specie alloctona, Insediamento, Vettore di agenti patogeni.

Introduzione

Aedes koreicus (EDWARDS, 1917) (Diptera, Culicidae) is an alien mosquito native to East Asia (China, South Korea, Japan, eastern Russia). In Europe, it was first found in 2008 in Belgium (VERSTEIRT et al. 2012a, 2012b). From 2011 to 2013 it was reported from a large piedmont area of north-eastern Italy (provinces of Belluno, Treviso, Verona, Vicenza, Trento), where it is currently established (CAPELLI et al. 2011; MONTARSI et al. 2014). In 2013 it was detected in European Russia (BEZZHONOVA et al. 2014), and in the Italian Lombardy region and Switzerland (SUTER et al. 2015). In 2015 it was found in Germany (WERNER et al. 2015).

Ae. koreicus has a biology and ecology similar to those of the invasive Asian tiger mosquito, *Ae. albopictus* (SKUSE, 1894). In Friuli Venezia Giulia this last species was first found in 1995 (ZAMBURLINI 1996) and subsequently has become the most serious biting nuisance

in the plain urban areas, as shown by the results of the specific regional entomological surveillance system (ZAMBURLINI & FRILLI 2006). Both *Ae. albopictus* and *Ae. koreicus* are multivoltine (from March to October in north-eastern Italy), overwinter at the egg stage and the immature stages colonize small, natural or artificial, water containers. Albeit polyphagous, the adults of both species prefer to bite humans during daytime.

Whereas *Ae. albopictus* is an important vector of arboviruses and filarial nematodes that can affect humans and animals (GRATZ 2004; MEDLOCK et al. 2012; SCHAFFNER et al. 2013; SCHAFFNER & MATHIS 2014), up to date the role of *Ae. koreicus* as a vector of pathogens in natural conditions is not well-defined (CAPELLI et al. 2011; MEDLOCK et al. 2012; MONTARSI et al. 2015).

Ae. koreicus seems to withstand colder temperatures than *Ae. albopictus*; in fact, in Veneto *Ae. koreicus* is prevalent over 400 m a.s.l., reaching up to 1250 m a.s.l., whereas *Ae. albopictus* is dominant under 200 m a.s.l.

(MONTARSI et al. 2014); the latter in Friuli Venezia Giulia is rare or absent over about 900 m a.s.l. (R. ZAMBURLINI, unpublished data).

The aim of this study was to verify the occurrence of *Ae. koreicus* in the Friuli Venezia Giulia, in particular in an area of the Pordenone province bordering the infested area of the Veneto region.

Materials and Methods

The study was carried out in 2014 and 2015 in 18 sites covering eight different municipalities of a piedmont area of the Pordenone province (Friuli Venezia Giulia, north-eastern Italy) (tab. I). The sampling sites are located at an altitude between 21 and 453 m a.s.l.

Immature and adults mosquitoes were collected in potential breeding water containers, such as tires, catch-basins, vases and flowerpots, located in sites with greater likelihood of infestation, such as tire markets and cemeteries.

Collected mosquitoes were observed at the stereomicroscope. Several sampled larvae and pupae were reared to obtain adults. Some specimens (larvae, larval and pupal exuviae and male genitalia) were slide mounted in Faure medium. The adults were dry preserved. Observation of morphological characters of slide mounted

specimens was carried out under a Zeiss Axioplan microscope at 100× magnification.

The identification of larvae and adults to the species level was carried out using the morphological keys by GUTSEVICH et al. (1974), and TANAKA et al. (1979). The studied material is deposited in the Diptera Culicidae collection, Department of Agricultural and Environmental Sciences - Entomology, University of Udine (Italy).

Results

Ae. koreicus specimens were found only in 2015, in two sites, i.e. the cemeteries of Marsure di Aviano and Montereale Valcellina, located respectively at 226 and 330 m a.s.l. (tab. I). Overall, five larvae, three from Marsure di Aviano site and two from Montereale Valcellina site, as well as two adult males obtained from larval rearing (one from each site), were identified as *Ae. koreicus* on the basis of the diagnostic characters (Fig. 1-6).

In all sampled sites and in both years of the survey, numerous *Ae. albopictus* specimens (larvae, pupae and adults) were collected (tab. I).

In 2015, other collected culicid species were identified as *Culiseta longiareolata* (MACQUART, 1838) (site of Marsure di Aviano) and *Ochlerotatus geniculatus* (OLIVIER, 1791) (site of Budoia) (tab. I).

Municipality	Site and date	Mosquitoes stage	N. specimens collected	Species ident. collected
2014				
Budoia	Industrial zone, tire market, 46°02'07"N, 12°32'53"E, 89 m a.s.l., 10/09/2014	Larva, pupa and adult	Numerous	<i>Aedes albopictus</i>
	Budoia, cemetery, 46°02'45"N, 12°32'17"E, 153 m a.s.l., 10/09/2014	Larva and pupa	Numerous	<i>Aedes albopictus</i>
Caneva	Caneva, cemetery, 45°57'44"N, 12°26'53"E, 43 m a.s.l., 10/09/2014	Larva and pupa	Numerous	<i>Aedes albopictus</i>
	Fiaschetti, cemetery, 45°58'38"N, 12°28'26"E, 30 m a.s.l., 10/09/2014	Larva and pupa	Numerous	<i>Aedes albopictus</i>
Polcenigo	San Giovanni, cemetery, 46°01'27"N, 12°31'06"E, 58 m a.s.l., 10/09/2014	Larva and pupa	Numerous	<i>Aedes albopictus</i>
Pordenone	Industrial zone, tire market, 45°59'26"N, 12°38'07"E, 68 m a.s.l., 10/09/2014	Larva	Numerous	<i>Aedes albopictus</i>
Roveredo in Piano	Roveredo in Piano, cemetery, 46°00'38"N, 12°37'21"E, 96 m a.s.l., 10/09/2014	Larva	Numerous	<i>Aedes albopictus</i>
Sacile	Sacile, cemetery, 45°56'43"N, 12°30'10"E, 21 m a.s.l., 10/09/2014	Larva and pupa	Numerous	<i>Aedes albopictus</i>
2015				
Aviano	Aviano, cemetery, 46°04'38"N, 12°35'23"E, 175 m a.s.l., 27/08/2015	Larva, pupa and adult	Numerous	<i>Aedes albopictus</i>
	Giais, cemetery, 46°06'49"N, 12°36'28"E, 313 m a.s.l., 27/08/2015	Larva	Numerous	<i>Aedes albopictus</i>
	Marsure, cemetery, 46°05'29"N, 12°35'33"E, 226 m a.s.l., 27/08/2015, 4/9/2015 and 15/9/2015	Larva	Numerous	<i>Aedes albopictus</i>
			3 larvae	<i>Aedes koreicus</i>
Budoia	Budoia, cemetery, 46°02'45"N, 12°32'17"E, 153 m a.s.l., 27/8/2015	Larva, pupa and adult	2 larvae	<i>Culiseta longiareolata</i>
			Numerous	<i>Aedes albopictus</i>
	Dardago, cemetery, 46°03'05"N, 12°31'56"E, 181 m a.s.l., 27/08/2015	Larva	5 larvae	<i>Ochlerotatus geniculatus</i>
Montereale Valcellina	Grizzo, cemetery, 46°08'54"N, 12°39'17"E, 300 m a.s.l., 4/09/2015	Larva and pupa	Numerous	<i>Aedes albopictus</i>
	Malnisio, cemetery, 46°08'48"N, 12°38'27"E, 296 m a.s.l., 4/09/2015	Larva and pupa	Numerous	<i>Aedes albopictus</i>
	Montereale Valc., cemetery, 46°09'59"N, 12°39'39"E, 330 m a.s.l., 15/09/2015	Larva and pupa	Numerous	<i>Aedes albopictus</i>
			2 larvae	<i>Aedes koreicus</i>
Polcenigo	Coltura, cemetery 46°02'08"N, 12°30'09"E, 58 m a.s.l.15/09/2015	Larva	Numerous	<i>Aedes albopictus</i>
	Mezzomonte, cemetery 46°02'47"N, 12°29'31"E, 453 m a.s.l.15/09/2015	Larva	Numerous	<i>Aedes albopictus</i>

Tab. I - Visited sites in the Pordenone province, in 2014 and 2015, and mosquitoes collected and identified.

- Siti visitati in provincia di Pordenone, nel biennio 2014-2015, e materiale entomologico raccolto e identificato.

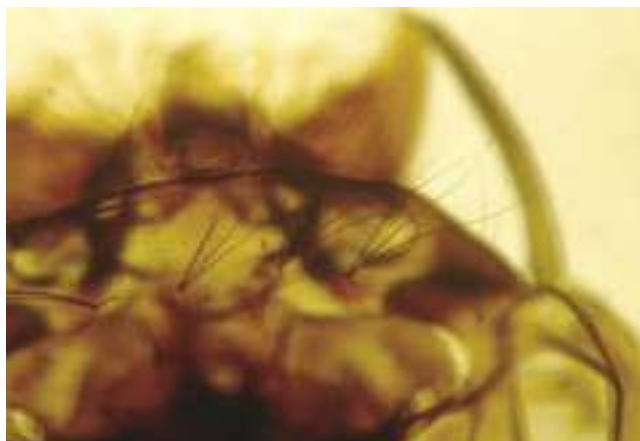


Fig. 1 - *Aedes koreicus* larva. Head, the inner and outer frontal setae with three (or more) branches.
- *Larva di Aedes koreicus*. Capo, setole frontali interne ed esterne trifide o multifide.

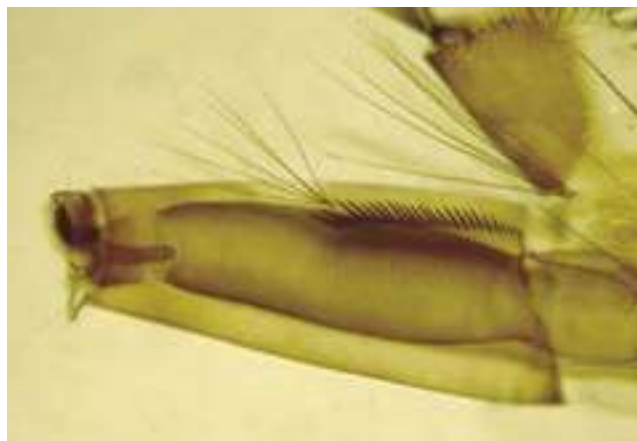


Fig. 4 - *Aedes koreicus* larva. Abdomen, siphonal pecten with 18-27 teeth bearing multiple denticles; the distal teeth form an acute angle with the longitudinal axis of the siphon.
- *Larva di Aedes koreicus*. Addome, pettine sifonico con 18-27 denti seghettati; i denti distali formano un angolo acuto con l'asse longitudinale del sifone.



Fig. 2 - *Aedes koreicus* larva. Head, antennae covered with spicules; the antennal tuft proximal to the middle of antenna with 2-4 branches.
- *Larva di Aedes koreicus*. Capo, antenne con spicole; setola antennale in posizione mediana con 2-4 rami.



Fig. 5 - *Aedes koreicus* larva. Abdomen, detail, multiple denticle on the teeth of siphon pecten.
- *Larva di Aedes koreicus*. Addome, dettaglio, denti del pettine sifonico seghettati.

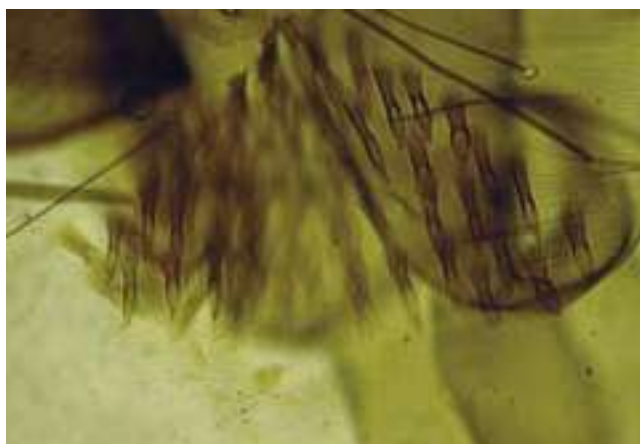


Fig. 3 - *Aedes koreicus* larva. Abdomen, VIII segment, the comb scales (30-72) apically and laterally fringed.
- *Larva di Aedes koreicus*. Addome, VIII segmento, spine del pettine (30-72) frangiate apicalmente e lateralmente.

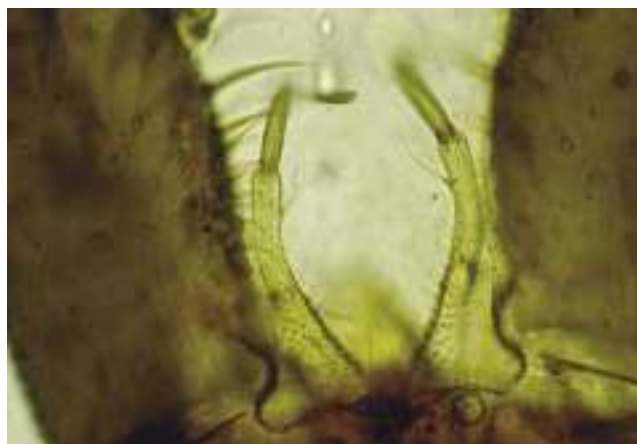


Fig. 6 - *Aedes koreicus* adult. Male genitalia, structure of the hypopigium.
- *Adulto di Aedes koreicus*. Genitali del maschio, struttura dell'ipopigio.

Discussion

The first records of *Ae. koreicus* in Friuli Venezia Giulia have both a faunal and sanitary significance, despite the already recognized occurrence in the nearby Veneto region.

From the faunal point of view, *Ae. koreicus* represents a new species of the regional mosquito catalogue together with several others found in the last two decades (ZAMBURLINI 1996; ZAMBURLINI & CARGNUS 2009). This new detection is a further evidence of the current "entomological globalization" affecting also this region (CARGNUS et al. 2013).

Moreover, the establishment and spread of another anthropophilic species such as *Ae. koreicus* could be a new source of nuisance and a new potential vector of pathogens (CAPELLI et al. 2011; MEDLOCK et al. 2012), especially at higher altitudes (over 900-1000 m a.s.l.) where the Asian tiger mosquito is so far rare or absent.

The other two species collected during the survey, *Cs. longiareolata* and *O. geniculatus*, are typical small container colonizers; they are already known for Friuli Venezia Giulia (ZAMBURLINI 1996).

Manoscritto pervenuto il 23.XI.2015 e approvato il 10.XII.2015.

Acknowledgements

Thanks to prof. Pietro Zandigiacomo of the Dipartimento di Scienze Agrarie e Ambientali (Udine University) for useful suggestions in the preliminary version of the manuscript.

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