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Trapping blood-feeding mosquitoes (Diptera: Culicidae) in the first lethal canine dirofilariasis site in Szeged, Hungary

Attila Trájer[1]*, Tamás Hammer[2] & Antal Rengei[3]

[1]*MTA-PE Limnoecological Research Group, University of Pannonia, H-8200 Veszprém, Egyetem utca 10, Hungary. E-mail: atrajer@gmail.com*
[2]*Department of Limnology, University of Pannonia, H-8200 Veszprém, Egyetem utca 10, Hungary. E-mail: hammert@almos.uni-pannon.hu*
[3]*Pet Ambulance Ltd., H-6724 Szeged, Körtöltés út 23, Hungary. E-mail: rengeiantal@gmail.com*

Abstract – Dirofilariasis caused by *Dirofilaria immitis* (Leidy, 1856) is one of the most important mosquito-transmitted filarioid infections in the Carpathian Basin and many parts of Europe. It can lead to lethal hearth infection in dogs and can be the source of serious diagnostic problems in humans. In August 2014 an exploratory mosquito collecting was performed for blood-fed mosquitoes in the site of the first known lethal canine dirofilariasis, Szeged. The trapped mosquito material showed 95% dominance of *Culex pipiens* Linnaeus, 1758. The potential vectors of *Dirofilaria immitis*, *Aedes vexans* (Meigen, 1830) and *Anopheles maculipennis* (Meigen, 1818) mosquitoes were also present in the collected material. *Ochlerotatus dorsalis* (Meigen, 1830), a species associated with the lowland sodium-rich waters was also trapped. With 9 figures and 1 table.

Key words – Culicidae, *Culex pipiens*, dirofilariasis, mosquito trapping

INTRODUCTION: DIROFILARIASIS IN THE CARPATHIAN BASIN

One of the causative agents of canine heartworm infection, *Dirofilaria immitis* (Leidy, 1856) is a mosquito-transmitted filaroid nematode which infects mammals, usually dogs (Vörös *et al.* 2000). Human *D. immitis* infections sporadically present in the European Union (Muro *et al.* 1999) mainly in the Mediterranean region (Jelinek *et al.* 1996). Literature provides several human medical aspects of *D. immitis* infection, which can be the source of serious diagnostic errors in the human medicine (Ciferri 1982, Ro *et al.* 1989), e.g. unnecessarily performed thoracotomia (Merrill *et al.* 1980). *D. immitis* also can cause severe infections of different organs as the infection of the spermatic cord (Theis *et al.* 2001) and intra-ocular infections in humans (Moorhouse 1978).

* Corresponding author.

Endemic dirofilariasis is a newcomer in the Carpathian Basin. The first autochthonous canine heartworm cases were reported from western Slovakia in 2005 (Svobodova *et al*. 2005), in 2009 in Hungary and Austria (Duscher *et al*. 2009, Jacsó *et al*. 2009). A study confirmed the presence of *D. immitis* in dogs in Northern Serbia (Tasić *et al*. 2008, Jacsó *et al*. 2009). The first proven autochthonous case of *D. immitis* infection in Hungary was confirmed in the case of a ferret (Molnár *et al*. 2010). In Hungary a serological study, which was based on the blood sample of 1305 individuals, found that about 2.4% of the dogs are infected with *Dirofilaria immitis* (Farkas *et al*. 2014). Despite the fact that in humans *Dirofilaria immitis* parasites do not usually develop into the adult form, microfilariae were found in humans (Muro *et al*. 1999).

Dirofilaria immitis caused dirofilariasis reaches its northern geographical limit in the Carpathian Basin in East Central Europe (Genchi *et al*. 2005). The annual potential average generation number of the heartworm is 1–2 in Hungary. It is plausible that if the actual climatic trend continues, the heartworm infection will spread into northern areas (Genchi *et al*. 2005). From this perspective, the heartworm disease can be used as an important, early climate health indicator of global warming.

Aedes (e.g. *Aedes scapularis* (Rondani, 1949), *Aedes taeniorhynchus* (Wiedemann, 1821) in Brasil, *Aedes albopictus* (Skuse, 1894) in Italy and Japan) and *Culex* species (e.g. *Culex quinquefasciatus* (Say, 1823) in Brasil and *Culex tritaeniorhynchus* (Giles, 1901) in Japan) are the most important vectors of *Dirofilaria immitis* (Cancrini *et al*. 2003, Labarthe *et al*. 1998, Tesh 1989). Zittra *et al*. (2015) performed mosquito trapping in 2013 to detect the potential vectors of *Dirofilaria immitis* in Szeged, and detected the presence of *Dirofilaria immitis* pathogens in *Culex pipiens* Linnaeus, 1758 and *Ochlerotatus caspius* (Pallas, 1771). We aimed the collection of the blood-feeding fauna of the case site regardless of the previous authors.

METHODS

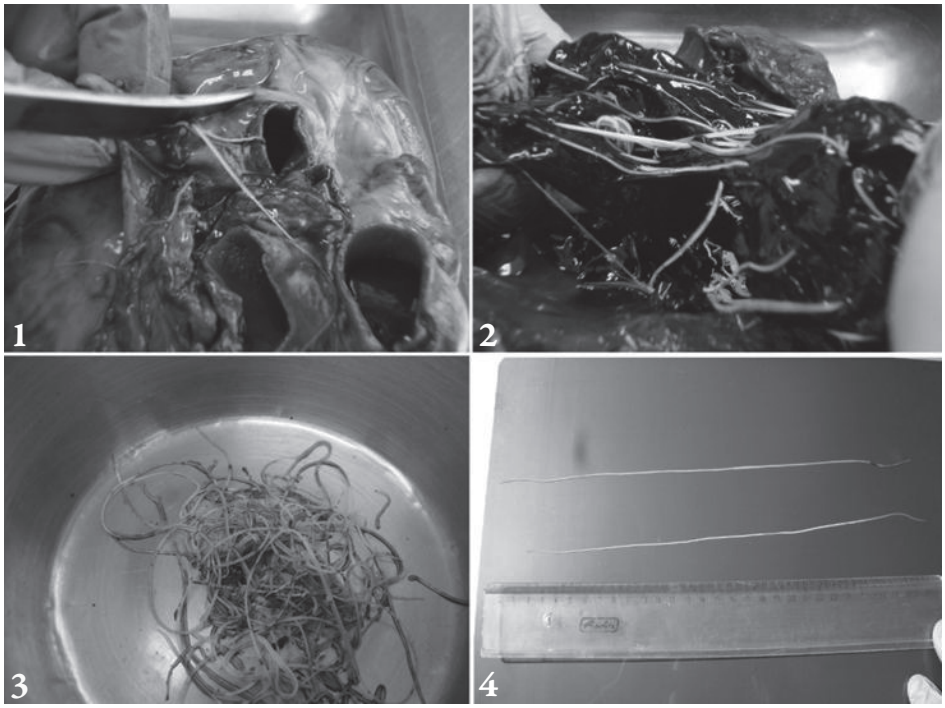
Szeged as an endemic site of canine dirofilariasis – The first emaciated 6-year-old male German shepherd dog was examined in the veterinary surgery in 4 April 2013 in the praxis of the Pet Ambulance, Szeged. The animal spent its life in Mihálytelek, a suburb district of Szeged. The animal did not have any contact with foreign dogs. Ascites, abdominal and foot edema and dyspnea were the most conspicuous clinical signs. The physicians heard cardiac murmur above the right hearth while the ultrasonography showed moving shadows in the right hearth, congestive swelling in the stomach and the viscera. Microfilariae were detected directly from the blood and the *Dirofilaria* (ag) specific ELISA serology test confirmed the suspect of dirofilariasis. Three weeks later the animal died

of caval vein syndrome. A total of 38 adult *D. immitis* specimens were collected from the right side of the heart and the pulmonary artery and 20 specimens were sent to the Department of Parasitology of the University of Veterinary Science, Budapest, where the worm species as *D. immitis* was confirmed (Figs 1–4).

In 15 January and 30 July 2014 nineteen canine *Dirofilaria immitis* cases were found and confirmed in the praxis of the Pet Ambulance of Szeged. The major parts of the cases were found in the suburban areas of the town. According to the widespread occurrence of the disease within the town it can be stated that *Dirofilaria immitis* caused dirofilariasis is endemic in the area (Fig. 5).

Mosquito trapping – Mosquito trapping was performed with a Bio Mosquito Trap™ collector in the night of 4 and 5 August 2014 from 7:00 pm to 7:00 am in the first known canine infection case site. The used collector was a non-specific UV-trap and had no chemical attractant component.

The weather in the trapping days was hot and humid and it was a storm in the night of the trapping. The collector was operated in the place of died dog and hanged about 180 cm height. The material was kept in dry, cool environment. The non-mosquito elements were removed from the material.



Figs 1–4. Adult *Dirofilaria immitis* (Leidy, 1856) filariae: 1–2 = in the right ventricle, in situ photograph, 3–4 = ex situ photograph (photo A. Rengei)

RESULTS

Culicinae – *Ochlerotatus dorsalis* (Meigen, 1830) (Fig. 6) and *Aedes vexans* (Meigen, 1830) (Fig. 8) formed only about 5% of the trapped biting mosquitoes. *O. dorsalis* is a frequent member of the mosquito fauna of saline lakes. It is notable that the original habitat of *O. dorsalis* was one of the saline lakes near to Szeged. *Culex pipiens* Linnaeus, 1758 (Fig. 9) formed the major part (almost 95%) of the collected biting mosquito material (Table 1).

Anophelelini – The members of the *Anopheles maculipennis* (Meigen, 1818) complex (Fig. 7) formed also a small portion, only 1.7% of the collected mosquitoes.

DISCUSSION

Almost 95% of the material was dominated by *C. pipiens* which is a confirmed vector of *D. immitis* in Hungary (Kartman 1953, Zittra *et al.* 2015).

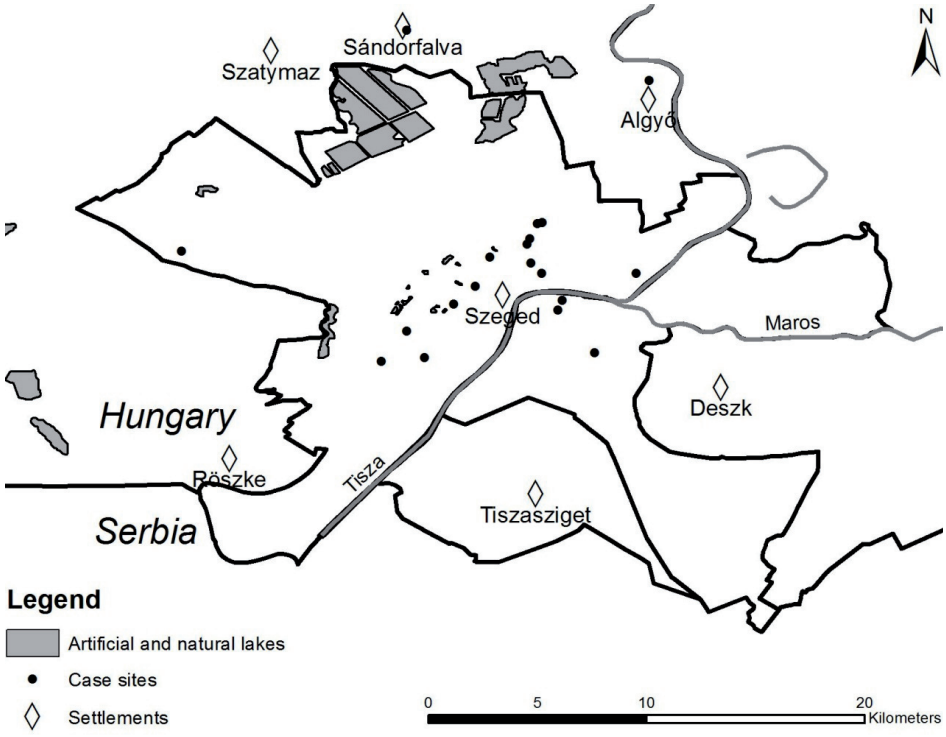
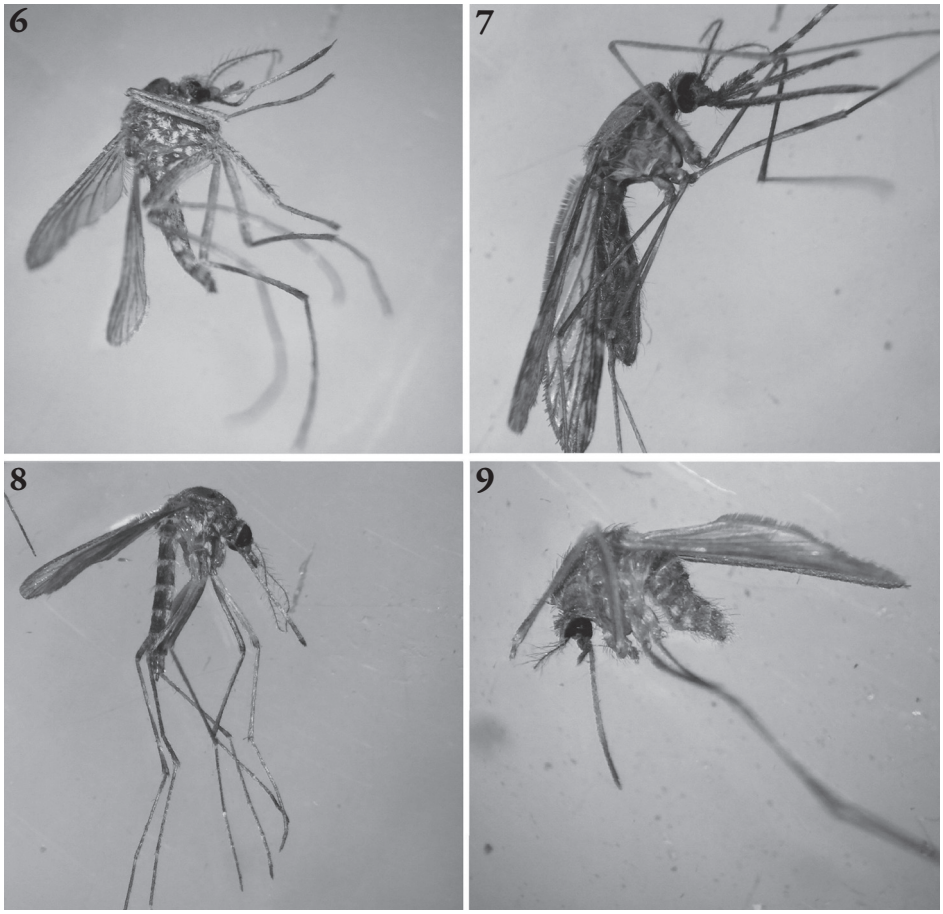


Fig. 5. Spatial occurrence of canine *Dirofilaria immitis* (Leidy, 1856) cases in the praxis of the Pet Ambulance, Szeged in 15 January and 30 July 2014

Table 1. The trapped mosquito species. Vector status according to Walters & Lavoipierre (1982), Rossi *et al.* (1999), Zittra *et al.* (2015); ? = vector status is unknown

Species name	*Dirofilaria immitis* vector status	Number of specimens	%
Aedes (Aedimorphus) vexans (Meigen, 1830)	confirmed and suspected vector status	14	4
Anopheles (Anopheles) maculipennis complex	possible vector status	6	1.7
Culex (Culex) pipiens Linnaeus, 1758	confirmed and suspected vector status	332	94.85
Ochlerotatus (Ochlerotatus) dorsalis (Meigen, 1830)	?	2	0.57



Figs 6–9. The trapped mosquito species: 6 = *Ochlerotatus dorsalis* (Meigen, 1830), 7 = species of the *Anopheles maculipennis* (Meigen, 1818) complex, 8 = *Aedes vexans* (Meigen, 1830), 9 = *Culex pipiens* Linnaeus, 1758 (photo M. Vass & A. Trájer)

In addition, several other studies confirmed the *D. immitis* vector status of *C. pipiens* by the identification of the non-infective stage of *D. immitis* in *C. pipiens* (Vezzani *et al.* 2011) or by detecting the filarial DNA in the mosquito (Yildrim *et al.* 2011).

Aranda *et al.* (1998) emphasised the importance of *C. pipiens* in the transmission of the filaria in canine cases. The habitat preference of the found species coincides with the frequency found; however, the number of *C. pipiens* highly exceeded the number of the other species. *A. vexans* is a cosmopolitan species preferring flooded grasslands and the inundation area of rivers. *A. maculipennis* mosquitoes prefer several types of aquatic habitats. *C. pipiens* is a very frequent species in Hungary and also prefers several types of the aquatic habitats (Kenyeres & Tóth 2008). The above mentioned species are common elements of the Hungarian mosquito fauna, and only *O. dorsalis*, which is a not too frequent, but typical species of the mosquito fauna of the lowland saline waters forms a rarer element within the collected mosquito material.

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