Illegally dumped white goods waste as a potential nematocera breeding habitats

Jozef Oboňa[1] – Zuzana Matúšová[2] – Miroslav Očadlík[3] – Soňa Ščerbáková[3] – Peter Manko[1]

Abstract

This paper has the ambition to bring information about importance and significance of specific small water bodies – called anthrotelmata in Slovakia. These artificial habitats often arise from illegally disposed waste. These overlooked small, but important ecosystems, are occupied by remarkable and often epidemiologically significant insect species in favourable conditions. In the present study, three fly taxa - mosquito (Culex pipiens), *midge* (Chironomus *sp.*) *and non-biting moth flies* (Clogmia albipunctata) *were found. The importance of selected taxa found in illegally dumped fridge as well as the need for research of anthrotelmata are highlighted.*

Keywords

anthrotelmata, human waste, puddles, diptera, mosquitoes, epidemiology

Introduction

With the growth of the human population, the amount of garbage produced also increases (e.g. McKinney 2002). There are various ways that a householder can dispose of their old white goods responsibly. However, it is not a rarity to find areas which have become illegal dumping hot-spots (e.g. in the outskirts of villages, in woods, in ravines, canals etc.) (e.g. Jordá-Borrell et al. 2014). Substances contained in fridges and other white goods and e-waste are very harmful for the environment if disposed of incorrectly. Improperly disposed waste may also retain precipitation water and create small waters bodies in certain conditions. These small water bodies belong to specific group of habitats called anthrotelmata (sing. anthrotelma) - a wide variety of small, temporary water habitats artificially created as a result of human activities (Williams 2006). They can serve as temporary habitats for development and reproduction of many aquatic or semiaquatic organisms. In proper climatic conditions, many organisms are able to complete their larval life cycles in these habitats and expand into the surrounding environment. Different Diptera families were included in some studies dealing with artificial or man-made containers-breeding species (e.g. Ebeling 1975; Hribar et al. 2004; Rubio et al. 2012) recognising that wide range of aquatic habitats is used by dipterans. Despite the abundance of these habitats, their research is being of very small interest in

[1] *Department of Ecology, Faculty of Humanities and Natural Sciences, University of Prešov, 17. novembra 1, SK–081 16 Prešov, Slovakia; obonaj@centrum.sk,*

[2] *Stred 364, 027 05 Zázrivá, Slovakia; zuzana.matushova@gmail.com*

[3] *Water Research Institute, Nábrežie arm. gen. L. Svobodu, SK–812 49 Bratislava 1, Slovakia; scerbakova@vuvh.sk, ocadlik@vuvh.sk*

Slovakia. In tropical and subtropical regions, these habitats are much more in interest of scientists particularly due to the higher epidemiological risk. There are number of epidemiologically interesting organisms breed in these habitats (e.g. Culicidae, Ceratopogonidae, etc.) (e.g. O'Meara et al. 1997). However, also in Europe, other anthrotelmata may serve as a habitat for expanding epidemiologically significant species (e.g. Schaffner et al. 2009) or for native species which could be agents of various diseases (e.g. Oboňa et al. 2017). Moreover, waste (discarded man-made objects with retention capacity) as a source of aquatic insect habitats is of marginal attention except for used tyres which is known as an important breeding-sites. Its transport is the mechanism of dissemination of invasive aquatic invertebrates from which many are potential disease vectors (e.g. Medlock et al. 2015). Therefore, it is necessary, to pay attention to temporary habitats to consider their importance, mitigate their health risks and better understand biology and ecology of their fauna.

Material and methods

This report represents only a small contribution to knowledge and significance of anthrotelmata. It is based on the finding of illegally discarded waste (part of an old fridge) at the border of the forest near Lanice (Zvolen town, 295 m a.s.l.) on August 30. 2014 (Fig. 1). Unfortunately, such findings are not rare in Slovakia, but it has attracted our attention because of apparently high density of diptera larvae.

Figure 1. Small illegal anthrotelma with a Multi 3401i (WTW).

Basic environmental parameters, such as pH, temperature, oxygen saturation, and conductivity (25 °C), were measured with Multi 3401i (WTW) in the field (Fig. 1, Tab. 1).

Table 1. The values of basic environmental water parameters.

Water temperature (°C)	pH	Dissolved oxygen (%)	Conductivity (µS/cm)	Water volume (l)
16	7.416	0.2	403	1.3

Substrate were taken by D-shaped hand net (mesh size 0.2 mm) from the anthrotelma, deposited in the collection container and transported to laboratory. In laboratory, all insect samples were sorted and preserved in 75% ethanol and then identified to the lowest possible taxonomic level using general and specialized keys for benthic macroinvertebrates (Rozkošný 1980; Langton 1991; Nilsson 1997; Becker et al. 2003). The material is deposited in the Laboratory and Museum of Evolutionary Ecology, University of Prešov, except non-biting midges (deposited in the Department of Hydrobiology, Microbiology and Ecotoxicology, Water Research Institute, Bratislava, Slovakia).

Results and discussion

Overall, from the anthrotelma were obtained 60 insects individuals which belong to three families of Diptera order (see Tab. 2).

Table 2. List of insect taxa from anthrotelma.

Diptera		
Chironomidae *Chironomus* sp.	**Culicidae** *Culex pipiens* Linnaeus, 1758	**Psychodidae** *Clogmia albipunctata* (Williston, 1893)
10	5	45

Artificial water bodies are commonly known as ecosystems with lower species diversity and more extreme environmental parameters than the natural ecosystem (Williams 1996; Wood et al. 2001; Williams et al. 2003). Because water in anthrotelma came from precipitation, it is affected by the leaching of organic matter from the surrounding environment (leaf litter, soil, etc.) and was characterized by oxygen deficiency, higher conductivity, and neutral to slightly alkaline pH (see Tab 1). The presence of three different taxa in this temporary ecosystem is undoubtedly interesting. These taxa exhibit characters of R-strategy. According to McLachlan (1993), these species are widely spread, have rapid growth, short life cycles and are not food specialists, rather generalists. It seems that these species are likely to be the most frequent and successful colonizers of such temporary aquatic ecosystems. Certainly, worth is mentioning the possible epidemiological significance of the environment through the organisms that inhabit it. The epidemiological significance

of *C. pipiens* mosquitoes is well known (e.g. Becker et al. 2003). This species can transfer a number of pathogens that can infect humans and animals. This is, for example, West Nile Virus (Filipe 1972) or Sindbis virus (Francy et al. 1989).
Notable is also the presence of *C. albipunctata* in this habitat. It is an expanding, originally tropical and subtropical species. In Europe, it represents a new synanthropic species, known only for a few years in Slovakia (Ježek et al. 2012; Oboňa & Ježek 2012a; Oboňa et al. 2016). It appears, that *C. albipunctata* are gradually trying to colonize also non-anthropogenic habitats (Oboňa & Ježek 2012b; Kvifte et al. 2013). Medvecká et al. (2014) have indicated that if the invasive species in the new environment are stalled, they are beginning to invade both semi-natural and natural habitats. For *C. albipunctata*, however, the ability to survive winter season in these non-synantropic habitats is still questionable. Likewise, this species is epidemiologically interesting as a potential agent for urogenital myiasis (e.g. Hovius et al. 2011). Many nematocera larvae are able to survive in discarded tires and artificial water containers in houses and peridomestic areas (Detachew et al. 2015). The types of the containers, water quality, and conditions of water containers are important for breeding (Chen et al. 2009)
Anthrotelmata are numerous but overlooked temporary aquatic habitats which can be inhabited by many interesting organisms. Because they are almost always present in the urban environment or in its immediate vicinity, it is necessary to pay more attention to them, especially for the presence of several epidemiologically interesting species particularly in tropical and subtropical regions where diversity of insect vectors and also diseases agents are much higher.

Acknowledgements
This study was partly supported by the Slovak Scientific Grant Agency, contract No. VEGA-2/0030/17 and by the Slovak Research and Development Agency under the contract No. APVV-16-0236.

Literature

Becker, N. – Petric, D. – Zgomba, M. – Boase, C. – Dahl, C. – Lane, J. – Kaiser, A., 2003. Mosquitoes and their control. Kluwer Academic / Plenum Publisher, New York. p. 498.

Chen, C. D. – Lee, H. L. – Stella-Wong, S. P. – Lau, K. W. – Sofian-Azirun, M., 2009. Container survey of mosquito breeding sites in a university campus in Kuala Lumpur, Malaysia," Dengue Bulletin, 33(1): 187–193.

Ebeling, W., 1975. Urban entomology. Univ. California Press, Berkeley, CA (1975), pp. 553–577

Filipe, A.R., 1972. Isolation in Portugal of West Nile virus from *Anopheles maculipennis* mosquitoes. Acta Virol. (Praha) 16: 361

Francy, D.B. – Jaenson, T.G.T. – Lundström, J.O. – Schildt, E.B. – Espmark, A. – Henriksson, B. – Niklasson, B., 1989. Ecologic studies of mosquitoes and birds as hosts of Ockelbo virus in Sweden, and isolation of Inkoo and Batai viruses from mosquitoes. Am. J. Trop. Med. Hyg. 41: 355–363.

Getachew, D. – Tekie, H. – Gebre-Michael, T. – Balkew, M. – Mesfin, A., 2015. Breeding sites of Aedes aegypti: potential dengue vectors in Dire Dawa, East Ethiopia. Interdisciplinary perspectives on infectious diseases, 2015. Article ID 706276, 8 p

Hovius, J.W. – Wagner, R. – Ziegler, J. – Mehlhorn, H. – Grobusch, M.P., 2011. A hairy problem. What is your diagnosis? Photo Quiz (p. 531). Answer to Photo Quiz (p. 534). The Netherlands Journal of Medicine 69(11): 531–534.

Hribar, L.J. – Vlach, J.J. – DeMay, D.J. – James, S.S. – Fahey, J.S. – Fussell, E.M., 2004. Mosquito larvae (Culicidae) and other Diptera associated with containers, storm drains, and sewage treatment plants in the Florida Keys, Monroe County, Florida. Florida Entomologist 87(2): 199–203.

Ježek, J. – Lukáš, J. – Kvifte, G.M. – Oboňa, J., 2012. New faunistic records of non-biting moth flies (Diptera: Psychodidae) from the Czech Republic and Slovakia. Klapalekiana 48: 121–126.

Jordá-Borrell, R. – Ruiz-Rodríguez, F. – Lucendo-Monedero, Á.L., 2014. Factor analysis and geographic information system for determining probability areas of presence of illegal landfills. Ecological Indicators 37: 151–160.

Kvifte, G.M. – Ivković, M. – Klarić, A., 2013. New records of moth flies (Diptera: Psychodidae) from Croatia, with the description of *Berdeniella keroveci* sp.nov.. Zootaxa 3737 (1): 057–067

Langton P.H., 1991. A key to pupal exuviae of WestPalaearctic Chironomidae. Private publication. Langton PH, 3, St. Felix Road, Ramsey Forty Foot, Huntingdon, Cambridgeshire. England PE17 1YH. p. 324

McKinney, M.L., 2002. Urbanization, biodiversity, and conservation: the impacts of urbanization on native species are poorly studied, but educating a highly urbanized human population about these impacts can greatly improve species conservation in all ecosystems. Bioscience 52(10): 883–890.

McLachlan, A., 1993. Can two species of midge coexist in a single puddle of rain-water? Hydrobiologia 259: 1–8

Medlock, J.M. – Hansford, K.M. – Versteirt, V. – Cull, B. – Kampen, H. – Fontenille, D. – Hendrickx, G. – Zeller H. – Bortel, W. – Schaffner, F., 2015. An entomological review of invasive mosquitoes in Europe. Bulletin of entomological research 105(6): 637–663.

Medvecká, J. – Jarolímek, I. – Senko, D. – Svitok, M., 2013. Fifty years of plant invasion dynamics in Slovakia along a 2,500 m altitudinal gradient. Biol Invasions (2014) 16: 1627–1638.

Nilsson, A.N., 1997. Aquatic Insects of North Europe: A Taxonomic Handbook. Odonata-Diptera, Volume 2. Apollo Books: Stenstrup, Denmark. p. 440

O'Meara, G.F. – Evans, L.F. – Womack, M.L., 1997. Colonization of rock holes by Aedes albopictus in the southeastern United States. Journal of the American Mosquito Control Association 13: 270–274.

Oboňa, J. – Balážiová, L. – Cáfal, R. – Dobránsky, M. – Filipovič, P. – Ivčič, B. – Ježek, J. – Matúšová, Z. – Očadlík, M. – Ox, K. – Smoľák, R. – Tábi, L. – Vojtek, P., 2016. Additions to the range expansion of the invasive moth midge *Clogmia albipunctata* (Williston, 1893) in Slovakia (Diptera: Psychodidae). Acta Universitatis Prešoviensis, Folia oecologica 8(1): 5–14.

Oboňa, J. – Demkova, L. – Smolak, R. – Dominiak, P. – Sčerbákova, S., 2017. Invertebrates in overlooked aquatic ecosystem in the middle of the town. Periodicum biologorum 119(1): 47–54.

Oboňa, J. – Ježek, J., 2012a. Range expansion of the invasive moth midge Clogmia albipunctata (Williston, 1893) in Slovakia (Diptera: Psychodidae). Folia faunistica Slovaca 17 (4): 387–391

Oboňa, J. – Ježek, J., 2012b. First records of dendrolimnetic moth flies (Diptera: Psychodidae) from Slovakia. Klapalekiana 48: 279–287

Rozkošný, R., 1980. Klíč vodní chlarev hmyzu. Academia, Praha. p. 519

Rubio, A. – Bellocq, M.I. – Vezzani, D., 2012. Community structure of artificial container-breeding flies (Insecta: Diptera) in relation to the urbanization level. Landscape and urban planning 105(3): 288–295.

Schaffner, F. – Kaufmann, C. – Hegglin, D. – Mathis, A., 2009. The invasive mosquito Aedes japonicus in Central Europe. Med. Vet. Entomol. 23: 448–451.

Williams, D.D., 1996. Environmental constraints in temporary fresh waters and their consequences for the insect fauna. J. N. A. Benthol. Soc. 15(4): 634–650.

Williams, D.D., 2006. The Biology of Temporary Waters. Oxford University Press

Williams, P. – Whitfield, M. – Biggs, J. – Bray, S. – Fox, G. – Nicolet, P. – Sear, D., 2003. Comparative biodiversity of rivers streams, ditches and ponds in an agricultural landscape in Southern England. Biol. Conserv. 115: 329–341.

Wood, P.J. – Greenwood, M.T. – Barker, S.A. – Gunn, J., 2001. The effects of amenity management on the conservation value of aquatic invertebrate communities in old industrial pools. Biol. Conserv. 102: 17–29.