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Short note

The fruits of laziness: a case study on the Asian bush mosquito and the drain fly

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Abstract
The paper provides brief information about the ability of the Asian bush mosquito (*Aedes japonicus* (Theobald, 1901), Diptera: Culicidae) and the drain fly (*Clogmia albipunctata* (Williston, 1893), Diptera: Psychodidae) larval stages to survive under laboratory conditions at a temperature of 4°C. According to our observations, Asian bush mosquito larvae were able to survive these conditions for up to 5 months. The observed results confirm that this invasive species is able to overwinter in the natural environment even via the larval stages; however, overwintering mostly in the eggs stage has been predominantly observed. Drain fly larvae were able to survive in these conditions for only 48 hours. Therefore, we believe that this invasive species is not able to overwinter in the natural environment and prefers protected synanthropic habitats.

Keywords: experiment, Diptera, *Aedes, Clogmia,* larval stages, low temperature

Introduction

The results presented in this research come from other projects, and they are the "fruits" of laziness and the pandemic measures. The fourth-instars larvae of the Asian bush mosquito (*Aedes japonicus* (Theobald, 1901)) were originally collected from rainwater barrels in a private garden. Larvae of the drain fly (*Clogmia albipunctata* (Williston, 1893)) were obtained from our own laboratory breeding. The living larvae of both targeted organisms were placed in a refrigerator with a constant temperature of 4°C (Min. 2.50°C Max. 5.50°C Mean 3.82°C Median 4.00°C) and an average humidity of 26% in mid-October 2021.
Note: The DS1925L-F5# Thermochron, a high-resolution iButton® focused on low-temperature applications, was used to measure the temperature in the refrigerator.
The *A. japonicus* larvae were kept in glass 200 ml containers filled up to one a half with rain water. The *C. albipunctata* larvae were placed in similar containers filled up to one-fifth with a wet organic substrate. The containers were closed with a breathable fabric in an effort to prevent the escape of any possibly emerged adults. All containers were first checked after a 5-month period on 15 March 2022. Subsequently, an identical experiment was established, but only for a 7-day period in which the samples were checked every 24 hours.

Case study of *Aedes japonicus* (Theobald, 1901) larvae

Larvae of *A. japonicus* were able to survive 5 months of exposure under laboratory conditions at the temperature of 4°C. During the 7-day experiment, the larvae were alive at each daily observation. *A. japonicus* is a cold-tolerant invasive species that overwinters primarily in the egg stage (Haddow et al. 2009) however, overwintering in the larval stage has also been observed (Iriarte et al. 1991; Andreadis et al. 2001; Scott 2003; Andreadis & Wolfe 2010; Kaufman et al. 2014). Adults of the Asian bush mosquito are active earlier in the spring and later in the fall in comparison to ecologically similar species (Miyagi 1971; Takaoka 1982; Irish & Pierce 2008). Larvae of *A. japonicus,* which can be found earlier in the year than other container-dwelling species (Irish & Pierce 2008), inhabit rock pools, tree holes, bamboo stumps and artificial containers, particularly those made of stone or concrete (e.g., Miyagi 1971; Sota et al. 1994; Čabanová et al. 2021). Reuss et al. (2018) noted that the Asian bush mosquito can develop to female adults in temperatures ranging from 7°C to 31°C, while larvae cannot survive from 0°C to 5°C. On the contrary, our findings (4°C) pointed to the ability of this species to adapt to new and unfavourable conditions and thus its tolerance for the winter is also changing. Another possibility is that there are more genetic populations in Europe (see e.g., Čabanová et al. 2021) and they have different cold tolerances. Further research in this area is therefore needed.
The results of our experiment confirm the ability of the species to overwinter not only in the stage of an egg, but also in the larval stage. According to our results, the species is obviously able to survive winter directly in the natural environment and especially in small-scaled water-filled tree hollow cavities (dendrotelmata) or in water containers or flower pots (antropotelmata) stored in cellars or conservatories.

Case study of *Clogmia albipunctata* (Williston, 1893) larvae

Larvae of *C. albipunctata* did not survive 5 months of exposure under laboratory conditions at the temperature of 4°C. Equally, during the 7-day experiment, approximately

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50% of the larvae died after the first 24 hours of observation. During the second observation, after 48 hours of exposure, 100% larvae mortality was observed. *C. albipunctata* is an expansive, often synanthropic moth midge species alien to Europe. Its larvae develop in sewer drains, plant pots, swamps, etc. In winter, the species occurs at all stages in human dwellings (e.g., Oboňa & Ježek 2012; Ezer 2015; Oboňa et al. 2016, 2021; Trájer & Juhász 2017; Salmela et al. 2019; Zittra et al. 2020; Morelli & Biscaccianti 2021). Humans can easily disperse *C. albipunctata* over long distances with garbage or small water containers, such as car tires. Underground sewage systems may aid local dispersal. Alternatively, the species may spread on its own during the summer, when it also breeds outdoors (Boumans et al. 2009). However, our experiment confirms that the species is obviously unable to survive winter in the natural environment in the larval stages, since longer exposures (>48 hours) at low temperatures (<5°C) are fatal to the larvae; it prefers protected synanthropic habitats.

Summary

Larvae of the two invasive Diptera species were tested for the ability to survive a longer (5 months), as well as shorter (7 days) period under laboratory conditions at the temperature of 4°C. Based on our observations, larvae of the Asian bush mosquito *A. japonicus* were able to survive at a temperature of 4°C for up to 5 months. The drain fly *C. albipunctata* larvae were unable to live at a temperature of 4°C, since after 48 hours 100% larvae mortality was observed. *A. japonicus*, a cold-tolerant invasive species, is therefore obviously able to overwinter even in the larval stage, especially in protected, small-scale ecosystems e.g. in tree holes, water containers, flowerpots in cellars or conservatories. Therefore, its entry into natural ecosystems may be earlier, and its impact on native species could be greater. Equally, the species' ability to overwinter also in the larval stages provides a possible basis for the creation of stable, year-round populations even in areas with a traditional cold winter period. In connection to the medical importance of the species as a possible vector of the several mosquito-borne diseases, information is becoming more serious. *C. albipunctata* is obviously able to overwinter only near human dwellings. Therefore, its entry into natural ecosystems occurs later and therefore its impact on native species, in comparison to *A. japonicus,* is suggested to be lower.

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References

Andreadis TG, Anderson JF, Munstermann LE, Wolfe RJ, Florin DA. 2001. Discovery, distribution, and abundance of the newly introduced mosquito *Ochlerotatus japonicus* (Diptera: Culicidae) in Connecticut, USA. *Journal of Medical Entomology* 38(6): 774779.

Andreadis TG, Wolfe RJ. 2010. Evidence for reduction of native mosquitoes with increased expansion of invasive *Ochlerotatus japonicus japonicus* (Diptera: Culicidae) in the northeastern United States. *Journal of medical entomology* 47(1): 43–52.

Boumans L, Zimmer J–Y, Verheggen F. 2009. First records of the 'bathroom mothmidge' *Clogmia albipunctata*, a conspicuous element of the Belgian fauna that went unnoticed (Diptera: Psychodidae). *Phegea* 37: 153–160.

Čabanová V, Boršová K, Svitok M, Oboňa J, Svitková I, Barbušinová E, Derka T, Sláviková M, Klempa B. 2021. An unwanted companion reaches the country: the first record of the alien mosquito *Aedes japonicus japonicus* (Theobald, 1901) in Slovakia. *Parasites & Vectors* 14(1): 1–10.

Ezer E. 2015. První nálezy koutule *Clogmia albipunctata* (Williston, 1893) (Diptera: Psychodidae) na východní Moravě. *Acta Carpathica Occidentalis* 5: 190–191.

Haddow AD., Moulton JK, Gerhardt RR, Mccuiston LJ, Jones CJ. 2009. Description of the egg of *Ochlerotatus japonicus japonicus* (Diptera: Culicidae) using variable pressure scanning electron microscopy. *Journal of Medical Entomology* 46(1): 9–14.

Iriarte WLZ, Tsuda Y, Wada Y, Takagi M. 1991. Distribution of mosquitoes on a hill of Nagasaki city, with emphasis to the distance from human dwellings. *Tropical medicine* 33(3): 55–60.

Irish SR, Pierce CS. 2008. Update on the distribution of *Ochlerotatus japonicus* in Oregon and Washington. *Journal of the American Mosquito Control Association* 24(1): 110–111.

Kaufman MG, Fonseca DM. 2014. Invasion biology of *Aedes japonicus japonicus* (Diptera: Culicidae). *Annual review of entomology* 59: 31–49.

Kaufman MG, Stanuszek WW, Brouhard EA, Knepper RG, Walker ED. 2014. Establishment of *Aedes japonicus japonicus* and its colonization of container habitats in Michigan. *Journal of medical entomology* 49(6): 1307–1317.

Miyagi I. 1971. Notes on the *Aedes* (*Finlaya*) *chrysolineatus* subgroup in Japan and Korea (Diptera: Culicidae). *Tropical Medicine* 13(3): 141–151.

Morelli A, Biscaccianti AB. 2021. New records of moth flies (Diptera Psychodidae) mainly from protected areas of peninsular Italy. *Redia* 104: 111–123.

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, Ježek J. 2012. 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, Fogašová K, Manko P, Korneyev VA. 2021. The moth fly *Clogmia albipunctata* (Diptera: Psychodidae) in Ukraine. *Ukrainska Entomofaunistyka* 12(3): 13–16.

Reuss F, Wieser A, Niamir A, Bálint M, Kuch U, Pfenninger M, Müller R. 2018. Thermal experiments with the Asian bush mosquito (*Aedes japonicus japonicus*) (Diptera: Culicidae) and implications for its distribution in Germany. *Parasites & vectors* 11(1): 1–10.

Salmela J, Keskitalo M, Metsälä P. 2019. Perhossääski *Clogmia albipunctata* (Williston) havaittu Suomesta (Diptera, Psychodidae). *Sahlbergia* 25(1): 15–17.

Scott JJ. 2003. The ecology of the exotic mosquito *Ochlerotatus (Finlaya) japonicus japonicus* (Theobald 1901) (Diptera: Culicidae) and an examination of its role in the West Nile virus cycle in New Jersey. Dissertation, The State University of New Jersey-New. Available from: https://www.academia.edu

Sota T, Mogi M, Hayamizu E. 1994. Habitat stability and the larval mosquito community in treeholes and other containers on a temperate island. *Researches on population ecology* 36(1): 93–104.

Takaoka H. 1982. Microsporidan infection of *Aedes japonicus* larvae in Japan. *Medical Entomology and Zoology* 33(1): 71–72.

Trájer A, Juhász P. 2017. A *Clogmia albipunctata* (Diptera: Psychodiadae) kórházihigiénés jelentősége. *In Egészségtudomány* 61(3): 1–53.

Zittra C, Schoener ER, Wagner R, Heddergott M, Duscher GG, Fuehrer HP. 2020. Unnoticed arrival of two dipteran species in Austria: the synanthropic moth fly *Clogmia albipunctata* (Williston, 1893) and the parasitic bird louse fly *Ornithoica turdi* (Olivier in Latreille, 1811). *Parasitology Research* 119(2): 737–740.