

Brief Report

Hitchhiking Exotic Clam: *Dreissena polymorpha* (Pallas, 1771) Transported via the Ornamental Plant Trade

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Abstract: Ornamental aquaculture is one of the main sources of non-native species worldwide. Unintentionally transported “hitchhiking” organisms have been previously recorded; although most of these species are transported from tropical regions, here we report on the first accidental transport of the zebra mussel (*Dreissena polymorpha*) in a shipment of ornamental *Aegagropila linnaei* (Chlorophyta) from Russia to the Czech Republic. This invasive mussel is listed on the national blacklist of alien species in the Czech Republic and can be easily released in outdoor garden ponds together with *A. linnaei*. Since the Czech Republic is known to be a gateway for aquatic ornamental species from a European perspective, re-export to other European countries is also possible. Thus, the spread of *D. polymorpha* via this pathway cannot be excluded. This finding should be of importance to conservationists, traders, decision-makers and other stakeholders.

Keywords: zebra mussel; *Aegagropila linnaei*; Europe; aquarium; invasive species



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In the era of globalization, biological invasions cause huge environmental and socio-economic losses worldwide, costing billions of dollars each year [1]. Ornamental aquaculture was identified as one of the main sources of non-native organisms [2–5] with thousands of individuals of thousands of animal and plant species transported per day both intra- and intercontinentally via the pet trade [6–10]. The occurrence of non-native biota is generally perceived as unwanted and harmful, even if there also exists certain examples of introduced endangered species such as *Arapaima gigas*, the fish of ornamental origin which is native and endangered in South America and recorded in the wild in Indonesia as a potential invader [11]. Therefore, decision-makers try to regulate this pathway via legislative restrictions, but the effectiveness is controversial and contentious in certain cases due to poor education of the general public in this regard [12].

When intentionally released or accidentally escaped, ornamental species can establish, multiply, and subsequently spread to the vicinity and behave as invasive, such as the marbled crayfish *Procambarus virginalis* in many European countries [13] and the apple snail *Pomacea* sp. in South Europe [14]. Certain ornamental species have been recorded in small quantities in the wild, such as the redclaw *Cherax quadricarinatus* [15] and the Mexican dwarf crayfish *Cambarellus patzcuarensis* [16] in Hungary, but their further spread cannot be excluded, at least in the case of the latter. Moreover, non-native pathogens, such as oomycete *Aphanomyces astaci* causing crayfish plague, are transmitted by their ornamental hosts [17,18] and can persist in the new environment by infecting native species even if their hosts do not survive.

Not only ornamental species are highlighted in this regard, but also associated biota have been recorded as being transported via this pathway [19,20]. These faunal assemblages are also known as “hitchhikers” and their ornamental hosts can be both animals and plants [21,22]. The predicted and discussed invasion potential of so-called hitchhikers is usually higher in comparison with ornamental species [23]. Some species are transported

without close association with any of the ornamental species and can live without hosts freely when introduced to a new locality, and thus their invasion potential is high [22,24]. Improving knowledge about the spread of non-native species including hitchhikers via the international pet industry is crucial to establish effective management strategies to reduce introduction rates. The Czech Republic is known as one of the leading importers and exporters of aquatic ornamental species [2,8]. Most of these organisms are imported from tropical regions in South and South-east Asia, Africa and South America, while imports from other countries in temperate zones are mostly overlooked [2,7].

Therefore, we decided to inspect the shipment of dark green ornamental Marimo (also known as *Cladophora* balls or moss balls), which is a rare form of *Aegagropila linnaei* (Chlorophyta), to check on the possible presence of hitchhiking organisms. The shipment included 100 pcs of Marimo balls and was delivered by van from Moscow river in Russia, with a stop in Ukraine, to the Czech Republic in January 2021. Within the personal inspection we found one living and vital individual of freshwater zebra mussel *Dreissena polymorpha* [25]. This voucher individual had a shell length of 18 mm (Figure 1), which indicated it to be in the adult stage [26]. The voucher specimen was preserved in pure alcohol and deposited at the Department of Zoology and Fisheries, Czech University of Life Sciences Prague, the Patoka's Lab Collection, No. JP2021/01-001. The record is in line with anecdotal notes on *Dreissena polymorpha* associated with Marimo balls by hobbyists and aquarium owners [27]: <https://eu.indystar.com/story/news/environment/2021/03/12/here-5-things-know-invasive-zebra-mussels-mossballs/4652002001/> (accessed on 19 July 2021).



10 mm

Figure 1. The voucher specimen of zebra mussel *Dreissena polymorpha* transported via the ornamental plant trade from Russia to the Czech Republic; scale bar is equal to 10 mm.

Dreissena polymorpha (Bivalvia: Dreissenidae) is native to the Ponto-Caspian region [28], and thus Moscow river is out of its native range. *Dreissena polymorpha* appeared here from the middle of the 19th century [29,30]. The main method of dispersal of *D. polymorpha* is its 'natural' spread through channels and other artificial constructions, while drifting macrophytes and human transport can also be viewed as vectors of this mollusc dispersal [31]. For example, it was recently demonstrated that the overland transport of boats can facilitate dispersal of this species [32,33]. This clam is one of the most successful biofouling and prolific aquatic invasive species, jeopardizing native biota and entire ecosystems [34]. It is currently spread in 33 European countries (including the Czech Republic), 33 U.S. states and territories, and two provinces of Canada [35]. With the use of byssal threads, this mussel attaches to hard submerged surfaces and substrates, forming large colonies which may cause increased water turbidity, displacement of native mussel species, and alteration of nutrient cycling and trophic relationships [35–37]. Moreover, mutualistic interactions between *D. polymorpha* and certain invasive aquatic macrophytes from the genera *Elodea*, *Myriophyllum*, and *Potamogeton* have been recorded to enhance the biomass of the mentioned species [37]. Certain species from the first two mentioned genera are included on

the list of invasive species of European Union concern (Regulation No. 1143/2014 on the prevention and management of the introduction and spread of invasive alien species).

Dreissena polymorpha was first recorded in the current territory of the Czech Republic in the early 1900s [38]. Subsequently, based on classification as invasive species with massive environmental impacts, it was added in the national blacklist of alien species [39]. Marimo balls are recommended as suitable species for ornamental outdoor pond planting/stocking (see: https://rybicky.net/atlasrostlin/cladophora_aegagropila [in Czech] (accessed on 19 July 2021)), a hobby which has increasing popularity in the Czech Republic [40]. Therefore, it is obvious that overlooked hitchhiking *D. polymorpha* can be released together with the Marimo balls and penetrate new waterbodies, for instance, when the ornamental pond is flooded.

Since the Czech Republic has been identified as a gateway for aquatic ornamental species from a European perspective, many imported animals and plants are subsequently re-exported abroad [2]. Thus, hitchhikers can be easily transported via this pathway to other European countries together with ornamental species.

From the aforementioned, it follows that *D. polymorpha* is a species of global concern and monitoring its introduction pathways is very important for improving the effectiveness of focused management and regulations. The first record of its introduction via international trade with ornamental aquatic plants should be of the attention of conservationists, traders, decision-makers and other stakeholders. Moreover, our finding highlighted the importance of monitoring the route of certain ornamental species transportation from non-tropical regions to the global market.

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