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Research Article

Range Extension of the Ponto-Caspian polycheate *Manayunkia caspica* Annenkova, 1929 (Annelida: Fabriciidae) in the Danube River

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Abstract: Freshwater polychaetes are the most diverse in the Palaearctic, including the Ponto-Caspian region as an important area of diversity. One of several polychaete species that are spreading from this area is *Manayunkia caspica*. For a certain period of time, the range of this species in the Danube River has been limited, probably because of the Iron Gate dam. This Ponto-Caspian species, which is established along the Romanian stretch of the Danube River, was recorded for the first time in the Serbian part of the river in November 2005, and subsequently, it has been repeatedly found in the Iron Gate II Reservoir at 934 rkm (the town of Kladovo). During the Joint Danube Survey 3 (JDS 3) in September 2013, it was observed that *M. caspica* has extended its distribution from the Ponto-Caspian region to Central and Western Europe, with Klizska Nema (Slovakia/Hungary) as the most upstream locality. The findings presented herein show that the distribution of *M. caspica* has for the first time expanded upstream of the Iron Gate, where it appeared to have established population, making this species a regular component of the macroinvertebrate fauna along the entire stretch of the Danube River.

Key words: Polychaeta, alien species, spread, Danube River.

Introduction

The genus *Manayunkia* Leidy, 1858 belongs to Fabriciidae (Annelida), a clade of small-bodied (usually 2–6 mm in length), mainly marine fan worms, previously classified as a subfamily within Sabellidae. However, a recent molecular phylogenetic study places them closer to Serpulidae than to the other sabellids (Huang et al. 2011). As the authors observed, this is a group that generally inhabits shallow water, and is mostly found living intertidally on hard substrates. Unusually for polychaetes, some fabriciids live in fresh water, and the genus *Manayunkia* is one of them.

Freshwater polychaetes are the most diverse in the Palaearctic region, and besides Lake Baikal, the second notable area of diversity is the Ponto-Caspian region comprised of waters with low salinity (0.5–5%) of the Black and Caspian seas (Glasby & Timm 2008). There are several polychaete species that are spreading from this area, such as *Hypania invalida* (Grube, 1860), which is widespread in the Danube

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region (Bacesco 1948, Popescu & Prunescu-Arion 1961, Rusev & Marinov 1964, Kothé 1968, Popescu-Marinescu 1992, 1997, Šporka 1998, Tittizer et al. 2000, Zorić et al. 2011) and *Manayunkia caspica* Annenkova, 1929, whose range has been limited by the Iron Gate dam. The latter Ponto-Caspian species was found in the Danube River for the first time in 1943 and has become common along almost the entire Romanian stretch of the river (Popescu-Marinescu 2008). It reached the Serbian Danube River section in November 2005 (Jakovčev-Todorović et al. 2006), and after this initial finding the species has been repeatedly recorded in the Iron Gate II Reservoir at 934 rkm (at the town of Kladovo) (Martinović-Vitanović et al. 2009). Both *H. invalida* and *M. caspica* belong to the most ancient group of polychaetes called Ponto-Caspian relicts (Surugiu 2008).

On its anterior part, the genus *Manayunkia* has a radiolar crown of tentacles attached to the joined prostomium and peristomium. The individuals live in horizontal tubes, but can also abandon them (Timm 2009). The reproductive method in the fabriciids appears to be relatively uniform (Rouse 1995), with oviposition, egg development and larval stages that take place in the maternal tube. There are several larval stages from an egg to an adult, and larvae are never free-living. The sizes of adult specimens vary depending on the reproduction period, and the greatest length is reached during maximum breeding intensity, from May to September for *M. caspica* (Popescu-Marinescu 1964).

According to the taxon list of the World Register of Marine Species (WoRMS Editorial Board 2019), there are nine nominal species of the genus *Manayunkia* (Read & Fauchald 2019). Two of them appear to be true freshwater animals, *M. baicalensis* (Nusbaum, 1901) and *M. speciosa* (Leidy, 1859) (Holmquist 1967), with the latter species recognized as invasive in North America. *Manayunkia speciosa* serves as an intermediate host of the myxosporean parasite *Ceratomyxa shasta* (Noble, 1950) that causes intestinal infections and mortality of juvenile chinook salmon (*Oncorhynchus tshawytscha* (Walbaum in Artedi, 1792) (Schloesser 2013).

Regarding *Manayunkia caspica* Annenkova, 1928, additional research is needed to determine its invasiveness and to better understand how the presence of this species will affect existing communities.

This paper contributes to the knowledge of *M. caspica* distribution in the Danube River by presenting new findings of the species upstream of the Iron Gates, which shows the extending of its range from the Ponto-Caspian region to Central and Western Europe.

Materials and Methods

The material was collected during the Joint Danube Survey 3 (JDS 3) in September 2013. More than 2,580 km of the Danube River were investigated, including 68 sites.

The sampling methodology of biotic and abiotic components is explained in detail in Liška et al. (2015). A modified multi-habitat-sampling approach (AQEM Consortium 2002) was performed to highlight the importance of specific microhabitats in terms of biodiversity, and a combination of techniques was used: kick and sweep multihabitat sampling (EN 27828 (1994)) with a FBA hand net, mesh size 500 µm and dredging. The macroinvertebrate assemblages were fixed in 4% formaldehyde and stored in 70% alcohol.

Results

During JDS 3, *M. caspica* (Fig. 1) was recorded at five localities (presented in Table 1), with Klizska Nema as the most upstream locality. At most localities, *M. caspica* was recorded in low abundance, while the sampling site between Slovakia and Hungary (Iza/Szony) is distinguished by a higher number of specimens.

Discussion

Most of the sampling sites were dominated by a medium-sized substrate, which corresponds to previous findings of *M. caspica* in the Danube River and observations that it prefers habitats with a hard substrate (gravel, cobbles, pebbles, and coarse medium-sized sand) (Popescu-Marinescu 2008, Martinović-Vitanović et al. 2009). Further, Popescu-Marinescu (2008) has noted that *M. caspica* is the most oxyphilic among the three Ponto-Caspian polychaetes found in the Danube River (the other two *Hypaniola kowalewskii* (Grimm, 1877) and *H. invalida*). Although *M. caspica* has no individual saprobic indicator value, it has always been recorded under mesosaprobic conditions (Martinović-Vitanović et al. 2009).

There is no doubt that Ponto-Caspian species spread very fast in freshwater ecosystems since they have the ability to adapt successfully to different environmental conditions. Their high dispersal potential could be due to a combination of several ecological and biological characteristics, especially those linked to euryhalinity, nonspecific food preference, reproductive factors, such as rapid growth, early sexual maturity, short generation time,

A B

Fig. 1. *Manayunkia caspica* from sampling site JDS19 (Iza/Szony). A – The whole specimen; B – Anterior part with the radiolar crown and two eyes.

Table 1. New records of *Manayunkia caspica* along the Danube River during JDS3.

Country	Sampling site	River km	Number of individuals	Hydromorphology
Romania/Bulgaria	JDS49 Pristol/Novo Selo	834	1	coarse gravel (20-63 mm) high current flow (>0.7 m/s) bank reinforcement in small sections of the river stretch
Hungary	JDS21 upstream of Budapest	1660	1	medium gravel (6.3–20 mm) medium current flow (0.3–0.7 m/s) no hydrological alterations/free-flowing river stretch
Hungary	JDS20 Szob	1707	5	medium gravel (6.3–20 mm) medium current flow (0.3–0.7 m/s) bank reinforcement in small sections of the river stretch
Slovakia/Hungary	JDS19 Iza/Szony	1761	183	fine and medium gravel (2–20 mm) medium current flow (0.3–0.7 m/s) bank reinforcement in large sections of the river stretch
Slovakia/Hungary	JDS17 Klizska Nema	1790	1	no hydrological alterations/free-flowing river stretch

high fecundity and the existence of a dispersive phase (larvae) (Bij de Vaate et al., 2002, Gabel et al. 2011). Norf et al. (2010) demonstrate the importance of larval dispersal through the water column for *H. invalida*, which is capable of establishing dense populations exclusively by settlement of drifting juveniles, and thus, explain its rapid range expansion throughout European waterways. However, *M. caspica* does not have free-living larval stages, which could be the cause of its slower upstream spread along the Danube River.

We can further ask the question if this species, unlike *H. invalida*, has been restricted by the Iron Gate dam for so long? Martinović-Vitanović et al. (2009) suggested, regarding the facts that damming has complex and numerous consequences, including changes in hydrological regime and substrate type (slowing current velocity and increasing deposition of suspended matter) that *M. caspica* found a suitable microhabitat to establish its population at Kladovo (934 rkm), while its further expansion and the spread of many macroinvertebrates in the Danube River, were prevented by the dam.

It is obvious that *M. caspica* is capable of overcoming different barriers (such as dams) and establishing populations in new environments. Our results show that this Ponto-Caspian species has expanded its current distribution and become a regular component of the macroinvertebrate fauna along the entire stretch of the Danube River.

Although of low abundance and with no obvious repercussion on native fauna so far, *M. caspica* needs further research in order to determine its invasiveness and to better understand how its presence will affect existing communities in the upstream sections of the Danube River.

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