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NEW DATA TO THE DISTRIBUTION OF THE RECENTLY APPEARED REPRESENTATIVES OF THE ORDER MYSIDA (CRUSTACEA) IN THE HUNGARIAN FAUNA: *KATAMYSIS WARPACHOWSKYI* G. O. SARS 1893 AND *HEMIMYSIS ANOMALA* G. O. SARS 1907

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ÚJ ADATOK A MYSIDA REND (CRUSTACEA) MAGYAR FAUNÁBAN ÚJABBAN MEGJELENT TAGJAI ELTERJEDÉSÉHEZ: *KATAMYSIS WARPACHOWSKYI* G. O. SARS 1893 ÉS *HEMIMYSIS ANOMALA* G. O. SARS 1907

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KIVONAT: Hosszú ideig a pontusi tanúrák (*Limnomysis benedeni*) volt az egyetlen Magyarországon előforduló Mysida faj. Az utóbbi néhány évben azonban további két ponto–kaszpikus eredetű hasadtlábú rákfaj jelent meg a magyar faunában. A mikroherbivor *Katamysis warpachowsky*it 2001-ben találták meg, a másik fajt, a mindenevő *Hemimysis anomalá*t 2005-ben írták le először. Ez utóbbi faj rendkívül nagy intenzitással terjed, meghódította csaknem egész Európát (a Mediterráneumot leszámítva), újabban pedig az észak–amerikai Nagy–tavakban is megjelent. Terjedésüket valószínűleg a hajózás segíti. Magyarországon jelenleg csak a Dunából ismertek. A *Katamysis warpachowskyi* a 2002-2003-as időszak mintáiból a Duna főágának számos helyéről előkerült. A *Hemimysis anomalá*t 2006-ban kimutattuk haltáplálékból. Megjelenésük következményeinek felmérése további vizsgálatokat igényel.

ABSTRACT: For a long time *Limnomysis benedeni* was the only mysid species occurring in Hungary. However, in the last few years two additional Ponto–Caspian mysid species appeared in the Hungarian fauna. The microherbivore *Katamysis warpachowskyi* was found in 2001, the other species, the omnivore *Hemimysis anomala* was first described in 2005. The latter species is spreading with high intensity; it invaded almost all of Europe (except for the Mediterranean), and recently appeared in the North American Great Lakes, too. Their spread is probably promoted by navigation. In Hungary they are known currently only from the Danube. *Katamysis warpachowskyi* turned up at several locations of the main arm of the Danube from the samples of the period 2002-2003. We found *Hemimysis anomala* in fish diet in 2006. Assessing the consequences of their appearance needs further research.

Key words: Mysida, *Katamysis warpachowskyi*, *Hemimysis anomala*, occurrence in Hungary, invasion

Introduction

In the last few decades considerable changes have taken place in the biodiversity of the Danube, which affected every group of the organisms including the macrofauna of the littoral region. Primarily, the change has meant decrease in species number and population density (WACHS 1997, TITTIZER 2006), but the immigration of non-indigenous species has also played a role (TITTIZER 2006). Neither has the Hungarian reach of the Danube been devoid of these changes, of course. A good example for the appearance of non-indigenous species is the appearance of the three mysid species in the Hungarian fauna. *Limnomysis benedeni* Czerniavsky 1882 appeared first, the first specimens were collected in September 1946 in the Lágymányosi-öböl (WOYNÁROVICH 1954). For a long time this was the only mysid species occurring in Hungary. However, in the last few years two additional Ponto–Caspian mysid species appeared in the Hungarian fauna. *Katamysis warpachowskyi* G. O. Sars 1893 was found in 2001 (WITTMANN 2002), *Hemimysis anomala* G. O. Sars 1907 was first described in 2005 (WITTMANN 2007). In this article we would like to contribute to the knowledge about the distribution of the two latterly found species. Our samplings yielded *Katamysis warpachowskyi* at several locations of the main arm of the Danube from the samples of the period 2002-2003. We found *Hemimysis anomala* in fish diet in 2006. Additional samples from the two wetland areas of the Danube (Szigetköz and Gemenc) are under processing.

Material and methods

The species

Katamysis warpachowskyi G. O. Sars 1893

This originally Ponto–Caspian species expanded its range in the upper and middle Danube and in the Don (WITTMANN 2002, 2007). In October 2001 it was found at several sites of the Austrian Danube, and in the Slovakian–Hungarian reach at Komarno (Slovakian side) and Komárom (Hungarian side) (WITTMANN 2002). In July 2005 it was evinced from the Croatian and from the Serbian Danube (WITTMANN 2007).

The habitat preference of this species is broad. The largest densities were observed in anthropogenic sites, on boulders and stones of rip-raps, but they also occur on natural substrates with plant detritus, among macrophytes, etc. (WITTMANN 2007). They prefer deep waters (>1,5 m) (WITTMANN 2007), where they cling to solid surfaces tightly; therefore, they can tolerate strong current (WITTMANN 2002). The oxygen demand of this species is relatively high, about 6 mg/l (WITTMANN 2002). They feed predominantly on algae, which is similar to the diet of *Limnomysis benedeni* (WITTMANN 2002).

Hemimysis anomala G. O. Sars 1907

The mysid shrimp *Hemimysis anomala* is native in the Black, Caspian and Azov Seas and about 50 km upstream in the discharging rivers. In the 1950s and 1960s it was deliberately introduced into several reservoirs in the former Soviet Union, including Lithuania (ARBACIAUSKAS 2002) to enhance fish production. However, in the last 15 years it performed a rapid range expansion throughout North, Northwest and Central Europe. In 1992 it was found in the Baltic Sea near Finland (SALEMAA and HIETALAHTI 1993) and in 1995 near Sweden (KAUTSKY 1996,

cit. in: JANAS and WYSOCKI 2005). In 1997-1998 it was recorded in The Netherlands (KELLEHER et al. 1999, cit. in: KETELAARS et al. 1999), and in the rivers Rhine and Neckar, Germany (SCHLEUTER et al. 1998). In 1998 it reached the Austrian Danube (WITTMANN et al. 1999), followed by Belgium in 1999 (VERSLYCKE et al. 2000). The invasion continued in 2002 in the Gulf of Gdansk and the Odra estuary, Poland (JANAS and WYSOCKI 2005), in 2003 in the Czech Republic (HORECKÝ et al. 2005), in 2004 in the UK (HOLDICH et al. 2006). In 2005 the species was evinced from France (DUMONT 2006, cit. in: WITTMANN 2007), Switzerland, Slovakia, Hungary, Croatia and Serbia (WITTMANN 2007). The first record for Hungary was at Dunaújváros (rkm 1578), on 28-29th July 2005, 40 specimens were collected by drift net (WITTMANN 2007). The newest sensation is that the species appeared in the North American Great Lakes (www.glerl.noaa.gov/pubs/brochures/hemimysis.pdf).

Hemimysis anomala shrimps can tolerate a wide range of salinity (0-18 ‰) (BĂCESCU 1954), but within the native range of the species the populations are not totally independent from saltwater (SCHLEUTER et al. 1998). In the currently invaded areas it inhabits both freshwater and seas. In freshwater it occurs in both lentic (especially reservoirs) and lotic (riverine) habitats, but seems to avoid strong current. It shows diurnal migration: during the day the animals avoid light, usually hide in crevices among stones in deeper parts of the water. At night they leave their shelters and usually form pelagic swarms. This behaviour has been observed at all of their occurrences, regardless of the type of it. In rivers they inhabit almost exclusively anthropogenic sites. They are omnivorous, but feed prevalently on zooplankton.

The sampling of this species in not easy due to its peculiar lifestyle. ODENWALD et al. (2005) propose a smart trap made of PET bottles with algae tablets as bait.

Identification of the species

Mysid species can be identified to the highest certainty by the shape of their telsons, antennal scales, and other features (see BĂCESCU (1954)), but there are some characteristics, that make it easier to distinguish the three species occurring in Hungary (the size of the eyes and eyestalks, body colour, if alive).

The telson of *Hemimysis anomala* (Figure 1. A) is blunt ended. Their eyes are large, spherical, and their eyestalks are relatively short. They have characteristic red chromatophores on their body. The colour of the body varies from deep red to translucent, depending on light circumstances. They reach a length of about 10 mm.

The telson of *Limnomysis benedeni* (Figure 1. B) is slightly V shaped on the apex. Their eyes are small, spherical, the eyestalks are relatively long. The colour of the body is light greyish or brownish. They attain a length of about 10 mm.

The telson of *Katamysis warpachowskyi* (Figure 1. C) is tongue shaped, their eyes are small, oval, the eyestalks are short. Their body is slightly flattened, broad, dark brown. They are smaller than the other two species; the length of their body is about 4-6 mm in the Middle Danubian population (WITTMANN 2002).

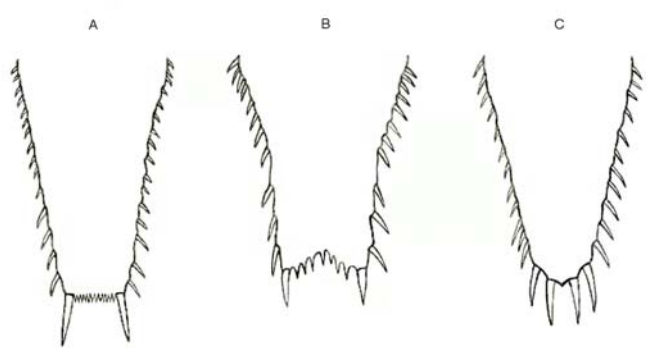

Figure 1. The telson of (A) *Hemimysis anomala*, (B) *Limnomysis benedeni*, (C) *Katamysis warpachowskyi* (modified after BACESCU 1954).

Sampling sites and methods

The samples of 2002-2003 originate from a four-year investigation aimed at revealing the recent status of macroinvertebrate biodiversity both in the main arm of the Danube and in the adjacent wetland areas Szigetköz and Gemenc (NOSEK and OERTEL 2004). The methods applied were collection by kick & sweep net (mesh size: 720 µm, width: 40 cm), by dredge (triangular, width: 27 cm), and by hand (using forceps). The electro-fishing in 2006 was a part of a study independent from this one. The kick & sweep sample of 2006 is a result of a focused collection (the net was the same). The data concerning the sampling sites are summarized in Table 1.

Table 1. The characteristics of the sampling sites.

Site	Code	Bank	Rkm	Latitude (N)	Longitude (E)
Nagybajcs, gravel bank	NBA2	Right	1802.0	47 46 01,9	17 41 43,1
Koppánymonostor, gravel bank	KOP1	Right	1776.0	47 44 59,2	18 01 08,0
Esztergom, gravel bank	ESZ1	Right	1719.0	47 47 38,9	18 43 57,2
Szob, gravel bank	SZO1	Left	1707.0	47 48 54,6	18 51 46,3
Vác, silt deposition	VAC1	Right	1680.0	47 46 49,7	19 06 54,9
Vác, gravel bank	VAC3	Right	1680.0	47 46 49,8	19 06 54,5
Göd, rip-rap	FGK1	Left	1671.0-1670.5	47 42 18,8-47 42 03,2	19 07 41,7-19 07 43,7
Göd, rip-rap	FGK2	Left	1670.0	47 41 48,9	19 07 45,0

Results

The results are summarized in Table 2. The samplings of 2002-2003 were not quantitative; therefore the numbers of specimens do not indicate the real size of the population. One specimen of *Hemimysis anomala* was found in the stomach of a bighead goby (*Neogobius kessleri* Günther 1861, also being a Ponto–Caspian invader), which was caught in the course of an electro-fishing at the rip-rap bank of the Danube at Felsőgöd in the night of 23rd June 2006. After an unsuccessful trial by

day, 21 additional specimens were caught in the evening of 13th September 2006 with a kick & sweep net (simply used as a hand net), from the depth of about 0,5-1 meter at approximately the same location. The net hauls contained *Limnomysis benedeni* as well.

Table 2. Summary of the results. The numbers of specimens do not indicate the real size of the population.

Date	Code	Method	Katamysis warpachowskyi	Hemimysis anomala	Leg	Det
01.07.2002	NBA2	Kick & sweep net	8		Nosek	Borza
03.07.2002	ESZ1	Kick & sweep net	6		Nosek	Borza
04.07.2002	VAC1	Dredge	4		Nosek	Borza
23.09.2002	KOP1	Kick & sweep net	1		Nosek	Borza
13.05.2003	ESZ1	Kick & sweep net	1		Nosek	Borza
13.05.2003	SZO1	Kick & sweep net	1		Nosek	Borza
13.05.2003	VAC3	Kick & sweep net	2		Nosek	Borza
14.05.2003	KOP1	Kick & sweep net	10		Nosek	Borza
23.06.2006	FGK1	Electrofishing (see text)		1	Borza	Borza
13.09.2006	FGK2	Kick & sweep net		21	Borza	Borza

Discussion

The invasion history of *Hemimysis anomala* cannot be revealed from the data available about the records, because they are too sparse both spatially and temporally, and it is very likely that the rapid spread is promoted by navigation, which means that there might have been jumps in the dispersal. Genetic analysis should be carried out to obtain certain information about the invasion history.

Concerning the effect of the invasion of these species few data are available. In the case of *Hemimysis anomala* KETELAARS et al. (1999) observed dramatic alterations in the zooplankton abundance and composition in Dutch reservoirs. VERSLYCKE et al. (2000) reported a decline of the native *Neomysis integer* Leach 1814 population coincident with the invasion. In the case of *Katamysis warpachowskyi* WITTMANN (2002) estimates the probability of substantial changes in zooplankton composition – such as observed by KETELAARS et al. (1999) – low, but other effects cannot be excluded. Assessing the consequences of their appearance needs further research.

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