
Communications

First records of Ponto-Caspian gammarids in the Gulf of Gdańsk (southern Baltic Sea)

OCEANOLOGIA, 52 (4), 2010.
pp. 727–735.

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KEYWORDS

Non-indigenous species
Ponto-Caspian gammarids
Pontogammarus robustoides
Dikerogammarus
haemobaphes
Dikerogammarus villosus
Obesogammarus crassus
Gulf of Gdańsk
Baltic Sea

ALDONA DOBRZYCKA-KRAHEL

HALINA RZEMYKOWSKA

Institute of Oceanography,
University of Gdańsk,
al. Marszałka Piłsudskiego 46, PL-81-378 Gdynia, Poland;
e-mail: oeadk@ug.edu.pl; halina.rzemykowska@gmail.com

Received 6 October 2010, revised 8 October 2010, accepted 15 October 2010.

Abstract

The paper reports the first records of non-indigenous Ponto-Caspian gammarid species: *Pontogammarus robustoides* (G. O. Sars, 1894), *Obesogammarus crassus* (G. O. Sars, 1894), *Dikerogammarus haemobaphes* (Eichwald, 1841) and the latest colonizer – *Dikerogammarus villosus* (Sowinsky, 1894) – in the Gulf of Gdańsk (southern Baltic Sea).

On 18 July 2010 *Pontogammarus robustoides* (G. O. Sars, 1894), *Dikerogammarus haemobaphes* (Eichwald, 1841) and *Obesogammarus crassus* (G. O. Sars, 1894) were recorded for the first time in the waters of the Gulf of Gdańsk. The sampling station (Świbno) is located in the coastal zone, approximately 300 m west of the point where the River Vistula flows into the Baltic Sea. On 10 August 2010 individuals of these species were found at the

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Górki Wschodnie sampling station, and *P. robustoides* (G.O. Sars, 1894) *O. crassus* (G.O. Sars, 1894), *Dikerogammarus haemobaphes* (Eichwald, 1841) as well as specimens of *Dikerogammarus villosus* (Sowinsky, 1894) were found at the Sobieszewo sampling station (Table 1). The animals were collected in the shallow littoral zone (0.2–0.5 m) with 1 mm mesh hand nets by two people for 45 min at each station. The results of this research are qualitative. Water temperature and salinity were measured, the latter with a salinometer (WTW – TetraCon 96–1.5 Microprocessor Conductivity Meter). The water temperature during sampling was 20–23°C, the salinity 5.8–6.1 PSU. The gammarids were found on a bottom of coarse sandy sediment, which at some stations supported *Cladophora* sp. and *Enteromorpha* sp.

Table 1. Records of gammarid species in the Gulf of Gdańsk

Location	Record coordinates	Record date	Water salinity [PSU]	<i>P. robustoides</i> (number of indiv. in sample)	<i>O. crassus</i> (number of indiv. in sample)	<i>D. haemobaphes</i> (number of indiv. in sample)	<i>D. villosus</i> (number of indiv. in sample)
Świbno (near the mouth of the River Vistula)	N 54°21.598' E 18°56.636'	18 July 2010	5.8	173	3	2	–
Sobieszewo	N 54°21.110' E 18°51.222'	10 Aug. 2010	6.1	22	10	–	9
Górki Wschodnie	N 54°22.009' E 18°47.468'	10 Aug. 2010	6.1	42	42	3	–

All the gammarid species found are of Ponto-Caspian origin, that is, from the Black Sea, the Caspian Sea, the Sea of Azov, and the rivers and freshwater and saltwater lakes in this drainage area (Mordukhaj-Boltovskoj et al. 1969, Dedyu 1980, Jażdżewski 1980). They have been able to move across Europe along rivers and canals, and inhabit reservoirs and drainage systems in the vicinity of such waterways. *P. robustoides* and *O. crassus* arrived via the so-called northern invasion corridor, *D. haemobaphes* via the central one and *D. villosus* via the southern and central corridors (Bij de Vaate et al. 2002, Grabowski et al. 2007a).

All the recent colonizers of the Polish part of the Baltic Sea are Ponto-Caspian species. Three gammarid species – *P. robustoides*, *O. crassus* and *D. haemobaphes* – were recorded along the Polish Baltic sea coast

in 2004 (Jażdżewski et al. 2005). Earlier, the three species (*P. robustoides*, *O. crassus* and *D. haemobaphes*) had been recorded in the Vistula and Szczecin Lagoons (Gruszka 1999, Jażdżewski & Konopacka 2000, Gruszka et al. 2003, Jażdżewski et al. 2004, Wawrzyniak-Wydrowska & Gruszka 2005, Grabowski et al. 2007a). *P. robustoides* was first recorded in the Szczecin Lagoon in 1988 (Gruszka 1999, Wawrzyniak-Wydrowska & Gruszka 2005) and in the Vistula Lagoon in 1998 (Jażdżewski & Konopacka 2000). *D. haemobaphes* was first recorded in the Vistula Lagoon in 1998 (Jażdżewski & Konopacka 2000, Jażdżewski et al. 2004) and in the Szczecin Lagoon in 2001 (Gruszka et al. 2003), and *O. crassus* was first recorded in the Vistula Lagoon in 1999 (Konopacka & Jażdżewski 2002), in the Szczecin Lagoon in 2001 (Gruszka et al. 2003).

D. villosus (Figure 1 and 2) is the latest colonizer. It was first found in the Szczecin Lagoon in 2002 (Gruszka & Woźniczka 2008); to date it has not been recorded in the Vistula Lagoon.

Ponto-Caspian gammarids have occurred in other parts of the Baltic Sea. *P. robustoides* and *O. crassus* were recorded in the 1960s in the Curonian Lagoon (Gasjunas 1972). *P. robustoides* also spread into the eastern Gulf of Finland: Neva Bay (1999) (Berezina & Panov 2003), Narva Bay (2006) (Herkül et al. 2009) and the Gulf of Riga (2009) (Kalinkina & Berezina 2010).



Figure 1. *Dikerogammarus villosus* (photograph by A. Dobrzycka-Krahel)

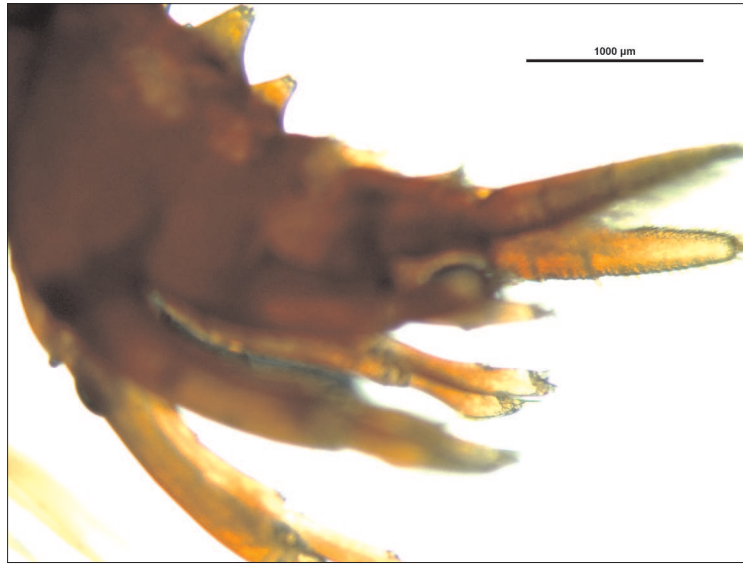


Figure 2. Characteristic urosome with 'hills' ['chimneys' according to Konopacka (2004)] (photograph by A. Dobrzycka-Kraheil)

The success of these amphipod invaders is due to their biotic potential and ecological tolerance. Depending on ambient temperatures, Ponto-Caspian gammarids can have up to three generations per year (Muskó 1990, Bączela & Konopacka 2005, Bączela et al. 2009). They are omnivorous, mainly herbivorous and detritus feeders (Cummins & Klug 1979, Dedyu 1980, Dick & Platvoet 2000, Berezina et al. 2005, Platvoet et al. 2006), but they can also be predators (Dick & Platvoet, 2000, Dick et al. 2002). They are eurythermic and relatively tolerant of low dissolved oxygen (Dedyu 1980, Bruijs et al. 2001, Wijnhoven et al. 2003, Arbaciauskas 2005). All these species are tolerant of a wide range of salinity (Romanova 1959, Bruijs et al. 2001, Santagata et al. 2008).

They inhabit stony bottoms, usually covered by vegetation, but have also been found on sand and mud (Dedyu 1980, Muskó 1990, Jażdżewski et al. 2004). Biological and ecological features like high fecundity, rapid growth and juvenile maturation, non-specific food preferences, high genetic variability and tolerance of changing environmental conditions predispose non-indigenous species to achieve success in a new environment following invasion (Dedyu 1980, Bij de Vaate et al. 2002, Grabowski et al. 2007b).

D. villosus is called the 'killer shrimp' because of its predatory and extremely aggressive behaviour. Predation by *D. villosus* was tested on *Gammarus duebeni* and *Gammarus tigrinus* (Dick & Platvoet 2000). Being

capable of eliminating both native and exotic species, *D. villosus* is therefore likely to reduce further amphipod diversity in different habitats.

To assess the capability of *D. villosus* to consume not only other aquatic microinvertebrates but also fish eggs, laboratory experiments to discover more about the species' food preferences were performed with eggs of whitefish *Coregonus lavaretus* (Casellato et al. 2007). These experiments showed that whitefish eggs are willingly consumed by *D. villosus*.

D. villosus has been extending its range very rapidly in recent years. It has spread to western Europe through the southern and central migration corridors (Bij de Vaate et al. 2002, Grabowski et al. 2007a). After the opening of the Danube-Main-Rhine canal in 1992, the species quickly invaded central and western Europe (Van den Brick & Van der Velde 1991, Dick & Platvoet 2000, Müller et al. 2002, Mürle et al. 2003, Casellato et al. 2007, Kley & Maier 2006, Tricarico et al. 2010).

D. villosus is the latest gammarid species to have colonized Poland, being first recorded in the River Odra in 1999 (Gruszka 1999) and subsequently in the Szczecin Lagoon in 2002 (Gruszka & Woźniczka 2008). The penetration of the species into the Odra basin was possible via the so-called southern corridor, i.e. the River Danube (Bij de Vaate et al. 2002). In 2002–2004 *D. villosus* was identified in the Szczecin Lagoon and adjacent coastal waters (Gruszka et al. 2003, Gruszka & Woźniczka 2008).

The discovery in 2003 of this species in the River Bug (Konopacka 2004) showed that this species also migrates to Poland along the central migration corridor, that is, via the Pripet-Bug connection. Later, the species was recorded in the River Vistula – near Wyszogród in 2007 (Baćela et al. 2008). Being naturally connected to the Bug, the Vistula is part of the European central invasion corridor (Bij de Vaate et al. 2002) (Figure 3). To date, this species has not been recorded in the Vistula Delta or the Vistula Lagoon (Surowiec & Dobrzycka-Kraheil 2008).

The hydrological conditions in the coastal waters of the Gulf of Gdańsk are highly dynamic, especially around the Vistula mouth. In particular, the fluctuations in water salinity make this region inhospitable to native benthic macrofauna and render it vulnerable to the invasion of non-native species (Olenin & Leppäkoski 1999, Zaiko et al. 2007).

The floods that afflicted Poland in May and June 2010 could have had a significant influence, intensifying as they did the inflow of water from the Vistula into the Gulf of Gdańsk. This could have accelerated the arrival of individuals of these species.

Ponto-Caspian gammarid species have never previously been recorded in the Gulf of Gdańsk. The possible invasion of non-native gammarids may have important consequences for the benthic fauna communities in the Gulf

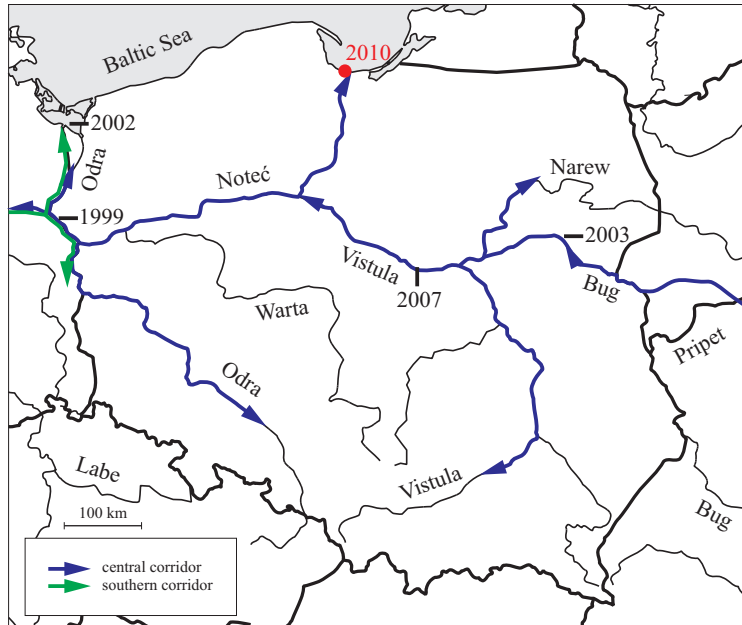


Figure 3. Invasion (with directions of invasion and dates of first records) of *Dikerogammarus villosus* in Poland (based on Gruszka et al. 2003, Konopacka 2004, Grabowski et al. 2007a, Bączela et al. 2008, Gruszka & Woźniczka 2008)

of Gdańsk. The populations of non-native gammarids, which have taken just a few years to establish, have completely supplanted the native amphipod species in the Vistula Lagoon (Surowiec & Dobrzycka-Kraheil 2008). In the future, monitoring of littoral zone macrofauna should be continued.

Acknowledgements

The authors are grateful to Hanna Łądkowska MSc and Piotr Kendzierski MSc for their help in collecting the materials.

We express our gratitude to Prof. Anna Szaniawska for her constructive comments, which helped us to improve the manuscript.

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