



***Pontogammarus robustoides* (G.O. SARS, 1894) (Crustacea, Amphipoda), a new Ponto-Caspian invader in Great Masurian Lakes (NE Poland)**

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Abstract: Recently *Pontogammarus robustoides*, a Ponto-Caspian amphipod species that has invaded Baltic lagoons and lower Vistula River at the end of 20th century, abundantly appeared in some water bodies of the Great Masurian Lakes area.

Key words: *Pontogammarus robustoides*, Crustacea, alien species, biological invasion, Great Masurian Lakes

INTRODUCTION

A summary of amphipod acclimatization attempts and migration of these crustaceans through man-made canals putting in contact hitherto separated drainage basins in Europe, was presented already by Jażdżewski (1980). At the end of the 20th century Central-European waters experienced particularly drastic changes in their amphipod fauna caused by very fast invasions of alien gammaroids. A group of successful invaders are four Ponto-Caspian pontogammarids (*Dikerogammarus haemobaphes*, *D. villosus*, *Pontogammarus robustoides* and *Obesogammarus crassus*) which have entered central and west European waters from the south east. All these invasions were enhanced by various human activities, especially canal constructions and intentional or unintentional (for instance with ships and barges) introductions. A review of quite recent range extensions in Europe of these gammaroids has been published by Bij de Vaate et al. (2002), Berezina (2007) and Holdich & Pöckl (2007). The history of the still changing distribution of these amphipod invaders in Polish waters is presented by Jażdżewski & Konopacka (2002), Konopacka (2004), Jażdżewski et al. (2005) and Grabowski et al. (2007b). All the above listed gammarid species move along the main water-courses, i.e. large rivers connected by canals (Dnieper, Pripet, Bug, Narew, Vistula, Noteć, Oder, Elbe, Rhine etc.), but also along the southern Baltic shores, although, in this case, boat or ballast water transportation is probably the main vector of range extension. Now, in large rivers, Amphipoda are represented mainly by alien species. In general, they do not enter smaller tributaries and lakes situated far from these main courses; here native amphipods are usually still present and sometimes abundant.

Great Masurian Lakes, this very special area of high natural value, are connected by small rivers Pisa and Węgorapa with larger flows of Narew and Pregel (Pregola) rivers, respectively. Until the end of the 20th century the Masurian Lakes were inhabited only by native *Gammarus lacustris* G.O. Sars, 1863 and *Pallaseopsis quadrispinosa* (G.O. Sars, 1867) (Willer 1928, Schellenberg 1934, Micherdziński 1959, Jażdżewski & Konopacka 1995). However, in 2001 a Ponto-Caspian invader, *Dikerogammarus haemobaphes* (Eichwald, 1841), has been recorded in 5 lakes of this area (Jażdżewski 2003). In August 2007, in several haphazard samples taken

in Great Masurian Lakes, we have found one more alien amphipod, the Ponto-Caspian *Pontogammarus robustoides* (G.O. Sars, 1894).

METHODS

Samples were taken using a hand net in shallow waters and simply hands and knife to grasp and tear out dense alder roots of the lake's shore – just at the water line. Gammaroids were fixed in 96% ethanol for further DNA studies.

RESULTS

Gammaroids were present in 4 samples out of 6 sampling attempts (Fig. 1). The determination of animals gave the following results.

1. Tałty Lake, near Tałty village; 16.08.2007, from detritus in shallow littoral, mainly juveniles: *D. haemobaphes* – 25 ind. (48%), *P. robustoides* – 27 ind. (52%)
2. Beldany Lake, *vis-a-vis* Kamień village; 17.08.2007, in detritus at the shoreline, many pairs in praecopula: *P. robustoides* – 60 ind. (100%)
3. Beldany Lake, near Wierzba village; 18.08.2007, from the roots of trees and detritus near the water line: *D. haemobaphes* – 9 ind. (21%), *P. robustoides* – 34 ind. (79%)
4. Tałty Lake, small island at the entrance to the Modliszki Bay; 18.08.2007, in the roots of trees at the water line: *G. lacustris* – 7 ind. (19%), *P. robustoides* – 29 ind. (81%).

In all samples *Pontogammarus robustoides* was the dominant species.

The proportion of males, females and juveniles in the whole material differed depending on species (Table 1). Ovipigerous females constituted 30% of all females in case of *D. haemobaphes* and 44% of *P. robustoides*, respectively. No ovipigerous females were observed in *G. lacustris*.

DISCUSSION

Native habitats of *Pontogammarus robustoides* are freshwater and brackish basins of the Ponto-Caspian area: the littoral of lower river courses, estuaries, lagoons and coastal lakes (Jażdżewski 1980, Starobogatov 1995; Konopacka 2004). In the 1960s, during Soviet times, the species was successfully introduced into several dam reservoirs in Georgia, Ukraine and Lithuania, among others to the Kaunas artificial reservoir on the Neman (Nemunas) river (Lithuania) and then to the Baltic Curonian (Kuronskij) Lagoon and many lakes in Lithuania (Gasiunas 1965, Arbaciauskas 2002). In late 1980s and early 1990s *P. robustoides* was noted for the first time in Polish waters in Oder estuary and Szczecin Lagoon by Gruszka (1999) and in lower Vistula River and Vistula Lagoon (Konopacka 1998, Jażdżewski & Konopacka 2000). In 1994 the species was recorded in Germany, in Peene River emptying to the Szczecin Lagoon (Rudolph 1997) indicating its possible westward penetration *via* brackish Baltic waters, through both human transport (boats) or natural dispersion. However, the species could have entered Vistula Lagoon and Vistula estuary also through the Pregel (Pregola) River system which connects Curonian and Vistula lagoons with a freshwater link. *P. robustoides* penetrated upstream the Vistula River as far as to Zegrzyński Reservoir built on the Narew River just at its mouth to the Vistula River (Grabowski et al. 2007b). Also it has been recorded recently in a rather isolated Lucieńskie Lake, situated in the Vistula valley (Grabowski & Baćela 2005).

The present record of *Pontogammarus robustoides* in Great Masurian Lakes poses the question of its possible arrival route to this water system. One possibility is its upstream penetration *via* Narew and Pisa rivers. The possibility of this invasion corridor is high, taking into account the boat traffic between the Vistula River and Great Masurian Lakes; natural

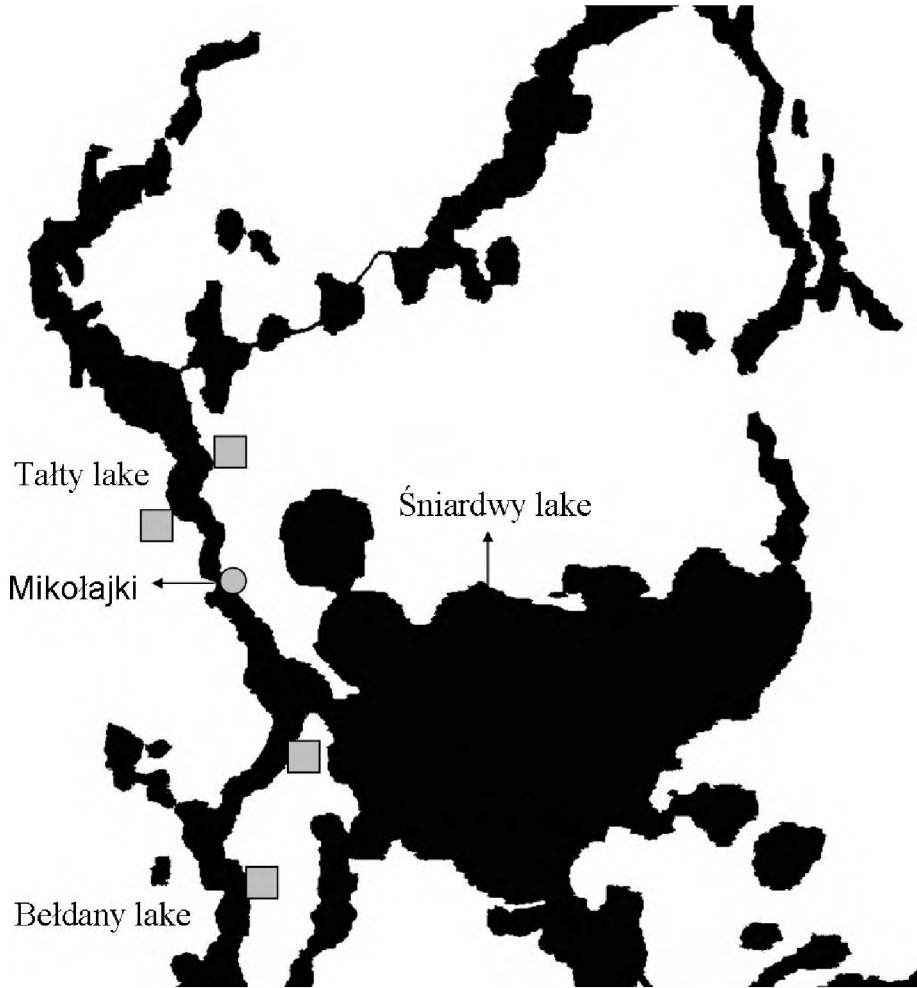


Fig. 1. Occurrence of *P. robustoides* in Great Masurian Lakes.

Table 1. The percentage of males, females and juveniles and size ranges in every species.

Species	N	Proportions %			Size range (mm)			
		♂	♀	juv.	♂	♀	ovig. ♀	juv.
<i>Dikerogammarus haemobaphes</i>	34	18	59	23	5.5–15	6.5–14	11–14.5	3.5–5.5
<i>Pontogammarus robustoides</i>	148	4	49	17	5.5–13.5	5–11.5	9.5–12	3.5–5.5
<i>Gammarus lacustris</i>	7	86	14	0	11–11.5	8.5	–	–

dispersal this way is also possible. However, until June 2006 this species has not been recorded from the middle and upper Narew River nor in Pisa River (Konopacka, pers. comm.). A shorter way, but in this case for natural dispersal only, would be through the Pregel and Węgorzapa rivers. Theoretically, one cannot exclude also the natural penetration of *P. robustoides* from the Neman (Nemunas) River (Lithuania) through the Augustowski canal, Biebrza River, Narew River and then Pisa River (Fig. 2). To solve that problem, further investigations have to be conducted. Worth of notice is the fact that *P. robustoides* has been successfully introduced into many water bodies in the Neman River basin, and it occurs abundantly e.g. in the Dusia Lake situated very near to the Polish-Lithuanian border (Arbaciauskas 2005, Gumuliauskaite 2007).

The population structure of collected *P. robustoides* indicates that it has been in the breeding state in August. Ovigerous females constituted over 40% of all females. The size of breeding females indicates that the second, summer generation was observed here (Baćela & Konopacka 2005).

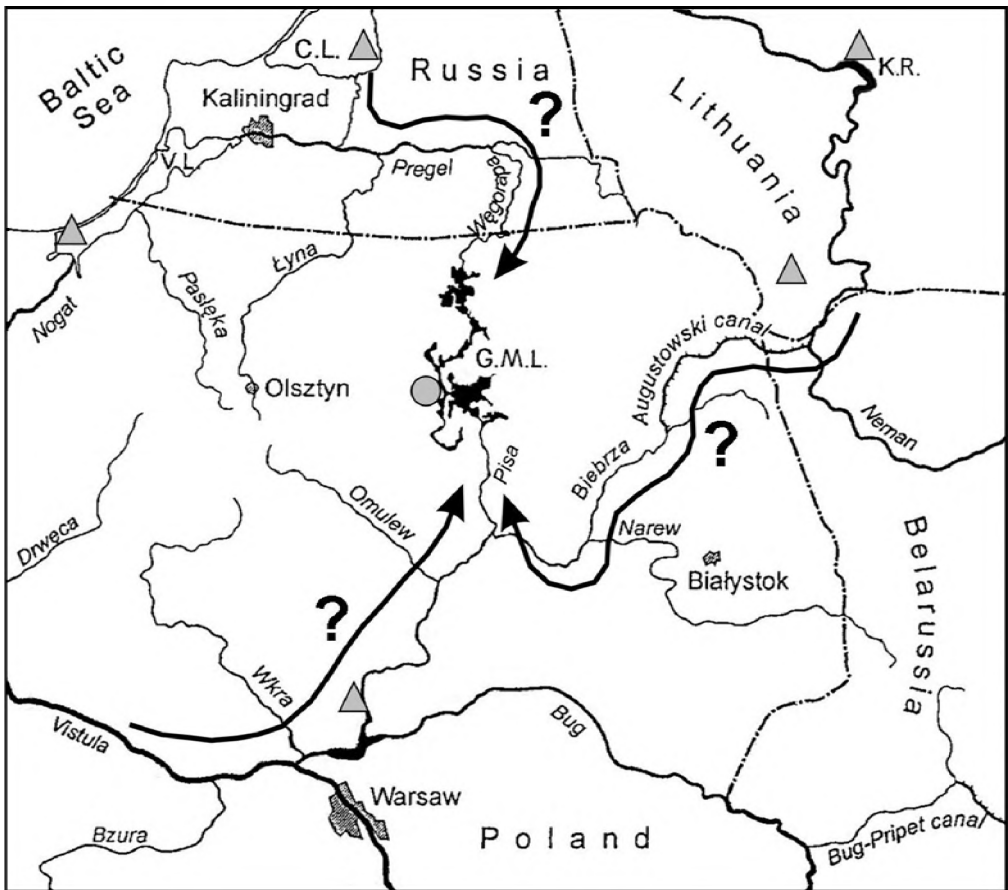


Fig. 2. Possible routes of invasion of *P. robustoides*; ● – new localities, ▲ – hitherto noted occurrence, K.R. – Kaunas reservoir, C.L. – Curonian Lagoon, V.L. – Vistula Lagoon, G.M.L. – Great Masurian Lakes

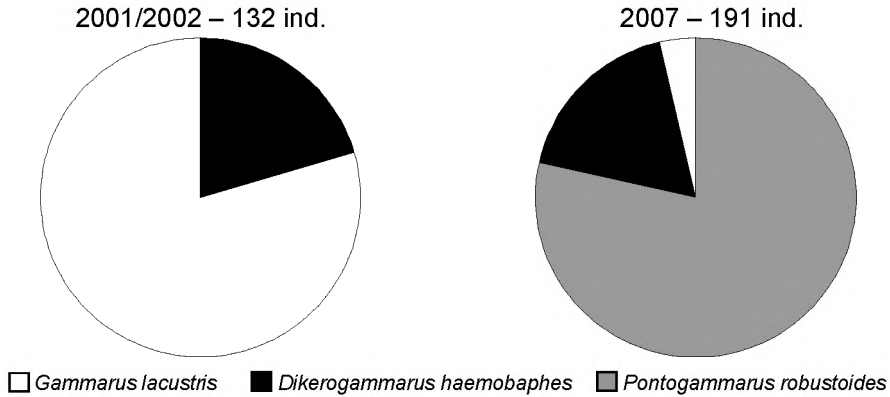


Fig. 3. Proportion of different gammarid species in collections of 2001/2002 and of 2007.

The proportion of gammaroid species found few years ago in Mazurian Lakes as well as those observed in the present study (4 samples) has been compared (Fig. 3). In the former study *Gammarus lacustris* was the dominant species and it was accompanied by *Dikerogammarus haemobaphes*. *Pontogammarus robustoides* was not noticed. The results of our present investigation show that the dominance in the gammaroid taxocene has been changed completely. *G. lacustris* is no longer the dominant species and its position is taken over by the next invasive amphipod – *P. robustoides*. Noteworthy is the comparison of the faunistic change observed by Grabowski & Baćela (2005) in the Lucieńskie Lake in the Vistula River valley with our results presented in Fig. 3. In 2000, only *G. lacustris* was recorded in Lucieńskie Lake, whereas 3 years later two aliens appeared – *D. haemobaphes* and *P. robustoides*; they constituted approximately a quarter of the amphipod population of this lake, native *G. lacustris* being still the dominant amphipod.

Our results, although preliminary and based on scanty material, support the observations by Baćela & Konopacka (2005), Grabowski et al. (2007a) and Gumuliauskaite (2007) who have stated that *P. robustoides*, producing 2–3 generations per year, has a much greater demographic potential than native *G. lacustris*. Similar observations concerning invasive potential of *P. robustoides* were published by Berezina (2007). Omnivorous feeding habits of this pontogammarid, together with its mass occurrence, may result in the decrease of the abundance both of benthic invertebrates as well as filamentous algae (Gasiunas 1975, Berezina 2007).

Taking into account the proportion of alien amphipods in our samples from Great Masurian Lakes one could say that the invasion process was successful. It seems also that the first invader, *D. haemobaphes*, recorded some years ago by Jażdżewski (2003), was outcompeted by the second one – *P. robustoides*. In both alien species summer breeding generation was observed indicating that the species have acclimatized well in these waters and probably they will extend their range in this area.

The present record of new invasive species in a valuable, natural area of Poland should be followed by the extensive monitoring to bring reliable empirical data for a possible management of the effects of this invasion (Strayer et al 2007).

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STRESZCZENIE

[Inwazja następnego ponto-kaspijskiego gatunku *Pontogammarus robustoides* (Crustacea, Amphipoda) w Wielkich Jeziorach Mazurskich w północno-wschodniej Polsce]

W kilku stanowiskach w jeziorach Tałty i Beldany (Wielkie Jeziora Mazurskie) latem 2007 roku stwierdzono występowanie nowego dla tego rejonu gatunku kielża – ponto-kaspijskiego *Pontogammarus robustoides*. W zgrupowaniu kielży płytkiego litoralu *P. robustoides* był zdecydowanym dominantem, współwystępując z rodzimym *Gammarus lacustris* lub z również obcym, niedawno zarejestrowanym w tym akwenie (Jażdżewski 2003) *Dikerogammarus haemobaphes*. Przedyskutowano różne możliwości dotarcia *P. robustoides* do Wielkich Jezior Mazurskich.

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