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An invasive Ponto-Caspian amphipod – *Dikerogammarus haemobaphes* (Eichwald, 1841) – conquers Great Masurian Lakes, north-eastern Poland

Abstract: A Ponto-Caspian gammarid – *Dikerogammarus haemobaphes* – a recent invader of the Vistula and Oder rivers, appeared also in Great Masurian Lakes. Possible routes of its invasion are discussed.

Key words: *Dikerogammarus haemobaphes*, Crustacea, alien species, biological invasion

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INTRODUCTION

In the last decade we experienced a real flood of information on the invasions of alien species conquering new territories and water basins. Intentional and accidental introductions, for instance by ballast water transportation, as well as the construction of canals joining formerly separated drainage basins are responsible for range extensions of many aquatic species, causing serious biogeographical changes (i.a. JAŹDŹEWSKI 1980, DI CASTRI 1989, MILLS *et al.* 1993, MACISAAC *et al.* 2002). Detailed reviews of recent range extensions of various hydrobionts, especially crustaceans, in European waters are published by BIJ DE VAATE *et al.* (2002) and LEPPAKOSKI *et al.* (eds., 2002), whereas the situation in Polish waters is discussed by JAŹDŹEWSKI & KONOPACKA (2000, 2002) and JAŹDŹEWSKI *et al.* (2002).

Among invasive taxa the most diverse and active appeared to be Ponto-Caspian peracarid crustaceans, and especially *Amphipoda* of the genera *Dikerogammarus*, *Obsogammarus* and *Pontogammarus* (all *Pontogammaridae*) originally inhabiting lower courses of large rivers emptying to the Black Sea and Caspian Sea as well as their brackish lagoons (CARASU *et al.* 1955, MORDUKHAI-BOLTOVSKOJ 1960, BIRSHEJN &

ROMANOVA 1968, MORDUKHAJ-BOLTOVSKOJ *et al.* 1969). Large transplantation projects undertaken in former Soviet Union in the period 1950–70 aiming at the enrichment of fish food resources, have brought large populations of Ponto-Caspian crustaceans to many basins to the North and West; many species have been acclimatized in new lakes and rivers (GASJUNAS 1968, KARPEVICH 1975, ARBACIAUSKAS 2002) whereas artificial water-ways, constructed often much earlier, helped in the further species dispersal.

In 2001 few haphazard gammarid samples taken by the author in the Great Masurian Lakes area (north-eastern Poland) revealed to contain *Dikerogammarus haemobaphes* (EICHWALD, 1841). This discovery has inclined the present author to undertake in 2002 a more extensive sampling not only in the Masurian Lakes system but also along the water-way naturally connecting these lakes with the Vistula river system from where the species could reach new basins. Samples were also taken from the Węgorapa river outflowing from Mamry Lake and connecting it with the Pregel river system.

METHOD

Sampling was performed quite simply, using a hand net, so in principle it was merely a qualitative method. However, except of three first samples, the sampling time was equal and amounted to 45 min, so the samples are to some extent comparable. Gammarids were preserved in 96% ethanol to enable further mitochondrial DNA-studies.

RESULTS

Altogether in 2001–2002 sampling *Dikerogammarus haemobaphes* was found in 5 localities out of 7 checked lakes in the Great Masurian Lakes system and along its most probable route from the Vistula system, namely in Pisa river (1 locality) and in Narew river (2 localities) as well as in the Węgorapa river – a northern outflow of the Mamry lake. All these new localities of *D. haemobaphes* are listed below and presented in Figure along with some localities of this species recorded earlier (in 1998) in the Vistula river and Narew–Bug system.

1. Dobskie lake at the Fułędzka beach; 16.08.2001, coarse detritus at the shore; in common with *Gammarus lacustris* G. O. SARS.

2. Kisajno lake, at the eastern shore of Dębowa Górka island; 19.08.2001, shallow littoral among *Phragmites*; in common with *Gammarus lacustris*.

3. Roś lake, near the village of Rybitwy, 5.08.2002, shallow littoral among *Phragmites*.

4. Canal joining the Śniardwy lake with Łuknajno lake, at the bridge; 11.09.2002, old stakes covered by *Dreissena* and shallow bottom with unionid shells.

5. Mikołajskie lake, at the Hydrobiological Station of the former Institute of Ecology, PAS; 11.09.2002, coarse detritus and dead reed sticks; in common with *G. lacustris*.

6. Węgorapa river, near the village of Prynów; 11.09.2002, *Potamogeton* meadow.
7. Pisa river, in the village of Jeże; 12.09.2002, bottom of gravel and *Potamogeton* meadow.
8. Narew river, in the town of Nowogród; 12.09.2002, between submerged shore vegetation; in common with *Chaetogammarus ischnus* (STEBBING) (very numerous), *Gammarus fossarum* KOCH and *G. varsoviensis* JAŹDŹEWSKI.
9. Narew river, in the town of Różan; 12.09.2002, between submerged shore vegetation and on the stake with *Dreissena*; in common with *Gammarus varsoviensis* and *Chelicorophium curvispinum* (G. O. SARS).



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Figure. Distribution of *Dikerogammarus haemobathes* in north-eastern Poland: 1 – immigration route, 2 – new localities in Masurian Lakes and Narew river system (2001–2002), 3 – older localities (1998–2000), V.L. – Vistula Lagoon, C.L. – Curonian Lagoon.

Sampling in 2002 in the Great Masurian Lakes area revealed that *D. haemobathes* occurs there rather commonly, sometimes in mixed populations with native *Gammarus lacustris*. Abundance of *D. haemobathes*, except in the station of the canal between

Śniardwy and Łuknajno lake, was usually low; in the above-mentioned rich sample there were some gravid females among mostly subadult specimens – most probably the second, autumn generation. In all running water stations, in Węgorapa, Pisa and Narew rivers the abundance of *D. haemobaphes* was also low, despite this species is often recognized as a rheophilous gammarid.

DISCUSSION

Masurian Lakes are connected with the Vistula system through the Pisa river, an affluent of Narew river. Narew–Bug basin, the largest part of Vistula's drainage system, is connected by the Bug–Prypet' (Królewski) canal with the Dnieper river system via the affluent of Pripet' river and this route has been commonly accepted as a main invasion corridor of several Ponto-Caspian amphipods reaching this way the Baltic Sea drainage system (JAŹDŹEWSKI 1980, BIJ DE VAATE *et al.* 2002, JAŹDŹEWSKI & KONOPACKA 2002).

The distribution of new localities of *Dikerogammarus haemobaphes* (Fig. 1) is rather scattered, reaching to the north the Pregel river system (Węgorapa river); one can suppose that this gammarid is not a quite recent newcomer – it could occur in Great Masurian Lakes already for several years. We have no data with reliable gammarid determinations in materials collected in this region since the 1970s.

The problem of *D. haemobaphes* invasion in Polish waters has been discussed recently by KONOPACKA (1998) and JAŹDŹEWSKI & KONOPACKA (2000, 2002), whereas its penetration farther to the west has been summarized by BIJ DE VAATE *et al.* (2002). Already MORDUKHAJ-BOLTOVSKOJ (1964) predicted that *D. haemobaphes* will soon penetrate other drainage systems from the Ponto-Caspian basin. Noted in the Danube river in the 1950s as far upstream as some 1700 km from its mouth (STRASKRABA 1962) *D. haemobaphes* entered the Rhine drainage system in the 1990s through the recently reopened Danube–Main canal, reaching the North Sea basin (SCHLEUTER *et al.* 1994, NESEMANN *et al.* 1995) through the so-called southern corridor (BIJ DE VAATE *et al.* 2002). The species has been discovered in Poland in lower Vistula in 1997 (KONOPACKA 1998) and soon it appeared that the species is a dominant gammarid in nearly whole Vistula, even farther upstream than the San river mouth (JAŹDŹEWSKI & KONOPACKA 2000, 2002, JAŹDŹEWSKI *et al.* 2002). Our sampling in 1998 proved that *D. haemobaphes* occurs also in the Bug river (Fig. 1), thus indicating its immigration route to the Vistula river from the Dnieper system (via Pripet'–Bug canal), and then also in Notec river (JAŹDŹEWSKI & KONOPACKA 2002). Finally this species appeared also in lower Oder (GRUSZKA 2000, MÜLLER *et al.* 2001, JAŹDŹEWSKI *et al.* 2002). This route is called central corridor by BIJ DE VAATE *et al.* (2002).

The penetration of *D. haemobaphes* far upstream the Vistula (now nearly to Cracow) from its obvious „entering gates“ (Narew–Bug mouth to the Vistula), and now upstream Narew and Pisa rivers as far as to the Great Masurian Lakes, shows its very high ecological potency. It is worth to remember that among native gammarids we have a few species occurring both in rivers and lakes – the only example could be *Gammarus pulex* (L.), which is, however, very rare in stagnant waters.

D. haemobathes did not belong to the group of several Ponto-Caspian crustaceans introduced in Soviet times to Lithuanian waters of the Neman (Nemunas) river system and then to the Curonian Lagoon (GASJUNAS 1968, ARBACIAUSKAS 2002). Therefore its appearance in Węgorapa river, the affluent of Pregel river cannot be the result of its upstream migration, first from Curonian Lagoon and then through the Vistula Lagoon to the Pregel. It is worth to remember that recent studies of gammarids in the Vistula Lagoon (own unpubl. observations) has shown that *D. haemobathes* occurs only in the westernmost part of the Vistula Lagoon, evidently entering this lagoon through the Nogat branch.

Although *D. haemobathes* could theoretically reach Neman river through the old Ogiński canal joining Neman and Prypet' system, there are no data on its occurrence in Neman river (ARBACIAUSKAS 2002) and there is an information that Ogiński canal does not exist any more (BIJ DE VAATE *et al.* 2002). The lack of *D. haemobathes* in the Neman river implies also that it could not migrate to the Narew river via the Augustowski canal joining Neman river and Narew river through the Biebrza river.

At the moment *D. haemobathes* co-occurs with some native species; one should bear in mind, however, that rather euryoecious Ponto-Caspian amphipods deplete quickly native gammarid populations when conquering new basins (DERMOTT *et al.* 1998, DICK & PLATVOET 2000, VAN DER VELDE *et al.* 2000). Therefore the monitoring of gammarid populations in our waters is of utmost interest for ecologists and biogeographers.

It is worth while to comment new localities of some co-occurring amphipod species. Both *Gammarus fossarum* and *G. varsoviensis* were already noted in the Narew river system (JAŹDŹEWSKI 1975, JAŹDŹEWSKI & KONOPACKA 1995). The new localities of *Chaetogammarus ischnus* in Narew near Nowogród and of *Chelicorophium curvispinum* in this river near Różan are their most upstream situated sites of occurrence in this river. These two amphipods are also Ponto-Caspian invaders, known in Polish waters already from the beginning of the 20th century (KULMATYCKI 1930, JAROCKI & DEMIANOWICZ 1931, JAŹDŹEWSKI 1980). However, they were hitherto recorded in Narew river only below its confluence with Bug river (JAŹDŹEWSKI & KONOPACKA 1995).

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STRESZCZENIE

[Tytuł: Inwazyjny ponto-kaspijski obunóg – *Dikerogammarus haemobaphes* (EICHWALD, 1841 – opanowuje Wielkie Jeziora Mazurskie w północno-wschodniej Polsce]

Ponto-kaspijski kielż *Dikerogammarus haemobaphes* (Crustacea, Amphipoda), który stosunkowo niedawno dotarł do Wisły poprzez jej połączenie z dorzeczem Dniepru kanałem Bug–Prypeć (Królewski), a następnie do Odry przez Kanał Bydgoski i Noteć (KONOPACKA 1998, JAŻDŻEWSKI & KONOPACKA 2002) pojawił się obecnie w wodach kilku jezior z kompleksu Wielkich Jezior Mazurskich (Dobskie, Kisajno, Mikołajskie, Śniardwy, Roś). Obecność tego gatunku stwierdzono również w kilku stanowiskach w rzekach Pisie i Narwi, a więc w systemie rzeczonym łączącym Jeziora Mazurskie z Wisłą, a także w rzece Węgorapie wypływającej z jez. Mamry na północ i wpadającej do Pregoly.

D. haemobaphes w kilku jeziorach współwystępował z z rodzimym *Gammarus lacustris*, a w rzekach – z rodzimymi gatunkami *G. fossarum* i *G. varsoviensis* oraz z wcześniejszymi, ponto-caspijskimi imigrantami – *Chaetogammarus ischnus* i *Chelicorophium curvispinum*.

Przedyskutowano drogi migracji *D. haemobaphes* w wodach Europy.