

## ***Dikerogammarus villosus* (Sowinsky, 1894) (Crustacea, Amphipoda) enters Vistula – the biggest river in the Baltic basin**

Karolina Baćela\*, Michał Grabowski and Alicja Konopacka

Department of Invertebrate Zoology and Hydrobiology, University of Łódź, Banacha 12/16, 90-237 Łódź, Poland

\*Corresponding author

E-mail: [karolina@biol.uni.lodz.pl](mailto:karolina@biol.uni.lodz.pl)

Received 30 October 2007; accepted in revised form 20 February 2008; published online 23 March 2008

### **Abstract**

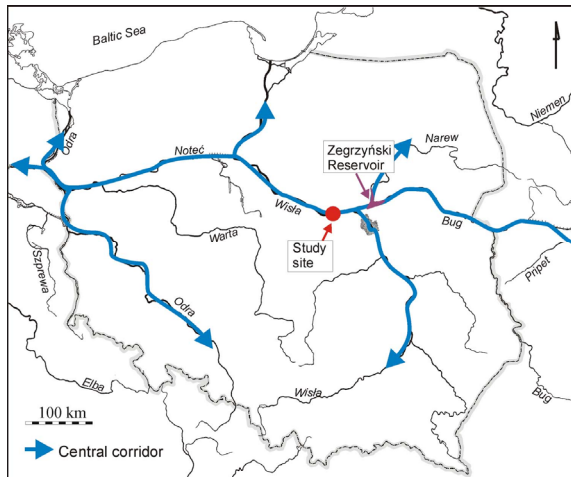
*Dikerogammarus villosus* (Sowinsky, 1894) has been recorded for the first time in the Vistula River, the biggest river in Poland and in the whole Baltic drainage system. Until now the species has been found in the Bug River that is a tributary of the Vistula. It has migrated there from the Ponto-Caspian basin through the central invasion corridor (namely Pripet-Bug canal). Another population of that species has been found in the Oder River. It came there via the Mittelland Canal from the Rhine River that had been colonised from the Black Sea basin through the southern invasion corridor. In the Vistula River, *D. villosus* co-occurs only with other Ponto-Caspian gammarids.

*Key words:* *Dikerogammarus villosus*, biological invasions, alien species, Vistula River, central corridor

The Vistula River (Figure 1) is one of the major European rivers, with a length of 1047 km and a drainage area of 194,400 km<sup>2</sup> of which 168,699 km<sup>2</sup> lies within Poland (over half the area of the country). The mean flow of the river at the mouth is 1080 m<sup>3</sup>/s. The river empties into the Baltic Sea in the Gulf of Gdansk. Navigable for barges in its lower course, two big artificial reservoirs were constructed on the river, Goczałkowicki (in its upper course) and Włocławski (in the middle course). The Vistula River is part of the European central invasion corridor as it is naturally connected to the Bug (and further by artificial canal to Pripet and Dnieper rivers) (Bij de Vaate et al. 2002; Galil et al. 2007). Another artificial canal (Bydgoski Canal) joins the Vistula to the Noteć and Oder rivers (and consequently to the North Sea basin).

There are few detailed studies on the native freshwater gammarids of the Vistula River. The earliest note of any gammarid species inhabiting this river is that of Seligo (1920) who observed *Gammarus pulex* (Linnaeus, 1758) in the lower Vistula River. *Gammarus fossarum* Koch in Panzer, 1836 was observed upstream of Cracov (Konopacka 2004) and in numerous small affluents (Jażdżewski and Konopacka 1995). The Vistula River is inhabited by several other invasive species. One of the earliest invaders is the Balkan species *Gammarus roeselii* Gervais, 1835 that has been present only in the lower part of the river, in the closest vicinity of some affluents. North American *Gammarus tigrinus* Sexton, 1939 and Ponto-Caspian *Obesogammarus crassus* (G.O. Sars, 1894) inhabit only the brackishwater parts of the Vistula

deltaic system. *Chaetogammarus ischnus* (Stebbing, 1899), the oldest Ponto-Caspian coloniser, is present in the middle and lower sections of the river, accompanied by dominating *Dikerogammarus haemobaphes* (Eichwald, 1841), and in the more lentic parts by *Pontogammarus robustoides* (G.O. Sars, 1894).



**Figure 1.** Study site and main waterways of the central invasion corridor in Poland

The newest coloniser, *Dikerogammarus villosus* (Sowinsky, 1894) (Figure 2), originates from the lower courses of large rivers in the Black and Caspian Sea basins (Mordukhai-Boltovskoi 1969). It has spread to Western



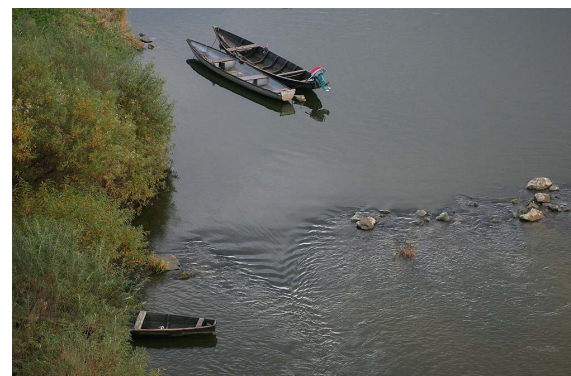
**Figure 2.** *Dikerogammarus villosus* (alive specimen, photograph by Michał Grabowski)

Europe through the southern and central migration corridors (Bij de Vaate et al. 2002; Grabowski et al. 2007). The species has been extending its range very rapidly in recent years.

It was found first in the upper Danube in 1992 (Nesemann et al. 1995), then recorded in the lower Rhine River from where it has spread into the other parts of Western and Central Europe (Bij de Vaate and Klink 1995; Bij de Vaate et al. 2002). The species was recorded in the Oder river in 1999 (Gruszka 1999; Müller et al. 2001; Jażdżewski et al. 2002) downstream of the



**Figure 3.** Vistula river near Wyszogród (photograph by Michał Grabowski)



**Figure 4.** Habitat of *D. villosus* in the Vistula river near Wyszogród (photograph by Michał Grabowski)

canal connecting the Oder river with the Elbe basin. From there it has colonised the entire flow of this river in Poland (Grabowski et al. 2007). The penetration of *D. villosus* into the Oder basin is especially interesting since it has used first the so-called southern corridor, i.e. Danube river, for westward range expansion (Bij de Vaate et al. 2002). In 2003 this species was discovered in the Bug River in Poland (Konopacka 2004), where it migrated along the central migration corridor, through the Pripiet-Bug connection. From the date of *D. villosus* discovery in that river, its most westward

locality in the Vistula basin was the Zegrzyński Reservoir, constructed on the junction of the Bug and Narew rivers near their mouth to the Vistula.

Our recurrent monitoring (samplings twice a year since 2003) in the Vistula River discovered the species in the autumn of 2007, where it was found in that river near Wyszogród (Figure 1). This locality (Figures 3, 4) is 60 kilometres downstream from the previous findings of the species. The species, second in abundance, was accompanied only by three other Ponto-Caspian gammarids: the most numerous *D. haemobaphes*, and scarce *Chateogammarus ischnus* and *Pontogammarus robustoides* (Annex 1). Looking at the examples of other big European rivers, as Rhine (Dick and Platvoet 2000; van Riel et al. 2006), Meuse (Devin et al. 2001, 2003; Bollache et al. 2004), Danube (Pöckl 2006) and Oder (own unpublished data), we may expect fast colonisation of almost entire Vistula's flow by the species and drastic deterioration of benthic communities due to the very high predatory abilities of *D. villosus*.

#### Acknowledgements

We thank two anonymous reviewers for comments on earlier version of this paper. The above study was performed within the grant no. N N304 2891 33 funded by the Polish Ministry of Science and Higher Education.

#### References

- Bij de Vaate A, Klink AG (1995) *Dikerogammarus villosus* Sowinsky (Crustacea: Gammaridae) a new immigrant in the Dutch part of the Lower Rhine. *Lauterbornia* 20: 51-54
- Bij de Vaate A, Jazdzewski K, Ketelaars HAM, Gollasch S, Van der Velde G (2002) Geographical patterns in range extension of Ponto-Caspian macroinvertebrate species in Europe. *Canadian Journal of Fisheries and Aquatic Sciences* 59(7): 1159-1174
- Bollache L, Devin S, Wattier R, Chovet M, Beisel JN, Moreteau JC, Rigaud T (2004) Rapid range extension of the Ponto-Caspian amphipod *Dikerogammarus villosus* in France: potential consequences. *Archiv für Hydrobiologie* 160: 57-66
- Devin S, Beisel JN, Bachmann V, Moreteau JC (2001) *Dikerogammarus villosus* (Amphipoda: Gammaridae): another invasive species newly established in the Moselle river and French hydrosystems. *Annales de Limnologie* 37: 21-27
- Devin S, Piscart C, Beisel JN, Moreteau JC (2003) Ecological impacts of the amphipod invader *Dikerogammarus villosus* on a mesohabitat scale. *Archiv für Hydrobiologie* 158: 43-56
- Dick JTA, Platvoet D (2000) Invading predatory crustacean *Dikerogammarus villosus* eliminates both native and exotic species. *Proceedings of the Royal Society of London* 267: 977-983
- Galil BS, Nehring S, Panov VE (2007) Waterways as invasion highways – Impact of climate change and globalization. In: Nentwig W (ed), *Biological Invasions. Ecological Studies* Nr. 193, Springer, Berlin, pp 59-74
- Grabowski M, Jazdzewski K, Konopacka A (2007) Alien Crustacea in Polish waters – Amphipoda. *Aquatic Invasions* 2 (1): 25-38
- Grabowski M, Konopacka A, Jazdzewski K, Janowska E (2006) Invasions of alien gammarid species and retreat of natives in the Vistula Lagoon (Baltic Sea, Poland). *Helgoland Marine Research* 60: 90-97
- Gruszka P (1999) The River Odra Estuary as a Gateway for Alien Species Immigration to the Baltic Sea Basin. *Acta Hydrochimica et Hydrobiologica*. 27: 374-382
- Jazdzewski K, Konopacka A (1995) Pancerzowce (Malacostraca) prócz równonogów łądowych. *Katalog Fauny Polski XIII* (1) Warszawa: 165 pp
- Jazdzewski K, Konopacka A, Grabowski M (2002) Four Ponto-Caspian and one American gammarid species (Crustacea, Amphipoda) invading Polish waters. *Contribution to Zoology* 71(4):115-122
- Jazdzewski K, Konopacka A, Grabowski M (2004) Recent drastic changes in the gammarid fauna (Crustacea, Amphipoda) of the Vistula River deltaic system in Poland caused by alien invaders. *Diversity and Distributions* 10: 81-87
- Konopacka A (2004) Inwazyjne skorupiaki obunogie (Crustacea, Amphipoda) w wodach Polski. *Przegląd Zoologiczny* 48: 141-162
- Mordukhai-Boltovskoi FD (1969). Osobennosti kaspiskoj fauny v basseine Dunaya. In *Limnologicheskije issledovaniya Dunaya*. Kiev, 1969: 98-105
- Müller O, Zettler ML, Gruszka P (2001) Verbreitung und Status von unteren Strom-Oder und den angrenzenden Wasserstrassen. *Lauterbornia* 41: 105-112
- Nesemann H, Pöckl M, Wittmann KJ (1995) Distribution of epigeal Malacostraca in the middle and upper Danube (Hungary, Austria, Germany). *Miscellanea Zoologica Hungarica* 10: 49-68
- Pöckl M (2006) Strategies of a successful new invader in European fresh waters: fecundity and reproductive potential of the Ponto-Caspian amphipod *Dikerogammarus villosus* in the Austrian Danube, compared with the indigenous *Gammarus fossarum* and *G. roeseli*. *Freshwater Biology* 52: 50-63
- Seligo A (1920) Das Leben im Weichselstrom. *Mitteilungen Westpreussischen Fischerei-Vereins* 32: 2-16
- Van Riel MC, Van der Velde G, Rajagopal S, Marguiller S, Dehairs F, Bij de Vaate A (2006) Trophic relationships in the Rhine food web during invasion and after establishment of the Ponto-Caspian invader *Dikerogammarus villosus*. *Hydrobiologia* 565: 39-58

**Annex 1**

Records of gammarid species in the Vistula River in Wyszogród. The relative abundance in the sample is presented, based on effort unit (2 people/hour) (Jażdżewski et al. 2004; Grabowski et al. 2006)

Location	Record coordinates		Record date	Relative abundance of <i>D. villosus</i>	Relative abundance of <i>D. haemobaphes</i>	Relative abundance of <i>P. robustoides</i>	Relative abundance of <i>C. ischnus</i>	Collector
	Latitude (decimal degrees N)	Longitude (decimal degrees E)						
Vistula River in Wyszogród	52.39	20.19	18.10.2007	61	174	3	8	Bącela, Grabowski