

Short communication

Dikerogammarus villosus (Sowinsky, 1894) (Crustacea, Amphipoda) colonizes next alpine lake – Lac du Bourget, France

Michał Grabowski^{1*}, Karolina Bączela¹ and Remi Wattier²

¹Department of Invertebrate Zoology and Hydrobiology, University of Łódź, Banacha 12/16, 90-237 Łódź, Poland

²UMR 5561, Biogéosciences, Université de Bourgogne, 6 Boulevard Gabriel, 21000 Dijon, France

*Corresponding author

E-mail: michalg@biol.uni.lodz.pl

Received: 4 August 2007 / Accepted: 13 September 2007

Abstract

Dikerogammarus villosus has been recorded for the first time in the alpine lake – Lac du Bourget, French Alps. Low abundance of the alien species in gathered samples suggests that the colonization is just in its initial stage. Two native gammarid species: *Gammarus fossarum* (Koch, 1835) and *G. pulex* (Linnaeus, 1758) are still present in the lake. The invader has most probably reached the lake through the Canal de Savières joining the lake to the Rhone River in which it has been already present since late 1990s.

Key words: *Dikerogammarus villosus*, biological invasions, alien species, alpine lakes

Dikerogammarus villosus (Figure 1) has been naturally distributed in the lower courses of large rivers in the Black and Caspian Sea basins (Mordukhai-Boltovskoi 1969). From there it has spread to Western Europe through the southern and central migration corridors used by several other Ponto-Caspian hydrobionts (Bij de Vaate et al. 2002, Grabowski et al. 2007). The species has extended its range very rapidly. Outside its natural area of distribution, it was found first in the upper Danube in 1992 (Nesemann et al. 1995) and soon after, it was recorded in high abundance in the lower Rhine River from where it has spread throughout many other European countries (Bij de Vaate and Klink 1995, Bij de Vaate et al. 2002). In 2003 this species was also discovered in the Bug River in Poland (Konopacka 2004), where it migrated along the central migration corridor, through the Pripet-Bug connection.

In 1997, it was recorded for the first time in the French inland waters, in the Saone River (Devin et al. 2001, Bollache 2003), and in 1998



Figure 1. *Dikerogammarus villosus* (specimen preserved in EtOH, Photograph by Michał Grabowski).

it was found also in the Rhone and Meuse rivers. Most probably from the Rhone system it was introduced to several alpine lakes: Lake Léman in 2002 (Bollache 2004), Lake Neuchâtel (2003), Lake Bienne (2005), Lake Morat (2006) and in

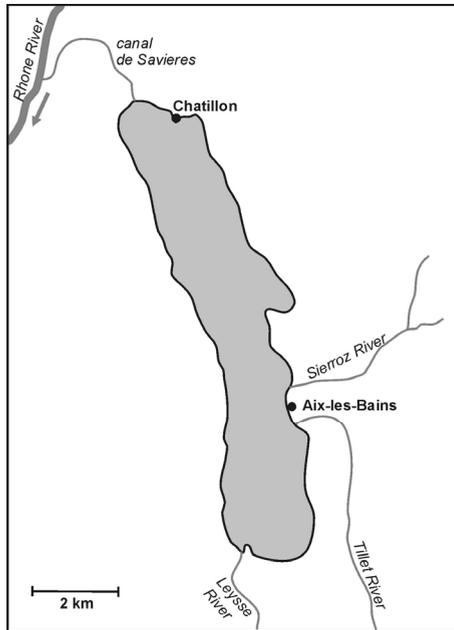


Figure 2. Lac du Bourget (France) with sampling localities.



Figure 3. Sampling site in Chatillon. Photograph by Michał Grabowski.

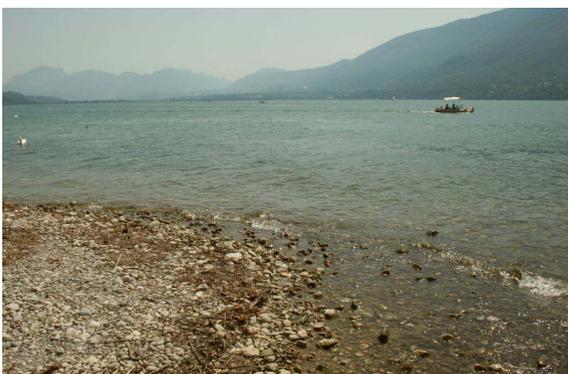


Figure 4. Sampling site in Aix-les-Bains. Photograph by Michał Grabowski.

Lake Zürich (2006) (Lods-Crozet and Reymond 2006, Steinmann et al. 2006). In 2003, it was recorded for the first time in Lake Garda in Italian Alps (Casellato et al. 2006).

On August 1st, 2007 we have sampled two sites (Figure 2) on Lac du Bourget in Savoie department on the outskirts of French Alps, on the mean altitude of some 231 m asl. It is one of the largest (surface of 44.5 km²) and deepest (mean depth 85 m, maximum depth 145 m) lakes of the country, formed during the Würm glaciation some 19,000 years ago. The lake is fed by the rivers Leysse, Tillet and Sierroz. It drains towards the river Rhône through the artificial canal de Savières. The lake is an important area for tourist activities (boating, thermal baths in Aix-les-Bains) and undergoes eutrophication.

Our first sampling point (Figure 3) was a tourist village of Chatillon on the north-western shore of the lake few kilometers from the entrance of the Savières canal. The sample was taken with the standard hydrobiological hand-net from the shallow littoral of the lake (depth 25-50 cm) composed of stones overgrown with algae and zebra mussel colonies. The amphipod community composed of the alien *Dikerogammarus villosus* and native *Gammarus fossarum* (Koch, 1835). The newcomer clearly dominated in abundance over the local species.

The second sampling point (Figure 4) was located in yacht marina of Aix-les-Bains, a town on the south-eastern shore of the lake, near the mouth of a Sierroz River flowing to the lake. Sample was taken with the same method and from the same substrate as previously. Besides the above two species, another native – *Gammarus pulex* (Linnaeus, 1758) was found in the place. Abundance of the alien species was very low and the site was clearly dominated by the natives.

Relatively high abundance of *D. villosus* in the sampling site near the entrance of the Savières canal joining the lake to the Rhône River contrasting with very low abundance on the opposite side of the lake may suggest that colonization of this waterbody has begun very recently. Knowing the high competitiveness of the species and its abilities of efficient eradication of local invertebrate fauna (Devin et al. 2003, Dick and Platvoet 2000), we may expect a rapid and complete change in the composition of macroinvertebrate communities in the lake as it was observed in other freshwater systems (Van Riel et al. 2006).

Acknowledgements

We acknowledge two anonymous reviewers for comments. The study was supported by the EGIDE-Polonium grant no. 6526/R06/R07.

References

- Bij de Vaate A and 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 and 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, <http://dx.doi.org/10.1139/r02-098>
- Bollache L (2003) Trois espèces d'Amphipodes épigées nouvelles pour la Saône bourguignonne. *Bulletin Scientifique de Bourgogne* 51: 1-9
- Bollache L (2004) *Dikerogammarus villosus* (Crustacea, Amphipoda): another invasive species in the Lake Geneva. *Revue Suisse de Zoologie* 111: 303-307
- Casellato S, La Piana G, Latella L and Ruffo S (2006) *Dikerogammarus villosus* (Sowinsky, 1894) (Crustacea, Amphipoda, Gammaridae) for the first time in Italy. *Italian Journal of Zoology* 73: 97-104, <http://dx.doi.org/10.1080/11250000500502293>
- Devin S, Beisel JN, Bachmann V and 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, <http://dx.doi.org/10.1051/limn/2001001>
- 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, <http://dx.doi.org/10.1127/0003-9136/2003/0158-0043>
- Dick JTA and Platvoet D (2000) Invading predatory crustacean *Dikerogammarus villosus* eliminates both native and exotic species. *Proceedings of the Royal Society of London* 267: 977-983, <http://dx.doi.org/10.1098/rspb.2000.1099>
- Grabowski M, Jazdzewski K and Konopacka A (2007) Alien Crustacea in Polish waters – Amphipoda. *Aquatic Invasions* 2(1): 25-38, <http://dx.doi.org/10.3391/ai.2007.2.1.3>
- Konopacka A (2004) Inwazyjne skorupiaki obunogie (Crustacea, Amphipoda) w wodach Polski. *Przegląd Zoologiczny* 48: 141-162
- Lods-Crozet B and Reymond O (2006) Bathymetric expansion of an invasive gammarid (*Dikerogammarus villosus*, Crustacea, Amphipoda) in Lake Léman. *Journal of Limnology* 65(2): 141-144
- Mordukhai-Boltovskoi FD (1969) Besonderheiten der kaspischen Fauna im Bassin der Donau. *Limnologische Donauforschungen*, Kiev, pp 98-105
- Nesemann H, Pöckl M and Wittmann KJ (1995) Distribution of epigeal Malacostraca in the middle and upper Danube (Hungary, Austria, Germany). *Miscellanea Zoologica Hungarica* 10: 49-68
- Steinmann P, Mürle U and Ortlepp J (2006) *Dikerogammarus villosus* in der Aare und ihren Zuflüssen. Report, Hydra Büro für Gewässerökologie, Öschelbronn, 8 pp
- Van Riel MC, Van der Velde G, Rajagopal S, Marguiller S, Dehairs F and 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, <http://dx.doi.org/10.1007/s10750-005-1904-8>

Supplementary material

The following supplementary material is available for this article:

Annex 1. Records of amphipod species in Lac du Bourget, France.

Annex. Records of amphipod species in Lac du Bourget, France.

Location	Record coordinates		Record date	Raw abundance of <i>D. villosus</i>	Raw abundance of <i>G. fossarum</i>	Raw abundance of <i>G. pulex</i>	Collectors
	Latitude, °N	Longitude, °E					
Lac du Bourget in Chatillon	45.8000	5.8500	01.08.2007	116	40	-	Baçela, Grabowski, Wattier
Lac du Bourget in Aix-les-Bains	45.7000	5.9167	01.08.2007	4	89	2	Baçela, Grabowski, Wattier