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First record of the Ponto-Caspian amphipod *Obesogammarus obesus* (Sars, 1894) (Amphipoda: Pontogammaridae) from the Netherlands

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Abstract

Obesogammarus obesus (Sars, 1894), a Ponto-Caspian amphipod, is reported for the first time from the Netherlands in the Amsterdam–Rhine canal near Nigtevecht. In addition to the first finding in October 2012, a record of *O. obesus* in October 2015 from the same locality indicates that the species may have established itself in this canal. Ship-assisted transport is the most likely explanation of introduction at the site.

Key words: Amphipoda, exotic species, the Netherlands, first finding

Introduction

Invasive species play an important role in the fauna composition of the Rhine system. The connection of two catchment areas after completion of the Main–Danube canal in 1992 made the migration of species from the Danube to the Rhine system possible (southern corridor). A migration route via the Dnieper, Vistula, Oder and Elbe rivers to the Rhine system (central corridor) was already established in the 18th century. The southern corridor is nowadays the most important dispersal route for Ponto-Caspian species to Western Europe (Bij de Vaate et al. 2002). Since 1985, non-indigenous species have dominated the macroinvertebrate communities in the Rhine system in the Netherlands (Bij de Vaate 2013). In the River Rhine, more than 20% of the species are exotic and these exotic species are responsible for 90% of the biomass (Galil et al. 2007). Leuven et al. (2009) reported a contribution of exotic species to the total species richness in the River Rhine of 11.3%.

The Ponto-Caspian amphipod *Obesogammarus obesus* (Sars, 1894) is native to the Azov, Black and Caspian seas as well as the catchment areas of the river Danube and Dnieper, where it can be found in the lower reaches (Sars 1894; Carausu et al. 1955; Nehring 2006). Between 1991 and 1995 *O. obesus* gradually moved further upstream and in 1995 it was observed for the first time in Germany (Nesemann et al. 1995; Weinzierl et al. 1996). Like upstream movements of other Ponto-Caspian gammarids, it is unclear why the species is triggered to do so (Bij de Vaate et al. 2002). The first record from the River Rhine near Koblenz on the western side of the Main–Danube canal originates from 2004. Additional records from the same location in 2005 and 2006 indicate that this species has established itself in the central section of the River Rhine (Nehring 2006).

Bij de Vaate et al. (2002) and Nehring (2006) speculate that *O. obesus* could be expected to extend its distribution to the German and European river and canal systems in the near future. Here, we present the first record from the Rhine delta system in the Netherlands.

Table 1. Species and their origin at the sampling site near Nigtevecht from 2004 to 2015.

Species	Sampling Year					Origin
	2004	2006	2009	2012	2015	
Ancylus fluviatilis (Müller, 1774)		x		x		indigenous
Aulodrilus pluriseta (Piquet, 1906)			x			indigenous
Branchiura sowerbyi Beddard, 1892					x	non-indigenous
Chelicorophium curvispinum (Sars, 1895)		x	x	x		non-indigenous
Chelicorophium robustum (Sars, 1895)			x	x	x	non-indigenous
Corbicula fluminalis (O. F. Müller, 1774)			x			non-indigenous
Corbicula fluminea (O. F. Müller, 1774)		x	x		x	non-indigenous
Dendrocoelum romanodanubiale (Codreanu, 1949)				x		non-indigenous
Dreissena bugensis (Andrusov, 1897)			x	x	x	non-indigenous
Dreissena polymorpha (Pallas, 1771)			x		x	non-indigenous
Gammarus tigrinus Sexton, 1939					x	non-indigenous
Hemimysis anomala Sars, 1907			x			non-indigenous
Hypania invalida (Grube, 1860)			x	x	x	non-indigenous
Jaera istri Veuille, 1979			x		x	non-indigenous
Lithoglyphus naticoides (Pfeiffer, 1828)					x	non-indigenous
Obesogammarus obesus (Sars, 1894)				x	x	non-indigenous
Pisidium casertanum (Poli, 1791)					x	indigenous
Pisidium moitessierianum Paladilhe, 1866					x	indigenous
Polypedilum bicrenatum Kieffer, 1921		x				indigenous
Potamopyrgus antipodarum (Gray, 1843)	x		x	x	x	non-indigenous
Total number of species	1	4	11	8	13	

Material and methods

As part of the national rivers assessment (in Dutch: Monitoring Waterstaatkundige Toestand des Lands), commissioned by Rijkswaterstaat Central Information Services (RWS-CIV) to determine the biological and chemical quality of national waters, macroinvertebrates are used as bioindicators and collected each year. The location in the Amsterdam–Rhine canal near Nigtevecht (WGS84, latitude 52.27, longitude 5.02) was sampled in the autumns of 2004, 2006, 2009, 2012 and 2015 by means of a Van Veen grab sampler in the profundal zone of the canal (Figure 1).

Physical and chemical conditions of the Amsterdam –Rhine canal are measured three times per year at the nearby sampling site Nieuwersluis (latitude 52.20, longitude 5.00) (data RWS-CIV). The average pH (8.0) and average value of dissolved oxygen (8.5 mg/l) were constant in the period 2012–2014. The amount of total phosphorus in the water column ranged from 0.12 to 0.23 mg/l in this period.

Samples were fixed with 96% ethanol establishing an end concentration of 70%. Sorting and identification of invertebrates were performed using a binocular microscope (Olympus SZX9). Eggers and Martens (2001, 2004) were used to identify *O. obesus*.

Figure 1. The Amsterdam–Rhine canal near Nigtevecht. Photograph by Arie Kersbergen.

Results

In October 2012, nineteen specimens of *O. obesus* were collected at a water depth of 5.86 metres. The presence of *O. obesus* at approximately the same location was confirmed in October 2015, when two specimens were collected at a water depth of 5.75 metres. Between October 2012 and October 2015 the site had not been sampled. In samples collected at the same site in the autumns of 2004, 2006 and 2009, individuals of *O. obesus* were not present (Table 1).

Obesogammarus obesus (Figure 2) can be recognized easily by the following characteristics. The urosome segments do not have dorsal tubercles (separation from *Dikerogammarus* species). The basipodites of pereiopod VII (Figure 3) are strongly widened and uropod III is very short (Figure 4). The outer ramus (exopod) is only slightly longer than the pedunculus, and fringed with setae that are often as long as the exopod itself. The habitus of *O. obesus* in lateral view is squat and is distinctive due to the relatively short antennae (Lincoln 1979; Eggers and Martens 2001).

Discussion

Invasive alien species are recognized as the second greatest threat to global biodiversity through their impacts on habitat structure, alterations of the nutrient cycle and shifts in food-web structure (Vandekerkhove et al. 2013). Since the completion of the Main–Danube canal in 1992, at least twelve macroinvertebrates originating from the Ponto-Caspian area have been found in the Rhine Delta (e.g. Van der Velde et al. 2002; Bernerth and Stein 2003; Werkgroep Exoten 2016). The most extensive range expansions were observed within the Crustacea, and seven out of the twelve species belonged to this group. The invasion of amphipods can largely be attributed to passive dispersal through ship transport, and the ability of most amphipods to migrate long distances in freshwater as well as marine ecosystems and man-made waters has facilitated their growing range expansion (Bij de Vaate et al. 2002; Berezina 2007). On 1 January 2015, EU Regulation 1143/2014 on invasive alien species entered into force. This Regulation seeks to protect native biodiversity and ecosystem services, as well as to minimize and mitigate human health or economic impacts that invasive alien species can have. In December 2015, a list of 37 invasive alien species of Union concern was drawn up, but no Amphipoda were included.

In addition to the records of *O. obesus* in the Rhine near Koblenz (Nehring 2006) and Nigtevecht (this study), we know of no other findings from the Main and the Rhine systems (IKSR/CIPR/ICBR 2015; pers. comm. F. Schöll). With this scattered distribution it is rather puzzling what place *O. obesus* will take in the Rhine biocoenosis and what this may mean for the present species composition in the River Rhine. In the middle Danube, *O. obesus* seems to be restricted to the main course and prefers large river flows, and is chiefly found in gravel (Nesemann et al. 1995). However, *O. obesus* is also found in the upper reaches of impoundments of the navigable section of the Danube River in Germany, which are characterized by widespread silt deposits (Tittizer et al. 2000). Nehring (2006) found the species in the littoral zone on stones that were part of the bank stabilization in a small backwater of the Rhine that is characterized by a strongly reduced flow velocity (<0.1 m/sec) compared to the main river.

The connection between the Danube and the Main via the Main–Danube canal is the main reason that mobile species like amphipods originating from the Danube ecosystem and the Ponto-Caspian area can migrate to the Rhine basin, especially the species which have already been observed in the upper and middle Danube (Galil et al. 2007). However, other transport mechanisms, such as shipping, are also expected to contribute to the dispersal of Ponto-Caspian species through the canal. Ricciardi and Rasmussen (1998) identified some Ponto-Caspian euryhaline macroinvertebrate species with recent invasion histories, including *O. obesus*, that have likely been transported through ballast water. As a result, these species have been classified as high invasion risk.

Like other amphipods originating from the Ponto-Caspian region, *O. obesus* has life history traits, such

Figure 2. Lateral view of preserved specimen of *Obesogammarus obesus* from the Amsterdam–Rhine canal. Photograph by Christophe Brochard.

Figure 3. Detail of the strongly widened basipodites of pereiopod VII. Photograph by Christophe Brochard.

Figure 4. Detail of the urosome, where uropod III is very short. Photograph by Christophe Brochard.

as large brood size, high partial fecundity, early maturation, a high number of generations per year and a non-specific food preference (Grabowski et al. 2007; Bij de Vaate 2013), that are linked with successful invaders from the Ponto-Caspian area. Also, alien species present higher tolerance towards disturbed environmental conditions, i.e. elevated salinity and human degradation of the environment. The above features seem to facilitate the colonization of new areas and competition with native species (Grabowski et al. 2007).

In total, twenty macroinvertebrate species were collected at our sampling site between 2004 and 2015 (see Table 1; data RWS-CIV), of which fifteen were non-indigenous. The macroinvertebrate community of the upper Rhine and the Rhine delta has been severely altered by the invasion of several highly successful alien species and the disappearance or population decline of native species (Bernauer and Jansen 2006; Bij de Vaate 2013).

Important lessons that can be learned from studied introductions of Ponto-Caspian species outside their natural range of distribution is that some of them show pronounced shifts in impact and behaviour. Thus, extrapolation of information from original ecological niches may not always be sufficient to predict the impact of such organisms in a new environment (Bij de Vaate 2013).

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