The Ponto-Caspian amphipod *Obesogammarus obesus* (Sars, 1894) arrived the Rhine River via the Main-Danube Canal

Stefan Nehring
AET umweltplanung, Bismarckstraße 19, 56068 Koblenz, Germany
E-mail: nehring@aet-umweltplanung.de

Received 20 June 2006; accepted in revised form 7 August 2006

Abstract

The Ponto-Caspian amphipod *Obesogammarus obesus* (Sars, 1894) was first recorded in the Rhine River near Koblenz, Germany in October 2004. Additional records of small numbers of *O. obesus* from the same location in 2005 and 2006 indicate that this alien species may have become established in the central section of the Rhine River. Ship transport via the Main-Danube Canal, connecting the Danube basin (Black Sea catchment area) and the Rhine basin (North Sea catchment area), is the plausible mode of introduction of *O. obesus* to the site at Koblenz. The possible ecological effects of *O. obesus* in the Rhine River remain uncertain and require further study. Based on the invasion history of other Ponto-Caspian amphipods, it can be speculated that *O. obesus* will extend its distribution within the German and European river and canal systems in the near future.

Key words: *Obesogammarus obesus*, Crustacea, Danube, Rhine, first record

Introduction

The introduction and spreading of numerous alien macroinvertebrates has recently accelerated in European waters, mainly a consequence of the removal of natural geographic barriers and rapid increases in the volume of international trade. Following the opening of the Main-Danube Canal in 1992, connecting the Danube and Rhine river basins, this southern corridor proved to be the most important dispersal route into western Europe for Ponto-Caspian species (Tittizer et al. 2000, Bij de Vaate et al. 2002, Nehring 2002). More than 20% of the species and more than 90% of the macroinvertebrate biomass are represented by alien species in the Rhine River, making this river a truly ‘international waterway’ (Galil et al. in press). There is consistent evidence that the number of aquatic alien species is still increasing (Gebhardt et al. 1999, Leppäkoski et al. 2002, Nentwig et al. 2005, Bernauer and Jansen 2006), with potentially severe consequences for the river ecosystem.

The amphipod *Obesogammarus obesus* is native to the Caspian, Azov’s and Black seas as well as to rivers flowing into these basins (Sars 1894, Carausu et al. 1955, Jazdzewski and Konopacka 1988). The species also occurs naturally in the lower parts of the Danube River (Dudich 1967) (Figure 1). In the last few decades, *O. obesus* has extended its distribution upstream and has successively established populations in the Hungarian, the Slovakian, the Austrian and German sections of the river (Nesemann et al. 1995, Weinzierl et al. 1996, Pöckl 2002). In 1996, Weinzierl et al. (1996) predicted that *O. obesus* soon would penetrate into the Rhine basin via the Main-Danube Canal. Here, we present the first record of *O. obesus* from the Rhine River.
The Ponto-Caspian amphipod arrived the Rhine River

**Records**

In the Danube, the native occurrence of *Obesogammarus obesus* (Figure 2) was restricted as far upstream as the Kazan-pass (river kilometers 965 to 974), which separates the Eastern Pannonian lowlands from the lower Danube (Dudich 1967). In 1991, *O. obesus* was observed in the middle Danube at several sites in the Hungarian section of the river first (Figure 1). It was found as high upstream as the Szentendrei Duna (river kilometer 1,672), approximately 30 km north-wards from Budapest right next to the border with Slovakia. Downstream the Hungarian capital, at Dunaújváros and Harta, *O. obesus* was collected rather frequently (Nesemann et al. 1995). In Austria this species was first recorded in samples collected in 1994 in the Danube near Klosterneuburg at river kilometer 1,942 (Pöckl 2002).

On April 11, 1995 the first observation of *O. obesus* in Germany were made by Weinzierl et al. (1996). Two individuals were found in the Danube River near Jochenstein at river kilometre 2,204. Subsequently, *O. obesus* was found at several sites between river kilometre 2,204 and 2,366 from May to November 1995 (Weinzierl et al. 1996) (Annex).

---

**Figure 1.** Native distribution and recently observed spreading of the Ponto-Caspian amphipod *Obesogammarus obesus* within Europe

**Figure 2.** *Obesogammarus obesus* (Sars, 1894). Adult male, viewed from right side, and adult female, viewed from left side. The taxonomically distinguishing features: a) Pereiopod IV, b) Pereiopod V, c) Uropod III (modified after Sars 1894)
In the North Sea catchment area *O. obesus* was observed for the first time in the River Rhine at Koblenz (Germany) (Figure 1). On October 7, 2004, *O. obesus* was first found in the Rhine ‘Lache’, a small backwater at river kilometer 590. The Rhine Lache is about 1.2 km long and characterized by strongly reduced flow velocity (< 0.1 m/sec) compared to the river mainstream (av. 1.6 m/sec) (Figure 3). Two individuals of *O. obesus* were found in the littoral zone from individual stones that were part of the bank stabilization. The sampling site was located approximately 0.5 km away from the main stream, quite close to a sports boat marina with about 50 berths. The presence of *O. obesus* at the same location as in 2004 was confirmed in autumn 2005 and in spring 2006, when one and three specimen, respectively were collected (Annex). In samples collected in the spring of 2005 individuals of *O. obesus* were not present. Furthermore, in simultaneous control samplings in near shore areas of the main channel of the Rhine between river kilometre 500 and 600 no individuals of *O. obesus* were found up to now. A comparison of the specimen from the Rhine Lache with specimen from the German section of the Danube, deposited in the Federal Institute of Hydrology in Koblenz, revealed that they are similar in every morphological respect.

Figure 3. A) The Rhine River at Koblenz (river kilometer 590), upstream view, to the right opening of the backwater Rhine Lache. B) Rhine Lache, view of the backwater from the opening. C) Rhine Lache, sampling site quite close to a sports boat marina
The Ponto-Caspian amphipod arrived the Rhine River

Discussion

Biological invasions in our waters take place in most parts in a hidden manner. Today discovery of alien species often depends on occasional reporting. And, we are often faced with the impact at a very late stage when the species might have been there for several generations and already spread their offspring to other areas.

The interconnection of river basins has facilitated the range expansions of many species in Europe. After the opening of the Main-Danube Canal in Germany in 1992, connecting the Rhine and Danube basins, this southern corridor is today the most important link between the Ponto-Caspian area and Western Europe. To date 14 macroinvertebrate and fish species originating in the Danube have been found increasingly in the German rivers Main and Rhine (Tittizer et al. 2000, Galil et al. in press). The most extensive range expansions were observed within the Crustacea. For example, the invasions by amphipods can largely be attributed to successful ship transport and the generally great mobility of most members of this group (e.g. Dikerogammarus villosus and Echinogammarus trichiatus) (Bij de Vaate et al. 2002). An examination of the hulls and cooling water filters of ships frequenting the Main-Danube Canal revealed the presence of six alien species (one mussel, five crustaceans), emphasizing the importance of ships as an important vector of bioinvasions (Reinhold and Tittizer 1999).

Like many other Ponto-Caspian species, the amphipod Obesogammarus obesus began to extend its distribution upstream in the Danube several decades ago (see above). This pattern is probably related to increasing ship traffic. For example, the cargo transported annually along the navigable section of the Danube River from Austria to the river delta increased from about 180,000 tonnes in 1947 to more than 3,500,000 tonnes by the end of the 1980s (Dosch 2004). The range extension of O. obesus over the past 15 years and our recent observations of the species in the Rhine River strongly suggest that O. obesus used the Main-Danube Canal and the Main River for its westward range extension. The records of this alien species near a Koblenz marina further suggest ship transport as the major mode of dispersal. To verify the geographic origin of the specimens of O. obesus found in the Rhine River, genetic analyses with individuals from the Danube and Rhine rivers are currently being performed.

Recently the macroinvertebrate community in the Rhine 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). The possible effects of O. obesus in the Rhine remain uncertain and require further study. According to Nesemann et al. (1995), O. obesus is most characteristic for the potamon biocoenosis where the species is mainly found in moderate abundances on gravel substrate. However, O. obesus can attain densities of up to 3,300 individuals/m² in the upper reaches of impoundments of the navigable section of the Danube River in German which are characterized by widespread silt deposits (Tittizer et al. 2000). These high abundances of O. obesus were associated with a displacement of several other amphipod species (i.e., Dikerogammarus spp.) (Tittizer et al. 2000).

Many of the alien species that have invaded German inland waters have shown a dynamic geographic extension which has been facilitated by several man-made canals in northern Germany, providing migration routes between all large river systems (Rhine, Ems, Weser, Elbe, Oder) (Figure 1). For example, after its initial introduction via the Main-Danube Canal in 1995 to the Main River, Dikerogammarus villosus has achieved rapid and wide dispersal. By 2000 this amphipod was observed more than 1,000 km away from the Main in the Oder (Nehring 2005). Given the relatively rapid spread of O. obesus through the middle and upper Danube River and the Main-Danube Canal and the Main River into the Rhine River, it can be speculated that this species will similarly use the German and European river and shipping canal systems for further dispersion into Europe.

Knowing that each introduced species potentially can have ecological as well economic impacts, preventive measures against the introduction of alien species should be given high priority (Nehring and Klingenstein 2005). Other Ponto-Caspian species are expected to extend its distribution into the Rhine River via the Main-Danube Canal, especially those species that have already been observed in the Upper and Middle Danube, like the amphipods Chelicorophium sowinskii, Dikerogammarus bispinosus and Niphargus hrabei (Jazdzewski 1980, Nesemann et al. 1995, Bij de Vaate et al. 2002). However, up to now no concepts were realized in Europe to reduce the uncontrolled range extensions of alien species by the interconnection of river and sea...
basins through canals. Due to recent discussions on the development of an ‘European Strategy on Invasive Alien Species’ (EC Council 2004), the installation of migration barriers (deterrent electrical systems, chloride or pH-altered locks etc.) in key canals (such as the Main-Danube Canal) should be realized as soon as possible. And, European countries seem to lack of an effective alien alarm system for aquatic habitats, an integration of the specific investigation criterion ‘alien species’ into aquatic observation programmes in combination with an appropriate adaptation of the monitoring strategy is recommended.

Acknowledgements

The author greatly appreciated the assistance of Mrs. Ute Albrecht (Koblenz, Germany). Dr. Wolfgang Jansen (North/South Consultants Inc., Winnipeg, Canada) gave fruitful comments to the manuscript.

References


### The Ponto-Caspian amphipod arrived the Rhine River

#### Annex

**Records of *Obesogammarus obesus* in German waters in 1995-2006***

<table>
<thead>
<tr>
<th>Location</th>
<th>Record coordinates</th>
<th>Record date</th>
<th>Species abundance</th>
<th>Reference/Collector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danube River (kilometre 2366)</td>
<td>49°01' N 12°15' E</td>
<td>10.05.1995</td>
<td>1</td>
<td>Weinzierl et al. 1996</td>
</tr>
<tr>
<td>Danube River (kilometre 2204)</td>
<td>48°31' N 13°41' E</td>
<td>21.06.1995</td>
<td>2</td>
<td>Weinzierl et al. 1996</td>
</tr>
<tr>
<td>Danube River (kilometre 2359)</td>
<td>49°00' N 12°19' E</td>
<td>28.06.1995</td>
<td>1</td>
<td>Weinzierl et al. 1996</td>
</tr>
<tr>
<td>Danube River (kilometre 2364)</td>
<td>49°00' N 12°17' E</td>
<td>28.06.1995</td>
<td>1</td>
<td>Weinzierl et al. 1996</td>
</tr>
<tr>
<td>Danube River (kilometre 2366)</td>
<td>49°01' N 12°15' E</td>
<td>28.06.1995</td>
<td>1</td>
<td>Weinzierl et al. 1996</td>
</tr>
<tr>
<td>Danube River (kilometre 2230)</td>
<td>48°34' N 13°24' E</td>
<td>31.07.1995</td>
<td>5</td>
<td>Weinzierl et al. 1996</td>
</tr>
<tr>
<td>Danube River (kilometre 2204)</td>
<td>48°31' N 13°41' E</td>
<td>15.11.1995</td>
<td>3</td>
<td>Weinzierl et al. 1996</td>
</tr>
<tr>
<td>Rhine Lache (backwater of Rhine River, kilometre 590)</td>
<td>50°20' N 07°35' E</td>
<td>07.10.2004</td>
<td>2</td>
<td>S. Nehring</td>
</tr>
<tr>
<td>Rhine Lache (backwater of Rhine River, kilometre 590)</td>
<td>50°20' N 07°35' E</td>
<td>06.10.2005</td>
<td>1</td>
<td>S. Nehring</td>
</tr>
<tr>
<td>Rhine Lache (backwater of Rhine River, kilometre 590)</td>
<td>50°20' N 07°35' E</td>
<td>06.04.2006</td>
<td>3</td>
<td>S. Nehring</td>
</tr>
</tbody>
</table>