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Quagga mussels *Dreissena rostriformis bugensis* (Andrusov, 1897) in the Main River (Germany)

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Abstract

The first record of the quagga mussel *Dreissena rostriformis bugensis* (Andrusov, 1897) in Germany is described. This species has expanded its distribution area in Europe at a slower rate than the zebra mussel *Dreissena polymorpha* (Pallas, 1771). Recent records from the Danube in Romania and from an enclosed Rhine-Meuse estuary in The Netherlands, suggest that the Main-Danube canal and River Rhine have functioned as the dispersal pathway of the quagga mussel to The Netherlands. The record of this species in the River Main supports this hypothesis.

Key words: Quagga mussel, *Dreissena rostriformis bugensis*, invasive species, Germany, Main-Danube canal
Romania. The neighbourhood of Drobeta Turnu-Severin was considered by these authors the most western recorded occurrence in Europe of this species. However, Molloy et al. (2007) found the species for the first time on the 19th of April 2006 in the Hollands Diep near Willemstad in The Netherlands, where it occurred in relatively low numbers between the zebra mussels (1% were quagga mussels). Molloy et al. (2007) suggested that the quagga mussel entered via the Main-Danube canal, as did so many other Ponto-Caspian invaders (Bij de Vaate et al. 2002). These records in The Netherlands and Romania however, show an enormous geographical distance gap without any records in between. The invasion of quagga mussels in The Nether-lands could also be caused by the discharge of ballast water from the Black Sea area in the Rotterdam Port. However, it should be noted that, in the Port of Rotterdam itself we have only sampled zebra mussels thus far. During a trip to Hungary in 2007 we sampled along the River Main (19th of May), the Main- Danube canal (25th of May), the Danube at various sampling sites (19th and 25th of May) in order to obtain dreissenid mussels for genetic analysis. To our surprise, in the River Main east of Würzburg near Hörlbach, we found quagga mussels (*D. rostriformis bugensis*) (13 specimens sampled) on stones up to a depth of 1 m besides zebra mussels (*Dreissena polymorpha*) (26 specimens sampled within half an hour) (Figure 1). During this sampling the River Main showed hardly any flow. Yellow water lilies (*Nuphar lutea* (L.) Smith), showing underwater leaves only, were present. Besides zebra mussels and quagga mussels we found the native snails *Ancylus fluviatilis* (Müller, 1774), *Radix auricularia* (L., 1758) and *Bithynia tentaculata* (L., 1758) on riparian stones at a water depth of 20 to 100 cm. Freshwater sponges were commonly present on dreissenid colonised stones and were even found overgrowing these mussels, in particular *D. polymorpha*. Within the sediment, *Unio tumidus* (Philipsson, 1788) was present together with numerous Asian clams *Corbicula fluminea* (Müller, 1774).

The finding of quagga mussels in the Main makes it very likely that this mussel species took the southern corridor from the mouth of the Danube, upstream to the Main-Danube canal and subsequently colonized downstream in the Main, Rhine and Rhine delta (Figure 2). Because the largest quagga mussel we sampled had a length of 29.8 mm, the Main must certainly have been invaded several years before 2007. We also tried to sample this species from the Main-Danube...
Quagga mussels in the Main River

Figure 2. The distributional expansion of *Dreissena rostriformis bugensis* in Europe. Historical distribution indicated as white spot. Range extensions from 1941 till 2002 black (according to Orlova (2003) and Zhulidov et al. (2004, 2005)). Arrows indicate the most recent records (open triangles), Hollands Diep, The Netherlands (Molloy et al. 2007), Danube, Romania (Popa and Popa 2006) and Main, Germany (this paper), see Annex for coordinates.

The following localities have been sampled: the Danube west of Regensburg near Kiefenholz (Pfatter), Vilshofen an der Donau west of Passau (stones sampled at 1 m depth); Main-Danube canal at Kelheim, Essing, Hilpoldstein (steep walls scraped by a scrape net to a depth of 3m). However, in spite of our efforts to sample specimens of quagga mussels from the Main-Danube canal as well as the Danube itself, we collected only zebra mussels from these localities.

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**Annex**

**Recent records of *Dreissena rostriformis bugensis* in Europe**

| Site No. | Location | Record coordinates | Record date | Number collected | Collector/Reference |
|----------|----------|---------------------|-------------|-----------------|---------------------|
| 1        | Danube, Cernavoda, 297 | 44°19′06″, 28°03′91″ | March 2004 | ca. 500 | Dragos Micu/Micu and Telembici 2004 |
| 2        | Danube, Drobeta Turnu Severin 931 | 44°40′01″, 20°55′19″ | 23 August 2005 | 20 | Popa and Popa 2006 |
| 3        | Main, Hirblach | 49°47′00″, 10°13′00″ | 19 May 2007 | 13 | Gerard van der Velde and Dirk Platvoet |
| 4        | Hollands Diep, Willemstad | 51°42′11″, 04°28′34″ | 19 April 2006 | ca. 20 | Abraham bij de Vaate/Molloy et al. 2007 |