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Aquatic Invasions Records

First occurrence of the Ponto-Caspian amphipod *Echinogammarus trichiatus* (Martynov, 1932) (Crustacea: Gammaridae) in Belgium

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Abstract

The Ponto-Caspian amphipod species *Echinogammarus trichiatus* (Martynov, 1932) was found in Belgium for the first time in June 2009 at two different locations in an artificial lake bordered by two large canals. Adults as well as juveniles were found in small numbers and occurred together with several other Ponto-Caspian species such as *Dikerogammarus villosus* (Sowinsky, 1894) and *Dreissena polymorpha* (Pallas, 1771). An identification key to the genus *Echinogammarus* of inland waters in Western Europe is provided. This first record of yet another new amphipod invader in Belgium demonstrates the continuous introduction of alien species into West European waters.

Key words: alien species, Amphipoda, artificial lake, distribution, Flanders

Introduction

The opening of the Rhine-Main-Danube canal, eased the colonization of species endemic to the Ponto-Caspian region into Eastern and Western Europe (Bij de Vaate et al. 2002; Messiaen et al. 2010). Among these, crustaceans and mollusks are particularly successful due to their intrinsic characteristics, such as a short generation time, rapid growth with early sexual maturity, high fecundity and their euryhaline and omnivorous characteristics (Devin and Beisel 2007; Grabowski et al. 2007; Boets et al. 2011a, b). Several of these alien species are widespread and represent an important share of the macroinvertebrate community in many rivers across Europe (e.g. Bernauer and Jansen 2006; Žganec et al. 2009; Labat et al. 2011). Some macroinvertebrate species, like *Dikerogammarus villosus* (Sowinsky, 1894) and *Chelicorophium curvispinum* (G.O. Sars, 1895), are very successful (Boets et al. 2010a; Messiaen et al. 2010). Currently, at least 22 alien macrocrustaceans are present and have established populations in fresh and brackish waters in Belgium (Wouters 2002; Josens et al. 2005; Boets et al. 2009; Boets et al. 2010b; Messiaen et al. 2010; Soors et al. 2010). Many of these species originate from the Ponto-Caspian area and have been recorded for the first time in Belgium during the last 10 to 15 years (Wouters 2002; Messiaen et al. 2010). Here, we report on the first observation of another Ponto-Caspian amphipod species, *Echinogammarus trichiatus* (Martynov, 1932), previously also known as *Chaetogammarus tenellus major* Cărăuşu, 1943.

Materials and methods

Echinogammarus trichiatus was sampled for the first time in June 2009 in an artificial lake in the East of Flanders (Belgium) at two different locations (51°14'05"N, 05°10'23"E and 51°13'30"N, 05°10'01"E) (Figure 1). The samples were taken by the Flemish Environment Agency (VMM), which has been monitoring the water quality in Flanders (Belgium) for more than 20 years. Consequently, a large macroinvertebrate

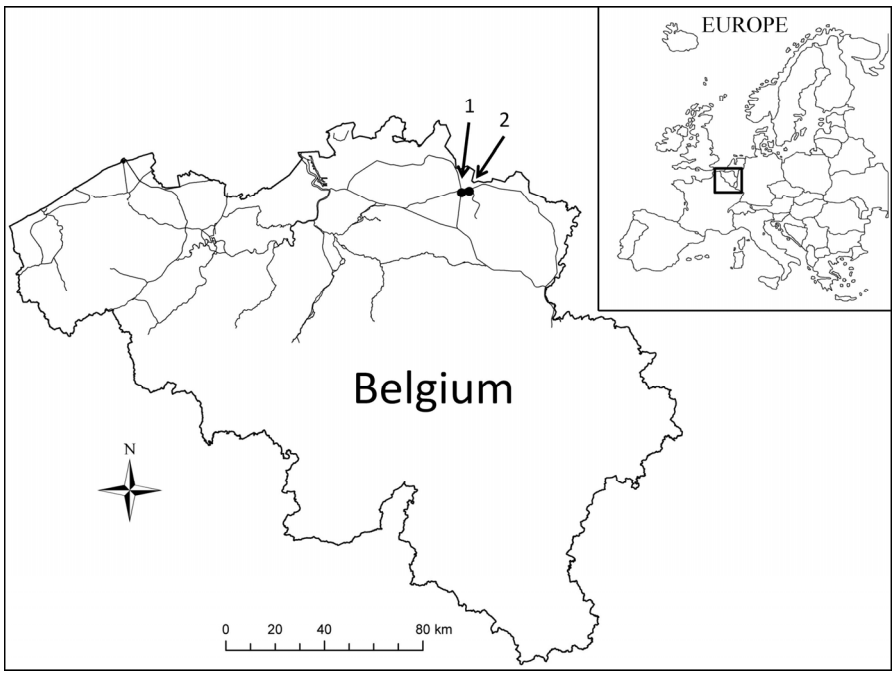

Figure 1. Map of Belgium with indication of the two sampling locations (black circles), where *Echinogammarus trichiatus* was found.

Figure 2. Artificial lake in Mol (Belgium) where *Echinogammarus trichiatus* was sampled (Photograph by Flemish Environment Agency, VMM).

collection with more than 10,000 samples scattered over 2,500 sampling locations is available and stored at the Royal Belgian Institute for Natural Sciences (KBIN). Because the samples of the VMM were only identified to the level needed to calculate the Multimetric Macroinvertebrate Index for Flanders (Gabriels et al. 2010), *E. trichiatus* remained unnoticed until September 2011. The species was discovered when investigating over 3,000 samples containing Crustacea in the scope of an ongoing PhD research related to the impact and spread of alien macroinvertebrates in Flanders (Belgium). Both samples were taken by hand net (mesh size: 300µm, diameter: 20×30cm) as described by Gabriels et al. (2010). With the hand net, a stretch of approximately 10–20 m was sampled during five to ten minutes. Sampling effort was proportionally distributed over all accessible aquatic habitats. This included the substrate (stones, sand or mud), macrophytes (floating, submerged, emerged), immersed roots of overhanging trees and all other natural or artificial substrates, floating or submerged in the water. Standard physical-chemical parameters (dissolved oxygen, pH, conductivity) were measured in the field by means of hand electrodes at the date of biological sampling. The standard length (distance from base of the rostral tip to the end of the last abdominal segment) of all individuals of *E. trichiatus* was measured in the laboratory by means of a stereomicroscope (SZX10, Olympus) and the software package CellSens dimension (version 1.4). Individuals that measured under 10mm were classified as juveniles.

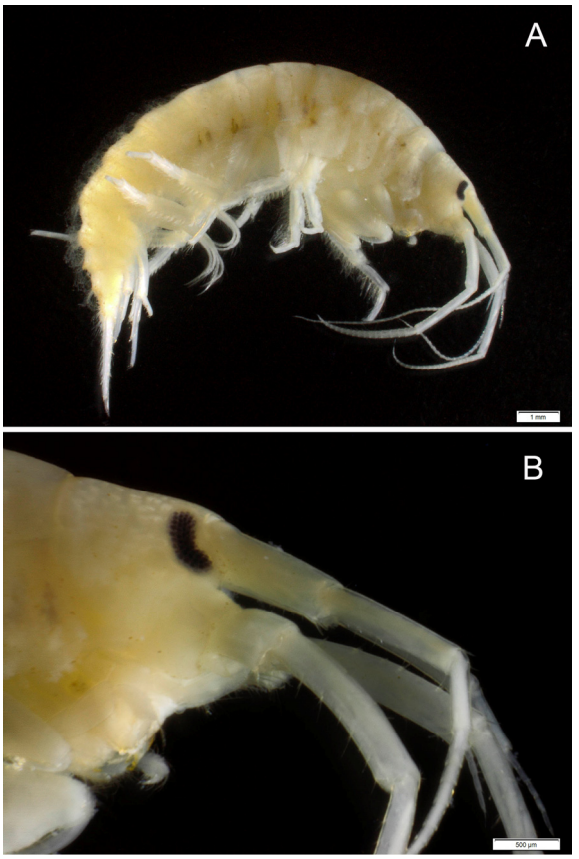

Figure 3. Picture of *Echinogammarus berilloni* found in the river Lesse in Belgium, **A**) adult specimen and **B**) head (Photographs by P. Boets).

Results

Both sampling locations, where *E. trichiatus* was found, are situated in an artificial lake, which resulted from water intrusion into an old sand pit, where excavation took place in previous decades (Figure 2). The pond is situated close to the Bocholt-Herentals canal and is connected with the Dessel-Kwaadmechelen canal. The first sampling location had a Multimetric Macro-invertebrate Index (MMIF) of 0.7 (good water quality) and the second a MMIF of 0.85 (high water quality) (VMM 2011). Chemical parameters measured were: conductivity 342 and 346 µS/cm, pH 8.9 and 8.4 and dissolved oxygen 13.4 and 10.4 mg O_2/l for the first and second sampling location, respectively.

One adult and five juveniles were found in the first sample and four adults and one juvenile in the second sample. The size ranged from 5.7 mm to 9.6 mm for juveniles and from 11.9 mm to 16.7 mm for adults. This is comparable with that indicated by Cărăuşu et al. (1955), who report sizes between 12.0 and 15.5 mm for adult males and between 10.0 and 13.0 mm for adult females. All other alien species, originating from the Ponto-Caspian region, encountered in the samples were: *Chelicorophium curvispinum* (G.O. Sars, 1895), *Dikerogammarus villosus* (Sowinsky, 1894), *Limnomysis benedeni* Czerniavsky, 1882, *Jaera istri* Veuille, 1979, *Dreissena polymorpha* (Pallas, 1771) and *Hypania invalida* (Grube, 1860).

In Western Europe, the genus *Echinogammarus* is now represented by three species in inland fresh and slightly brackish waters: *E. trichiatus*, *E. ischnus* (Stebbing, 1899) and *E. berilloni* (Catta, 1878). To date, *E. ischnus* has not yet been found in Belgium. The genus *Echinogammarus* can be distinguished from the genus *Gammarus* by uropod III, which is of "uniramus-type" with reduced, squamose, endopode (inner ramus) (Eggers and Martens 2001). In some *Gammarus* species, the endopode may measure 20-25% of the outer ramus (variiramus-type), but the endopode is never reduced to a squamose process. The eyes of all three species are reniform and situated at the anterior part of the head. Identification was based on Martynov (1932), Cărăuşu et al. (1955) and Eggers and Martens (2001).

Key to the *Echinogammarus species* found in Western Europe based on Martynov (1932), Cărăuşu et al. (1955) and Eggers and Martens (2001):

1 Metasome and urosome segments are covered with numerous long tufts of curved setae (especially males, much reduced in females or juveniles) …….. *Echinogammarus berilloni* (Figure 3a, b)

- Metasome and urosome segments are not covered with numerous tufts of long setae **2**.

2 Uropod III with spines and densely set, curled setae in males, the female has at least on the distal part dense straight setae. The first two segments of the urosome have groups of two-three spines (dorso-lateral and lateral) and the hairs between the spines are missing. The third segment has always two submedian spines. The lateral lobes of the head are truncated and the body length of adult males is usually over 12 mm …….. *Echinogammarus trichiatus* (Figure 4a, b)

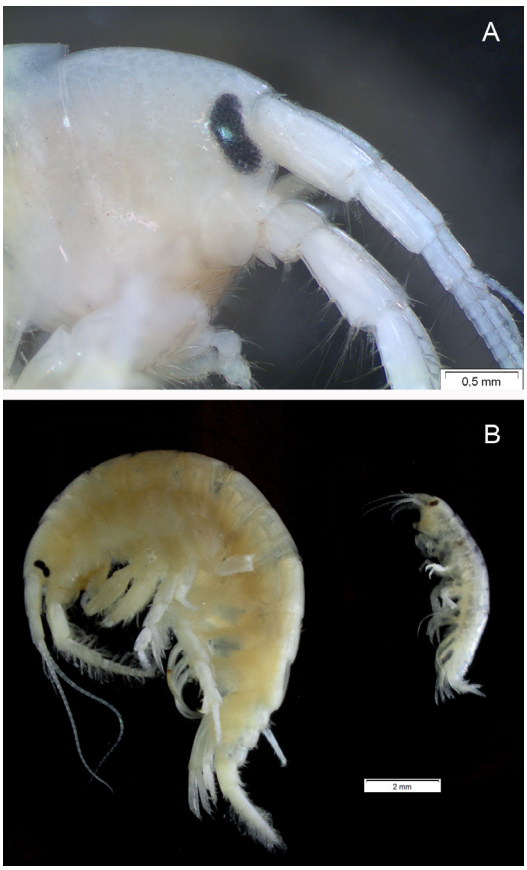

Figure 4. Picture of *Echinogammarus trichiatus* found in the artificial lake in Belgium, **A**) head and **B**) adult (left) and juvenile (right) (Photographs by **A)** D. Tempelman and T. Van Haaren and **B)** P. Boets).

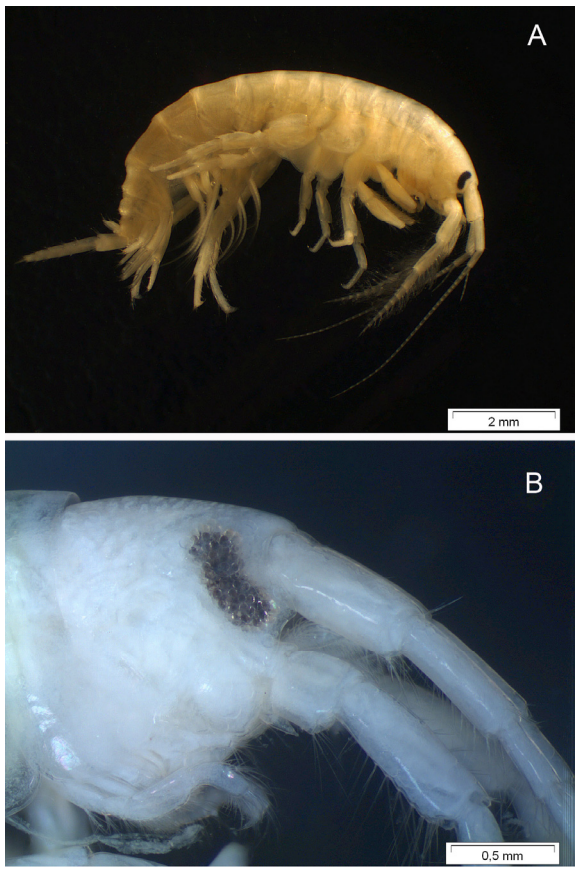

Figure 5. Picture of *Echinogammarus ischnus* from the River Ijssel in the Netherlands, **A**) adult specimen and **B**) head (Photographs by D. Tempelman and T. Van Haaren).

- Uropod III with spines and with a few scattered setae in males and females. The first two segments of the urosome have four spines each, two of them are submedian with a small hair and two of them occur at the dorso-lateral side of each segment. The third urosome segment has two hairs instead of spines. The lateral lobes of the head are slightly truncated. The body length of adult males is up to 10 mm ..... *Echinogammarus ischnus* (Figure 5a, b)

Discussion

Echinogammarus trichiatus is native in the Black Sea and Azov Sea and the Danube River basin, where its original distribution was limited to the Danube Delta as well as the Romanian and Bulgarian part of the River Danube (Cărăuşu et al. 1955; Russev 1979). The species was recorded for the first time outside its native range in Germany in 1996 in the Bavarian section of the River Danube (Weinzierl et al. 1997). Two years later, the species was found 120 km downstream (Tittizer et al. 2000). Since then, the species started to expand to the Rivers Rhine in 2000 (Podraza et al. 2001), Main in 2002 (Bernerth and Stein 2003) and subsequently several other navigable waterways in Central and North-East Germany (Eggers 2005; Hirt and Schödel 2005; Müller and Eggers 2006). According to Borza (2009), the distribution of this species cannot be explained by a gradual spread upstream in the River Danube, since it was not recorded earlier in the middle section of the river. It is suggested that the species was introduced via human-mediated transport. From

the Danube, the species has probably spread into the Main-Danube canal and afterwards into the Rhine (Hirt and Schödel 2005). Research on the hull fouling community of recreational boats in Germany indicated that *E. trichiatus* can survive outside the water for six days between mussel layers of *D. polymorpha* (Martens and Grabow 2008). This indicates that apart from dispersal via water, there is an increased risk of an unintended introduction into lakes by overland transport (Martens and Grabow 2008).

In its native area, the species prefers fresh or slightly brackish littoral lakes situated close to the sea. The niches are situated under rocks or on sandy substrate in water with a relatively strong current. The species is often sampled together with *D. polymorpha* and/or *E. ischnus* (Cărăuşu et al. 1955). In the invaded area, the species is also reported among reed (Müller and Eggers 2006), on a mixture of sand and gravel (Podraza et al. 2001), between pebbles (Hirt and Schödel 2005) and on artificial rip-raps as well as near-natural gravel banks (Eggers 2005; Borza 2009).

Outside Germany, *E. trichiatus* is also found in the Netherlands in the Grensmaas, near Ohé, where the species was found in the profundal zone in October 2010 (Templeman 2011) and in the Gouwzee and Markermeer in reeds bordering the banks (Pers. comm. D. Platvoet). At the latter location, *E. trichiatus* occupies those niches that are avoided by *D. villosus* (Pers. comm. D. Platvoet). The species has been found at several other locations in The Netherlands in the rivers Maas, Waal, Lek and Rhine (Duijts 2011).

Before this study, in this genus, only *E. berilloni* was recorded in Belgium (Wouters 2002). The species was found for the first time in 1925 and is currently only rarely abundant (Messiaen et al. 2010). *Echinogammarus ischnus* has, to date, not been recorded in Belgium, although the species is already present in the Netherlands (van den Brink et al. 1993), France (Labat et al. 2011) and Germany (Eggers and Martens 2001). Therefore, it is expected that *E. ischnus* will soon be discovered in Belgium as well. A detailed distribution of *E. ischnus* and *E. trichiatus* in the Netherlands is yet to be determined since some samples containing *Dikerogammarus haemobaphes* (Eichwald, 1841) have been wrongly identified as *Echinogammarus* species (Pers. obs. D. Tempelman).

To date, no information is available on the possible impacts of *E. trichiatus* on the local biota (Gollasch and Nehring 2006). Our record denotes, too, that the species (*E. trichiatus*) can coexist with its relatives already present, but future changes in their relative abundances cannot be excluded (Borza 2009). Competition between *Gammarus tigrinus* Sexton, 1939 and *E. trichiatus* is expected in the Gouwzee, where *G. tigrinus* is possibly excluded from reed covered banks, but still occurs in the bottom substrates (D. Platvoet, pers. obs.). Observations by Duijts (2011) indicate that at several locations in the Netherlands, *E. trichiatus* can be found on soft substrates where *G. tigrinus* was previously abundant. On rocky substrates, *D. villosus* is still the most abundant species on hard substrates or in mussel banks. Taking these field observations into consideration, it is important to closely monitor the invaded sites in order to detect possible impacts of this new invader.

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