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SHORT COMMUNICATIONS

The first finding of the Ponto-Caspian mysid shrimp *Hemimysis anomala* G. O. Sars (Mysidae) in the Estonian coastal sea

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Abstract. The aim of this paper was to provide new data on the nektobenthic crustacean *Hemimysis anomala* in the Estonian coastal sea using trawling data on the density of mysid species. The non-native shrimp was found for the first time in the Estonian coastal sea in 2009. The species was found only once at the outer Pärnu Bay, the Gulf of Riga. The habitat where the species was found was characterized by coarse sand mixed with gravel, clay, and algal debris. The species was associated with the native mysid *Neomysis integer*. As the abundance of *H. anomala* was low, it is likely that the species does not affect the structure and functioning of phyto- and zooplankton communities or compete with fish fry for food.

Key words: Baltic Sea, benthic invertebrate, mysid, nonindigenous, *Hemimysis anomala*.

INTRODUCTION

Since the 1990s, the northern Baltic Sea has witnessed an increased rate of invasions by animals originating mainly from the freshwater and estuarine margins of the Ponto-Caspian region (Kotta & Kotta, 1998; Kotta et al., 2004; Herkül et al., 2006, 2009; Herkül & Kotta, 2007). The crustaceans *Gammarus tigrinus* Sexton, *Chelicorophium curvispinum* (Sars), *Pontogammarus robustoides* (Sars), and *Paramysis intermedia* (Czerniavsky) are the most recent newcomers in the Estonian coastal sea, all sighted for the first time in the 2000s. All these species have formed permanent populations and at present some occupy large areas of the coastline (Herkül et al., 2009). Futhermore, a few species have become ecologically aggressive and have caused significant shifts in community structure and functioning (Kotta et al., 2001, 2006; Kotta & Ólafsson, 2003; Orav-Kotta et al., 2009a).

The bloody-red mysid *Hemimysis anomala* G. O. Sars is the most recent non-native species in the Estonian coastal range. This mysid was deliberately introduced into a number of water bodies with the intention of increasing fish production, including the Kaunas Reservoir on the Nemunas River in Lithuania,

already in the early 1960s (Gasiunas, 1964). In 1960 this species was also introduced into the Estonian Lake Saadjärv (Mäemets, 1968); however, it has never been found there later on. By 1962 the species had migrated into the Curonian Lagoon (Gasiunas, 1964). It took 30 more years for the species to be found elsewhere in the Baltic Sea. The non-native shrimp was discovered in Finland, the northern Baltic Sea, in 1992 (Salemaa & Hietalahti, 1993), then in Sweden in 1995 (Lundberg & Svensson, 2004), and finally in Gdansk Bay, the southern Baltic Sea, in 2002 (Janas & Wysocki, 2005). It is surprising, therefore, that despite intensive long-term sampling of mysids, this non-native mysid was found in Estonia only in 2009.

In this paper we give an overview of this first sighting of *H. anomala* in the Estonian coastal sea and compare its habitat characteristics in the district of origin and in recipient areas. We also list some potential causes why the range expansion of *H. anomala* took so long in the Baltic Sea area.

MATERIALS AND METHODS

Mysid shrimps have been systematically studied in the Estonian coastal range since 1970. Except for 1971 and 1998–2001, a long-term series with daytime monthly sampling is available for a 10 m deep station (indicated by a star in Fig. 1) in the middle of Pärnu Bay, the northeastern Gulf of Riga, from the ice-free seasons of 1970–2009. In other stations in Pärnu Bay sampling was performed less regularly.

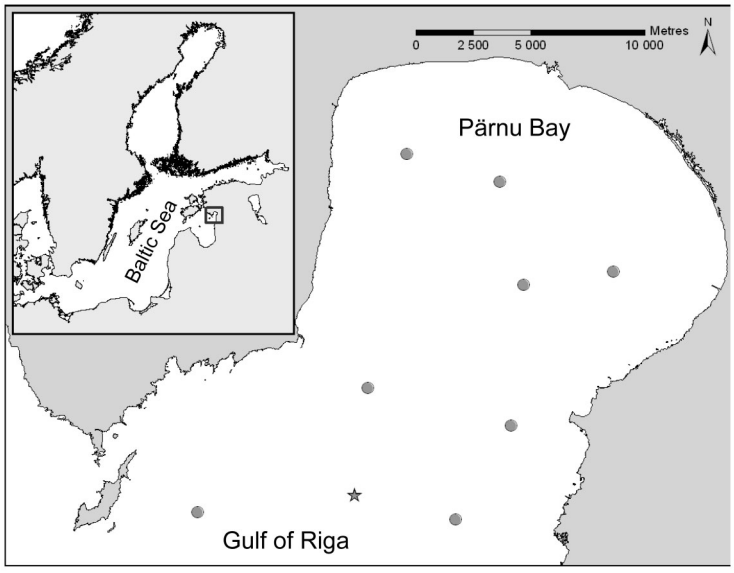

Fig. 1. Sampling stations in the Pärnu Bay area in 1970–2009. The star denotes the location where *Hemimysis anomala* was found.

A modified Rass dredge (Rass, 1933) was used for sampling. The dredge is made of a nylon netbag attached to a rectangular metal frame. An attached floater at the upper part of the frame keeps the dredge in an upward position and assures that the gear slides gently on the sediment surface without digging into it. The netbag has a mouth size of 20 cm × 60 cm. The mesh size of the nets was 0.4 mm.

The dredge was towed on a rotating metal cylinder (stone, gravel, sand, hard clay bottoms) or sledge (silty hard clay bottoms). The dredge is unsuitable for sampling on silty soft sediment where the mesh will be clogged up.

At the beginning of the sampling the dredge was slowly lowered while the ship was moving. The speed was slowed down when the length of the submerged wire rope exceeded two times that of depth. When the dredge touched the bottom (checked by hand), the speed was kept at approximately 1 km h^{-1}. By the end of the sampling (100 m, 5 min) the speed was increased so that the dredge rose above the bottom and the wire was pulled in. The amount of water that passed through the mesh during the sampling on the bottom was 17 ± 3 m^3.

All samples were stored in 4% buffered formaldehyde–seawater solution. In the laboratory all mysids were determined to the species level. Dry weight (dried at 60 °C for 48 h) of all mysid species was found to the precision of 0.001 g. The abundance and biomass values of each mysid species were then converted to areal basis using the knowledge on the surface area trawled. Additional details on the sampling procedure and data analysis were reported in Kotta et al. (2007).

In this study we present data obtained from more than 1100 Rass dredge samples collected from the Pärnu Bay area in 1970–2009 (databases of the Estonian Marine Institute). The long-term data set enables us to see whether the introduction of *H. anomala* is related to the dynamics of the native mysid species.

RESULTS AND DISCUSSION

Hemimysis anomala was found for the first time in the Estonian coastal sea in Pärnu Bay, the Gulf of Riga, on 27 October 2009. This was also the first finding of this non-native shrimp in the Gulf of Riga. The shrimp was sighted at 10 m depth in a deep trench of the outer Pärnu Bay. However, *H. anomala* did not occur at the other studied stations. The bottom substrate of the habitat where the species was found consisted of coarse sand mixed with gravel, clay, and algal debris. As this was the last sampling date of the year, we have no knowledge on whether or not *H. anomala* has remained in the area.

The abundances and biomasses of *H. anomala* were low, estimated at 0.033 individuals m^{-2} and 0.00028 g dry weight m^{-2}, respectively. Nevertheless, both adults and juveniles were present, suggesting that the species reproduced in the study area. Among native mysid species only *Neomysis integer* (Leach) was found at the same site that day. As compared to the non-native shrimp, *N. integer* had much higher abundance and biomass, respectively 7.849 individuals m^{-2} and

0.01586 g dry weight m^{-2}, exceeding the non-native species over 200 times in abundance and 50 times in biomass.

The introduction of *H. anomala* did not seem to be related to the population dynamics of the native mysid species in the Gulf of Riga. There were no clear trends in the abundances of the coldwater mysids *Mysis mixta* Lilljeborg and *M. relicta* Lovén, which only occasionally occur in the Pärnu Bay area. The population dynamics of the warmwater mysid *N. integer* had relatively stable abundances in the 1970s, fluctuating abundances from the early 1980s to the mid-2000s, and stable abundances again thereafter (Kotta et al., 2004; this study) (Fig. 2). This provides evidence of a regime shift between the early 1980s and the mid-2000s, possibly related to the recent shifts in weather patterns (e.g. Kotta et al., 2009). One can speculate whether or not such a regime shift might have

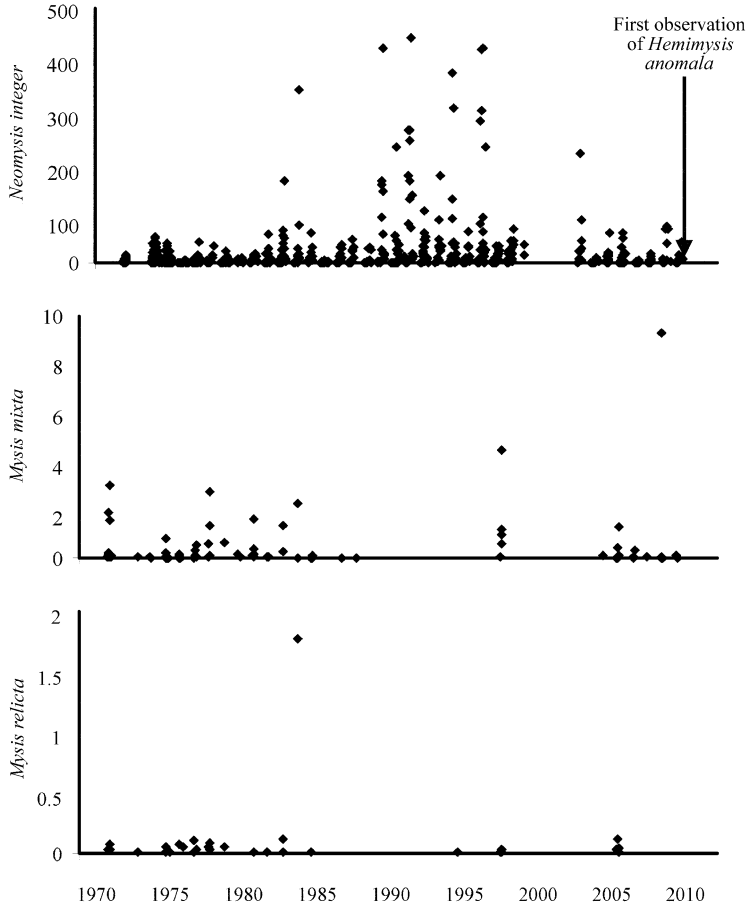

Fig. 2. Temporal variability in the abundances of *Neomysis integer*, *Mysis mixta*, and *M. relicta* (ind. m^{-2}) at the Pärnu Bay station where *Hemimysis anomala* was found. The timing of the first record of *H. anomala* is shown.

contributed to the recent introduction of *H. anomala* in the Estonian coastal range. Nevertheless, we think it is unlikely as the densities of the native *N. integer* were always relatively high, suggesting strong interspecific competition among mysids in the study area (Orav-Kotta et al., 2009b).

In this study *H. anomala* was observed in a habitat that conformed to the earlier findings of its range (Komarova, 1991; Salemaa & Hietalahti, 1993; Schleuter et al., 1998; Lundberg & Svensson, 2004; Janas & Wysocki, 2005). According to these findings, *H. anomala* is known to inhabit various types of habitats. During daylight hours, it is usually observed hidden close to the seafloor whereas by night it forages in the water column. In the northern Baltic Sea *H. anomala* is usually associated with stones and boulders. However, it may also inhabit mixed sediments; still, hard bottom prevails in such habitats with a thin cover of gravel, sand, and even silt. In the southern Baltic Sea the typical habitats of *H. anomala* are hollows among stones, boulders, or peat overhangs. In general, the abundance of *H. anomala* is much higher in the southern Baltic Sea than in the northern Baltic Sea. In its native habitats the species is also confined to rocky areas in the Black Sea and the Sea of Azov but also clayey hollows in the lower reaches of rivers.

As *H. anomala* has a sedentary and hidden mode of life, its dispersal rate is expected to be very low. Once established in an area, the species is likely to be recorded in the same localities (Janas & Wysocki, 2005), but it may take it several years to spread to other locations. Outside the Baltic Sea, however, this mysid may be a fast colonizer. It has been very successful in the Great Lakes basin where the large number of confirmed occurrences reveals its wide distribution in nearshore areas of all lakes (Marty et al., 2010).

In Pärnu Bay *H. anomala* has been found in low abundance only at one location. Therefore it is likely that the species does not affect the structure and functioning of phyto- and zooplankton communities there. Neither does it compete with fish fry for food. Nevertheless, *H. anomala* is known by its nocturnal behaviour and during daytime it hides under stones or within crevices (Janas & Wysocki, 2005). Thus, daytime sampling may give a false impression on its population size and higher values may be more realistic. Thus, our study points to the need for a large-scale night-time sampling in order to obtain better estimates on the spatial extent and abundances of the non-native mysid species in the Baltic Sea range. A few local attempts to estimate the densities of mysids in the water column during night have failed to find the non-native mysids such as *H. anomala* in the Estonian coastal range (Kotta, 1984; Kotta & Kotta, 1999; Kotta & Kotta, 2001a,b).

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Ponto-Kaspia päritolu müsiidi *Hemimysis anomala* esmaleid Eesti rannikumeres

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On antud ülevaade nektobentilise vähilaadse *Hemimysis anomala* levikust Eesti rannikumeres. Võõrliiki leiti esmakordselt Eesti rannikumerest 2009. aastal. Praeguseks on teda leitud vaid Pärnu lahe avaosast jämedaliivaselt põhjalt. Samas elupaigas elab ka kohalik müsiidiliik *Neomysis integer*. Võõrliik on tõenäoliselt naturaliseerunud, kuid väikese arvukuse tõttu ei avalda ta pelaagilisele kooslusele olulist mõju.