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SHORT COMMUNICATION

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## The first finding of the palaemonid shrimp *Palaemon elegans* Rathke in the Estonian coastal sea

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**Abstract.** The aim of this paper was to describe rapid colonization of the nekto-benthic crustacean *Palaemon elegans* in the Estonian coastal sea. The shrimp was caught for the first time from the Estonian coastal sea in July 2011. Within the same month the species was simultaneously found at high densities in four water basins: the Gulf of Finland, the Gulf of Riga, the West Estonian Archipelago Sea, and the Baltic Proper. Among individuals many mature females were found. Thus, having a wide distribution range, high densities, and great reproduction potential, *P. elegans* has most likely formed a permanent population all over the Estonian coastal sea.

**Key words:** Baltic Sea, benthic invertebrate, range expansion, shrimp, *Palaemon elegans*.

### INTRODUCTION

Since the 1990s a large number of species originating mainly from the freshwater and estuarine margins of the Ponto-Caspian region have invaded and formed permanent populations in the northern Baltic Sea (Kotta & Kotta, 1998, 2010; Kotta et al., 2004; Herkül et al., 2006, 2009; Herkül & Kotta, 2007). In addition to these invasive species, many Atlantic species have significantly expanded their range in the Baltic Sea, at present occupying large areas of the Baltic Sea coastline (e.g. Herkül et al., 2009). Until recently, the shrimp *Palaemon elegans* Rathke, 1837 was considered to belong to this category. However, the findings of Reuschel et al. (2010) showed that specimens from the southern Baltic Sea are genetically more similar to the specimens from the Black or Mediterranean seas than to the individuals inhabiting the Atlantic Ocean. Thus, the colonization of the Baltic Sea is most likely due to human introduction.

The shrimp *P. elegans* is native to the Atlantic coast of Europe and the North and Mediterranean seas (Campbell, 1994). It was formerly widespread only in the

western Baltic Sea but in recent years it has quickly spread practically all over the Baltic Sea, being currently found at the northern as well as the western shores of Finland (entrance to the Gulf of Finland) (e.g. Janas et al., 2004; Janas & Mańkucka, 2010). Nowadays, the species is very abundant in the southern Baltic Sea including the Polish shores where it has become the most common shrimp species inhabiting both the lagoons and the open sea areas. Since the establishment of *P. elegans* the density of another shrimp, *Palaemon adspersus* Rathke, has drastically declined, which may point to the potential of strong interspecific competition between them (Grabowski, 2006). Although *P. elegans* was observed for the first time in the northern Baltic Sea already in 2003 (Janas & Mańkucka, 2010), it was not recorded in the Estonian coastal sea until 2011 when it became very abundant. Our study describes the rapid colonization of *P. elegans* in the Estonian coastal sea and provides data on the characteristics of the habitats where the species is found.

## MATERIAL AND METHODS

Palaemonid shrimps are not systematically studied in the Estonian coastal range. However, the Estonian National Monitoring Programme targets the associated invertebrates together with benthic macrophytes. The phytobenthos sampling and sample analysis follows the guidelines developed for the HELCOM COMBINE programme (HELCOM, 1999). During monitoring the frame samples (400 cm<sup>2</sup> surface area) were collected randomly by a diver from seashore down to the deepest distribution limit of phytobenthos. The sampling was already initiated in 1995, and currently the programme covers the entire coastal area of Estonia. These data were supplemented by a semi-quantitative sampling with a benthic hand-net, with a dredge, and by divers. The samples were frozen at -20°C. In the laboratory all individuals were determined to the species level. The abundance values of shrimp species were then converted to areal basis using the knowledge on a surface of the sampled/dredged area.

## RESULTS AND DISCUSSION

In the Estonian coastal sea *P. elegans* was collected for the first time in July 2011. Within the same month the species was simultaneously found at high densities in all water basins around the Estonian coastal sea: Tallinn, Muuga, and Kunda bays in the Gulf of Finland; Kõiguste Bay in the Gulf of Riga; Haapsalu Bay in the West Estonian Archipelago Sea; and Küdema Bay in the Baltic Proper (Fig. 1). The density of the species varied between 1 and 30 individuals per square metre. Among samples many reproductive females were found.

A sudden appearance at high numbers seems to be characteristic of this species. This is apparently related to its reproductive strategy (Janas & Mańkucka, 2010) – a year or a few years after its arrival the species has become very numerous for

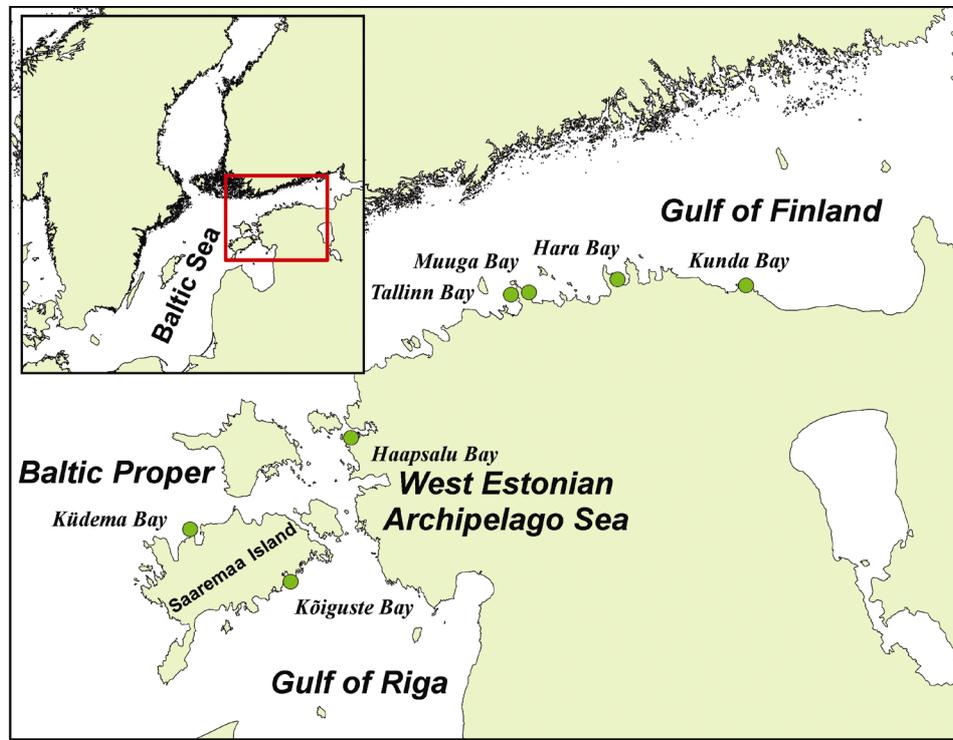


Fig. 1. Locations (filled circles) where *Palaemon elegans* was found in the Estonian coastal sea.

example in Poland (Janas et al., 2004; Grabowski, 2006), Iraq (Holthuis, 1975), and Estonia (this study).

It is plausible that *P. elegans* arrived in the Estonian coastal sea already in August 2010. Divers observed and photographed ovigerous females of *P. elegans* in Hara Bay, the southern Gulf of Finland (K. Haagen, personal communication). However, *P. elegans* stayed in the area only for about a week and was found later that year neither in Hara Bay nor in other locations of the Estonian coastal range.

The timing of the arrival of *P. elegans* in the Estonian coastal waters is most likely related to the increasing densities of the shrimp in the Finnish coastal sea in 2009 (Janas & Mańkucka, 2010). These two sites are only about 100 km apart, and elevated densities of the shrimp may result in the increased migration pressure across the Gulf of Finland. Besides, in recent years mass development of filamentous algae has been reported in the northern Baltic Sea and such drifting algal mats may facilitate the spread of the associated invertebrate species at wide distances (Kotta et al., 2008).

In the Estonian coastal range, *P. elegans* was the most abundant in shallow habitats with well developed benthic vegetation. In Kõiguste Bay, the Gulf of Riga, the species was found between the shoreline and 3 m depth both on hard and

soft substrate. It is probable that the species inhabits the neighbouring bays, but we lack samples from other near-coastal parts of the northern Gulf of Riga. Although extensive deeper areas (4–12 m) of the southern shores of Saaremaa Island were dredged, no individuals were found deeper down. The shrimp inhabited macrophyte communities dominated by *Cladophora glomerata* (L.) Kützing, *Fucus vesiculosus* L., *Potamogeton pectinatus* L., and *P. perfoliatus* L.

In Hara, Kunda, Muuga, and Tallinn bays of the Gulf of Finland, *P. elegans* was again the most abundant from the shoreline down to 3 m depth. The species was confined within the algal belt including mainly *Sphacelaria arctica* Harvey, *Polysiphonia fucoides* (Hudson) Greville, *C. glomerata*, *F. vesiculosus*, and *Pilayella littoralis* (L.) Kjellman. The last species seems to be one of the most rewarding food items as divers regularly observed *P. elegans* feeding on it. Janas & Barańska (2008) also reported that among macrophytes the principal dietary component of *P. elegans* was filamentous algae, but the dietary composition differed significantly between stations and months. Another native shrimp species, *P. adspersus*, is also known to extensively feed on *P. littoralis* (Orav-Kotta & Kotta, 2003). In the Gulf of Finland, *P. elegans* was mostly found on hard bottoms, some individuals inhabiting mixed bottoms but never soft bottoms.

In Haapsalu Bay of the West Estonian Archipelago Sea, *P. elegans* was observed at 0.5 m depth. The site was characterized by a mixture of boulders and sandy sediment. Boulders were covered with a dense community of *C. glomerata*, and within sand a sparse community of *Chara baltica* Bruzelius grew. The density of *P. elegans* was high, estimated at 25 ind. m<sup>-2</sup>.

In Küdema Bay, the Baltic Proper, the species inhabited the whole depth range of benthic vegetation, being mainly associated to *F. vesiculosus*, *P. littoralis*, and *C. glomerata*. Compared to the other studied basins, the density of *P. elegans* was much lower in Küdema Bay, hardly exceeding 1 ind. m<sup>-2</sup>. It inhabited only hard bottoms in this area.

However, *P. elegans* may occur also in deeper areas, although at lower densities. Some individuals were obtained from the stomachs of the shorthorn sculpin, *Myoxocephalus scorpius* (L.), caught at 15–20 m depth in Küdema Bay. In addition, divers have observed the species at 15 m depth in the vicinity of the wreck of the *Heino* in Tallinn Bay. Similarly to shallow-water habitats, these sites were characterized by the presence of macrophytes.

The habitat selection of *P. elegans* in the Estonian coastal sea seems to conform to the distribution pattern of the species elsewhere (Holthuis, 1975; Janas et al., 2004; Grabowski, 2006; Bilgin et al., 2008). Contrary to our observations, *P. elegans* was also observed in unvegetated sand bottom habitats in Poland (Janas et al., 2004). Although it avoids unvegetated sandy bottoms, the species can nevertheless invade a wide range of habitats in the Estonian coastal range including different wave-exposure regimes, hard and soft substrates as well as a large salinity range.

In conclusion, *P. elegans* seems to be mainly confined to shallow macrophyte habitats in the Estonian coastal range. The species is not selective about macrophyte species. At the time of capture seawater temperature was within the range of

4–20°C and salinity 4–7. Considering its wide distribution range, high densities, and great reproduction potential, *P. elegans* has likely formed permanent populations all over the Estonian coastal sea.

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## **Garneeli *Palaemon elegans* Rathke esmasleid Eesti rannikumeres**

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On antud ülevaade nektobentilise vähilaadse *Palaemon elegans* levikust Eesti rannikumeres. Teda leiti Eesti rannikumerest esmakordselt 2011. aasta juulis. *P. elegans* asustas arvukalt Liivi lahe, Soome lahe, Väinamere ja Ava-Läänemere rannikumerd. Tabati palju sigivaid isendeid. Tingituna liigi laiast levilast, suurest arvukusest ja sigimispotentsiaalist, on *P. elegans* tõenäoliselt naturaliseerunud kogu Eesti rannikumere ulatuses.