

First record of brush-clawed shore crab *Hemigrapsus takanoi* (Asakura and Watanabe, 2005) in the Gulf of Gdańsk (southern Baltic Sea)

Bartosz Witalis^{1,*}, Joanna Hegele-Drywa², Sławomira Gromisz¹, Agata Nowak¹

Abstract

The first occurrence of the brush-clawed shore crab *Hemigrapsus takanoi* was recorded during the monitoring of non-indigenous species carried out in the Port of Gdynia (Gulf of Gdańsk) in 2023. The discovery is important as it indicates an expansion of the biogeographic range of this crab in the southern Baltic Sea. Two males with carapace widths of 12.1 and 21.51 mm and wet weights of 3.32 and 6.88 g, respectively, were collected using a Fukui box trap and a self-designed habitat collector. Although *H. takanoi* is considered a successful invader, according to previous studies, the expansion of this species in the southern Baltic Sea may be limited by the salinity gradient. Its early life stages show low resistance to low salinity conditions, thus precluding the establishment of self-sustaining populations of this crab.

Keywords

Port; Invasive; Biofouling; Negative impact; Crab

¹ National Marine Fisheries Research Institute, Kołłątaja 1, 81–332 Gdynia, Poland

² Faculty of Oceanography and Geography, University of Gdańsk, al. Marszałka Piłsudskiego 46, 81–378 Gdynia, Poland

*Correspondence: bwitalis@mir.gdynia.pl (B. Witalis)

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The main vectors of distribution of non-indigenous species (NIS) in marine coastal environments are associated with ballast water, biofouling, and shellfish transport (Ojaveer et al., 2017; Wolf et al., 2018). Each year, new species are recorded outside their natural range, mainly due to anthropogenic activity, which often results in biodiversity loss and subsequent environmental changes (Simberloff et al., 2013; Lewis and Maslin, 2015; Pyšek et al., 2020). Crustaceans are considered one of the most frequently reported invaders of coastal habitats, with predatory brachyuran crabs being one of the most successful marine invasive groups (Rato et al., 2021). One such invader is the brush-clawed shore crab *Hemigrapsus takanoi*, native to the Western Pacific Ocean (Asakura and Watanabe, 2005; Bader et al., 2024). This species has been invading muddy and rocky shores of the intertidal zone, as well as sheltered estuaries and port areas of the European Atlantic and North Sea for more than three decades (Geburzi et al., 2015; Wood et al., 2015). It is believed to have been introduced from Asian populations through ballast water and ship hull fouling (Gollasch, 1999; Makino et al., 2018). Anthropogenic transport through biofouling on commercial ships and leisure boats, rather than larval dispersal, is now considered the main means of range expansion for

this species (Hänfling et al., 2002; O'Connor, 2014; Makino et al., 2018; Geburzi et al., 2020).

H. takanoi is a highly successful marine invader that tolerates a wide range of salinity and temperature (Mingkid et al., 2006; Nour et al., 2021). Juvenile and adult stages tolerate salinities as low as 9 (Gittenberger et al., 2010; Soors et al., 2010), while larvae require salinity of 20 to complete their development (Mingkid et al., 2006; Nour et al., 2021).

The species competes with native and introduced species and affects their abundance in the environments to which it has been introduced (Kraemer et al., 2007; Brousseau et al., 2014; Geburzi, 2018). *H. takanoi* has already demonstrated dominance over the native crab species *Carcinus maenas*, drastically reducing the number of juveniles through competition for shelter and food resources (Jensen et al., 2002; Griffen and Byers, 2009; Geburzi, 2018; Cornelius et al., 2021; Šargač et al., 2021; Rato et al., 2024). Furthermore, in the Baltic Sea, the species is currently considered an ecological threat, exhibiting a potentially population-destabilising functional response towards blue mussels (Theurich et al., 2022). Due to its possible negative impact on the environment and human health, as well as damage to property or resources, *H. takanoi* has been

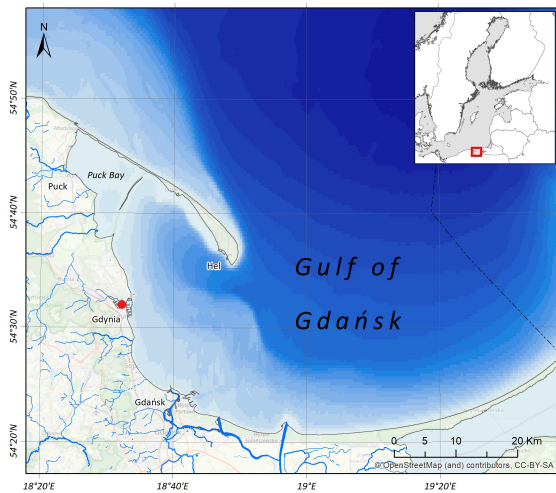


Figure 1. Location of monitoring survey in 2023 (red dot in Port of Gdynia) in the Gulf of Gdańsk, southern Baltic Sea.

included on the HELCOM Target Species list (IMO, 2007). Therefore, any new occurrence of this brush-clawed crab is of great interest.

Although this crab has been found in the Baltic Sea for almost ten years, its range was limited to the south-west coast only (AquaNIS, iNaturalist). This paper reports the first occurrence of *H. takanoi* in the southern Baltic Sea.

Two individuals of *H. takanoi* were collected in the Port of Gdynia located in the Gulf of Gdańsk (Figure 1) during a survey conducted in 2023 as part of the procedure for granting exemptions from the Ballast Water Management (BWM) Convention under Regulation A-4, in accordance with the Joint Harmonised Procedure for the Contracting Parties of HELCOM and OSPAR (HELCOM, OSPAR, 2020) and also for assessing the environmental status based on the newly-introduced NIS descriptor for the purpose of the Marine Strategy Framework Directive (2008/56/EC, MSFD).

The specimens were caught in April 2023 at a depth of 10.10 m ($T = 5.0^{\circ}\text{C}$; $S = 7$) using a Fukui box trap (Normant-Saremba et al., 2020) baited with sprat (*Sprattus sprattus*) and in September 2023 at a depth of 9.95 m ($T = 19.5^{\circ}\text{C}$; $S = 7$) using a self-designed artificial habitat collector (Figure 2). The Fukui box trap was deployed for 48 h at the sampling site, while the artificial habitat collector was installed for 4 weeks.

The collected specimens were identified based on the characters given in Breton et al. (2002) and Asakura and Watanabe (2005). Identification was made using species-specific characteristics, such as the shape and presence of three lateral spines on the dorsal carapace (Figure 3A), the



Figure 2. Self-designed artificial habitat collector size: 40 cm × 40 cm × 30 cm (filled with broken flowerpots, decorative stones, rubber and plastic pipes).

absence of coloured spots on the abdomen (Figure 3B), the interrupted infraorbital ridge (Figure 4A), and the chelar setal patch (Figure 4B). Both collected specimens were sexed as males with a carapace width of 12.1 and 21.51 mm and wet weight of 3.32 and 6.88 g, respectively.

The discovery of live specimens in the Port of Gdynia is very important as it indicates that the range of this species is expanding. This is its easternmost site in the Baltic Sea. To date, the easternmost record came from the Darss-Zingst Bodden Chain in Germany (AquaNIS), where salinity ranges from 1 in the innermost areas to 8–12 at the opening to the Baltic Sea (Schubert et al., 2010). However, the species is often recorded for the first time in ports (Geburzi et al., 2015; Zabrocki et al., 2021; Kazmierczak et al., 2020), as in the case described in this paper. Therefore, the arrival of this crab is likely to be attributed to transport on biofouled hulls as a potential vector of introduction. Since the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention), entered into force globally on 8 September 2017, the introduction of crabs by ballast water has been significantly reduced.

Although the Baltic Sea is considered a region susceptible to invasion by non-native species (Ojaveer et al., 2017), only species capable of establishing self-sustaining populations will occur in larger numbers and may become invasive (Ricciardi, 2012). The low salinity of the southern Baltic waters prevents full larval development of *H. takanoi* (Mingkid et al., 2006; Nour et al., 2021). Furthermore, there is only limited evidence of increased tolerance to low salinity in larvae from the Baltic Sea populations compared to other populations/regions (Geißel et al., 2024). Therefore, it is unlikely that the species will establish a self-sustaining population in this region due to unsuccess-

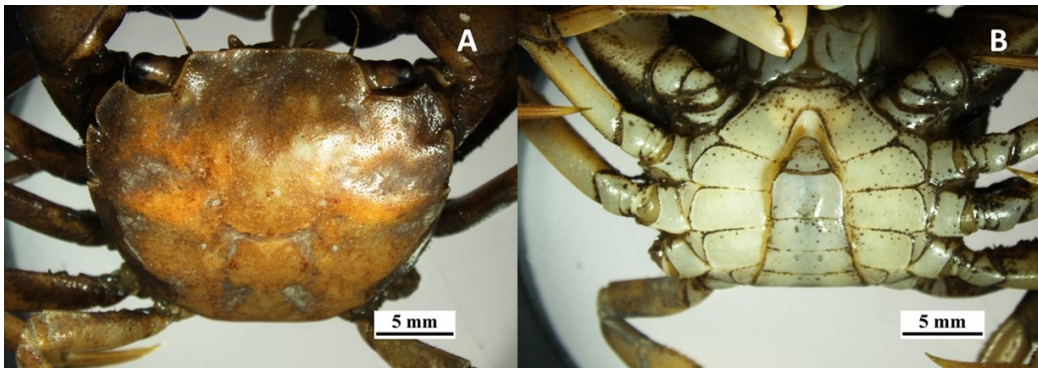


Figure 3. *H. takanoi* specimen with visible three lateral spines (A) and the absence of colored spots on the abdomen (B).

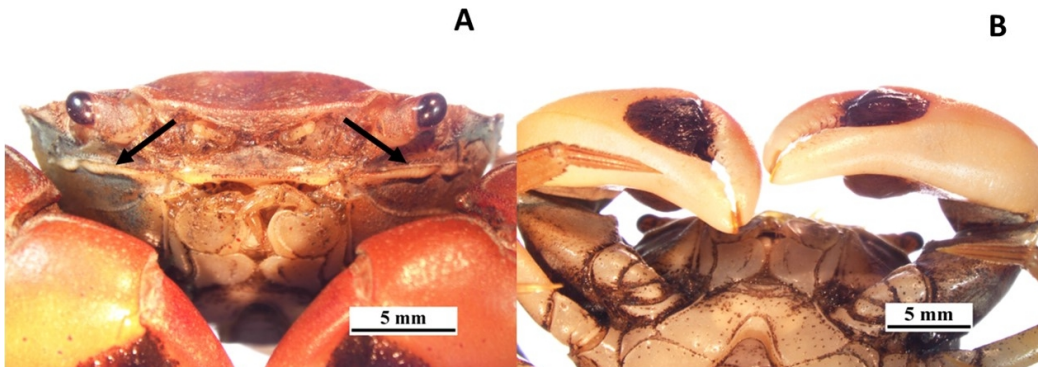


Figure 4. *H. takanoi* specimen with species specific features: an interrupted infraorbital ridge-marked with arrows (A) and chelar setal patch (B).

ful reproduction. This allows us to assume that invasion and further spread, as well as the negative impact of this crab in the southern Baltic, is rather unlikely. The occurrence of *H. takanoi* resembles that of the European green crab *Carcinus maenas* or the Chinese mitten crab *Eriocheir sinensis* in the region. The latter two species, reported to be highly invasive in introduced environments, have not established themselves there due to the low salinity. They are recorded in low abundance and ultimately pose no threat to local biodiversity. On the other hand, even at low abundance, *H. takanoi* can affect benthic communities through parasite transmission. Despite the fact that brush-clawed crabs are hosts for parasites mainly in their native regions (McDermott, 2011; Gong et al., 2022), with the exception of one case documented to date of specimens in a non-native environment, i.e. in the Wadden Sea in the Netherlands (Goedknegt et al., 2017), transmission of unwanted organisms via this species cannot be excluded.

In conclusion, the arrival of *H. takanoi* in the southern Baltic Sea requires close monitoring, especially in seaports, as they are recognized as hubs or hotspots for the introduction and translocation of marine invasive species (Tempesti et al., 2020; Costello et al., 2022). Despite the BMW Convention, there are no regulations for the management

of biofouling, thus this vector is likely to be responsible for further introductions. Nevertheless, as the key condition for the establishment of this species is successful reproduction, the likelihood of rapid invasion and negative impact on the ecosystem in the southern Baltic Sea is rather low.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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