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SHORT COMMUNICATION

A new record of the invasive blue crab (*Callinectes sapidus* Rathbun, 1896) and his parasite from the Baltic basin

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Summary A specimen of the invasive *Callinectes sapidus* was recently found in the catchment basin of the Baltic Sea (Lake Dąbie, Poland). The discovery is significant because it indicates a widening of the crab's biogeographic range in northern Europe and confirms its expansion along European estuaries. The captured juvenile specimen from Lake Dąbie (estuary of the Oder River) had a carapace width (CW) of 125.58 mm, carapace length (CL) of 53.23 mm, and weight (w) of 100.19 g. This is the first record of this species in this part of the Baltic Sea catchment basin, following the discovery of a female caught in a plaice net northeast of Copenhagen (1951) and an adult male caught off Skagen, Northern Jutland, between the Kattegat and the Skagerrak (2007).

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Marine non-indigenous species (NIS) pose a serious threat to the aquatic environment of coastal areas due to their adverse impact on native species, eco-system biodiversity, and habitats (Ojaveer et al., 2016). In recent decades, most introductions of invasive species have been related to increased human activity, specifically sea transport, aquaculture, and tourism (Murray et al., 2011).

In European waters at least 87 NIS have been characterized (Katsanevakis et al., 2014), including a significant number of crustaceans. One is *Callinectes sapidus* (blue crab), originating from the western Atlantic Coast (Millikin and

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Williams, 1984) and currently found distributed throughout European waters (Mancinelli et al., 2017), especially in the eastern Mediterranean (e.g. Adriatic and Aegean Seas) (Beqiraj and Kashta, 2010; Dulcic and Dragicevic, 2010; Sumer et al., 2013).

Although considered an invasive species in the Mediterranean (Katsanevakis et al., 2014), the negative effects of *C. sapidus* on native benthic communities and ecosystems are not well studied. This crustacean is characterized by high fertility and aggressive behavior, facilitating colonization of new waters (Millikin and Williams, 1984). Nonetheless, discovery of *C. sapidus* in the Baltic Sea catchment basin comes as a surprise, as over the last 50 years it has been reported only a handful of times in northern and central European waters.

In Europe this species has been noted since 1900 when it appeared on the French Atlantic coast. In the northern European waters *C. sapidus* was first observed in the Netherlands in 1932 (Wolff, 2005). Then, in 1981, it was first observed in Belgian waters (ICES WGITMO, 2007). On the German North Sea coast, *C. sapidus* was caught in 1964, 1965, 1990, 1998, 2007, and 2008 (Nehring and Meer, 2010; Nehring, 2011). Moreover, in Denmark, a single specimen was recorded in Øresund in 1951, and the next one near Skagen in 2007 (Tendat and Flintegaard, 2007). Those sites have been the furthest north-easterly locations of *C. sapidus* occurrence in Europe to date.

In this study, we report a novel occurrence of *C. sapidus* in the Baltic basin and discuss its morphometry and parasites.

The blue crab (*C. sapidus*) specimen was caught on 11 October 2018 during commercial fishing in the western part of Lake Dąbie, at the mouth of the Duńczyca Canal (coordinates: 53°25.566′N 014°36.979′E; 53°25.981′N 014°37.513′E) (Baltic Sea Basin) (Fig. 1). The specimen was photographed (Fig. 2) and sex was determined on the basis of external and internal structures (Millikin and Williams, 1984). Morphometric measurements (CW — carapace width including lateral spines, CL — carapace length, CH — carapace height) were performed (electronic caliper MEGA 150 mm 20513). Total body weight (W) and weight of hepatopancreas (WH) were also determined (laboratory balance RADWAG AS 160.R2).

On the basis of the obtained data, the condition of the crab was evaluated using the Fulton coefficient ($K = 100W/CW^3$,

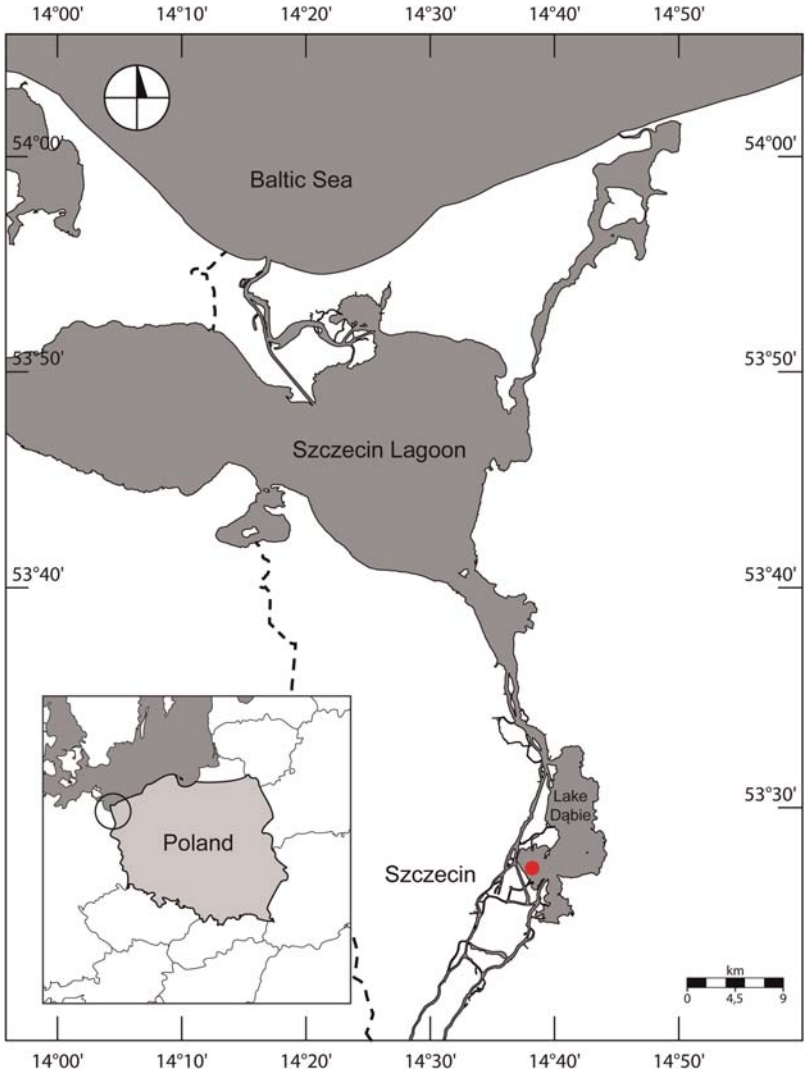

Figure 1 The site where the studied specimen of *Callinectes sapidus* (blue crab) was caught.

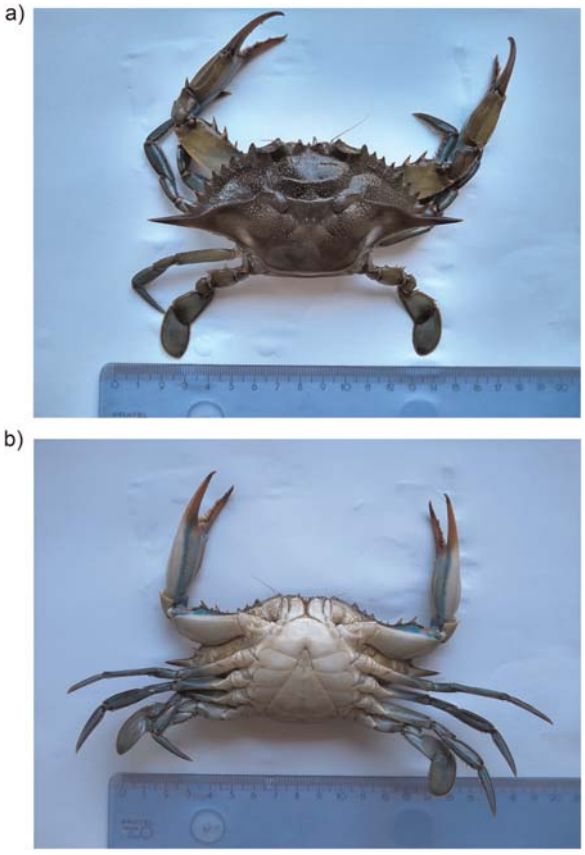

Figure 2 (a) Dorsal and (b) ventral view of the *Callinectes sapidus* juvenile female caught in Lake Dąbie.

where *W* is the crab weight [g] and CW is the carapace weight [cm]) (Sumer et al., 2013) and hepatosomatic index (HSI = WH × 100/*W*, where WH is the weight of hepatopancreas [g] and *W* is the crab wet weight [g]) (Cilenti et al., 2015).

Later, the crab was visually inspected to detect macroscopic lesions and visible external parasites. Heart, gonads, hepatopancreas, stomach, gut, and gills were prepared and examined for the presence of internal parasites (Goedknegt et al., 2017). Crabs gills were placed on a Petri dish and observed under a stereomicroscope (Zeiss Stemi DV4). In addition, microscopic preparations were made by collecting material from setae on claws and legs, from joint depressions of the legs, and from gills, which were inspected under transient light with the Olympus BX50 microscope equipped with an AxioVision camera with ZEN 2 core v.2.5 software.

The crab was characterized by a wide carapace (CW = 125.58 mm, CL = 53.23 mm, and CH = 26.31 mm) with a light blue dorsal surface (Fig. 2). The caught individual weighed 100.19 g.

The found female was identified as a juvenile based on the shape of its abdomen and internal organs (Millikin and Williams, 1984), even though the width of its carapace exceeded 125 mm. Immature females have a triangular abdomen with most segments indistinguishably fused but at the terminal maturation molt all segments become free (see Williams, 1974).

The Fulton coefficient provides important information about the 'well-being' of a species and can indicate aspects such as recent feeding conditions and the degree of adjustment to the environment. In the studied specimen calculated coefficient (*K*) value was 5.06, and hepatosomatic index (HSI) was 4.06. The Fulton coefficient indicated that the caught specimen was in good condition. The coefficient was higher than in the crab coming from the warmer waters of the Beymelek Lagoon — *K* = 4.60 (Sumer et al., 2013). The juvenile female from Lake Dąbie also had a better condition than adult females from Lesina (*K* = 3.28) and Verano (*K* = 3.86) lagoons (Cilenti et al., 2015).

Detailed parasitological analysis did not reveal the presence of internal parasites, including muscle parasites. Microscopic observation of material from joint depressions revealed the presence of the parasitic protozoan *Trichodina* sp. (Oligohymenophorea: Mobilida) (Fig. 3). It is difficult to

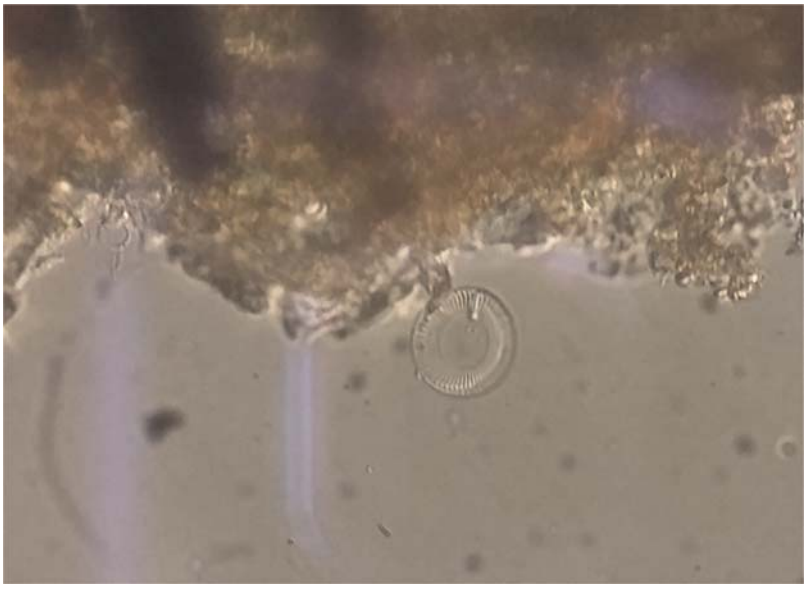

Figure 3 *Trichodina* sp. from the joint of the blue crab (*Callinectes sapidus*).

say that *Trichodina* sp. in this localization on the host is an epibiont or parasite, but it has been described as a parasite on another crab species – *Callinectes amnicola* (Enkamen et al., 2013). Although protozoa of the genus *Trichodina* have not previously been recorded on *C. sapidus* in European waters, they are common parasites of gills and body surfaces of fish in Western Pomerania (Mrozińska-Gogol, 2008). Due to the blue crab's migratory lifestyle, it could act as a vector spreading this parasite in the reservoir and thus could contribute to its transmission to fish, especially because *Trichodina* sp. proliferates exponentially and in favorable conditions a single specimen can reproduce very quickly by division and start a new invasion.

Establishing the presence of a new parasite for *C. sapidus* is particularly interesting because the parasitic fauna of this species residing in Europe is poorly understood. Messick and Sindermann (1992) identified 6 taxa of parasites recognized as crab pathogens in its native environment. Some of them, such as *Hematodinium perezi* (Protozoa), are also recorded in blue crabs found in Europe (Pagliara and Mancinelli, 2018). The change of the environment from marine to freshwater (and vice versa) acts as a specific disinfection treatment and there are few pathogens able to survive a change in salinity. This can explain the lack of other external parasites of the studied *C. sapidus*.

C. sapidus is a euryhaline and eurythermal species that inhabits estuaries and shallow coastal lagoons (Beqiraj and Kashta, 2010). Adult males prefer more brackish water (20–25 ppt) as evidenced by their discovery in the waters of the Rivers Elbe and Weser (1–23 ppt) (Grabemann et al., 1983), while adult females dominate in waters with higher salinity (>30 ppt). According to Costlow (1967), juveniles are more tolerant to variations in salinity and temperature than adults, and so it follows that the low salinity in Lake Dąbie is not prohibitive to immature individuals of this species. *C. sapidus* larvae require salinities above 22 ppt to survive, hence the low salinity in the estuary waters of the Oder and the Baltic Sea prohibits reproduction.

Ballast tanks of marine vessels are the most likely source bringing this species into European waters (Nehring, 2011) as in its native habitats *C. sapidus* occurs in large numbers close to major shipping lanes. *C. sapidus* exhibits an ability to adapt rapidly to new conditions and therefore, is a highly expansive species (Gennaio et al., 2006; Nehring et al., 2008). Successful competition for space and resources, supported by the large reinforced exoskeleton, strength, and eating habits of this crab, are of key importance in their fight for domination in trophic networks (Millikin and Williams, 1984). As a result, blue crabs may compete with other crab species, increasing mortality and affecting the distribution and dynamics of native crabs (Mancinelli et al., 2017). So far, however, there has been no evidence to indicate a negative impact on biodiversity, e.g. direct predation, displacement, or inhibition of other invertebrates, such as native crabs or other crustaceans (Katsanevakis et al., 2014).

It seems that the presence of the *C. sapidus* specimen in the waters of the Baltic Sea was not a result of invasion but an accidental and isolated case. Nevertheless, its appearance in a non-native habitat and good condition indicate that this species could successfully colonize waters of the western Baltic.

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