Status of the invasive blue crab *Callinectes sapidus* Rathbun, 1896 (Brachyura: Portunidae) in Slovenia

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Abstract: Authors present data regarding the presence of the invasive blue crab *Callinectes sapidus* Rathbun, 1896 (Brachyura: Portunidae) based on records gathered from local fishermen. This alien species was firstly recorded in Slovenian coastal waters in March 2019 and it was subsequently found in six other cases in 2019, 2020 and 2021. Crabs were collected or sighted in shallow coastal areas along the Slovenian coast. In addition, authors discussed about the status of the blue crab in marine and coastal habitats of Slovenia.

Keywords: Adriatic Sea, *Callinectes sapidus* Rathbun, 1896, invasive species, presence, Slovenia

Introduction

The blue crab *Callinectes sapidus* Rathbun, 1896 (Brachyura: Portunidae), is considered an economically important species throughout its native area of distribution (Nehring 2011) which comprises the western Atlantic coast from Nova Scotia to Argentina (Manfrin et al. 2016). Its population supports intensive fishery, which currently supplies over one-third of all US commercial blue crab landings (Miller et al. 2011). It is characterized by early maturity, rapid growth and high reproductive potential, strong swimming capacity and aggressive behaviour and is able to
efficiently exploit available resources in euryhaline and eurytherm environments (Piras et al. 2019). Nowadays, the blue crab is rapidly spreading its distribution worldwide (Mancinelli et al. 2021). During the last decades an expansion of the blue crab has been witnessed in almost all Mediterranean countries (Galil 2011, Cerri et al. 2020). The blue crab is considered as one amongst the most invasive crab species (Strerfatis and Zenetos 2006). Up to date it was reported in different habitat types, mainly in coastal lagoons, estuaries and coastal sea. The first record of this species in Europe originated from harbour of Rochefort in France in 1900 (Bouvier 1901). The first evidenced and documented record in the Mediterranean Sea was reported by Giordani Soika (1951) in the Lagoon of Marano and Grado in 1949, however, there are some findings showing that it may arrived already in the 1937 in the Aegean Sea (Nehring 2011). Since then the crustacean started emerging in different areas of the Mediterranean Sea (Cerri et al. 2020). The invasion of the blue crab is aided by warming sea temperatures (Nehring 2011). During the last two decades the records of blue crab specimens have been reported from different localities along the Adriatic coast in its southern (Onofri et al. 2008; Beqiraj and Kashta 2010, Dulčić et al. 2010, 2011, Cilenti et al. 2015), middle (Florio et al. 2008; Castriota et al. 2012) and northern parts (Scaravelli and Mordenti 2007, Manfrin et al. 2016). However, the species is considered established only in southern Croatia, northern Albania and southern Italy (Castriota et al. 2012).

Some authors mentioned different vectors as responsible of Mediterranean introduction of the blue crab, such as dispersal of larvae by ballast water (Nehring 2011, García et al. 2018) or by natural spreading due to its swimming ability (Galil et al. 2002). As it is a highly valued seafood, the possibility of an intentional introduction for aquaculture reasons could not be neglected, as well (Giordani-Soika 1951, Nehring 2011).

The aim of this contribution is to present all available data regarding the presence of the invasive alien crab in marine and coastal areas of Slovenia and to discuss its current status in the area.

**Material and methods**

Blue crab specimens were obtained by local fishermen who caught them in fishing nets or photographed them *in situ*. Blue crabs were captured accidentally from March 2019 to October 2021 in the Slovenian coastal waters. The collected crab specimens were measured by Vernier calliper to the nearest millimetre and weighed with digital balance. The biometric parameters which were measured were the carapace length (CL), carapace width (CW), abdomen length (AL), abdomen width (AW), propodus length (PL), dactylus length (DL), cheliped length (ChL), cheliped width (ChW) and cheliped height (ChH), and rostrum width (RW). The gender was easily assessed through the colour pattern and abdomen characters of specimens. According to the classification of Harding (2003), where blue crabs are divided in three size categories, e.g. small crabs if CW is lower than 80 mm, medium crabs, when CW range from 80 – 120 mm and large crabs, when CW is bigger than 120 mm.

**Results and discussion**

Specimens were collected at seven different localities (Tab. 1, Figs. 1, 2), which were all characterized by their shallowness and muddy bottom. The earliest record of the blue crab originates from Seča (Fig. 2a), in front of the Jernej’s canal on 15th March 2019 (Lipej and Rogelja 2021). Altogether 12 specimens were recorded, among which were 10 females and two males. Six specimens (5 females and one male; Fig 3) were collected, while another six specimens were sighted and photographed on 28 July 2020 (Table 1). All specimens were found in the period from March to October. The carapace width ranged between 159.5 mm to 182 mm, while their weight ranged between 173 g and 402 g (Tab. 2). Therefore, all individuals recorded in Slovenia were classified as large sized specimens.

Unlike in male blue crab, sexual maturity in females is established at the terminal moult, during which the coloration of the abdomen darkens and its shape changes from triangular to semi-circular presumably to provide a larger surface area for brooding eggs (Van Engel 1958,

Figure 2: Blue crabs, recorded in the marine waters of Slovenia. (A) - female blue crab, captured on 15 March 2019, (B) - An ovigerous female, recorded on 9 April 2020, (C) - female, captured recorded on 16 October 2019.

Based on these characteristics all five collected females are considered as sexually mature. Females have the only opportunity to mate immediately after the pubertal moult. They store the spermatophores containing sperm and can therefore produce multiple broods over several years, reaching 1 – 3 broods in temperate waters and up to 7 in tropical waters per year (Hines et al. 2003). The female collected on 9th April 2020 (Fig. 2b) and kept in the tank developed an egg mass beneath its aprons that was firstly noticed on 9th July 2020. The eggs were already brown and got darker in the period of four days, showing that the egg development was reaching its final stage. The egg mass was not noticed before as the female was less active and buried in the sand during the day. On 13th July the female was preventively translocated to a quarantine tank where it was kept until the release of larvae, so no accidental escape of larvae to the sea could be possible. On 17th July the female was returned to the aquarium in the public area.

The majority of specimens were caught in shallow waters on sedimentary bottom or in estuaries and channels. As an opportunistic species the blue crab is able to tolerate wide oscillations of temperature and salinity, typical conditions of brackish waters and adjacent eurytherm and euryhaline habitats (Piras et al. 2019). Such environment is characterized by low number of native species and seems to offer many non occupied ecological niches (Nehring 2006, 2011). Brackish waters are also in general known as environments where alien species are very successful in term of colonisation (Paavola et al. 2005).

The first record of *C. sapidus* in the northernmost part of the Adriatic Sea originated before seventy years (Giordani Soika 1951), however, only recently new findings were discovered in the area (Manfrin et al. 2016). Such records were reported only during the past five years. It is reasonable to speculate that the blue crab arrived in Slovenian waters from the Italian part of the Gulf of Trieste where it was recently discovered in Marano and Grado Lagoon (Manfrin et al. 2016). The second possibility is that the species came from the south, *i.e.* from Istria, where it is considered as frequent from Savudrija to Pula (Sladonja, personal communication), although there are no published records in that regard. However, Gljuščić (2019) in his Master thesis mentioned a case of the blue crab finding in the vicinity of Šćuza lagoon, near Pomer bay in southern Istria. The third possibility is that the blue crabs recruited to the Gulf of Trieste and Slovenian waters as settled larvae from ship’s ballast waters (Manfrin et al. 2016).
Taking into account recently published data of Benabdi et al. (2019) and Shaiek et al. (2021) the occurrence of *C. sapidus* is so far confirmed in 18 out of the 23 countries surrounding the Mediterranean Sea. Since the species was recently confirmed also in Slovenian waters (Lipej and Rogelja 2021), Slovenia represents the 19th country. On the basis of regular monitoring of non-indigenous species in marine waters of Slovenia up to date at least 57 non-indigenous species were reported in the Slovenian part of the Adriatic Sea (Orlando Bonaca et al. 2020, Mavrič et al. 2021). Among them the blue crab is the only alien crab. Since in the close proximity other alien crab species were recorded, such as *Callinectes danae* (Mizzan 1993), *Dyspanopeus sayi* (Mizzan 1995) and *Rhitropanopeus harrisii* (Mizzan and Zanella 1996) from the northern Adriatic lagoons, *Hemigrapsus sanguineus* from waters off Rovinj (Schubart 2003) and *Eriocheir sinensis* (Bettoso and Comisso, 2015) from the Lagoon of Grado and Marano, some of them could be recorded in Slovenia in nearby future.

Although the blue crab was recorded in three successive years in Slovenian coastal waters it is still not possible to consider the species as an established one. In fact, all findings were recorded in the warmer period of the year. Due to the low winter temperatures, the species is probably not able to survive such harsh conditions occurring in winter. However, there are some evidences from the estuary of the Neretva river where “muddy” individuals, which may emerged after overwintering buried in the sediments, were observed (Mancinelli et al. 2016).

In its native area, the Chesapeake Bay, the average winter temperatures on the sea bottom reach 3.4 °C. Rome et al. (2005) showed that significant mortality may not occur unless water temperatures drop significantly below 3° C for an extended period of time. Since the average winter temperature in the Slovenian sea is higher, with the average in the coldest month of February 7.3° C and minimal 6.3° C (ARSO, 2019), the blue crab could be able to over-winter in the studied area.

The arrival of this invasive alien crab in the waters off Slovenia was expected since it was previously recorded in the immediate vicinity at Italian sites (see Manfrin et al. 2016) and could be attributed to higher water temperatures. Although only few records have been reported to us so far, the local occurrence and the further dispersion of this species deserve to be cautiously monitored.
especially in order to gain data on the functional role that this taxon could play within benthic food webs in Mediterranean coastal habitats. According to Mancinelli et al. (2017) the blue crab can prey on a wide spectrum of native crab and fish or compete with them, which could inflict potentially high ecological impacts on the native biota. Since in its native area of distribution the blue crabs plays a major role in energy transfer within the food web of estuaries and lagoons, it may also be responsible for certain impacts in the invaded environments.

### Table 2: Biometrical parameters, measured on the collected specimens of blue crab, recorded in the coastal waters of Slovenia. All measurements are in millimetres.

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<tr>
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**Povzetek**

so značilna za brakične vode. Premer karapaksa rakovic je bil med 159.5 mm in 182 mm, telesna masa pa je bila med 173 g in 402 g. Čeprav je bila modra rakovica dosegla najdena le na manjšem številu lokalitet, je njeno pojavljanje in razširjanje smiselno spremljati, še posebej z vidika pridobivanja podatkov o funkcionalni vlogi, ki jo ima ta vrsta v pridrenem prehranjevalnem spletu sredozemskih obrežnih habitatov.

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References


