Further records of *Callinectes sapidus* (Rathbun, 1896) (Decapoda, Brachyura, Portunidae) in the Strait of Sicily

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Abstract

Five specimens of the invasive American blue crab *Callinectes sapidus* were caught from October 2018 to December 2019 off the Mazara del Vallo harbour, Strait of Sicily. This note documents further records of the species in the Strait of Sicily and its settlement in the area. In addition, an update of the spatial distribution of *C. sapidus* in the Mediterranean Sea was provided.

Keywords: Blue crab, Non-indigenous species, Biodiversity, Trammel net, Small scale fisheries

Introduction

The Atlantic blue crab, *Callinectes sapidus* (Rathbun, 1896), is an endemic species of the eastern coast of America living between southern Canada and northern Argentina (Squires 1990). This species is considered an opportunistic and aggressive predator feeding on fishes, molluscs, crustaceans, arthropods, and polychaetes (Gonzalez-Wanguemert and Pujol 2016; Mancinelli et al. 2017a). Additionally, the Atlantic blue crab shows scavenger and cannibalism behaviour, and it can eat algae as well (Kampouris et al. 2019). Being a eurythermal/euryhaline species, the Atlantic blue crab shows a high tolerance to extreme variation in water conditions living in muddy and sandy bottoms of estuaries, lagoons as well as coastal habitats up to 90 m of depth (Cabal et al. 2006; Benabdi et al. 2019).

Such characteristics make the *C. sapidus* one of the 100 worst invasive species in the Mediterranean Sea (Stretaris and Zenetos 2006).

In the Mediterranean sea, *C. sapidus* seems to be acclimatized since the mid-twentieth century (Garcia et al. 2018). The exact date of the first record of *C. sapidus* in the Mediterranean sea is unknown due to the misidentification of the species with *Portunus segnis* and *Portunus pelagicus*. As reported by Castriota et al. (2012), the first verified record in the Mediterranean occurred in 1949 in the northern Adriatic Sea. Then the expansion of *C. sapidus* went on almost all the Mediterranean, reaching a stable presence mainly along the northern coast of the basin (Zenetos et al. 2010; Servello et al. 2019; Cerri et al. 2020). Around the Sicilian waters, this species was first recorded in 1970 and 1972 near the harbour of Messina (Cavaliere and Berdar 1975), as well as in 1988–1990, which was recorded in the eastern coast of Sicily by Franceschini et al. (1993) and only recently off the harbour of Licata by Lipej et al. (2018).

Regarding the vector of Mediterranean introduction, three hypotheses were made by different authors: a) natural arrival by adults due to its swimming ability (Galil et al. 2002), b) dispersal of larvae by ballast water (Garcia et al. 2018), c) intentional introduction for commercial purposes as it happened in the eastern Mediterranean with its arrival from America in the 1930s (Giordani-Solka 1951). However, to date, none of these three different hypotheses were accepted by the scientific community as permanent explanation.
Taking into account the aim of the target 9 of the Aichi Biodiversity Targets (Strategic plan for biodiversity 2011–2020), “by 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment”, each record is crucial to be reported mainly for the species with high rate of invasiveness such as *C. sapidus*.

In light of the above considerations, this note documents the finding of further five specimens suggesting the successful settlement of *C. sapidus* in the Strait of Sicily and provides an updated map of all the records as from the one previously summarised by Mancinelli et al. (2017b) and Labrune et al. (2019).

**Materials and methods**

Five specimens of *C. sapidus* were caught during commercial trammel net fishing operations in the waters off the Mazara del Vallo harbour (approximate coordinates 37.642° N, 12.584° E) at about 3 m depth. The first specimen, which is the second-ever record in the Strait of Sicily, was caught on 3rd October 2018, the second on 14th November, while the remaining three were caught on 11th December 2019.

The first two specimens were photographed and weighed with an accuracy of 0.1 g (Fig. 1). Carapace length (CL, mm – the distance between the centre of the anterior interorbital margin and the centre of the posterior margin) and carapace width (CW, mm – the maximal distance between the posterior anterolateral spines) of the first two specimens were recorded with a calliper to the lowest millimetre. In contrast, sexual maturity was determined, according to Türeli et al. (2018).

Unfortunately, for the other specimens, it was not possible to collect biological and biometric information because we had only photos provided by the fishers. (Fig. 2). All the specimens were identified, according to Williams (1974). Further, an up-to-date of the Mediterranean species presence record of the Atlantic blue crab was made by using Quantum GIS software. (Fig. 3)

**Results and discussion**

The first specimen weighed 328.8 g and measured 81.5 and 207.5 mm in CL and CW, respectively. While the second one weighed 312.5 g and measured 80 and 197 mm in CL and CW, respectively. According to Türeli et al. (2018), both blue crabs were adult females (stage IV) with dark orange ovaries. The main features, such as brownish-green dorsal carapace surface with white spots, scattered mostly in its anterior portion, whitish ventral surface, and bright orange chelipeds, were in agreement with the description proposed by Williams (1974) (Fig. 1). Considering that the first record in the Strait of Sicily (i.e., Maltese waters) reported by Schembri and Lanfranco (1984) was a misidentification with *Portunus segnis* (Crocetta et al. 2015), our findings represent the second record of *C. sapidus* in the Strait of Sicily being 160 km westernmost to the first record collected off Licata by Lippej et al. (2018).

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**Fig. 1** *Callinectes sapidus*. The first specimen caught off Mazara del Vallo harbor. a) ventral view with abdomen cavity, b) dorsal view, c) particular of the dactyl, d) details of the antero-lateral and lateral spines and e) frontal view. Scale bar: 5 cm
In our opinion, the occurrence of the blue crab in the Strait of Sicily might be due to transport of larvae by ballast waters (Nehring 2011) related to the intense maritime traffic in the area (La Loggia et al. 2011; Mangano and Sarà 2017) or to the biofouling linked both to aquaculture facilities (Montalto et al. 2020) as well as to the Sicilian distant trawlers operating in the Eastern Mediterranean returning to home port. However, available information is not sufficient to provide a definite answer to either one of the two causes of its occurrence in the area. Nevertheless, these records together with the finding of other alien species (e.g. Katsanevakis et al. 2020; Dragičević et al. 2019; Geraci et al. 2018; Scannella et al. 2017) strengthen the hypothesis that the Strait of Sicily plays a key role in the spatial dynamics of alien species. Indeed, this area is characterized by a mesoscale circulation system that might facilitate their spread and arrival (Capodici et al. 2018) as well as by local conditions, such as water temperature, salinity, oxygen and seabed habitat, that can improve their settlement and survival ability (Montalto et al. 2020). Looking at the whole Mediterranean Sea, the Atlantic blue crab is almost ubiquitous in Aegean and Levantine basins and in the last two decades has become common along the Ionian coasts as well as in the Adriatic Sea, with repeated observations in Italy, Croatia, Montenegro, and Albania (Mancinelli et al. 2017b). In the last years, increasing records of blue crab have also occurred in Sardinian waters as reported by Piras et al. (2019) and in the North-East of the Iberian Peninsula by Fuentes et al. (2019), in Algeria by Benabdi et al. (2019), in Morocco by Oussellam and Hocine (Chartosia et al. 2018) and South-west Sicily (Lipej et al. 2018 and present records), suggesting that the species continues its expansion in the western sector of Mediterranean basin (Fig. 2). According to the available literature (see Fig. 2), it is interesting to note as C. sapidus seems to be widely distributed across the whole Mediterranean basin except the coasts of Tunisia and Libya, where the invasive species, native of the Indian Ocean, P. segnis, is very abundant in shallow waters with a negative impact on small scale fisheries (Amor et al. 2015). Probably, the absence of C. sapidus in these areas could be due to the limited freshwater supply needed to complete its life cycle. However, considering that most of the distant trawlers of the Mazara fleet operate also in the African shelf of the Strait of Sicily, closer monitoring of the catches off the coast of Tunisia and Libya should be necessary.

Taking into account that American blue crab is one of the 100 ‘Worst Invasive Alien species in the Mediterranean’ (Streftaris and Zenetos 2006), it is crucial to investigate its impact on biodiversity as well as on local fisheries. As for the biodiversity aspect, its colonization might alter the natural equilibrium since that in its native area play a crucial role in ecosystem functions being carnivorous, scavenger, and a voracious predator (Dulčić et al. 2011). Regarding local fisheries, the American blue crab could become a significant commercial resource (e.g., Bilen and Yesilyurt 2014; Manfrin et al. 2015; Abdel-Razek et al. 2006) or it could be the cause of the loss of commercial harvest, damage of fishing nets and fish harvesting difficulties (Amor et al. 2015). In some areas of the Mediterranean, such as Turkey (Bilen and Yesilyurt 2014), the Adriatic Sea (Manfrin et al. 2015), and Egypt (Abdel-Razek et al. 2006), the American blue crabs have become a valuable fishery resource. On the contrary, in Greece, the Blue crab has a poor commercial value (Perdikaris et al. 2016; Mancinelli et al. 2017c; Kevrekidis and Antoniadou 2018).

Regarding the negative effects of C. sapidus, as suggested by Mancinelli et al. (2017a), further studies should be made to understand the nature of impact and the implications for the native species due to its presence. However, as highlighted by several studies, C. sapidus can attack fish and other crustaceans trapped in fishing nets and damage fishing gear (Mancinelli et al. 2017b; Garcia et al. 2018).
Therefore, its voracity and aggressive behaviour might gradually alter the native Mediterranean biodiversity with socio-economic implications.

**Conclusions**

These findings confirm the ongoing expansion and settlement of *C. sapidus* in the northern part of the Strait of Sicily, central Mediterranean Basin. Considering the high spread rate of the species and its aggressive behaviour, it could soon colonize the Sicilian coasts, becoming a serious problem for a crucial socio-economic sector of the area such as artisanal fisheries. It is important to remember in this respect that the similar species *P. segnis* is causing a real problem for small scale fisheries in the Gulf of Gabes by damaging catches and trammel nets with a consequent loss of 70% of the fishers’ income (Khamassi et al. 2019).

Considering that the Strait of Sicily is one of the most important fishing areas for demersal resources in the Mediterranean (Milisenda et al. 2017), a specific monitoring programme will be needed to evaluate the potential harmful impact of this alien species and to activate early warning and prevention actions. Currently, as reported by Culurgioni et al. (2020) for the Sardinian waters, also in the northern part of Sicily, the spread of *C. sapidus* is monitored thanks to a fruitful collaboration among researchers, and both professional and recreational fishers. This collaboration, together with the Local Ecological Knowledge (LEK) approach (Azzurro et al. 2019), could represent a powerful tool to understand the future implications derived from the presence and potential settlement of *C. sapidus* in the Strait of Sicily.

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**Authors’ contributions**

FFA, DS and MLG performed the laboratory analysis. FFA, FF and MLG conceptualized the research. GS, SV and DS analysed the data. FFA, DS and GS drafted the manuscript, whilst SV and FF edited and reviewed the...
manuscript. All authors participated and commented in various aspects of discussing the results to achieve the final manuscript. The author(s) read and approved the final manuscript.

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**Availability of data and materials**
The datasets used and/or analysed during the current study are available from the corresponding author.

**Ethics approval and consent to participate**
Not applicable.

**Consent for publication**
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**Competing interests**
The authors declare that they have no competing interests.

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