

Further expansion of the Crucifix Crab, *Charybdis (Charybdis) feriata*, (Brachyura: Portunidae) into the western Mediterranean

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This note records the fourth specimen of the Crucifix Crab, *Charybdis (Charybdis) feriata* (Linné, 1758) to be registered in the western Mediterranean, this being the first specimen detected along the Valencian coast, specifically in front of Grau de Castelló de la Plana.

The importance of this finding lies in the fact that this individual expands the known distribution range of the species in the Mediterranean, thus showing a slow geographic extension of the recorded specimens in a NE-SW direction following the main oceanographic current present in the area, the Mediterranean Northern Current. We also discuss the possible coexistence with other large crabs present in the area, such as the American Blue Crab, *Callinectes sapidus*, and the Blue Swimming Crab, *Portunus segnis* given their habitat, temperature, and salinity preferences.

Keywords: biological invasions, Castelló de la Plana, population expansion, western Mediterranean, crab, coexistence.

Nova expansió del cranc de la creu, *Charybdis (Charybdis) feriata*, (Brachyura: Portunidae) al llarg de la Mediterrània occidental

En aquesta nota es deixa constància del quart exemplar de cranc de la creu, *Charybdis (Charybdis) feriata* (Linné, 1758) que es registra a la Mediterrània occidental, essent aquest el primer exemplar detectat a la costa valenciana. Aquest individu va ser capturat prop del Grau de Castelló de la Plana.

La importància del registre esdevé perquè constata l'expansió de l'espècie a l'oest de la Mediterrània, donada l'evolució geogràfica dels exemplars registrats fins al moment en el conjunt de la Mediterrània. Es discuteix sobre la possible cohabitació a la Mediterrània occidental d'aquesta espècie amb altres crancs de gran talla presents en aquesta mar, com el cranc blau americà, *Callinectes sapidus*, i el cranc blau indo-pacífic, *Portunus segnis*, degut a les diferències de temperatura, salinitat i hàbitat preferencial que presenten aquestes espècies.

Paraules clau: invasions biològiques, Castelló de la Plana, expansió poblacional, Mediterrània occidental, crancs, coexistència.

The crucifix crab, *Charybdis (Charybdis) feriata*, is a species of portunid crab native to, and widely distributed in, the Indo-Pacific region. It usually inhabits sublittoral areas with sandy-muddy bottoms (sometimes also on rocky bottoms) at depths of approximately 10m to 60m (Ng, 1998; Yan et al. 2004). It is a species with high commercial value, and most of the catch is exported to East Asia. They are caught by fishing boats using trawl nets, traps or fixed nets, and are also reared in aquaculture zones for the live market (Stephenson, et

al., 1957; Stephenson, 1972; Ng, 1998; Apel & Spiridonov, 1998). The first specimen reported in the western Mediterranean was caught in 2006 by a trammel net boat off Barcelona (Abelló & Hispano, 2006). The second record, being the first reported in Italian waters, was captured in 2015 off the port of Livorno (Karachle, et al., 2016) and, in 2017, a third specimen was captured again off the Catalan coast, confirming a possible settlement of this species in the western Mediterranean (Colmenero, et al., 2019). We herein report a fourth specimen

of *C. feriata*, captured by a trawler off Grau de Castelló de la Plana (western Mediterranean), which implies a further expansion of the species in the area.

Material examined

On the 24th of December 2019, a large portunid crab was captured by a trawler in the western Mediterranean, in a fishing ground called *Reclau*, near the *Grau de Castelló de la Plana* along the Valencian coast (approximate position: 39°58'N–00°07'E), at 35–45 m depth on sandy-rocky bottoms (Fig. 1). This fishing ground is very important for the local fishermen who work on small trawlers and with trammel nets, since the area is home to species of great commercial interest such as red mullets, *Mullus surmuletus* (Linnaeus, 1758) in the rocky area, and monkfish, *Lophius budegassa* (Spinola, 1807), on sandy bottoms.

The specimen of *C. feriata* herein reported has been deposited in the Reference Marine Biological Collections of the Institut de Ciències del Mar (ICM-CSIC) in Barcelona (Fig. 2); catalogue code: ICMD002657.

Morphological characteristics

The collected specimen was an adult male. Its main

characteristics and size measurements, together with those reported in the rest of Mediterranean specimens, are shown in Table 1: carapace length, from the sinus between the frontal spines to the posterior edge of the carapace; carapace width (including spines); cheliped handedness (occurrence of a large molar tooth on the right or on the left cheliped); fresh weight, for the present specimen, since it was missing a pereopod. No macroepibionts were present on the carapace.

Discussion

The present record of *C. feriata* in the western Mediterranean suggests that the current distribution area of the species is slowly enlarging towards the south of the Iberian Peninsula Mediterranean coasts (Fig. 1), following the path of the Northern Current, also known as Liguro-Provençal-Catalan current. This current follows the edge of the continental shelf from the eastern Ligurian Sea to the Gulf of Valencia (Salat, 1996), and could be used as a larval dispersal mechanism for the larvae of *C. feriata*, as also reported for other species of Mediterranean crabs, such as *Liocarcinus depurator* (Linnaeus, 1758), and *Carcinus aestuarii* (Nardo, 1847) (Abelló & Guerao, 1999). These authors found a strong

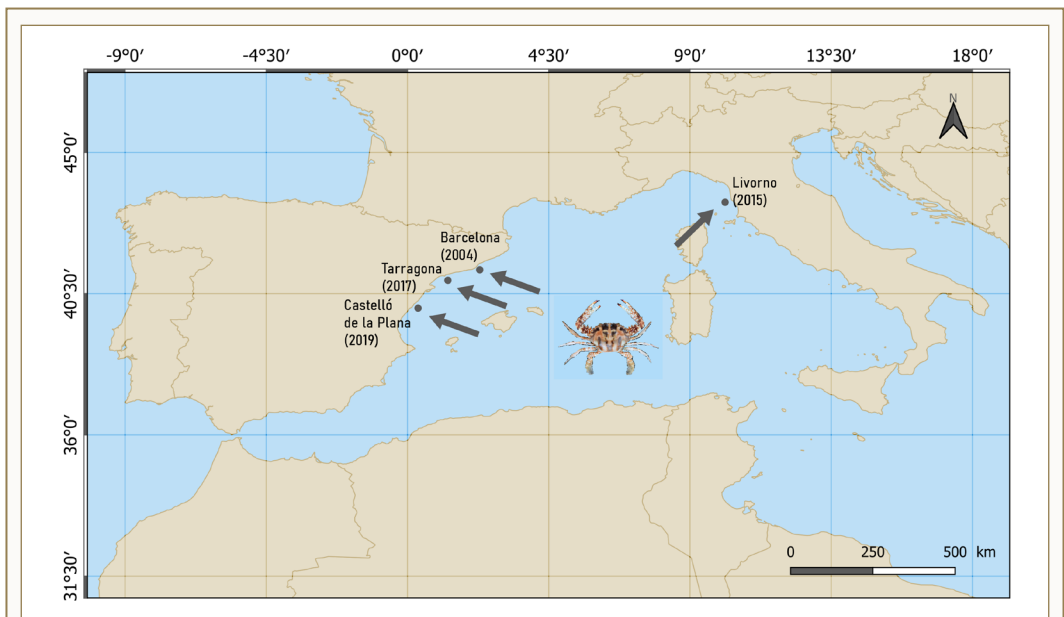


FIGURE 1. *Charybdis (Charybdis) feriata*: location of the four specimens so far reported in the western Mediterranean.

Charybdis (Charybdis) feriata: localització dels quatre exemplars trobats fins al moment a la mar Mediterrània occidental.

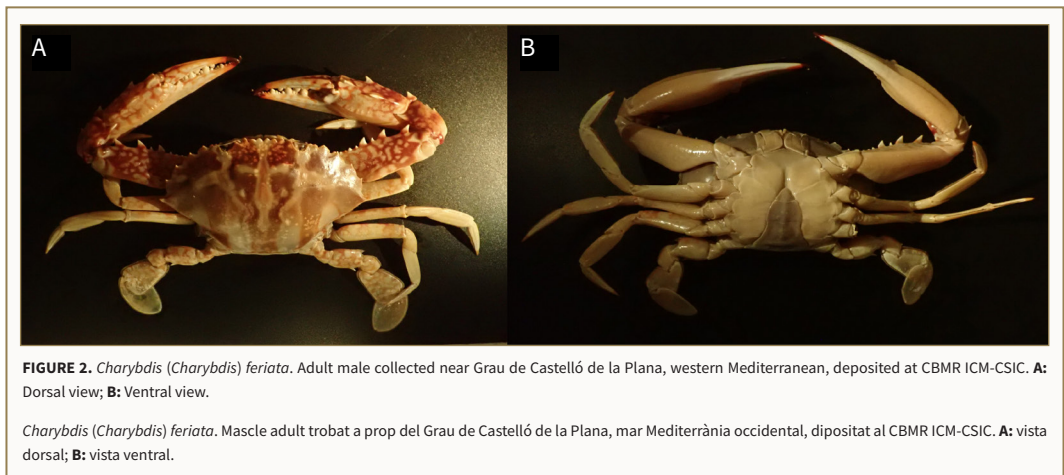
coupling between the distribution of megalopae, the last larval stage of brachyuran crabs, and the coastal hydrography, particularly via the Northern Current and its short-period fluctuations, with neustonic megalopae being restricted to the coastal and shelf water mass.

It is not clear whether or not we are facing the establishment of a population in the western Mediterranean, especially so because the mechanisms for the occurrence of the species in the Mediterranean are not yet known. Two main options are possible: one could be that larvae and/or postlarvae may be dispersed by ballast waters from ships entering the Mediterranean

through the Suez Canal, since the species is native to Indo-Pacific waters. The other could be that, since it is known that many crab species are commercialized alive, some of these crabs could escape or be thrown away while in ships (Colmenero et al., 2019).

Nevertheless, it is possible that we could be facing the establishment of *C. feriata* along the Iberian Peninsula coasts, thus being the second species of large non-indigenous brachyuran crab after the settlement of the American Blue Crab, *Callinectes sapidus* (Rathbun, 1896) in the western Mediterranean (Clavero et al., 2022).

Unlike *C. sapidus*, whose adults inhabit deltaic



Source	Sex	Depth (m)	Depth stratum	Net type	CL	CW	RCL	RCH	AW	Fresh weight (g)	Epibionts (presence/absence)
Abelló & Hispano (2006)	Adult Female	60-70	continental shelf	Trammel net	79.7	125.0	95.1	32.3	59.9	285	presence
Karachle et al. (2016)	Adult; sex not specified	5	shallow continental shelf	Trammel net		90					
Colmenero et al. (2019)	Adult Male	22	shallow continental shelf	Trammel net	82.0	133.7	115	33.8		394	presence
Rojas, Esteban & Abelló (present report)	Adult Male	35-45	shallow continental shelf	Trawler net	80.1	127.8	111	33.3			absence

TABLE 1. Characteristics of the four specimens of the species *Charybdis (Charybdis) feriata* so far reported in the western Mediterranean. Morphological measurements are given in mm: **CL:** carapace length. **CW:** carapace width. **RCL:** right cheliped propodus length. **RCH:** right cheliped propodus height. **AW:** maximum abdominal width.

Característiques dels quatre exemplars de l'espècie *Charybdis (Charybdis) feriata* citats fins al moment a la mar Mediterrània occidental. Les mesures morfològiques s'han pres en mm: **CL:** longitud de la closca. **CW:** amplada de la closca. **RCL:** longitud del propodi de la pinça dreta. **RCH:** alçada de la pinça dreta. **AW:** amplada abdominal màxima.

brackish waters and river mouths (López & Rodón, 2018; Clavero et al., 2022), all reported individuals of *C. feriata* have been located along the continental shelf, not in shallow coastal or deltaic/saltmarsh waters. From the few reported individuals, in Mediterranean waters, males appear to inhabit shallower waters (5–35 m) than females, which have all been captured in deeper waters (60–70 m).

This is in line with available knowledge from the Indo-Pacific regions where this species is autochthonous (Naimullah, et al., 2001; Baylon & Suzuki, 2007). Thus, it has been shown that *C. feriata* is mainly captured offshore and has a much smaller population in coastal waters. It is also known that all larval stages are intolerant to low salinity (<15PSU) and temperatures above 20°C. This would imply that areas under the strong influence of river outflows, such as, in the present case, the Ebro River area of influence, would not be adequate for the larval and juvenile development of the species. Temperatures higher than 20°C are easily reached in summer by epipelagic and coastal waters, which would also restrict the occurrence of larvae in shallow coastal waters. Both factors together would then limit the dispersal and successful recruitment of the megalopa larval stage and juveniles of this crab species in coastal waters influenced by freshwater sources (Baylon & Suzuki, 2007). This agrees with the fact that all the specimens so far reported along the western Mediterranean coasts have been found either north or south Ebro River direct area of influence, where the American Blue Crab *Callinectes sapidus* has invasively settled in recent years (López & Rodón, 2018; Clavero et al., 2022).

Another large crab species with which *C. feriata* could find a broad amplitude of competitive interactions is the Blue Swimming Crab, *Portunus segnis* (Forskäl, 1775), another Indo-Pacific species that has colonized the Eastern Mediterranean since the opening of the Suez Canal. This population remained restricted to that geographic area until recently, when it reached Tunisian waters and established a large population that is presently heavily exploited by a directed fishery (Rabaoui et al., 2015; O Ben Abdallah-Ben Hadj Hamida et al., 2019). *P. segnis* does not apparently strongly compete with the American Blue Crab, since its adult habitats are mainly marine while *C. sapidus* habitats are found in brackish waters,

except for berried females, which seasonally migrate to marine waters to spawn (López & Rodón, 2018; Clavero, et al., 2022). This could imply possible interactions if populations of *C. feriata*, *P. segnis* and *C. sapidus* may take place or are already taking place in the area.

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