



Six Years after the First Record: the Massawan Mantis Shrimp *Erugosquilla massavensis* (Kossmann, 1880) (Crustacea: Squillidae) in Tunisian Waters, Central Mediterranean Sea

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Abstract: Over a hundred specimens of the invasive Massawan mantis shrimp *Erugosquilla massavensis* (Kossmann, 1880) were captured in Tunisian waters (Gulf of Gabes) in 2018–2019 vs eight individuals recorded for the first time in 2013 in the same area. The species is already established and regularly caught among fishery resources by commercial benthic trawl. A competition with the native Mediterranean spot-tail mantis shrimp *Squilla mantis* (Linnaeus, 1758) is discussed.

Key words: invasive species, Gulf of Gabes, population, *Squilla mantis*, competition

Introduction

The native range of the stomatopod *Erugosquilla massavensis* (Kossmann, 1880) (Crustacea: Squillidae) includes the Red Sea and the Persian Gulf (FROGLIA & MANNING 1989). Introduced during the 1930s, it was the first Red Sea stomatopod species entering the Mediterranean Sea via the Suez Canal (STEUER 1936, 1938, GALIL et al. 2002). Successively, the species colonised the eastern and south-central Mediterranean coasts and *E. massavensis* is now widely distributed along the Levantine coasts, the south, eastern and western Aegean Sea, the Marmara Sea, westwards toward Egypt and the central Mediterranean Sea. More recently, the species has been recorded from the eastern region of the Libyan and Tunisian waters (SHAKMAN & KINZELBACH 2007, OUNIFI BEN AMOR et al. 2015) and

then from Italian waters, near the island of Sicily (CORSINI-FOKA et al. 2017). Six years after its first occurrence in the Tunisian waters, 115 male and female specimens in all development stages were collected in the same area (Gulf of Gabes). The present work highlights that the species is already established in Tunisian waters. Competition with the native Mediterranean spot-tail mantis shrimp is also discussed.

Materials and Methods

Study area

The Gulf of Gabes is situated in south-eastern Tunisia (Fig. 1). It is one of the most productive areas of the western Mediterranean Sea (BEN SALEM et al. 2002). It presents specific topographic and biological characteristics that confer the appearance of

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a farming area, which offers favourable conditions for the reproduction and development of many species (OUNIFI BEN AMOR et al. 2016). The Gulf of Gabes is known for its wide and shallow topography, characterised by a regular continental shelf being 60 m deep at 110 km from the coast (BEN OTHMAN 1973). This is the most important fishing area, comprising most of the Tunisian fishing fleet. The surface temperature varies between 13 and 26°C in winter and summer, respectively, while the surface salinity oscillates between 36.9 and 39.01‰ (DERBALI 2011).

Sampling

One hundred and fifteen specimens of *E. massavensis* were collected in the Gulf of Gabes (34°53' N, 10°7' E; Fig. 1), through trawling at a depth of c. 20 m on sandy-muddy bottom. Eighty specimens were captured in June 2018 and 35 specimens in March 2019. All specimens were identified following LEWINSHON & MANNING (1980). The specimens were measured and weighed (total length – TL, wet weight), their sex was determined and some females were examined for gonad maturity.

Results

Erugosquilla massavensis is easily distinguished from *Squilla mantis* due to the lack of the paired dark spots on the dorsal part of the telson (Fig. 2 B, C). Fresh individuals were light grey-orange, dotted with very small dark spots (Fig. 2A). The rostral plate margins, abdominal crests and margins were reddish; tubercles on telson reddish shaded blue, with whitish tips; uropod dark blue and basal prolongation of uropod bright orange. The raptorial claw was whitish. The merus and propodus were yellowish.

Of 115 specimens collected, 78 were males and 37 were females. The total length of the sampled specimens ranged between 100 and 170 mm, the weight ranged between 11 and 52 g. The largest male and female had TL 17 cm and 16 cm and weighted 52 g and 48 g, respectively. Of the 37 females, ten were ovigerous (TL 10.3–15.3 cm), the remaining were non-ovigerous. The mature females belonged to the population harvested in June 2018.

Discussion

The reproductive biology of the population of *E. massavensis* studied off the Egyptian coast is characteristic of an opportunistic species, with protracted reproductive period lasting (for females)

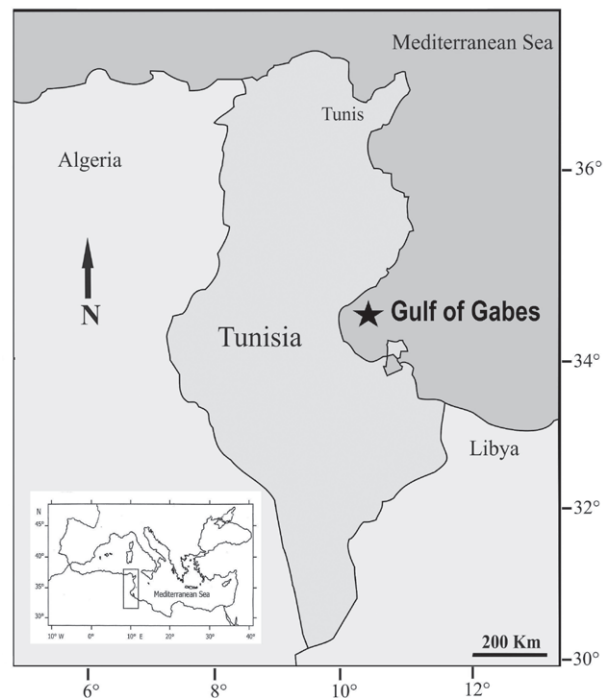


Fig.1. Map of Tunisia showing the Gulf of Gabes and the capture site of *Erugosquilla massavensis* (marked by the black star).

from February to August (SALLAM 2005). In our samples, the ovigerous females were observed among those captured in June and were with smaller sizes than those observed in Egypt (EL-SHERIF et al. 2012).

Erugosquilla massavensis was the dominant stomatopod in the upper shelf of the south-eastern Mediterranean Sea (LEWINSHON & MANNING 1980, ABDEL-SALAM & HAMDİ 2015). It appears that along the Levantine coast of Turkey, too, competitive displacement has modified the bathymetric ranges of the populations of the Erythraean and indigenous stomatopod species (Özcan et al. 2008). In 2007, specimens of *E. massavensis* were collected at depths of 150–200 m off the southern Aegean coast of Turkey (Özcan et al. 2008) and at 180 m off the coast of Egypt (ABDELSALAM 2014). Captures of specimens in open waters, such as the Gulf of Gabes, and restricted brackish areas, such as Tunis Southern Lagoon (OUNIFI BEN AMOR et al. 2015, 2016) and in the present work, suggest a possible adaptability of *E. massavensis* to salinity changes. It seems that the climatic niche of *E. massavensis* is wider than accounted for and the species may pose a higher invasion risk in the Central Mediterranean Sea than previously anticipated. Given its high fecundity and predaceous diet, allowing its population to expand, it may pose a threat to the native biota

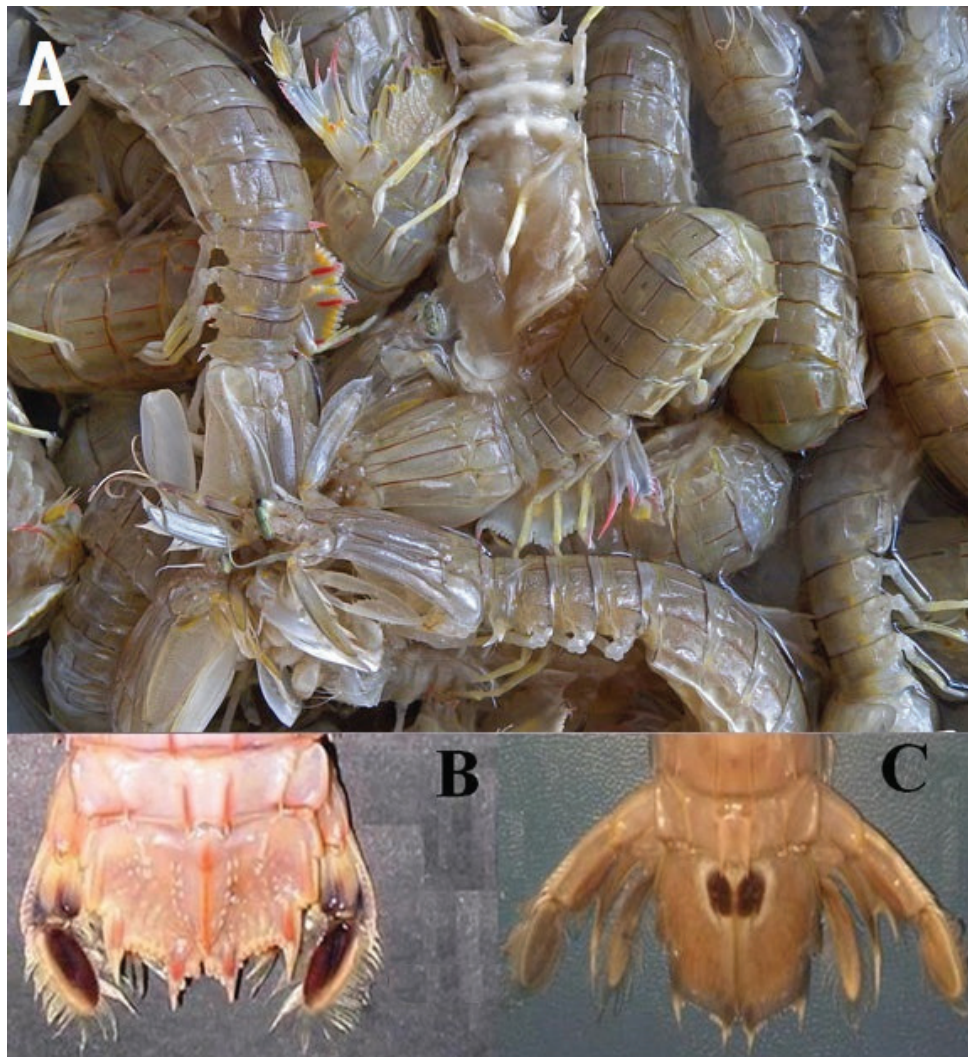


Fig. 2. A. Fresh specimens of *Erugosquilla massavensis* captured in March 2019. B. Telson of *Erugosquilla massavensis*. C. Telson of *Squilla mantis*.

(GIANGUZZA et al. 2019). *Erugosquilla massavensis* has long-lived pelagic larvae, which enhances its expansion throughout the Mediterranean Sea (LEWINSKON & MANNING 1980). Additionally, warming of Mediterranean waters (FRANCOUR et al. 1994) and introduction via ballast waters of commercial vessels, transporting larvae and juveniles (WONHAM et al. 2000) cannot be totally ruled out as factors promoting this expansion.

High densities and occurrence of all developmental stages of *E. massavensis* showed that a sustainable population is at present well established in its new environment. This confirmation was not possible with only eight specimens being recorded in 2013 (OUNIFI BEN AMOR et al. 2015). The species is already regularly caught among fishery resources by commercial benthic trawls. Competition between the native species and *E. massavensis* is confirmed in the Gulf of Gabes. Studies have shown that where

both species coexist, the hourly yields of the native mantis shrimp have dramatically decreased (7.2 kg / h in 2006 versus 2.4 kg / h in 2018) and the presence of *E. massavensis* even endangers the commercially important penaeid stocks, since they often prey benthic crustaceans (SOUFI KECHAOU et al. 2019). *Erugosquilla massavensis* is not sold in the Tunisian markets but to Italy and Egypt where the species is consumed (GIANGUZZA et al. 2019, ABDELSALAM 2014).

The Gulf of Gabes is considered a refuge or “transit” and acclimatisation zone for several invasive species, among which the Massawan mantis shrimp *Erugosquilla massavensis* is one of the most successful migrant species. The invader can become an exploitable fishery resource, similarly to the case of the invasive crab *Portunus segnis* (Forskål, 1775) that is exploited for human consumption, production of fish food or other protein-based food.

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Received: 30.04.2020

Accepted: 07.08.2020