

Inventory, Systematic and Biogeography of Brachyuran Crabs (Crustacea: Decapoda: Brachyura) on the Tunisian Coast

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Abstract

Several prospects on the northern, central and southern Tunisian coasts were carried out for the sake of a better interpretation of Brachyuran species distribution. Animals were either, captured by hand, caught with a fine mesh net or brought back by fishermen in nets or dredges. A total of 21 species belonging to twelve families and inhabiting different substrates were collected and divided into littoral species and species of depth. Five species were reported for the first time, in Tunisia. The littoral species are *Carcinus aestuarii*, *Liocarcinus corrugatus*, *Liocarcinus vernalis*, *Pachygrapsus marmoratus*, *Pachygrapsus maurus*, *Brachynotus sexdentatus*, *Eriphia verrucosa*, *Maja squinado*, *Maja crispata*, *Acanthonyx lunulatus* and *Pisa tetraodon*. The species of depths are *Portunus hastatus*, *Euchirograpsus liguricus*, *Xantho granulicarpus*, *Ilia nucleus*, *Inachus dorsettensis*, *Lissa chiragra*, *Pisa corallina*, *Pisa armata*, *Calappa granulata* and *Dromia personata*. All these species are reported in the Mediterranean. Some are reported for the first time in Tunisia: *P. maurus*, *A. lunulatus*, *P. hastatus*, *E. liguricus*, *L. chiragra* and *P. corallina*. In order to know the frequency of each species, the presence index was calculated. *Carcinus aestuarii* present in 91% of prospected stations is the most frequent and wide-distributed brachyuran species along Tunisian coasts.

Keywords

Brachyurans, Biogeography, Tunisian Coasts, Mediterranean Sea

1. Introduction

The marine environment is characterized by a very important biodiversity where we meet species belonging to all phylogenetic levels from microorganisms to

mammals [1]. Today, despite the development of science, it is recognized that only a small fraction of this marine life is known [2].

We estimate that 8500 macroscopic species live in the Mediterranean, which represents between 4% and 18% of the number of marine species in the world. This figure seems important if we consider that the Mediterranean represents only 0.82% of the global surface of the Earth and 0.32% of the total water volume. This wealth of biodiversity makes the Mediterranean unique in the world [3].

Biodiversity offers us a wide range of goods and services, including products derived from biological resources that are necessary for many human activities, both pharmaceutical and industrial. However, nowadays, we are witnessing major environmental problems, mainly due to climate change that results in the degradation and/or modification of habitats. This is accompanied by an increase in the rate of disappearance of many species in favor of the introduction of invasive alien species with all the consequences that this could have on the balance between humans and nature and on their viability. To face these problems, it is more and more imperative to lean towards the recognition of the little or no known species that could be the guarantee of the survival of the man in the years to come.

Among the species known to have important economic and ecological properties in most aquatic ecosystems are crabs. Crabs belong to the sub-order of Crustaceans that present a great diversity if one considers their habitats, their physiologies, their structures and their behaviors [4] [5]. They are widely distributed in all regions of the globe and are found in freshwater, brackish and sea habitats. The most primitive is marine [6].

The Decapod Crustaceans of Tunisia appeared late in the literature. The first works date back to the end of the 19th century; in 1885, [7] drew up an inventory of the species present in the Mediterranean Sea and their place of harvest, but he didn't report any Tunisian locality. The biology of Penet shrimp has been studied by Heldt (1955), in a short bibliographic overview reported by Tunisian seas. In a faunistic and floristic inventory of the island of Zembra, [8] reported the presence of 17 species of Decapod Crustaceans.

The Brachyura, commonly called crabs, is part of the Decapod Crustaceans. Despite the economic interest of certain species, the study of crabs was fragmentary in Tunisia. Indeed, [9] produced a collection of 30 species of Brachyours from the Tunisian seas. Ref. [10], during their study of the Gulf of Gabes, determined the distribution and frequency of 12 species of crabs. In a faunistic and floristic inventory of the island of Zembra, Ref. [8] reported the presence of a large spider crab at 3 m depth. Due to the disparity and the fragmentary aspect of the studies on the crabs of the Tunisian coasts, we undertook this synthesis of the different works concerning these Decapod Crustaceans in order to establish a preliminary census, a morphological description and a geographical distribution of the species of the harvested crabs that we have classified into twelve families.

Thus, this study aims to: 1) produce an exhausting list of Brachyure species collected along the Tunisian coast, and 2) focus on the biogeographic factors likely to explain their spatial distribution.

2. Material and Methods

Several surveys are carried out along the Tunisian coasts to collect marine species of Brachyures commonly called crabs. Coastal species are captured either by hand on rocky shores, under stones and algae, or caught with a fine mesh net with a quadrangular metal frame, or brought back by fishermen in the nets. Crabs living in more or less deep waters are brought back into the gill nets of the fishermen.

These animals are kept either in a one-third mixture of 70% alcohol, glycerin and 10% formalin, or in formalin diluted to 4% in seawater.

Dissection and observation of appendages were performed under a binocular loupe.

The different species collected from 37 stations are represented in **Figure 1** and grouped in the following list:

Northern Tunisia: Bizerte, Menzel Abderrahman, Menzel Jemil, Menzel Bourguiba, Cape Zebib, Rafrat, Ghar El Melh, Kalat Landalous, Raoued, Carthage Amilcar, Tabarka Kelibia, Menzel Temime, Sidi Rais, Korba, Zembra, La Galite.



Figure 1. Sampling stations in Tunisia.

Central Tunisia: Sousse, Khniss, Ksibet El Médiouni, Sayada, Teboulba, Bekalta, Mahdia.

Southern Tunisia: Sidi Mansour, Sfax, Mahrès, Skhira, Oued akarit, Zarat, Ajim, Jlijen, Guellala, Zarzis, Ras Trab, Solb.

We have established the following key to determine the families of harvested species:

- A - Triangular buccal frame.....B
 - Quadrangular buccal frame.....C
- B - Pterygostomial edge of the carapace in front of the pereopod I separated from the sternal region by dilatation of the epipodite of the third pair of maxilliped.....**Calappidae.**
 - Pterygostomial edge of the carapace welded to the sternum. No opening in front of the pteropod I.....**Leucosiidae.**
- C - Square, hexagonal or oval shell.....D
 - Triangular shell covered with bristles, elongated legs.....**Majidae**
 - Curved shell, slender legs, short and flattened rostral spines.....**Inachidae**
 - Pentagonal, triangular or diamond-shaped shell, long rostral spines.....**Epialthidae**
- D - Hexagonal or quadrangular shell, maxilliped III with carp attached to the inner edge of the merus.....E
 - Square shell with the maxilliped III carp attached to the outer edge of the merus.....**Grapsidae**
 - Subcircular or quadrangular shell, palp of the maxilliped III developed.....**Plagusiidae**
 - Rectangular shell with transverse ridges.....**Varinidae**
- E - Flattened body, toothed anterolateral edges, flattened pereopod V in a swimming palette.....**Portunidae**
 - Oval body, wider than long, with arched anterolateral edges and converging posterolateral edges. Claws fingers almost always black.....**Xanthidae**
 - Hexagonal body, anterolateral edge shorter than the posterolateral and armed with six bifid spines.....**Eriphidae**
 - Oval body, toothed anterolateral edge, reduced IV and V pereopods and rejected dorsally.....**Dromiidae**

The frequency (*F*) of a species on the coasts corresponds to an index of presence defined by the ratio of the number of stations in which the species is present (*ns*) by the total number of stations prospected (*Ns*) brought to 100.

$$F = ns/Ns \times 100$$

ns: number of stations where the species is present.

Ns: total number of stations.

The collected species can be classified according to their frequencies in:

- Rare species: if $0 \leq F \leq 4.9\%$.
- Species present: if $5 \leq F \leq 29.9\%$.
- Common species: if $30 \leq F \leq 49.9\%$.

- Frequent species: if $50 \leq F \leq 79.9\%$.
- Very frequent species: if $80 \leq F \leq 100\%$.

3. Results and Discussion

3.1. Podotremata Section Guinot, 1977

We have collected a single species belonging to the Dromiidae family whose shell is strongly convex and covered, as well as the thick pubescence pereopods. The eyes and antennae are retractable. The pereopods IV and V are reduced and end in a hook-like cocksfoot. The abdominal segment VI is furnished with a pair of uropods in the form of plates. This species is *Dromia personata* (Linnaeus, 1758), *Cancer personata* Linné, 1758, *Cancer captumortum* Linné, 1767, *Dromia clypeata* Schonsboe, 1802, *Dromia vulgaris* Milne Edwards, 1837, *Dromia communis* Lucas, 1840, *Dromia mediterranea* Leach, 1875, *Dromia personata* Holthuis & Gottlieb, 1958.

We collected a single specimen on the island of Zembra between the algae. It is a rare species on the Tunisian coast. *Dromia personata* (Linnaeus, 1758) has been reported in Tunisia off the Gulf of Tunis at -250 m and in the East of Hergla at -70 - 90 m [8] [10]. It is reported in several places around the Mediterranean and even the Atlantic.

3.2. Eubrachyura Section Ng et al. (2008)

Heterotremata subsection Guinot, 1977

The Heterotremata listed belong to the following eight families:

Family of Calappidae is characterized by a strongly convex shell with spiny or lobed edges. The eyes are small. These crabs are called “shameful crabs” or “box crabs” because they cover their ventral side with their bulky, large and identical claws, which allow them to open the shells of Molluscs [11].

Genus *Calappa*

Calappa granulata (Linnaeus, 1758), *Cancer granulatus* Linné, 1758, *Calappa granulata* Fabricius, 1798; Risso, 1816; Roux, 1828; Carus, 1885; Pesta, 1918; Miranda, 1933; Vilela, 1936; Bouvier, 1940; Zariquiey-Alvarez, 1946 Holthuis and Gottlieb, 1958; Heller, 1963; Forest, 1965

We collected a single specimen at Rafrac brought back into the nets of fishermen -30 - 50 m deep. *C. granulata* is considered a rare species. It was harvested in 1956 by Forest & Guinot east of Hergla (70 - 90 m) on the bottom of a vase with abundant fixed fauna. [10], in their work on the gulf of Gabes reported the presence of *Calappa granulata* in this region in the South-East of Tunisia

Many authors have reported the presence of *Calappa granulata* in the Mediterranean: Italy and Spain [7], Balearic Islands [12], it is very common throughout the Mediterranean from 0 to -40 m [13]; Mediterranean and Adriatic Sea [14] and [11]. It is also reported in the Atlantic: coasts of Morocco [15]; Eastern Atlantic from Portugal to the Cape Verde Islands (Bauchau, 1966); Northeast Atlantic from northern Spain to Cape Verde and Senegal [13].

Family of Leucosiidae

Crabs belonging to this family have a globular shell covering the abdomen. The buccal frame is triangular and sharply narrowed anteriorly with the pterygostomian border welded to the sternum. The eyes are reduced. They are buried in the substrate leaving only the tips of the eyes visible. For this reason, they are called “purse crabs”. We have collected the species *Ilia nucleus* (Linnaeus, 1758) *Cancer nucleus* Linnaeus, 1758, *Ilia nucleus* Leach, 1817; Heller, 1863; Carus, 1885; Pesta, 1918; de Miranda, 1933; Bouvier, 1940; Zariquiey-Alvarez, 1946; Monod, 1956; Holthuis & Gottlieb, 1958; Holtuis, 1961; Forest, 1965 *Ilia rugolosa* Risso, 1827; Carus, 1885, *Ilia laevigata* Risso, 1827. This species is lagoon; we collected two specimens from fishermen’s nets, one at Bizerte lagune in Menzel Abderrahmen and the other in Ghar El Melh. The presence index of this species is 5.5% so it is present on the Tunisian coasts. This species lives buried in sand and seagrass, it was reported in the South East region of Tunisia by [10], during their work on the Gulf of Gabes.

Ilia nucleus (Linnaeus, 1758) is reported from several regions of the Mediterranean: the Balearic Islands [12]; in Türkiye, Palestine and Egypt [16]; throughout the Mediterranean and the Adriatic Sea [13]; [14] and [11]. In the Atlantic, this species has a distribution localized in the Cape Verde islands [17]; [16] and [13] (Figures 3(a)-(c)).

Family of Portunidae

The majority of representatives of this family are known as “swimming crabs” with flattened, light bodies and specialized V-pereiopods; these have cocksfoot, in the shape of a very silky oval palette, suitable for swimming [18]. These crabs are distinguished by the shape of the flattened shell, not very convex, hexagonal or square and often wider than long. The regions of the carapace poorly defined, with anterolateral edges armed with 5 to 9 teeth, the cocksfoot of the last pair of pereiopods generally oval or paddle-shaped suitable for swimming.

Gender determination key

- A - Anterolateral edge with five teeth.....B
 - Anterolateral edge with nine teeth, the posterior tooth much longer and stronger than the others.....C
- B - P5 with flattened propode but with slightly enlarged cocksfoot and not swimming.....*Carcinus*
 - P5 with flattened cocksfoot and swimming.....*Liocarcinus*
- C - P1 about 2 times longer than the width of the carapace, forehead with four teeth or lobes.....*Portunus*

Genus *Carcinus*

Carcinus aestuarii Nardo, 1847; *Carcinus maenas* Nardo, 1847; Heller, 1863, *Carcinus maenas mediterranea* Czerniarsky, 1884, *Carcinus mediterraneus* Holthuis and Gottlieb, 1958, *Carcinus maenas mediterraneus* Almaça, 1961, *Carcinus aestuarii* Fischer *et al.*, 1987, Noël, 1992, Falciai-Minervini, 1996, Fano *et al.*, 1996 (Figure 2)

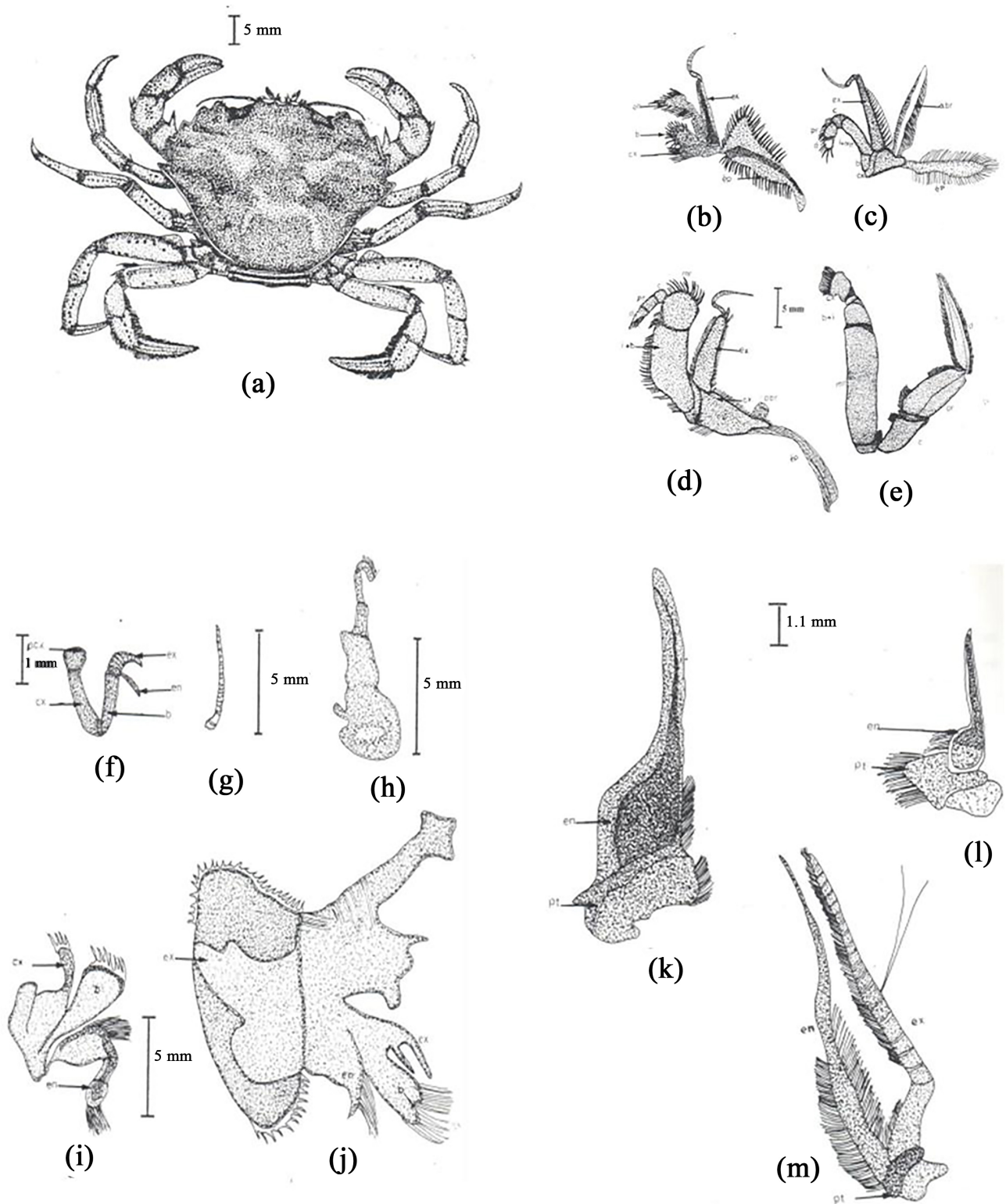


Figure 2. *Carcinus aestuarii* ♂ (a), maxilliped I (b), maxilliped II (c), maxilliped III (d), pereiopod V (e), antennule (f), antenna (g), mandible (h), maxillule (i), maxille (j), pleopod ♂ I (k), II (l), pleopod IV ♀ (m).

This species is collected in almost all places surveyed both at sea and in lagoons and estuaries. It is littoral and sublittoral. The presence index of 91%; it is

a very common species.

Carcinus aestuarii Nardo, 1847 has been reported from the Balearic Islands and Melilla Island (Algeria) [16]; very common throughout the Mediterranean from 0 to –5 or –10 m deep (Noël, 1992); the whole Mediterranean, Black Sea and Adriatic Sea [14], in the Adriatic Sea [19]. In the Atlantic this species is reported from the Canary Islands [13].

Genus *Liocarcinus*

We harvested two species: *Liocarcinus corrugatus* (Pennant, 1777) *Cancer corrugatus* Pennant, 1777, *Portunus corrugatus* Leach, 1816; Heller, 1863; Pesta, 1918; Palmer, 1927; De Miranda, 1933; Nobre, 1936; Bouvier, 1940; Zariquiey-Alvarez, 1946; Monod, 1956, *Macropipus corrugatus* Forest & Guinot, 1956; Zariquiey-Alvarez, 1956; Holthuis and Gottlieb, 1958, *Liocarcinus corrugatus* Holthuis, 1987.

This species is harvested at Ghar El Melh; the low presence index is 2.77%. It seems rare on the Tunisian coast. *Liocarcinus corrugatus* was reported east of Hergla and Zembra Island (70 - 90 m) by [8], in the Gulf of Tunis [10]. Many authors including [12] [13] [16] [20] and [14] reported that *Liocarcinus corrugatus* is a species common to the coastal areas of the Mediterranean region. It is also reported in the eastern Atlantic from the British islands [16], the Azores, from Scotland to Angola and in the Western Channel (Figures 3(d)-(f)).

Liocarcinus vernalis (Risso, 1827)

Portunus vernalis Risso, 1827, *Portunus valentieni* Cocco, 1833, *Portunus dubius* Rathke, 1837, *Portunus barbarus* Lucas, 1846, *Portunus holsatus* Heller, 1863; Bouvier, 1940; Zariquiey-Alvarez, 1946, *Portunus barbarus* Zariquiey-Alvarez, 1952; Monod, 1956, *Macropipus barbarus* Forest and Guinot, 1956; Forest and Gottlieb, 1958; Zariquiey-Alvarez, 1959; Holthuis, 1961, *Liocarcinus vernalis* Holthuis, 1987; Fischer *et al.*, 1987; Udekem and Rappé, 1991; Christmas, 1992; Mantovani *et al.*, 1992.

This crab was found in the stomach of the brown lionfish caught in Rafrac (Figure 1). We also caught it by hand at Menzel Temime where it fled very quickly into the sand; and it is also brought back into the fishing nets of Rafrac. *Liocarcinus vernalis* has been reported in Tunisia by [8] in the New Seas on a muddy bottom and on the island of Zembra. Many authors have reported the presence of this species in the Mediterranean: Balearic Islands [12], Morocco, Algeria and the Spanish coasts to Palestine and Egypt [16]; Greece and Türkiye [21]; the whole Mediterranean from 0 to –35 m where it is common; Adriatic Sea [20]; Mediterranean, Black Sea and Adriatic Sea [11] [14].

Genus *Portunus*

Portunus hastatus (Linnaeus, 1767), *Cancer hastatus* Linnaeus, 1767, *Portunus hastatus* Latreille, 1825, *Lupa dufourii* Roux, 1830, *Portunus dufourii* Guérin, 1832, *Lupa hastatus* Heller, 1863, *Neptunus hastatus* Pesta, 1918; Miranda, 1933; Bouvier, 1941; Zariquiey-Alvarez, 1946; Monod, 1956; *Portunus hastatus* Holthuis et Gottlieb, 1958 (Figure 3(g), Figure 3(h))

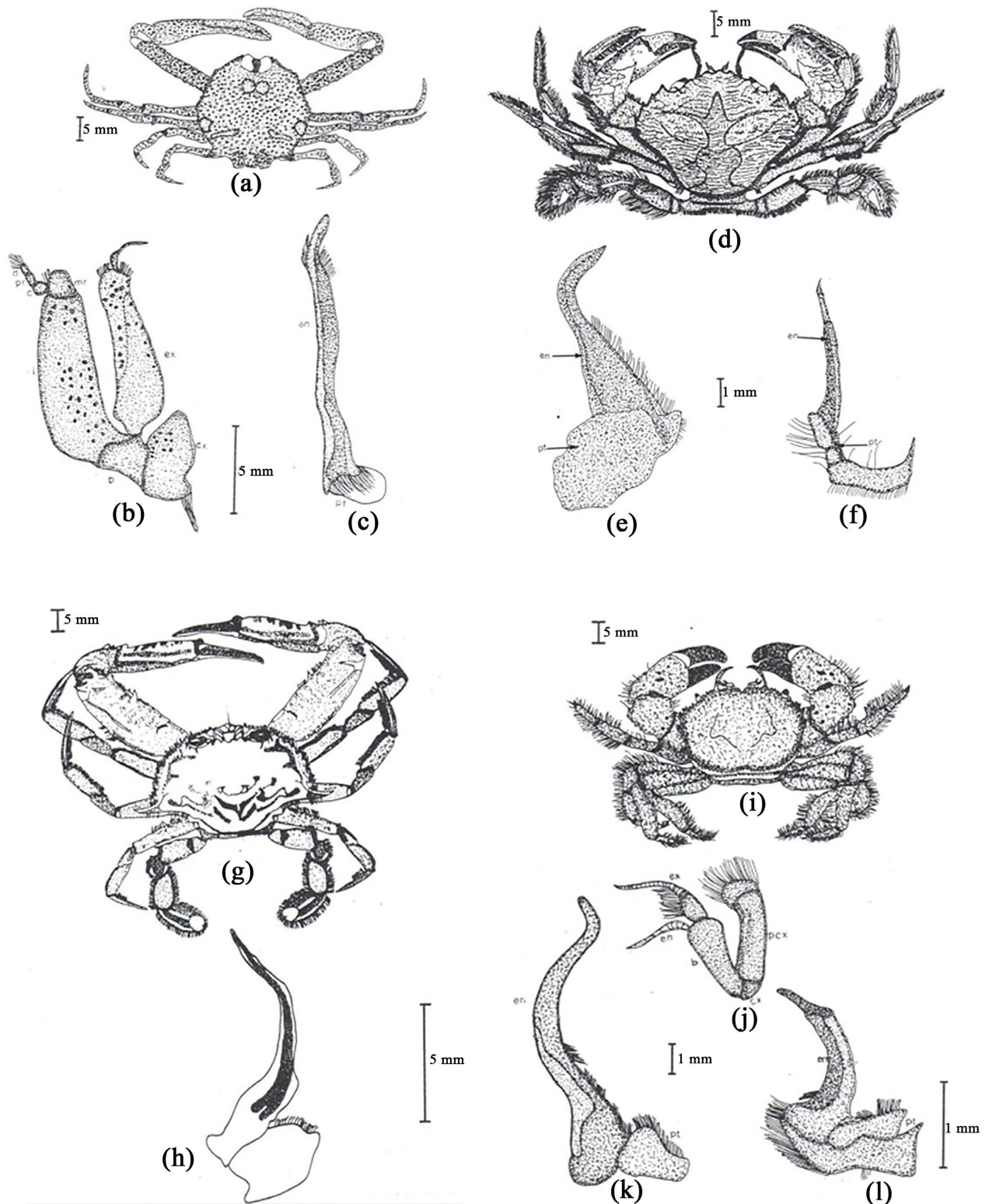


Figure 3. *Iliia nucleus*, dorsal side (a), maxilliped III (b), pleopod I ♂ (c); *Liocarcinus corrugatus* ♂, dorsal side (d), pleopod I (e), II (f); *Portunus hastatus* (g), pleopod I ♂ (h); *Eriphia verrucosa*, dorsal side (i), antennule (j), pleopod male I (k), II (l).

This species is brought back into fishermen's nets a few meters deep in the Rafrat region. The presence index, equal to 2.77%, makes this *Portunus* a rare

species. *Portunus hastatus* is reported for the first time in Tunisia. It is also considered, very rare, in the Mediterranean as in the Atlantic. Indeed, it is present on the Mediterranean coasts of the Balearic Islands and Melilla [16]; throughout the Mediterranean [13] [14] and on the coast of Piombino and the island of Cerboli [22]. It is also reported in the eastern Atlantic [16] and in the African Atlantic [13].

- **Family of Eriphiidae Macleay, 1838**

Stevic (2005) was the first to organize the Eriphiidae in the Eriphioidea superfamily. Eriphiidae have a hexagonal or oval carapace, with several rows of thorns and the lateral edges are convex and not parallel.

Genus *Eriphia*

Eriphia verrucosa (Forskål, 1775); *Cancer verrucosa* Forskål, 1775; *Cancer spinifrons* Herbst, 1785, *Eriphia spinifrons* Heller, 1863; *Orientalis* Czerniavsky, 1884; Balss, 1921; *Eriphia verrucosa* Holthuis et Gottlieb, 1958; Noël, 1992; Fano *et al.*, 1996 (**Figures 3(i)-(l)**).

In Tunisia, this species widely distributed from North to South. It is present in just over quarter of the stations surveyed in 27.7% where there are boulders. *E. verrucosa* has been reported at Sidi Daoud next to the stabling park on rocky bottoms and seagrass dotted with boulders and at Bibans, outside the fishery, on sand and mud [8]. Ktari-Chakroun and Azzouz (1971), in their general study of the Gulf of Gabès, reported the presence of *E. verrucosa* at a depth of 30 to 35 m. It is reported in several places around the Mediterranean: the Balearic and Moroccan coasts [16]; the whole Mediterranean from 0 to 10 m, Black Sea and Adriatic Sea [13] [14] and [11]. It is also reported on the Atlantic coasts of Morocco [15]; in the Northeast Atlantic of southern Brittany to Mauritania and the Azores [13] and to the Bay of Biscay [11].

- **Family of Xanthidae**

The shell of these crabs is wider than long. Its anterolateral edges are convex and the posterolateral edges are convergent. The frontal region is indented in the middle. The pliers' fingers are almost always black.

Genus *Xantho*, Leach, 1814

Xantho granulicarpus Forest in Drach & Forest, 1953

During our surveys, we only collected two specimens from Rafraf. It is a rare species with an occurrence index of 2.77%. In Tunisia, a single male specimen was encountered by [8] between the herbaria à la Goulette in front of the laboratory at 5 - 10 m. The species *X. granulicarpus* is strictly Mediterranean living in depths of 0 to 10 m or 100 m [13]. It has been reported in the Balearic Islands, in Melilla and it is common in Barcelona at -3 m depth [16]. It is also widespread on the Portuguese coast [23].

Family of Majidae

The Majidae have a generally triangular shell, previously narrowed. Its dorsal surface generally carries spines, spinules and it is often covered with algae, sponges, corals, Bryozoans. The ambulatory legs are often elongated, the chelipeds are equal. The orbit is incomplete (**Figure 4(a)**).

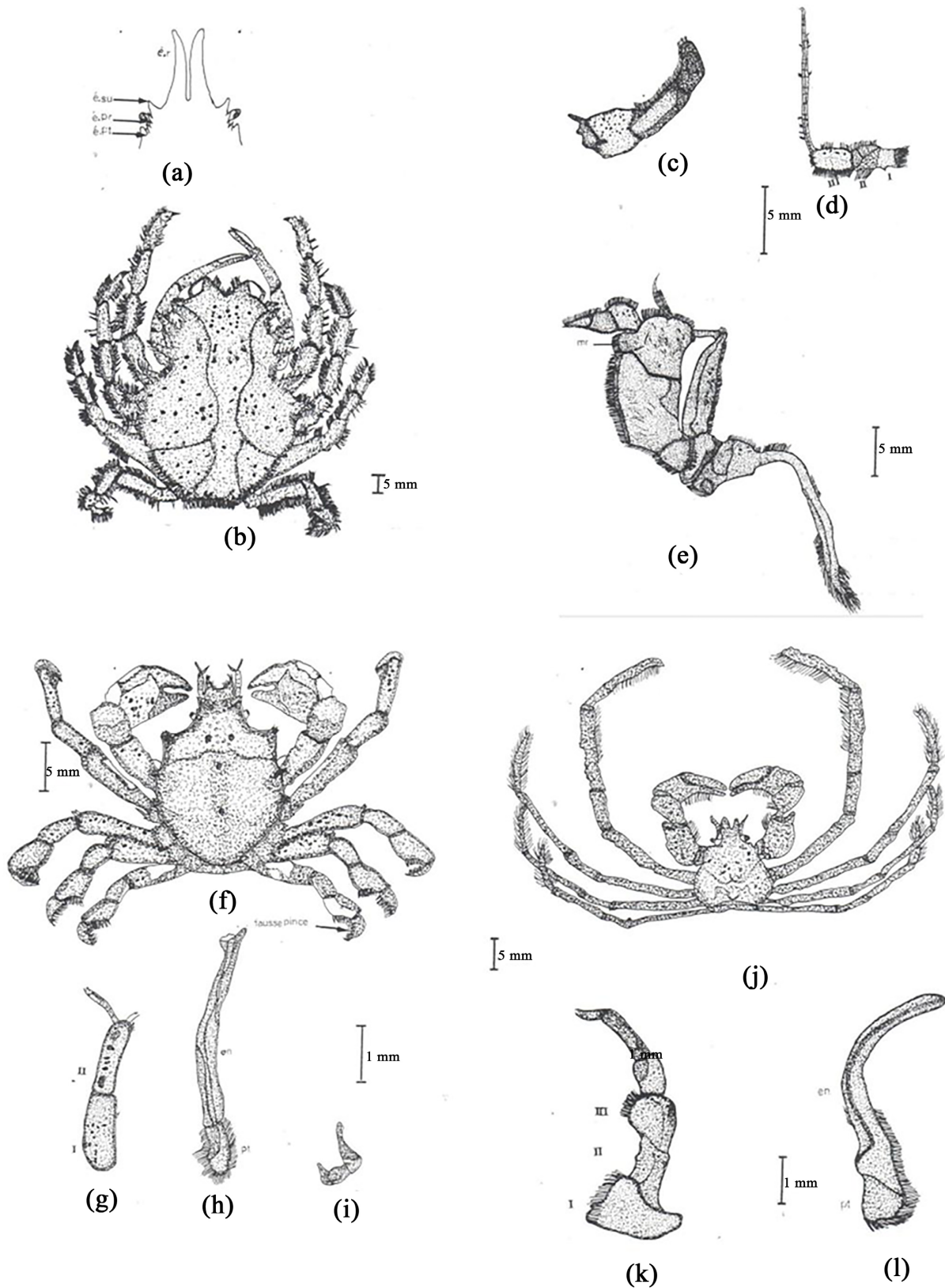


Figure 4. Rostrum and location of orbital spines in Majidae (a), *Maja squinado*, dorsal side (b), eye peduncle (c), antenna (d), maxilliped III (e); *Acanthonyx lunulatus*, dorsal side (f), antenna (g), pleopod ♂ I (h), II (i); *Inachus dorsettensis*, dorsal side (j), antenna (k), pleopod ♂ I (l).

Majidae or “Spider Crabs” are distinguished from other crabs by the existence of a polymorphism of males within the same species [24].

Genus *Maja*

Species key

A - Large very convex shell covered with more or less thorny tubers.....B

A' - Small shell with slightly pointed tubers.....B'

B - Rostral spines between 1/7 and 1/8 of the length of the carapace.....

.....*Maja squinado*

B - Rostral spines less than 1/5 the length of the carapace.....*Maja crispata*.

Maja squinado (Herbst, 1788) *Cancer squinado* Herbst, 1788, *Maia squinado* Leach, 1817; Pesta, 1918; Nobre, 1931; Bouvier, 1940, *Maja squinado* Heller, 1863; Capart, 1951; Monod, 1956 (**Figures 4(b)-(e)**).

Maja squinado is a common species on the Tunisian coast and present in 40% of prospected stations. We fished it on foot in Sayada and Ras Trab, while in the other stations it was brought back in fishermen’s nets (Menzel Jemil, Menzel Abderrahman, island of Zembra, Ghar El Melh, Cape Zebib, port of Skhira, port of Zarrat). The presence of a large *M. squinado* spider –3 m deep has been reported on Zembra Island [9]. Outside Tunisia, *M. squinado* also has a wide geographic distribution in the Mediterranean and even in the Atlantic: Mediterranean coasts: Balearic and Melilla Islands [16]; the whole Mediterranean from –10 to –146 m [13]; Mediterranean, Black Sea and Adriatic Sea [11] [14]; Atlantic coasts from Morocco to Casablanca [14]; from the North Sea to Guinea [16]; East Atlantic, from Namibia to the British Isles [21]; North East Atlantic from Ireland to Guinea from 0 to –50 m where it is very common and even in the English Channel [13].

Maja crispata Risso, 1827, *Maja verrucosa* Risso, 1827; Heller, 1863; Monod, 1956; Bauchau, 1966, *Maia verrucosa* Milne Edwards, 1834; Pesta, 1918; Nobre, 1931; Bouvier, 1940; Zariquiey-Alvarez, 1968, *Maja crispata* Noël, 1992.

The species we have collected fits well with the description of *Maja verrucosa* [15]. Only one specimen was collected on the island of Zembra. It is a rare species on the Tunisian coast. *Maja crispata* has been reported in Tunisia, on the island of Zembra and in La Goulette [8], in the Gulf of Gabes [10].

This species has been reported in several places in the Mediterranean: Balearic Islands [16]; the whole Mediterranean from 0 to –40 m where it is very common [13]; Mediterranean, Black Sea and Adriatic Sea [14] and [11]. In the Atlantic, it has been reported on the coasts of Morocco [15]; in the North-East Atlantic of Cape Blanc and the Cape Verde islands in Portugal [13] [21].

Family of Epialtidae MacLeay, 1838

Genus key

A - Basal section of the broad, rectangular or trapezoidal antenna, oval or triangular shell.....B

- Basal section of the triangular antenna, truncated at the apex, quadrangular shell.....*Acanthonyx*

B - Short eye stalk, hidden by the base of the postorbital spine.....C

C - Rostrum in the form of two truncated flat blades folded in a T at the top...

.....*Lissa*

D - Long rostral spines, parallel and cylindrical at least in their proximal part

.....*Pisa*

Genus *Acanthonyx*

Acanthonyx lunulatus (Risso, 1816), *Maia lunulatus* Risso, 1816, *Acanthonyx lunulatus* Heller, 1863; Pesta, 1918; Nobre, 1931; Bouvie, 1940; Zariquiey-Alvarez, 1946; Monod, 1956 (Figures 4(f)-(i)).

We collected a specimen (1 male, 13 mm wide) in the North Galiton between the algal stands of *Cystoseira compressa*, and we also found a population of three individuals of *A. lunulatus* female ovigerous at Cape Zebib and Sidi Rais whose width hardly exceeds 5 mm. It is a species present on the Tunisian coasts but, it has never been reported in Tunisia. This crab is reported in several places around the Mediterranean: Balearic Islands from 0 to 5 m [12]; from Spain to Egypt and Palestine [16]; Côte d’Azur and Provence [25]; the whole Mediterranean from 0 to -2 m or -20 m between the algae of *Cystoseira* [13]; Mediterranean and Adriatic Sea [14]. This species is also reported on the Atlantic coasts of Morocco [15] and in the Eastern Atlantic from Portugal to the Cape Verde Islands [16] and [17].

Genus *Lissa*

Lissa chiragra (Fabricius, 1775), *Cancer chiragra* Fabricius, 1775, *Lissa chiragra* Leach, 1815, *Pisa chiragra* Latreille, 1825 (Figures 5(a)-(c)).

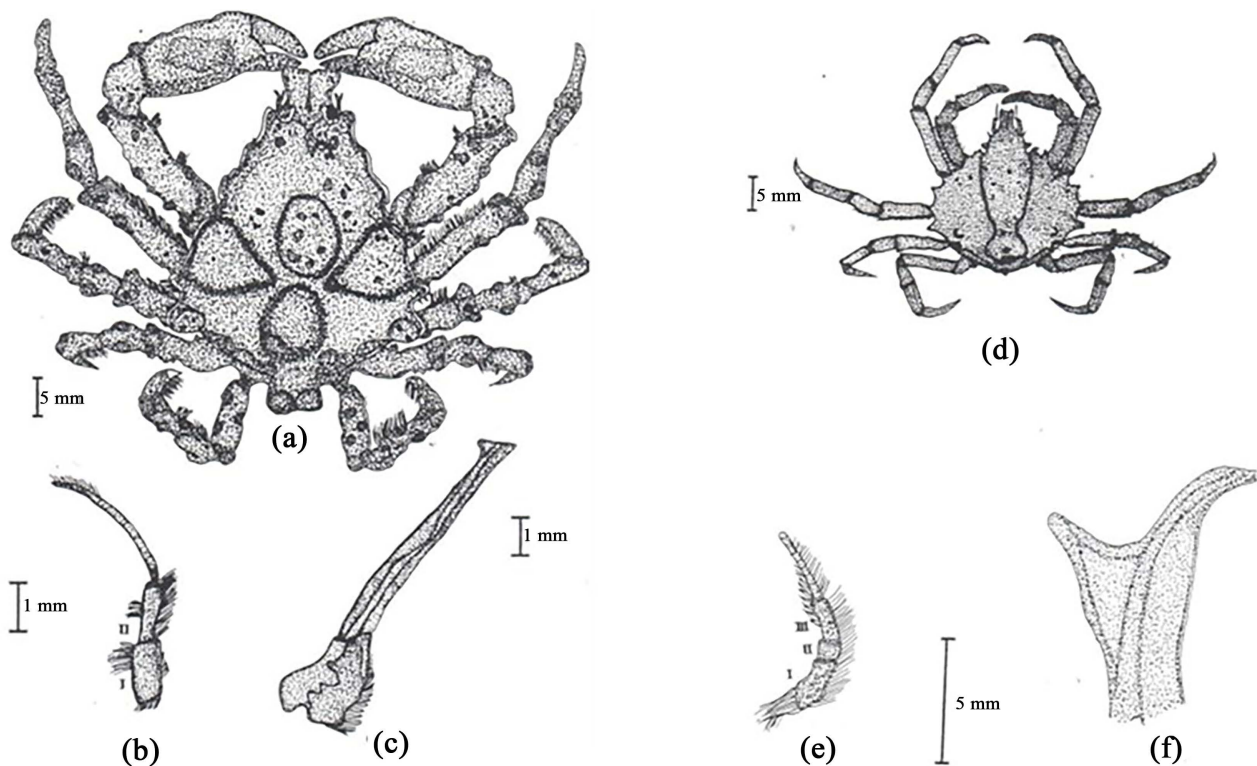


Figure 5. *Lissa chiragra*, dorsal side (a), antenna (b), pleopod I ♂ (c); *Pisa coralline*, dorsal side (d), antenna (e), apical part of the pleopod I (f).

We collected two specimens, one from Rafrat and the other from Zembra. It is a species present in 5.5% of the stations surveyed. *Lissa chiragra* has never been reported in Tunisia. It is exclusively Mediterranean. It has been reported from the Balearic Islands [12]; in the western Mediterranean between 30 and 60 m [16]; on the coasts of Spain [16]; throughout the Mediterranean from 4 to 90 m; in the Mediterranean and the Adriatic Sea [11] [13]. It was only reported in the Atlantic by [13] in Portugal.

Genus *Pisa*

Species key

A - Diamond-shaped shell decorated with tubers, slender and long rostral spines, short hepatic spine.....*P. coralina*

B - Triangular shell decorated with tubers, thicker and shorter rostral spines, larger hepatic spine.....*P. coralina*

C - Triangular shell adorned with velvety nipples, slender rostral spines, smaller and pointed hepatic spine.....*P. armata*

- *Pisa corallina* (Risso, 1816), *Maia corallina* Risso, 1816, *Inachus corallinus* Risso, 1827, *Pisa intermedia* Nardo, 1869, *Pisa corallina* Holthuis et Gottlieb, 1958; Zariquiey-Alvarez, 1959 (Figures 5(d)-(f)).

We encountered this species at the port of Zarrat, at the port of Skhira, Menzel Abderrahman, on the island of Zembra. It is presented on the Tunisian coast with an index of presence of 11.11% and it has never been reported in Tunisia. *Pisa corallina* is exclusively Mediterranean, it has been reported on the coasts of Spain [16], in the Mediterranean from 5 to 30 m, but it is rare in the Adriatic Sea [14].

- *Pisa tetraodon* (Pennant, 1777), *Cancer tetraodon* Pennant, 1777, *Pisa tetraodon* Heller, 1863

We found this species in three stations: Oued El Akarit, Sfax and Zembra with a frequency of 8.33%. [8] reported the presence of two specimens, a male at La Goulette between the seagrass at 5 - 10 m and a female at the island of Zembra, at -7 - 15 m on sand and seagrass. *P. tetraodon* is present both in the Mediterranean and in the Atlantic, from the English Channel to Mauritania. It has been reported on the English coast and the French coast (Carus, 1885); the Balearic Islands [12]; throughout the Mediterranean from 0 to 50 m (Noel, 1992); in the Mediterranean and the Adriatic [14] and [11]; in the North Atlantic—East of the Channel to Mauritania from 0 to 50 m [12]; from Gibraltar to Ireland up to 100 m [17] and to the British Isles and the North Sea [11].

- *Pisa armata* (Latreille, 1803), *Maia armata* Latreille, 1803, *Pisa gibbsii* Leach, 1815, *Pisa armata* Pesta, 1918; Nobre, 1931; Hothuis et Gottlieb, 1958

We collected a single specimen from Zembra Island. It is a rare species on the Tunisian coasts with a frequency of 2.77%. In Tunisia, this species is harvested for the first time by Forest & Guinot (1956) off the Gulf of Tunis at 250 m, East of Hergla at 70 - 90 m on the mud and off the island plane and Cape Zebib. It is present in several regions of the Mediterranean: Balearic Islands and Melilla [16]; the whole Mediterranean [13] and [14]. In the Atlantic, it is present on the

coasts of Morocco [15]; in the Azores up to –50 m [17]; in the eastern Atlantic from the Channel to Angola [16]; south of the North Sea and the English Channel from 0 to 90 m or 162 m [13].

Family of Inachidae MacLeay, 1838

Genus *Inachus*: Short, flattened rostral spines.

- *Inachus dorsettensis* (Pennant, 1777), *Cancer dorsettensis* Pennant, 1777, *Cancer scorpi* Fabricius, 1779, *Inachus scorpio* Heller, 1863, *Inachus dorsettensis* Pesta, 1918

A single specimen, from Ghar El Melh, was brought into the nets of the fishermen. *Inachus dorsettensis* is a rare species. It has been reported in Tunisia in the New Seas at –150 - 300 m, east of Hergla at –70 - 90 m and off Plane Island, Cap Zebib and the Gulf of Tunis [8] as well as in the Gulf of Gabes [10].

In a work of Lacaze-Duthiers' campaigns in the Balearic Islands, [12] indicates that *I. dorsettensis* occurs in Cape Blanc and Ibiza. This species is also reported throughout the Mediterranean [13] [14]. It is also present in the eastern Atlantic from Norway to Angola [16] and [17]; in the North East Atlantic and the Channel from 0 to 90 m or 300 m [13].

The Mediterranean and West African specimens of *I. dorsettensis* differ from those of the English Channel and the Bay of Biscay by the greater length of the ambulatory legs, carapace spines and their small size [12].

3.3. Thoracotremata Section

The thoracotremata listed belong to the following three families:

Family of Grapsidae

Species key

Grapsidae have a quadrangular shell with a wide front edge and straight, parallel side edges. The breast plate is very broad.

Genus *Pachygrapsus*

Species key

A - Ventral edge of the orbits extending to the buccal frame, maxillipeds III separated by a rhomboid space and with a narrow exopodite.....B

B - Sub-square shell with three anterolateral teeth.....*P. marmoratus*

C - Quadrangular shell with two anterolateral teeth.....*P. maurus*

- *Pachygrapsus marmoratus* (Fabricius, 1787), *Cancer marmoratus* Fabricius, 1787, *Grapsus varius* Latreille, 1802-1803, *Pachygrapsus marmoratus* Heller, 1863; Pesta, 1918; Vilela, 1936; Nobre, 1936; Bouvier, 1940; Zariquiey-Alvarez, 1952; Holthuis et Gottlieb, 1958; Holthuis, 1961, *Leptograpsus marmoratus* Milne-Edwards, 1853; De Miranda, 1933 (**Figures 6(a)-(f)**).

During our surveys, we harvested this marbled crab at Raoued in pools of water trapped between the stones, in the mediolittoral zone, at Ghar El Melh, at the ports of Sayada, Teboulba, Sousse, Kelibia; at the Jdairia wadi in terms of communication, sea and Bhirat El Bibans; at Carthage Amilcar between the algae; at Raf-raf. This common species, on the Tunisian coast wherever there are rocks and has a presence index of 40%.

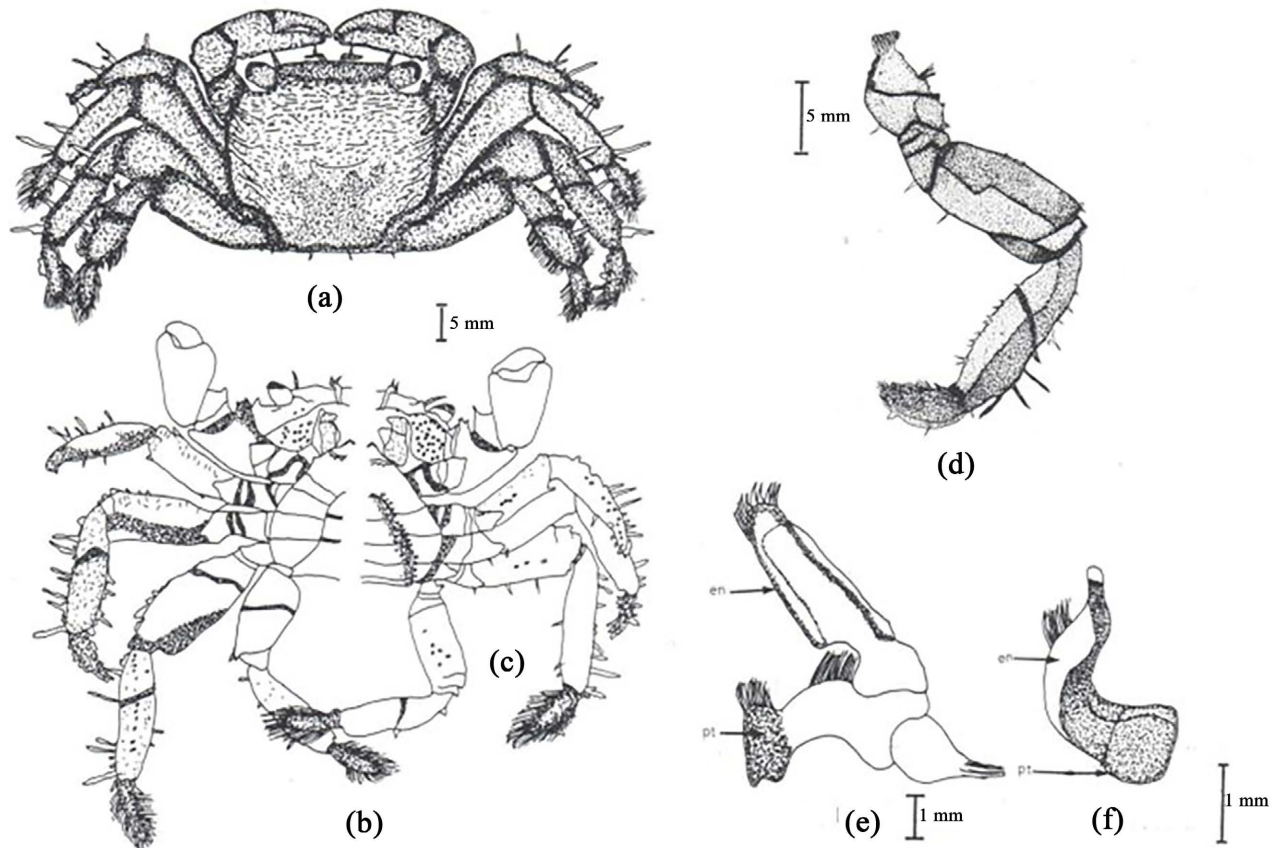


Figure 6. *Pachygrapsus marmoratus* ♂, dorsal side (a), ventral side male (b), ♀ (c), pereiopod V (d), pleopod I (e), II (f).

In Tunisia, this species was harvested for the first time [8] by shore fishing in Sidi Daoud, next to the stabling park on a rocky bottom in meadows dotted with boulders, outside Bibans of the fishery on sandy, muddy substrate and between meadows dotted with blocks. *P. marmoratus* is very common on the Mediterranean coasts. It has been reported in Spain [11] and [16]; throughout the Mediterranean Christmas (1992); in the Black Sea, Adriatic Sea and throughout the Mediterranean [14]. In fact, [15] reports that *P. marmoratus* occurs on several Atlantic coasts of Morocco. Furthermore, [26] indicated that this species was reported in the North of Brittany [21], thereafter this crab became very common over the years 20-30 in the Channel as in the ocean, then it has disappeared from the coast of Brittany since 1931 and it reappeared in 1981 becoming very common throughout the south of Brittany. In addition [13] also reports the presence of this crab in the Canary Islands, Morocco, Madeira.

- *Pachygrapsus maurus* Lucas, 1846, *Grapsus maurus* Lucas, 1846, *Goniograpsus simplex* Dana, 1852, *Leptograpsus maurus* Milne Edwards, 1853, *Pachygrapsus simplex* Stimpson, 1858, *Pachygrapsus maurus* Heller, 1863; Rathbun, 1918; Zariquiez-Alvarez, 1948

This very rare species is only represented in our sampling by a single female individual from Sidi Raeis. It has never been reported in Tunisia.

In the Mediterranean, this species has a very localized distribution area: Mélilla

(Carus, 1885) and [16]; the whole Mediterranean, Adriatic Sea and Black Sea [14]; Western Mediterranean [11]. This species is also reported in the Western Atlantic (Rio de Janeiro) and in the Eastern Atlantic in Madeira and the Canary Islands [16]. It has also been reported in the Azores [11].

Family of Plagusiidae Dana, 1851

The segments 3 - 6 of the male abdomen are fused and the exopodite of the maxilliped III is of normal length but the palp is developed (Davis, 2002 in Peter *et al.*, 2008).

Genus *Euchyropsus*. Abdominal segment I of the male occupies the entire sternal region between the coxa of the pereopods V.

Euchyropsus liguricus Milne Edwards, 1853, *Euchyropsus liguricus* Heller, 1863; Carus, 1885; Bouvier, 1914; Zariquiey-Alvarez, 1946, *Euchyropsus americanus* Milne Edwards, 1880 (Figures 7(a)-(d)).

In Tunisia, we harvested this species by hand in the lagoon of Bizerte in Menzel Bourguiba, Menzel Abderrahmen, Menzel Jemil in mussel ropes, in the port of Zarrat and in Ras Trab. It is a species present on the Tunisian coast but it has never been reported in Tunisia. *E. liguricus* is exclusively Mediterranean. It has been reported in Spain [16]; in Malaga and Alboran [13]; throughout the Mediterranean [14] and in the western Mediterranean [11].

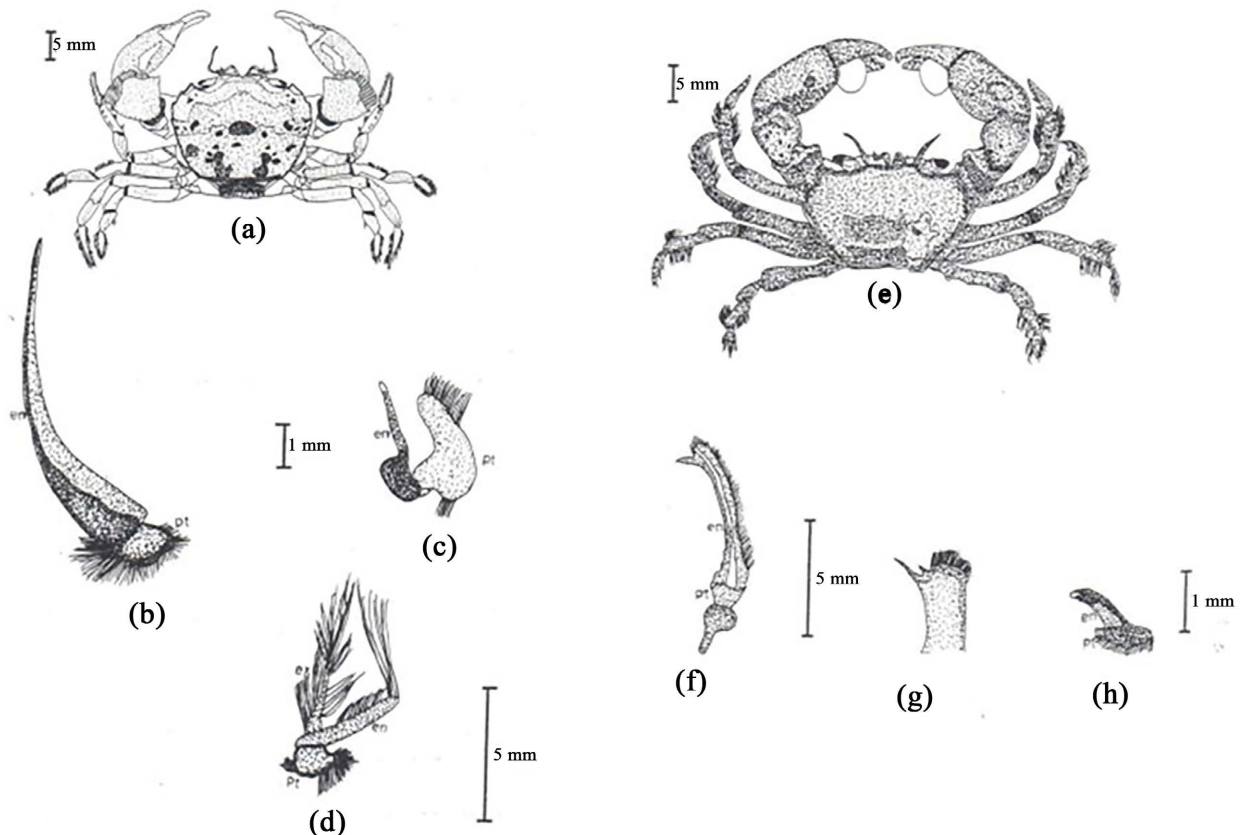


Figure 7. *Euchyropsus liguricus*, dorsal side (a), pleopod I (b), II (c), pleopod IV ♀ (d); *Brachynotus sexdentatus*, dorsal side (e), pleopod I ♂ (f), apical part (g), pleopod II ♂ (h).

Family of Varunidae H. Milne Edwards, 1853

Genus *Brachynotus*. Abdominal segment I of the male not occupying the entire sternal region between the coxa of the pereopods V.

Brachynotus sexdentatus (Risso, 1827), *Goneplax sexdentatus* Risso, 1827, *Cleistotoma gemmellari* Rizza, 1839, *Heterograpsus sexdentatus* Lucas, 1846, *Brachynotus sexdentatus* Milne Edwards, 1852, *Heterograpsus lucasi* Milne Edwards, 1853, *Brachynotus lucasi* Pesta, 1918 (Figures 7(e)-(h)).

Two specimens of *B. sexdentatus* were encountered on the dikes at the entrance to the Sfax saline. It is a rare species. This crab is harvested for the first time in La Goulette 5 - 10 m deep between the herbaria [8]. *B. sexdentatus* is considered a rare species in the Mediterranean and even in the Atlantic, Balearic Islands [16]; the whole Mediterranean, Black Sea and Adriatic Sea [11] [14], Atlantic coasts of Morocco [15], introduced in England [16], North-East Atlantic (Gibraltar) from 0 to 1 m but very rare [13].

4. Conclusions

As part of this work, we were interested in presenting a faunistic inventory and a geographical distribution of the crab species harvested during the surveys carried out on the Tunisian coasts. These crabs, which are divided into littoral species and deep-sea species, are described morphologically and ecologically. The present study has allowed us to harvest 21 marine species. The littoral species are *Carcinus aestuarii*, *Liocarcinus corrugatus*, *Liocarcinus vernalis*, *Pachygrapsus marmoratus*, *Pachygrapsus maurus*, *Brachynotus sexdentatus*, *Eriphia verrucosa*, *Maja squinado*, *Maja crispata*, *Acanthonyx lunulatus* and *Pisa tetraodon*. The species of depths are *Portunus hastatus*, *Euchirograpsus liguricus*, *Xantho granulicarpus*, *Ilia nucleus*, *Inachus dorsettensis*, *Lissa chiragra*, *Pisa corallina*, *Pisa armata*, *Calappa granulata* and *Dromia personata*. All these species are reported in the Mediterranean. Some are reported for the first time in Tunisia: *Pachygrapsus maurus*, *Acanthonyx lunulatus*, *Portunus hastatus*, *Euchirograpsus liguricus*, *Lissa chiragra* and *Pisa corallina*.

We are also interested in the geographical distribution of each species in Tunisia, the Atlantic and the Mediterranean. Then we determined the presence index of each species in order to know its frequency on the Tunisian coasts. This allowed us to conclude that *Carcinus aestuarii* is the most common species on our coasts; in fact, it is present in 91% of the stations surveyed. Prospecting other stations increases our knowledge of crabs on the Tunisian coast. We plan to follow the growth and the reproductive cycle of the most common species on our coasts *Carcinus aestuarii*, extend our surveys of other places in the Mediterranean: Algerian and Moroccan coasts, but also certain places in the Atlantic and compare Mediterranean species to those of the Atlantic, using molecular genetics.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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