

# OBSERVATIONS ON SOME INTERESTING COASTAL CRUSTACEA DECAPODA FROM THE AZORES, WITH A KEY TO THE GENUS *Eualus* THALLWITZ, 1892 IN THE NORTHEASTERN ATLANTIC AND THE MEDITERRANEAN

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Records of several rare or interesting Crustacea Decapoda from the Azores are presented in the present paper. *Periclimenes sagittifer* and *Athanas nitescens* are recorded for the first time in the archipelago. *Periclimenes sagittifer* was found on various hydroids and the antipatharian *Antipathes wollastoni*, some juveniles being also found amongst algae. *Athanas nitescens* was encountered free-living and in a shell inhabited by the hermit crab *Dardanus calidus*. Comparative illustrations are given for Azorean *Periclimenes sagittifer* and French specimens. New characters are proposed to distinguish *Eualus cranchii*, *E. drachi*, *E. occultus* and *E. pusiolus*, and a key to Northeastern Atlantic and Mediterranean *Eualus* species is provided. Azorean specimens of *Hippolyte varians* prove to be especially small and slender, whilst Azorean *Stenopus spinosus* may have red, white or even proximally red and distally white antennae. The association between the hermit crab *Nematopagurus longicornis* and the antipatharian *Antipathes wollastoni* is recorded for the first time. A possibly undescribed *Macropodia* species is here recorded and illustrated as *Macropodia* sp., as only juvenile and damaged adult specimens were found. Azorean *Portunus hastatus* prove to be much less pubescent than their Mediterranean counterparts, and detailed drawings are given for this common but rarely comprehensively illustrated species.

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## INTRODUCTION

The Azorean decapod fauna has been studied in a number of old and recent papers. The first detailed study was given by BARROIS (1888) who already recorded a considerable number of species. In a recent book, D'UDEKEM D'ACÓZ (1999) gives a summary of most published data. Since then, additional records have been published by D'UDEKEM D'ACÓZ (2000, 2001),

D'UDEKEM D'ACÓZ et al. (2001) and VIEIRA & MORATO (2001). In the present paper, we present further records and discuss some taxonomical problems in relation to the species studied.

## MATERIAL AND METHODS

The main part of the Azorean material studied in the present paper was collected by the authors, by means of SCUBA diving and by shore collecting.

Material collected between 15/VIII/1999 and 01/IX/1999 has been collected by both authors, whilst specimens collected at other dates were by P. WIRTZ, if not stated otherwise. The majority of specimens have been deposited in the Institut Royal des Sciences Naturelles de Belgique, Brussels. Additional specimens deposited in the collection of the Department of Oceanography and Fisheries of the University of the Azores at Horta (DOP) were also examined.

*Palaemon serratus* (Pennant, 1777)

*Material*

Faial island, Porto Pim, caught by Norberto Serpa with seine net, 28/V/1990: 1 specimen, DOP CR-280.

*Remarks*

*Palaemon serratus* has been recorded from Scotland to the Rio de Oro, Madeira, the Canary Islands and in the whole Mediterranean basin (D'UDEKEM D'ACÓZ 1999), but only recently from the Azores (MORTON et al. 1998). The species can occasionally be seen during night dives and the slide collection of the DOP contains numerous photographs of it. The related species *Palaemon elegans* Rathke, 1837 has been recorded by various authors (BARROIS 1888 as *Palæmon squilla*; CHAPMAN & SANTLER 1955; PAULA et al. 1992; MORTON et al. 1998) in the Azores and the species is quite common in shallow waters. *Palaemon adspersus* Rathke, 1837 has also been recorded in the archipelago (MORTON et al. 1998) but was not encountered during the present study.

*Periclimenes sagittifer* (Norman, 1861)

*Material*

Faial island, Monte da Guia, on *Antipathes wollastoni* Gray, 1857, 29 m depth, 10/VIII/1995: 8 specimens - Monte da Guia, on *Antipathes wollastoni*, 29-40 m depth, 1995: 2 specimens including an ovigerous female - Monte da Guia, on *Aglaophenia tubulifera* (Hinks, 1851), 38 m depth, 15/VI/1999: 2 specimens including an

ovigerous female - Monte da Guia, on *Sertularella polyzonias* (Hutton, 1873), 35 m depth, July 1998: 1 specimen - Monte da Guia, on *Aglaophenia tubulifera*, 40 m depth, 18/VIII/1999: 5 specimens - Monte da Guia (eastern part), on *Antipathes wollastoni*, 40 m depth, 27/VIII/1999: 3 specimens - Faial island, Baía Entre Montes, algae, 8-12 m depth, October-November 1998: 4 juveniles - Flores Island, Baixa do Morros, on *Aglaophenia* sp., 22 m depth, 27/VII/1999: 6 specimens - Flores Island, no further locality details, amongst the brown alga *Zonaria tournefortii* (J.V. Lamouroux) Montagne, 1846, 20 m depth, 1999: 3 juveniles.

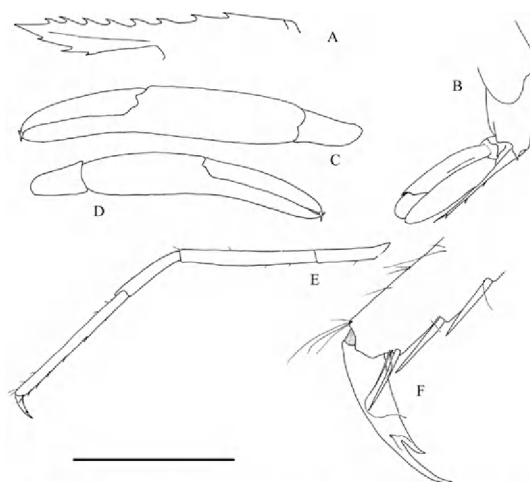


Fig. 1. *Periclimenes sagittifer* (Norman, 1861), ovigerous female, Faial, Monte da Guia, from a colony of *Antipathes wollastoni*. A: upper part of carapace in dorsal view; B: posterior part of abdomen; C, second right pereiopod; D, second left pereiopod; E, third left pereiopod; F, dactylus of third left pereiopod. Scale bar: A, B = 5.0 mm; C, D, E = 3.0 mm; F = 0.5 mm.

*Remarks*

Although smaller and more slender than the specimens from the French part of the English Channel and the Bay of Biscay examined, the Azorean *Periclimenes* of the *amethysteus* group are all referable to *P. sagittifer*, as they have unequal second pereiopods, with the major one having the fingers shorter than the palm. Furthermore the colour pattern of the mature specimens agrees with the photographs published

by WIRTZ (1995), GRIPPA & D'UDEKEM D'ACÓZ (1996, as *P. sagittifer sagittifer*) and DALY (1998). Adult specimens exhibit a broad dorsal pink transverse stripe on the second pleonite, a dorsal pink V-shaped drawing on the third pleonite, and dark dots on the carapace and pereopods. Most if not all Madeiran specimens referred to as *Periclimenes* aff. *scriptus* (Risso, 1822) by D'UDEKEM D'ACÓZ (1996b; 1999) also belong to this small slender form of *P. sagittifer*. The colour photographs of a Madeiran *Periclimenes* cf. *scriptus* by WIRTZ (1996) and of a Canarian *Periclimenes* sp. by GONZALEZ PÉREZ (1995) are also referable to this form of *P. sagittifer*. Figures of an Azorean ovigerous female and of French specimens are provided to allow a comparison between both forms.

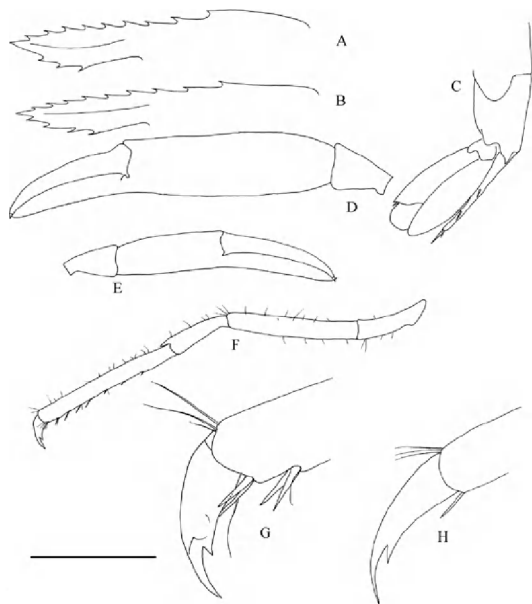


Fig. 2. *Periclimenes sagittifer* (Norman, 1861). A-G: females; H: male. A, B, H, France, northeastern Brittany, Saint Sulliac; C, D, E, F, G, France, Bay of Biscay, Guéthary. A, B: upper part of carapace in dorsal view; C: posterior part of abdomen; D, second right pereopod; E, second left pereopod; G, dactylus of third left pereopod; H, dactylus of left fifth pereopod. Scale bar A, B, C = 5.0 mm; D, E, F: 2.0 mm; G, H = 0.5 mm.

In the English Channel and in the Bay of Biscay, *P. sagittifer* has always been found in

association with sea anemones of the genus *Anemonia* (cf. D'UDEKEM D'ACÓZ 1999), so it is somewhat surprising to find it associated with a wide range of cnidarians and even free-living in the Azores. On *Antipathes wollastoni* Gray, 1857, *P. sagittifer* is found together with another, not closely related *Periclimenes* species: *Periclimenes wirtzi* (see D'UDEKEM D'ACÓZ 1996b).

*Eualus occultus* (Lebour, 1936)

#### Material

Faial island, Monte da Guia, on *Aglaophenia tubulifera* (Hinks, 1851), 38 m depth, 15/VI/1999: 1 specimen - Monte da Guia, on *Aglaophenia tubulifera*, 35 m depth, 25/VII/1999: 17 specimens including ovigerous females - Monte da Guia, hard bottom, on *Aglaophenia tubulifera*, 41 m depth, 18/VIII/1999: 12 specimens - Monte da Guia, 41 m depth, 19/VIII/1999: 1 specimen - Monte da Guia, in shells of dead *Megabalanus azoricus* Pilsbry, 1916, 44 m depth, 20/VIII/1999: 1 specimen - Monte da Guia, 35 to 41 m depth, 21/VIII/1999: 1 ovigerous female - Monte da Guia (eastern side), hard bottom, on *Antipathes wollastoni* Gray, 1857, 40 m depth, 23/VIII/1999: 8 specimens including an ovigerous female - Monte da Guia (eastern side), hard bottom, 40 m depth, 27/VIII/1999: 3 specimens - Faial island, Horta harbour, below stones, 5 m depth, October-November 1998: 12 specimens - Horta harbour, from the hull of an old boat, 02/VIII/2000: 2 large specimens including an ovigerous female - Horta harbour, below stones, 9 m depth, 1999-2000: about 20 specimens - Faial island, Varadouro, natural swimming pool, 2 m depth, 18/VIII/1999: 1 specimen - Terceira Island, Cabo da Praia, inner wall of the harbour, muddy rocks, night collecting, 10-22 m depth, 28/VIII/1999: 2 specimens.

#### Remarks

*Eualus occultus* has already been recorded from the Azores by WIRTZ & MARTINS (1993) and FRANSEN & WIRTZ (1997). The abundant material listed here indicates that it is a very common

species in coastal waters of the archipelago. In this context, it is important to point out that during the present investigation, we found no specimens of *Eualus cranchii* (Leach, 1817), a closely related coastal species which is usually considered very common in the Eastern Atlantic and which has been recorded both north and south of the Azores.

The distinction between *E. occultus* and *E. cranchii* is considered difficult and is usually based on the presence of a mandibular palp in *E. occultus* but not in *E. cranchii*, and on the number of segments on the carpus of the second pereopod: normally 7 in *E. occultus* and 6 in *E. cranchii*. However, we have occasionally seen *E. cranchii* with 6 segments on one side and 7 on the other one. So this character has no absolute taxonomic value. In this context, we would like to point out two very useful determinative characters for specimens of both sexes. First of all, it appears that the upper terminal projection of the third segment of the antennular peduncle is narrowly triangular in *E. occultus*, whilst it is broadly triangular in *E. cranchii*. This character has already been well described and illustrated by ZARIQUIEY CENARRO (1935) but has not been referred to in more recent literature. Furthermore, the ischium of the first pereopod of *E. occultus* (and *E. pusiolus* (Krøyer, 1841) and *E. drachi* Noël, 1978) has 1 to 3 tiny spinules on the ventral part of its distal border, while there are none in *E. cranchii*. Additionally, a useful character to distinguish the males of some *Eualus* species is the sexual dimorphism of the ambulatory pereopods. In *E. occultus* and *E. drachi*, only the third and fourth pereopods are sexually dimorphic, with in the male a considerable number of spines, very close to each other (in comb-like disposition) on the flexor border. In *E. cranchii*, the third, the fourth and the fifth pereopods are sexually dimorphic, with numerous spines in a comb-like disposition in the male.

It is also necessary to point out that *E. occultus* with the tip of the rostrum entire (i.e. without ventral tooth) are not uncommon, both in the Azores and elsewhere, and could therefore be confused with *E. pusiolus*, a distantly related

species which has never properly been described. Therefore, we think that it would be useful to indicate some diagnostic characters to separate both species. As already pointed out in the literature, *E. pusiolus* has a pterygostomial tooth (sometimes small) which is lacking in *E. occultus*, and *E. pusiolus* has an epipod on the first three pereopods, whilst in *E. occultus*, epipods do occur only on the first two. Furthermore, it appears that, in *E. pusiolus*, there is a short but well developed longitudinal carina on each side of the carapace behind the rostrum. This carina, which has been well illustrated by KOMAI & YAKOVLEV (2000), is lacking in *E. occultus* (as well as in *E. cranchii* and *E. drachi*). Furthermore, in *E. pusiolus* of both sexes, the merus of the last 3 pereopods has only one spine, in the subdistal part of its flexor border, as well illustrated by SOKOLOV (2001); while in *E. occultus* (as well as in *E. cranchii* and *E. drachi*), there are several spines on the third and fourth pereopods, and often also on the fifth one. Finally, in the last three pereopods of *E. pusiolus*, the flexor border of the propodus has usually more spines than in *E. occultus* (and in *E. cranchii*).

A provisional key to the Northeastern Atlantic and Mediterranean *Eualus* is given hereafter, although several problems remain unsolved (D'UDEKEM D'ACÓZ 1999). Material of *E. cranchii* (Leach, 1817), *E. drachi* Noël, 1978, *E. gaimardii* forma *gibba* (Krøyer, 1841), *E. gaimardii* forma *gaimardii* (H. Milne-Edwards, 1837), *E. occultus* (Lebour, 1936) and *E. pusiolus* (Krøyer, 1841) has been carefully examined. For other taxa, the key is based on the literature accounts only. Essential references are KRØYER (1841, 1842), RATHBUN (1910), DONS (1915), ZARIQUIEY CENARRO (1935); LEBOUR (1936), HOLTHUIS (1951), BOURDILLON CASANOVA (1960), GREVE (1963), CROSNIER & FOREST (1973), NOËL (1978, 1987), BUTLER (1980), SQUIRES (1990), GRIPPA, (1991), BARNICH (1996), JENSEN & JOHNSON (1999), KOMAI & YAKOVLEV (2000) and SOKOLOV (2001). In this context, it should be pointed out that the specimens of "*E. gaimardi gaimardi*" in SQUIRES (1990) look more like the form *gibba* (although not perfectly).

1 - Stylocerite reaching or overreaching tip of 1st segment of antennular peduncle (distal outer tooth, if present, not considered); propodus of P3 with spinule(s) on flexor border; P3 dactylus less than 4 times as long as wide (spines not considered) ..... 2

- Stylocerite reaching about 0.65 of 1st segment of antennular peduncle (distal outer tooth not considered); propodus of P3 without spinules on flexor border; P3 dactylus a little more than 4 times as long as wide (spines not considered); [rostrum reaching about tip of eyestalk, with 3 dorsal teeth, tip with one apical tooth, or with an apical tooth and a small subdistal ventral tooth; no lateral postrostral carinae; small pterygostomial tooth present; 1st segment of antennular peduncle with well developed distal outer tooth; mandibular palp present; epipod on P1-P2 only]; ..... *Eualus gracilipes* Crosnier & Forest, 1973 (2 females only known, collected between 150 and 275 m depth off Cape Verde Islands; small species)

2 - Rostrum much shorter than scaphocerite, ventrally straight or nearly straight, about the same height throughout its length; rostrum with ventral teeth, if any, restricted to distal 0.2 and often very close to the apex; first segment of antennular peduncle with well developed distal outer tooth; Mxp3 tip spines arranged symmetrically on both sides, very close to the apex ..... 3

- Rostrum about as long or longer than scaphocerite, proximally very narrow and distally expanded on its ventral side, ventral border very concave on proximal half and very convex on distal half; rostrum always with several (most commonly 3 or 4) widely spaced ventral teeth on distal 0.5; first segment of antennular peduncle without distal outer tooth; Mxp3 tip asymmetrical, spines forming subdistal row on mesial border with no counterpart on outer border; [no lateral postrostral carina on each side of carapace; pterygostomial tooth present; mandibular palp present; P1 ischium with minute spinules on the ventral side of its distal border; P2 carpus with 7 segments; P3-P5 merus with several spinules but not sexually dimorphic]; arctic and subarctic species; total length may exceed 50 mm ..... *Eualus gaimardii* (H. Milne Edwards, 1837);

comprises at least 3 "forms" of unclear taxonomical significance:

a - 3rd pleonite dorsally smooth in both sexes, colour pattern usually fairly uniform: forma *gaimardii* (H. Milne Edwards, 1837) (subarctic form; may be found intertidally in continental Norway)

b - 3rd pleonite of adult males exhibiting a large, non-hooked, laterally compressed triangular dorsal protrusion; 3rd pleonite dorsally smooth in females: forma *gibba* (Krøyer, 1841) (arctic form reaching its southern limit in Finnmark; usually found below 100 m depth in continental Norway, may be found in shallower waters farther north; male protrusion is the only significant difference with the nominal form)

c - 3rd pleonite of both sexes exhibiting a hooked and black-tipped dorsal protrusion; scaphocerite possibly broader than in other forms; abdomen distinctly striped: forma *belcheri* (Bell, 1855) sensu SQUIRES (1990) (high arctic form, restricted to the coldest waters; usually found below 100 m depth; most European records are unreliable)

3 - No lateral postrostral carina on each side of carapace behind the rostrum; pterygostomial tooth absent; merus of P3-P4 (and often P5) with several spines ..... 4

- Well developed lateral postrostral carina on both sides of carapace; pterygostomial tooth present; merus of P3-P5 with only one spine, in subdistal position [rostrum slightly shorter than eye, tip normally terminated in single tooth and without ventral teeth (very rarely bifurcate); mandibular palp present; epipod on P1-P3; P1 ischium with minute spinules on the ventral side of its distal border; 2 or 3 proximal strong setae on flexor border of P2 ischium; P2 carpus with 7 segments]; arctic and cold temperate species reaching its southern limit in the English Channel; intertidal (especially in the northern part of its range) and coastal waters ..... *Eualus pusiolus* (Krøyer, 1841)

4 - Non-corneal part of the eyestalk without dark pigment ..... 5

- Non-corneal part of the eyestalk with dark pigment [mandibular palp absent; P2 carpus 7-segmented; epipod on P1-P2]; Mediterranean and possibly Portugal; coastal waters ..... *Eualus*

*sollaudi* (Zariquiey Cenarro, 1935)

5 - Rostrum not especially slender; when ventral tooth/teeth present, usually very close to tip; legs not very slender; epipod on P1-P2 only; second segment of P2 carpus slightly longer than broad; 2 or 3 proximal strong setae on flexor border of P2 ischium; intertidal and coastal waters .....

6 - Rostrum slender and not very short, with at least 1 distoventral tooth, often with 2 or 3 moderately spaced distoventral teeth; legs slender; epipod on P1-P3; second segment of P2 carpus at least 2.7 times as long as broad; only 1 proximal strong seta on flexor border of P2 ischium [dorso-distal process of 3<sup>rd</sup> segment of antennular process narrowly triangular; mandibular palp present; P1 ischium with minute spinule(s) on the ventral side of its distal border; P2 carpus with 7 segments; P3-P4 but not P5 of males with spines in comb-like arrangement on merus flexor border]; not in very shallow water; Mediterranean sea and warm temperate Atlantic (Morocco: loc. nov.) ..... *Eualus drachi* Noël, 1978 (The tropical and possibly warm-temperate *E. lebourae* Holthuis, 1951 should also be keyed out here, at least on the basis of its epipod number; however its appendages are not especially slender and on the drawing of HOLTHUIS (1951), the second segment of P2 carpus is only 1.7 times as long as broad); actually *E. drachi* is possibly only a slender northern form of *E. lebourae*)

6 - Tip of rostrum usually bifurcate, but not unfrequently with a single tooth; dorso-distal process of 3<sup>rd</sup> segment of antennular process narrowly triangular; mandibular palp present; P1 ischium with 1-3 minute spinules on the ventral side of its distal border; P2 carpus with 7 segments; P3-P4 merus but not P5 merus of males with spines in comb-like arrangement on flexor border; Mediterranean and temperate northeastern Atlantic; intertidal and especially coastal waters ..... *Eualus occultus* (Lebour, 1936) (Rostrum usually shorter and often with less teeth, eyes a little bigger, Mxp3 often a little longer than in *E. cranchii*)

- Tip of rostrum usually bifurcate or trifurcate, occasionally more teeth (becoming ventro-apical) in the Mediterranean; tip of rostrum almost never with a single tooth; dorso-distal process of 3<sup>rd</sup>

segment of antennular process broadly triangular; mandibular palp absent; P1 ischium without spinules on the ventral side of its distal border; P2 carpus usually with 6 segments on both sides, sometimes with 6 segments on one side and 7 on the other side; P3-P5 merus of males with spines in comb-like arrangement on flexor border; Mediterranean, tropical and temperate northeastern Atlantic; intertidal and coastal waters ..... *Eualus cranchii* (Leach, 1817) (Mediterranean specimens and especially females usually have a longer rostrum with more teeth than Atlantic ones; taxonomic significance of which is not clear)

*Hippolyte varians* Leach, 1814

#### Material

Faial island, Monte da Guia, on *Sertularella polyzonias* (Hutton, 1873), 35 m depth, July 1998: 8 specimens - Monte da Guia, on *Aglaophenia tubulifera* (Hinks, 1851), 35 m depth, 25/VII/1999: 10 specimens including ovigerous females - Monte da Guia, on *Aglaophenia tubulifera*, 41 m depth, 18/VIII/1999: 15 specimens including ovigerous females - Monte da Guia, on *Antipathes wollastoni* Gray, 1857, 41 m depth, 19/VIII/1999: 8 specimens - Monte da Guia, no substrate record, 41 m depth, 19/VIII/1999: 10 specimens - Monte da Guia (eastern part), on *Antipathes wollastoni*, 40 m depth, 27/VIII/1999: about 20 specimens - Faial island, Baía Entre Montes (near Horta), algae, 8 to 12 m depth, October-November 1998: about 20 young specimens - Faial island, Varadouro, from algae, 15 m deep, 1999-2000: 6 specimens - Flores Island, Baixa do Morros, amongst hydroids, 15 m depth, 27/VII/1999: 6 specimens - Baixa do Morros, amongst *Aglaophenia* sp., 22 m depth, 27/VII/1999: about 20 specimens - Flores Island, no precise locality, on the brown alga *Zonaria tournéfortii* (J.V. Lamouroux) Montagne, 1846, 20 m depth, 1999: about 20 specimens.

#### Remarks

With a maximal total length of 12 mm, the Azorean *Hippolyte varians* are very small for this

species which may elsewhere reach up to 32 mm (D'UDEKEM D'ACÓZ 1996a). They are very slender, more slender than the Madeiran populations but less slender than the related Mediterranean form usually referred to as *H. holthuisi* Zariquiey Alvarez, 1952. We were surprised to find *H. varians* in so large numbers in the Azores, since the species was previously only known in the archipelago from a single young male (D'UDEKEM D'ACÓZ 1996a). The species proves to have a wide ecological distribution on coastal hard bottoms in the Azores, being found associated both with algae and with various cnidarians.

*Athanas nitescens* Leach, 1814

#### Material

Faial island, Monte da Guia, below stones, 18 m depth, 30/V/1999: 1 ovigerous female - Monte da Guia, rocks, 12 m depth, 21/VIII/1999: 1 specimen - Monte da Guia, inside a *Charonia lampas* (Linnaeus, 1758) shell inhabited by a large *Dardanus calidus* (Risso, 1827), 22/VIII/1999: 4 specimens - Monte da Guia (eastern side), hard bottom, 40 m depth, 27/VIII/1999: 1 juvenile - Baía Entre Montes (near Horta), rocks and algae, 10-18 m depth, 16/VIII/1999: 1 specimen - Faial island, Horta harbour, below stones, 5 to 9 m depth, October-November 1998: numerous specimens - Horta harbour, from the hull of an old boat, 02/VIII/2000: 2 ovigerous females - Santa Maria Island, Maia, tide pool, 22/V/1999: 1 specimen.

#### Remarks

*Athanas nitescens* has previously been recorded from southern Scandinavia to the Congo, in Madeira, the Canary Islands, the Cape Verde Islands and Annobon Island, and in the whole Mediterranean basin (D'UDEKEM D'ACÓZ 1999). We record it for the first time in the Azores where it proves to be quite common. As far we know, it is the first time that *Athanas nitescens* is recorded in association with a hermit crab (*Dardanus calidus* (Risso, 1827)), but a closely related species, *Athanas grimaldii* Coutière, 1911 has been found associated with another hermit crab species, *Petrochirus pustulatus* (Herbst, 1796)

(see CROSNIER & FOREST 1966). In addition to *Athanas nitescens*, two other alpheid shrimps are commonly encountered in the coastal waters of Faial island: *Alpheus dentipes* Guérin-Méneville, 1832 and *Alpheus macrocheles* (Hailstone, 1835) (personal observations).

*Philocheras bispinosus* (Hailstone, 1835) forma *neglectus* G.O. Sars, 1883

#### Material

Faial island, Horta harbour, sandy bottom, 9 m depth, November 1998: 5 small specimens including 2 ovigerous females (total length = 6 mm).

#### Remarks

*Philocheras bispinosus* has already been recorded by BARROIS (1888) in the Azores. However, it is the first time that the controversial forma *neglectus* is recorded in the archipelago. We have compared our Azorean material with Greek specimens of the closely related species *Philocheras monacanthus* Holthuis, 1961 and they look quite distinct. Unlike our Azorean material, most Madeiran *P. bispinosus* examined by us belong to the typical form.

*Philocheras fasciatus* (Risso, 1816)

#### Material

Faial island, Monte da Guia (SW side), below stones, 35-44 m, 20/VIII/1999: 1 specimen - Monte da Guia (Eastern side), hard bottom, 40 m depth, 23/VIII/1999: 1 specimen - Faial island, Horta harbour, 9 m depth, November 1998: 1 specimen - Faial island, Baía Entre Montes (near Horta), between algae, 8-12 m depth, October-November 1998: 1 specimen - Baía Entre Montes, 10-18 m depth, 16/VIII/1999: 1 specimen.

#### Remark

*P. fasciatus* was already recorded in the Azores by BARROIS (1888). All the specimens observed during the present study were very small (total length up to about 5 mm).

*Philocheras trispinosus* (Hailstone, 1835)

*Material*

Faial island, Horta harbour, sandy bottom, 15 m depth, 16/V/2000: 8 specimens including ovigerous females - Horta harbour, Agassiz trawl, at night, 22/IX/1999: 5 juveniles - Faial island, Baía Entre Montes (near Horta), sandy bottom, 8 to 12 m depth, November 1998: about 15 juveniles - Faial island, Porto Pim, sandy bottom, very shallow water, beach seine, 18/III/1999: about 30 specimens including ovigerous females - Porto Pim, sandy bottom, night collecting, 2 to 6 m depth, 21/VIII/1999: 2 specimens including an ovigerous female - Terceira Island, Cabo da Praia, sandy bottom near the outer wall of the harbour, 23 m depth, 28/VIII/1999: 2 specimens.

*Remarks*

*Philocheras trispinosus*, which was already recorded by BARROIS (1888), appears to be the commonest crangonid in the Azores. There is no evidence that the other littoral crangonids *P. monacanthus* Holthuis, 1961 and *Crangon crangon* (Linnaeus, 1758) occur in the archipelago.

*Stenopus spinosus* Risso, 1827

*Material*

Faial island, Horta harbour, from the hull of an old boat, 02/VIII/2000: 1 specimen - Faial island, Monte da Guia, big cave, 32 m depth, 1998-2000: 1 specimen photographed but not collected - Terceira Island, Cabo da Praia, basis of inner harbour inner wall, between rocks and on mud bottom close to the wall, SCUBA diving at night (21h 30'), 20 m depth, 28/VIII/1999: 30-40 specimens (not collected) - Flores Island, Gruta dos Enxarés, July 1999: 2 juveniles.

*Remarks*

*Stenopus spinosus* is a species widely distributed in the Mediterranean and the warm and warm-temperate parts of the Eastern Atlantic (LEWINSOHN & HOLTHUIS 1978), and was first recorded in the Azores by FIGUEIRA (1959). This

species usually has conspicuously white antenna. However, in the Azores, many individuals have red antennae instead of white ones and we have even seen individuals with the basal parts of the antennae red and the distal parts white.

*Palinurus elephas* (Fabricius, 1787)

*Material*

Faial island, Monte da Guia, 12 miles off the coast, 270 m depth, coll. M. Serpa, 26/I/1980: 1 specimen, DOP CR-127; Terceira Island, Cabo da Praia, basis of inner harbour inner wall, between rocks, SCUBA diving at night, 20 m depth, 28/VIII/1990: 1 specimen (not collected).

*Remarks*

D'UDEKEM D'ACÓZ (1999) did not list the Azores in the distribution of *Palinurus elephas* as these islands were not indicated in the distribution map for the species given by HOLTHUIS (1991). However, this species is in fact quite common in Azorean waters, as already stated by BARROIS (1888).

*Scyllarus pygmaeus* (Bate, 1888)

*Material*

The Azores, stomach of a *Serranus atricauda* GÜNTHER, 1874, coll. Norberto Medeiros, 29/VIII/1983: 1 specimen, DOP CR91A.

*Remarks*

Since the record by BOUVIER (1917), the species has never been recorded again in the Azores. A label in the vial, written by José Paula, correctly identifies the species but this record apparently was never published.

*Clibanarius erythropus* (Latreille, 1818)

*Material*

Faial island, Feteira, shallow rockpool, intertidal, shore collecting, 14/II/1998: 10 specimens.



#### Remarks

According to INGLE (1993), there are several Azorean records of *Clibanarius erythropus*. However, the occurrence of that species in the Azores needed confirmation, since it is replaced by *C. aequabilis* Dana, 1851 in the Canary Islands (SANTAELLA 1974; PÉREZ SÁNCHEZ & MORENO BATET 1991; GONZÁLEZ PÉREZ 1995) and since *C. aequabilis* is also the only *Clibanarius* species known with certainty from Madeira (D'UDEKEM D'ACÓZ 1999).

Although not rare, *C. erythropus* is not very abundant in the Azores, being restricted to the intertidal zone, in the few places where there are shallow rockpools.

It should be pointed out that several shallow-water hermit crabs common elsewhere in Southern Europe like *Diogenes pugilator* (P. Roux, 1829) and *Pagurus anachoretus* Risso, 1827 are apparently absent from the Azores, despite the existence of favorable biotopes.

#### *Anapagurus chiroacanthus* (Lilljeborg, 1856)

##### Material

Faial island, Varadouro, natural swimming pool, 2 m depth, P. WIRTZ coll., 19/VII/2000: 1 specimen - idem, 18/VIII/2000: 4 specimens.

##### Remarks

*Anapagurus chiroacanthus* is usually found at depth of at least 9 m depth (ZARIQUIEY ALVAREZ 1968) although very rarely found in the intertidal (GARCÍA GÓMEZ 1994). So, it is somewhat surprising to find several specimens in these rock pools. The distribution of this species has been reviewed by INGLE (1993) and GARCÍA GÓMEZ (1994).

#### *Anapagurus pusillus* Henderson, 1888

##### Material

Faial island, Monte da Guia, gravel and/or rocks, 35 to 41 m depth, 21/VIII/1999: 3 ovigerous full grown females and many juveniles.

#### Remarks

*Anapagurus pusillus* was only known from old records from the Azores and the Canary Islands and one recent record from Portugal (see GARCÍA GÓMEZ 1994). We record it again from the Azores where the species is probably not rare. A colour photograph of the species is here given for the first time (fig. 3).



Fig. 3. *Anapagurus pusillus* Henderson, 1888, ovigerous females, Faial, Monte da Guia.

#### *Nematopagurus longicornis* A. Milne-Edwards & Bouvier, 1892

##### Material

Faial island, Monte da Guia, on *Antipathes wollastoni* Gray, 1857, 41 m depth, 18/VIII/1999: 1 juvenile - Monte da Guia, on or near *Antipathes wollastoni*, 41 m depth, 19/VIII/1999: 1 ovigerous female - Monte da Guia, on *Antipathes wollastoni*, 40 m depth, 23/VIII/1999: 1 small male and 1 ovigerous female - Monte da Guia, on *Antipathes wollastoni*, 40 m depth, 27/VIII/1999: 1 ovigerous female and 1 juvenile.

##### Remarks

The finding of *Nematopagurus longicornis* at only 40 m depth was a surprise, since the species is normally found between 75 and 800 m and exceptionally down to 2600 m (A. MILNE-EDWARDS & BOUVIER 1900). We only know one record of the species in the same depth range as our specimens: NEVES (1977), who records a single male trawled between 20 and 50 m depth off Sesimbra, Portugal.

In the literature, *N. longicornis* has been recorded on various bottoms: muddy bottoms (FENZIA 1937; GARCÍA SOCÍAS & GRACIA 1988), muddy sand (A. MILNE-EDWARDS & BOUVIER 1900), coarse gravel with stones (SELBIE 1921), soft bottom with shell fragments (A. MILNE-EDWARDS & BOUVIER 1900; BOUVIER 1922; FOREST 1966; GARCÍA RASO 1996), or in association with the red coral *Corallium rubrum* (Linnaeus, 1758) (MANCONI & MORI 2000). A. MILNE-EDWARDS & BOUVIER (1900) indicate the occurrence of “corals” (no more detail given) in two of their *N. longicornis* stations, but they give no indication that there is any correlation between the occurrence of *N. longicornis* and their ‘corals’. The specimen examined by FENZIA (1937) was found at 100 m depth, on a muddy bottom amongst the hydroid *Aglaophenia myriophyllum* Lamouroux.

The present findings of *N. longicornis* associated with the black coral *Antipathes wollastoni* Gray, 1857 and those of FENZIA (1937) and MANCONI & MORI (2000) suggest a symbiotic association, possibly obligatory, between *N. longicornis* and some species of cnidarians. Indeed, the small hermit crabs collected at Monte da Guia in the same neighbourhood as our *N. longicornis* but outside of the *Antipathes wollastoni* colonies belong all to two other species: *Anapagurus pusillus* Henderson, 1888 and *Calcinus tubularis* (Linnaeus, 1767). Actually, we have also seen *C. tubularis* on *A. wollastoni*, but in this case the association is definitely facultative, since this hermit crab is extremely abundant on all coastal hard bottoms in the Azores.

Additionally to *N. longicornis*, we have observed many decapod species on *A. wollastoni* colonies at Monte da Guia: *Balssia gasti* (Balss, 1921), *Periclimenes sagittifer* (Norman, 1861), *Periclimenes wirtzi* d'Udekem d'Acoz, 1996, *Eualus occultus* (Lebour, 1936), *Hippolyte varians* Leach, 1814, *Calcinus tubularis* (Linnaeus, 1767) and *Macropodia* sp. Amongst them, *Periclimenes wirtzi* is the only species which is an obligatory commensal of antipatharians (WIRTZ & D'UDEKEM D'ACÓZ 2001).

Two colour photographs of *N. longicornis* (Fig. 4-5) are provided as the highly characteristic

colour pattern of this species has never been illustrated so far.



Fig. 4-5. *Nematopagurus longicornis* A. Milne-Edwards & Bouvier, 1892, ovigerous female, Faial island, Monte da Guia (both photographs are from the same specimen).

*Pagurus cuanensis* Bell, 1845

#### Material

Pico Island, opposite to Faial island, baited trap, 80 m depth, 21/III/1999: 2 specimens.

#### Remarks

There are only two records of *P. cuanensis* in the Azores: BARROIS (1888) and CHAPMAN & SANTLER (1955), and BARROIS was not absolutely sure of his identification. However, the species is quite common at the Azores and the second author has taken numerous photographs of it during night dives in shallow water.

*Herbstia condyliata* (J.C. Fabricius, 1787)

*Material*

Faial island, Monte da Guia, rocks, 12 m depth, 21/VIII/1999: 1 juvenile - Monte da Guia (eastern side), 40 m depth, 23/VIII/1999: 2 juveniles - Faial island, Monte da Guia, big cave, 32 m depth, 19/VII/2000: 1 adult male - Faial island, Varadouro, between algae, 15 m depth, october 1998: 1 juvenile - Faial island, Baía Entre Montes, underneath a stone, 12 m depth, P. WIRTZ coll., 09/VI/1999: an immature female - Pico Island, no further details, July 1999: 1 juvenile.

*Remarks*

The specimen from Varadouro has only one projection on the posterior margin of carapace, as in *Herbstia rubra* A. Milne-Edwards, 1869. However, this specimen is very small (6.5 mm carapace length) and is the smallest Azorean *Herbstia* in our collections. MANNING & HOLTHUIS (1981) had already illustrated a very small *H. condyliata* (4.2 mm carapace length) with a single posterior projection. *Herbstia rubra* has been recorded in the Azores by CHAPMAN & SANTLER (1955), but in all likelihood, this record is a misidentification for *H. condyliata*. The occurrence of *H. condyliata* in dark caves has previously been recorded by several authors, like LEDOYER (1968) and GILI & MACPHERSON (1987).

*Achaeus cranchii* Leach, 1817

*Material*

Faial island, Ponta do Forte, rocks with algae, 6 to 36 m depth, 17/VIII/1999: 1 immature female - Terceira island, Cabo da Praia, outer wall of the harbour, rocks with algae, 10 to 23 m depth, 28/VIII/1999: 1 adult male.

*Remark*

The male specimen is definitely not *Achaeus*

*gracilis* O.G. Costa, 1839 as described by FOREST & ZARIQUIEY ALVAREZ (1955) and ZARIQUIEY ALVAREZ (1968), under the name of *Achaeus gordonae* Forest & Zariquiey Alvarez, 1955 and agrees quite well with the previous accounts of *A. cranchii*, for most characters. Typical specimens of both species were furthermore available for comparison. In the Azorean male examined, the carapace is very wide, with well marked hepatic lobes and with a high conical cardiac protuberance. Its rostral horns are separated by a large U-shaped space and are very short, far from reaching the tip of the penultimate segment of the antennular peduncle. However its orbits are devoid of ornamentation except for a unique isolated but well developed tubercle on the left side. According to ZARIQUIEY ALVAREZ (1968) and many other authors, the orbits of *A. cranchii* are dorsally spiny. Despite this unusual character, we believe that there is little doubt that this specimen is a true *A. cranchii*. The female specimen agrees perfectly with the descriptions of *A. cranchii* and exhibits a row of short spinules on the border of its orbits. The Azorean records of *Achaeus cursor* A. Milne-Edwards & Bouvier, 1898 by A. MILNE-EDWARDS & BOUVIER (1899) and BOUVIER (1922) probably refer to *Achaeus cranchii*. Recent records of this species in the Azores have been given by FRANSEN (1991) and PAULA et al. (1992).

*Macropodia* sp.

*Material*

Faial island, Monte da Guia, rocky bottom, amongst *Aglaophenia tubulifera* (HINKS, 1851), 41 m depth, 18/VIII/1999: 1 damaged adult male - Same locality, on *Antipathes wollastoni* Gray, 1857, 41 m depth, 19/VIII/1999: 1 damaged ovigerous female - Same locality, on *Antipathes wollastoni*, 40 m depth, 23/VIII/1999: 2 immature females (possibly in the last prepuberal intermoult).



Fig. 6. *Macropodia* sp., adult male, Azores, Faial island, Monte da Guia. A, carapace in dorsal view; B, carapace in lateral view; C, merus of 1st left pereiopod; D, dactylus of left 4th pereiopod; E, apex of merus of the same. Scale bar: A, B, C = 2.0 mm; D, E = 1.0 mm.

#### Remarks

It has been impossible to identify these *Macropodia* with any described species of that genus. The most closely related species is possibly *Macropodia doracis* Manning & Holthuis, 1981, a species which has been described after a unique female specimen from the Cape Verde Islands (MANNING & HOLTHUIS 1981). However, the Azorean crabs have much stronger spines on the carapace, and, therefore, it is possible that they belong to an undescribed species. Unfortunately, the material available to us consists of only two badly damaged adults (both with carapace broken and some legs lacking) and two well preserved immature females. Under such conditions, we believe that it is premature to erect a new name for the Azorean *Macropodia*.

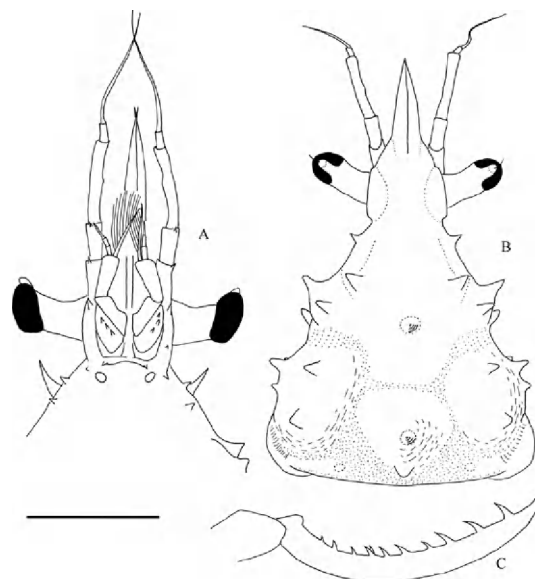


Fig. 7. *Macropodia* sp., Azores, Faial island, Monte da Guia. A, adult male, anterior part of body in ventral view; B, immature female, carapace in dorsal view; C, dactylus of left P 5 of the same specimen. Scale bar: A, B = 2.0 mm; C = 1.0 mm.

#### *Polybius marmoreus* (Leach, 1814)

#### Material

Faial island, Porto Pim, sandy bottom, very shallow water, beach seine, 20/1/1999: 2 adult females.

#### Remarks

This species has been recorded on several occasions in the Azores. However, as it has long been confused with its close relative *P. vernalis* (Risso, 1827), there were good reasons to consider all these records as questionable, with the exception of the material recorded at Flores by FRANSEN (1991). The two females examined display all the characters of *P. marmoreus* and there is no doubt as concerns their identity. So far, *P. vernalis* has never been recorded in the Azores.

*Portunus hastatus* (Linnaeus, 1767)

*Material*

The Azores, Faial island, Porto Pim, sandy bottom, shallow water, beach seine, 21.xi.1998 and 20.i.1999: many specimens - same locality, 1 m depth, August 1999: 12 juveniles

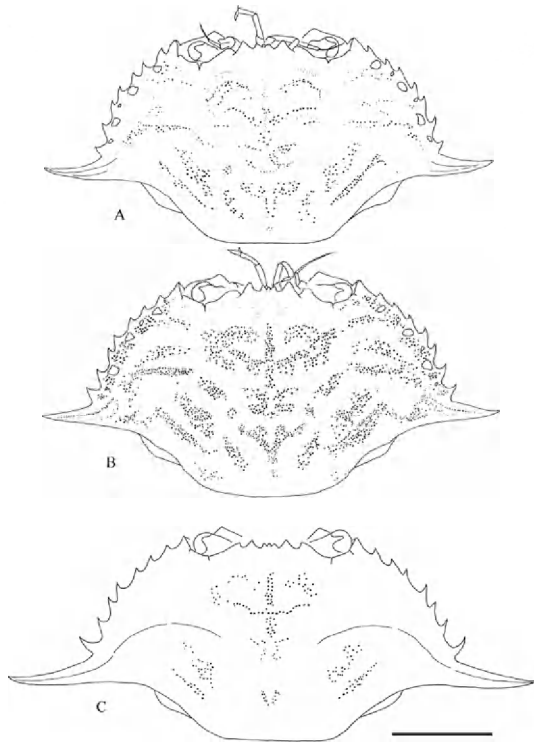


Fig. 8. A: *Portunus hastatus* (Linnaeus, 1767), Italy, Piombino area; B: *P. hastatus*, Azores, Faial island, Porto Pim; C: *P. inaequalis* (Miers, 1881), Calypso, station 19, Ivory Coast, 05°02.5'N 05°25'W. Carapaces of adult males. Scale bar = 10 mm.

*Comparative material*

Italy. Piombino area. R. Bedini coll., around 1998: 4 males - Greece. S.E. Peloponnese, Monemvassia, net bycatch, d'Udekem d'Acoz coll., 18.07.1986: 1 ovigerous female.

*Remarks*

The variability of *Portunus hastatus* (Linnaeus, 1767) and of the related species *P. inaequalis* (Miers, 1881) has briefly been discussed in

several previous papers (STEINITZ 1932; MONOD 1956; ZARIQUIEY ALVAREZ 1968; TÜRKAY 1976; MANNING & HOLTHUIS 1981; SANTAELLA ALVAREZ 1985; BEDINI 1998), but these previous accounts raise more questions than answers, and even the distinction between both species has been questioned (MONOD 1956).

These problems partly result from the close similarity between both species and their morphological variability, but also from the lack of adequate illustrations, especially for *P. hastatus* which has only correctly been illustrated by ROUX (1830) and CAPART (1951) for adults and by TÜRKAY (1987) for juveniles. Detailed line drawings of *P. hastatus* are therefore here given (fig. 8A-B, 9).

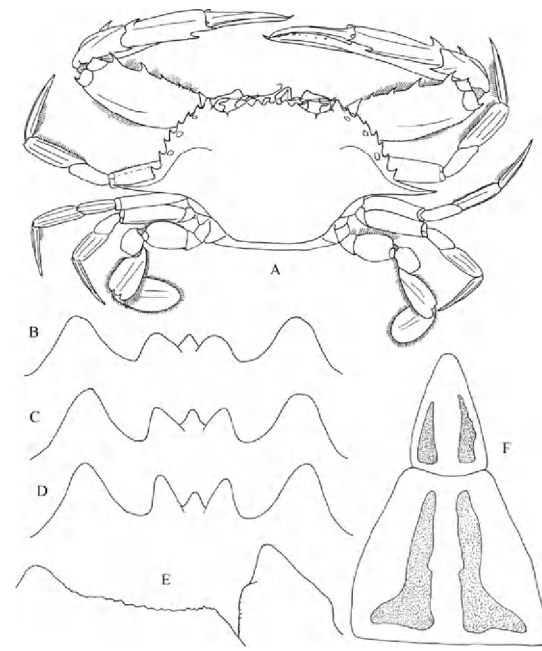


Fig. 9. *Portunus hastatus* (Linnaeus, 1767). A: female, Azores, Faial island, Porto Pim; B: male, Italy, Piombino area; C, D, E, F: males, Azores, Faial island, Porto Pim. A, crab in dorsal view; B, C, D, frontal area; E, left infraorbital area; F, distal part of pleon. Scale bar: A = 10 mm; B, C, D, E = 2.0 mm; F = 3.3 mm.

When comparing Azorean and Mediterranean *Portunus hastatus*, our first subjective impression was that they looked different. At this time we had in mind the remarks of ZARIQUIEY ALVAREZ (1968) who stated that *P. hastatus* includes

morphologically distinct populations within the Mediterranean Sea and of SANTAELLA ALVAREZ (1985) who stated that the *P. hastatus* from the Canary Islands show some similarities with the tropical and subtropical East Atlantic *P. inaequalis* (Miers, 1881). So, we decided to examine our material further and also to compare it with typical *P. inaequalis*.

It immediately appeared that *P. inaequalis* (fig. 8C) is quite distinct from both Azorean and Mediterranean *P. hastatus* (Fig. 8A-B). *P. inaequalis* harbours more acute anterolateral teeth, longer posterior teeth (when intact and not regenerated) and a wider carapace (even with the posterior teeth excluded). A descriptive (non illustrated) account of other morphological characters of *P. inaequalis* has been given by MANNING & HOLTHUIS (1981), and further figures have been given by MIERS (1881) and MONOD (1956).

On the other hand, the carapace shape of Azorean and Mediterranean *P. hastatus* exhibits absolutely no differences.

In this context, it should be pointed out that the ratio width/length of carapace given in the literature (MONOD 1956; SANTAELLA ALVAREZ 1985) should be considered with caution. Indeed the posterior teeth are easily broken, hence many specimens have regenerated and therefore shorter teeth. It should also be pointed out that in his key on page 194, MONOD (1956) committed a mistake indicating that *P. hastatus* has a wide carapace instead of *P. inaequalis*.

The different appearance of Azorean and Mediterranean *P. hastatus* is essentially due to their differential pilosity and in lesser degree to their colour pattern. The carapace of Mediterranean *P. hastatus* exhibits a well developed pubescence, while the dorsal setae are much shorter and less numerous in Azorean crabs. A similar difference is also observed in the grooves of the sternal area and of the walking legs. These grooves are densely filled with fur in the Mediterranean crabs while they comprise a much shorter and scarcer pubescence in the Azorean crabs, the pilosity being especially scarce in younger crabs.

The different pilosity of the sternal area has been proposed by MONOD (1956) to separate *P. hastatus* from *P. inaequalis*, but TÜRKAY (1976)

already pointed out that the sternal pilosity is variable in *P. hastatus*.

The coloration of the Azorean and Mediterranean *P. hastatus* examined appeared to be different, being variegated in the Azores and fairly uniform in our Greek female, which has been photographed just after its capture. However, the previously published colour photographs of *P. hastatus* indicate that the colour pattern is quite variable in that species (GONZÁLEZ PÉREZ 1995; WIRTZ 1995; BEDINI 1998; DEBELIUS 1999). It has even been shown that in some populations, two distinct colour patterns without intermediate may be observed side by side (BEDINI, 1998). Therefore, the colour differences observed in our Azorean and Mediterranean material probably have no taxonomic significance.

Interestingly, pilosity differences between Mediterranean and Atlantic populations have also been recorded in another portunid crab: *Polybius vernalis* (Risso, 1827). In that species, the Atlantic specimens have their carapace glabrous or very slightly pubescent while their Mediterranean counterparts usually have a very pubescent carapace (D'UDEKEM D'ACÓZ 1999).

Finally, it must be pointed out that *P. hastatus* and *P. inaequalis* are also closely related to *Portunus anceps* (de Saussure, 1857) from the Western Atlantic and from Ascension Island. However, in the latter the telson of the male is very short and rounded (MANNING & CHACE 1990), while it is elongated and triangular in *P. hastatus* and *P. inaequalis*.

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