

A worldwide review of hermit crab species of the genus *Sympagurus* Smith, 1883 (Crustacea: Decapoda: Parapaguridae)

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ABSTRACT

A review of species of the genus *Sympagurus* Smith, 1883 (*sensu* Lemaître) from the world oceans is presented. The study is based on the rich collections obtained during French campaigns in the Pacific and Indian Oceans, and on additional material in various museums and research institutions throughout the world. The 17 species recognised in this genus occur most frequently between 500 and 1000 m depth, and range from 80 to 2537 m. Some live in striking symbiosis with anthozoan or zoanthid coelenterates that can produce pseudo-shells. Three new species, *S. aurantium*, *S. chani* and *S. symmetricus*, are fully described and illustrated here. *Sympagurus rectichela* (Zarenkov 1990), a taxon originally described in *Parapagurus* Smith, 1879, has been found to be a junior synonym of *S. dofleini* (Balss, 1912); and *S. papposus* Lemaître, 1996 is a junior synonym of *S. burkenroadi* Thompson, 1943. All previously known *Sympagurus* species are diagnosed or redescribed and illustrated, and data on habitat, symbiotic associations, and coloration are provided. A key to aid in the identification of all *Sympagurus* species is presented, and their bathymetric and geographic distributions are summarised. The geographic distribution of 14 species (82.3%) includes the Pacific Ocean, 9 (52.9%) the Indian Ocean, and 3 (1.8%) the Atlantic Ocean. New Caledonia and adjacent islands have the highest number of *Sympagurus* species in the world, with 12 species known to occur there.

RÉSUMÉ

Révision mondiale des Bernardes l'ermite du genre *Sympagurus* (Crustacea : Decapoda : Parapaguridae).

Une révision mondiale des espèces du genre *Sympagurus* Smith, 1883 (*sensu* Lemaître) est présentée. L'étude est basée sur les riches collections obtenues par les campagnes françaises dans les océans Pacifique et Indien et sur du matériel supplémentaire provenant de différents musées et organismes de recherches. Les 17 espèces reconnues dans ce genre se trouvent principalement entre 500 et 1000 m de profondeur, avec des extrêmes de 80 à 2537 m. Quelques espèces vivent en étroite symbiose avec des anthozoaires ou des zoanthaires capable de fabriquer une pseudo-coquille. Trois nouvelles espèces sont décrites et illustrées ici : *S. aurantium*, *S. chani*, et *S. symmetricus*. *Sympagurus rectichela* (Zarenkov, 1990), décrit tout d'abord dans le genre *Parapagurus* Smith, 1879, s'avère être un synonyme plus récent de *S. dofleini* (Balss, 1912) ; *S. papposus* Lemaître, 1996 devient un synonyme plus récent de *S. burkenroadi* Thompson, 1943. Toutes les espèces connues de *Sympagurus* sont redéfinies et redécrites avec des illustrations. Les caractéristiques concernant les habitats, les

associations symbiotiques et les couleurs sont fournies. Une clef d'identification pour toutes les espèces de *Sympagurus* est donnée ainsi que leur répartition géographique et bathymétriques. La distribution géographique montre que 14 espèces (82,3%) sont dans le Pacifique, 9 espèces (52,9%) dans l'océan Indien et 3 espèces (1,8%) dans l'océan Atlantique. C'est la Nouvelle-Calédonie et les îles proches qui ont le plus grand nombre d'espèces de *Sympagurus* (12).

INTRODUCTION

The genus *Sympagurus* Smith, 1883 was recently redefined to include 13 species, and is one of ten genera currently classified in the family Parapaguridae (Lemaitre 1996). Species of the genus inhabit the lower continental shelf and upper slope regions of most world oceans where they are frequently found in depths between 500 and 1000 m, although they range from 80 to 2537 m. Individuals of some species reach the largest sizes recorded for parapagurids (shield length up to 26 mm), and some species live in striking symbiosis with pseudoshell-producing anthozoans or zoanthids (Fautin Dunn *et al.* 1981; Fautin Dunn & Liberman 1983; Fautin 1987). Although various *Sympagurus* species have been discussed in the last decade or so, details on their morphology and taxonomy are scattered in faunal studies of parapagurids from the western Atlantic (Lemaitre 1989), southeastern Pacific (Zarenkov 1990; Zhadan 1997), Antarctic and Subantarctic waters (Lemaitre & McLaughlin 1992), French Polynesia (Lemaitre 1994), Australia (Lemaitre 1996), Indonesia (Lemaitre 1997), New Zealand (Lemaitre 2000), and the western Indian Ocean (Zhadan in press).

While studying the rich and remarkable parapagurid collections obtained by French campaigns conducted in the Pacific and Indian Oceans, all but three of the previously known species of *Sympagurus* were found to be represented. Furthermore, three new species were discovered. Given that a good number of specimens of several poorly defined or rarely seen taxa were now available in these collections, a worldwide review of *Sympagurus* species was undertaken, augmented by material in major museums and other institutions from throughout the world. As result of this review, a total of 17 species of *Sympagurus* are recognised. *Sympagurus rectichela* (Zarenkov, 1990), a taxon originally described in *Parapagurus* Smith, 1879 and subsequently transferred to *Sympagurus* by Zhadan (1997), was found to be a junior synonym of *S. dofleini* (Balss, 1912). Moreover, *S. papposus* Lemaitre, 1996 was found to be a junior synonym of *S. burkenroadi* Thompson, 1943. The type and only known specimen of *S. spinimanus* (Balss, 1911), was determined as the juvenile stage of a species for which adults are yet unknown. Diagnoses and illustrations are provided for all species, and complete synonymies given. Information is supplied on habitat and symbiotic associations, and color photographs included for five species. A key to aid in the identification of the species is provided.

HISTORY OF GENERIC CLASSIFICATION

The genus *Sympagurus* has been subjected to a number of revisions and familial classifications since it was originally proposed by Smith (1883) for a single species, *S. pictus* Smith, 1883. Smith also noted that *Sympagurus* was very similar to a genus he had described earlier, *Parapagurus* Smith, 1879, except that the former had phyllobranchiae instead of trichobranchiae, larger eyes, and shorter ocular peduncles and antennules. Smith (1883, 1884, 1886) did not indicate a familial placement for *Sympagurus*, although he (Smith 1882) did propose the family Parapaguridae for *Parapagurus* on the basis of the trichobranchiae alone. Henderson (1888: 52) placed *Sympagurus* in the Paguridae *sensu* Dana, 1852, which along with the Coenobitidae made up his "Branch" Laminibranchiata, or forms with phyllobranchiae. Bouvier (1891) later criticized the use of gill type as a character for systematic grouping, and indicated that it was not natural to separate *Sympagurus* from *Parapagurus* based on differences of gill type alone. Milne-Edwards & Bouvier (1893) then abandoned Smith's (1882) and Henderson's (1888) familial arrangement based on gill structure and placed *Sympagurus* and *Parapagurus* in the family Paguridae. However, at the generic level the use of branchial structure to separate *Sympagurus* from *Parapagurus* continued to be used (Milne-Edwards & Bouvier 1893, 1894, 1897, 1899, 1900; Alcock 1901, 1905; Bouvier 1891, 1896, 1922, 1940; Prizbram 1905; Fowler 1912; Melin 1939; Thompson 1943; Gordan 1956). To Balss (1912), the separation of these two genera was unsustainable, and he formally synonymized *Sympagurus* with *Parapagurus*.

This arrangement was accepted by most subsequent carcinologists (e.g., Terao 1913; Forest 1955; de Saint Laurent 1972) until Lemaitre (1989) revised *Parapagurus*, and reinstated *Sympagurus*. The latter genus was at that time broadly defined by Lemaitre to include a morphologically diverse assemblage. More recently, Lemaitre (1996) restricted and redefined *Sympagurus* based on branchial characteristics and other morphological features, and proposed two other genera, *Oncopagurus* Lemaitre, 1996 and *Paragiopagurus* Lemaitre, 1996, for a number of species previously placed in *Sympagurus*.

BRANCHIAL STRUCTURE AND TERMINOLOGY

The parapagurid terminology used follows Lemaitre (1989, 1999), with some exceptions. The term *quadriserial*, herein used for gill structure, was defined by McLaughlin & de Saint Laurent (1998: 161, fig. 1) who pointed out that gills of parapagurids are not true trichobranchiae but rather a type of phyllobranchiae in which the lamellae inserted biserially on the rachis are divided. Although in *Sympagurus* species the division of the lamellae can vary from one end of the rachis to another, the maximum division of the lamellae (generally seen towards the midportion of the gill), can be of two kinds, herein described as *distally divided* (Figs 1a₁, g₁-l₁), or *deeply divided* (Figs 1b₁-f₁). In the former, each lamella is divided by a cleft that does not reach the midlength of the lamella, whereas in the latter the cleft reaches well beyond the midpoint of the lamella. The maximum division has been found to remain constant within each species.

Lemaitre's (1996) recent redefinition of *Sympagurus* was based primarily on a unique character among the Parapaguridae, i.e., the presence of a small subtriangular, flap-like structure on the wall of the last thoracic somite (Fig. 2). This structure is distally flexible, often delicate and transparent, and can be observed by gently raising the posterolateral portion of the posterior carapace just above the coxa of the fifth pereopod. This flap-like structure, which lacks lamellae, was considered to be a rudimentary branchia by de Saint Laurent (1972), for which, the term *vestigial pleurobranch* proposed by Lemaitre (1989) is preferred here. Whether or not this vestigial structure actually serves a respiratory function is unknown.

Mouthpart morphology in *Sympagurus* species is very similar, except for the endopod of the maxillule. Depending on the species, the external lobe of the endopod of the maxillule varies from obsolete or weakly-developed (Figs 1a₂, c₂, g₂, i₂) to moderately-developed (Figs 1b₂, d₂-f₂, h₂, j₂-l₂). The internal lobe has at least one or more long distal setae, and the number of setae can vary intraspecifically. Although only a limited number of specimens have been studied for maxillule morphology, it appears that the degree of development of the external lobe is characteristic of each species.

The first and second ambulatory legs refer to the second and third pereopods respectively. The term *semichelate* is used as defined by McLaughlin (1997: 435).

MATERIALS AND METHODS

Treatment of the species and measurements follows the organisation and methods used by Lemaitre (1999) in his review of the genus *Parapagurus* Smith, 1879, although in the present review the species are discussed in the order that they appear in the key presented for their identification. The numbers or range in millimetres (mm) included in the "material examined" sections following the number and sex of specimens, are measurements for shield length (sl), measured from the tip of the rostrum to the midpoint of the posterior margin of the shield.

The specimens from the French campaigns remain deposited in the Muséum national d'Histoire naturelle, Paris (MNHN), with duplicates in the National Museum of Natural History, Smithsonian Institution, Washington D. C. (USNM).

A significant number of specimens used came from other museums or institutions as follows.

AMS: The Australian Museum, Sydney;

BMNH: The Natural History Museum, London;

BPBM: Bernice P. Bishop Museum, Honolulu;

CBM-ZC: Natural History Museum and Institute, Chiba;

FRS: Fisheries Research Station, Hong Kong;
 NTM: Northern Territories Museum, Darwin;
 NTOU: National Taiwan Ocean University, Keelung;
 QM: Queensland Museum, Brisbane;
 SAM: South African Museum, Cape Town;
 SAMA: South Australian Museum, Adelaide;
 TAMU: Texas A & M University, College Station, Galveston;
 UMUTZ: University Museum, University of Tokyo, Zoology;
 ZMA: Zoologisch Museum, Universiteit van Amsterdam;
 ZMB: Museum für Naturkunde zu Berlin;
 ZMK: Zoologisk Museum, Copenhagen;
 ZMUM: Zoological Museum, Moscow State University;
 ZSM: Zoologische Staatssammlung, Munich.

Figures 26 and 32 are digital images obtained with a Sony Mavica camera (model MVC-FD95). The images were processed in Photoshop®.

Station data for the French campaigns from which *Sympagurus* material was examined, can be found in the following publications or unpublished reports:

BATHUS 1-4: Richer de Forges & Chevillon (1996);
 BERYX 11: Lehodey *et al.* (1992);
 BENTHEDI: unpublished report (A. Crosnier, pers. comm.);
 BIOCAL: Richer de Forges (1990);
 BIOGEOCAL: Richer de Forges (1990);
 BORDAU 2: unpublished report (A. Crosnier, pers. comm.);
 CHALCAL 2: Richer de Forges (1990);
 CORAIL 2: Richer de Forges (1991);
 French Polynesia, *Marara*: Poupin *et al.* (1990), Poupin (1996a);
 HALIPRO 1: Richer de Forges & Chevillon (1996);
 Madagascar, *NO Vauban*: Crosnier (1978);
 MUSORSTOM 4-6: Richer de Forges (1990);
 MUSORSTOM 7: Richer de Forges & Menou (1993);
 MUSORSTOM 8: Richer de Forges *et al.* (1996);
 SMIB 3, 4: Richer de Forges (1990);
 SMIB 5: Richer de Forges (1993);
 SMIB 8: Richer de Forges & Chevillon (1996);
 SMIB 10: unpublished report (A. Crosnier, pers. comm.);
 TAIWAN 2000: unpublished report (A. Crosnier, pers. comm.);
 VOLSMAR: Laboute *et al.* (1989).

SPECIES LIST

(Listed alphabetically. Asterisk indicates species found in the New Caledonia region)

Sympagurus acinops Lemaitre, 1989*
S. affinis (Henderson, 1888)*
S. andersoni (Henderson, 1896)
S. aurantium n. sp.*

- S. brevipes* (de Saint Laurent, 1972)*
S. burkenroadi Thompson, 1943 (= *S. papposus* Lemaitre, 1996)*
S. chani n. sp.
S. dimorphus (Studer, 1883)
S. dofleini (Balss, 1912) (= *Parapagurus rectichela* Zarenkov, 1990)*
S. pictus Smith, 1883
S. planimanus (de Saint Laurent, 1972)*
S. poupini Lemaitre, 1994
S. soela Lemaitre, 1996*
S. spinimanus (Balss, 1911)
S. symmetricus n. sp.*
S. trispinosus (Balss, 1911)*
S. villosus Lemaitre, 1996*

SYSTEMATIC ACCOUNT

Family Parapaguridae Smith, 1882

Genus ***SYMPAGURUS*** Smith, 1883

Sympagurus Smith, 1883: 37. Type species (monotypy): *Sympagurus pictus* Smith, 1883 (gender masculine). — Henderson 1888: 52. — Bouvier 1891: 402; 1896: 127; 1922: 21; 1940: 128. — Milne-Edwards & Bouvier 1893: 58; 1894: 67; 1897: 131; 1899: 55; 1900: 194. — Alcock 1901: 223; 1905: 103. — Przibram 1905: 197. — Fowler 1912: 582. — Melin 1939: 20. — Thompson 1943: 418. — Gordan 1956: 341. — Lemaitre 1989: 36; 1996: 169; 2000: 210. — Ingle 1993: 19. — Zhadan in press.
Parapagurus – Balss 1912: 96 (in part). — de Saint Laurent 1972: 101 (in part).

DIAGNOSIS. — Twelve pairs of gills: 11 pairs of quadriserial (2 arthrobranches on each third maxilliped, cheliped, and second through fourth pereopods, and 1 pleurobranch on seventh thoracic somite above fourth pereopod), with lamellae distally or deeply divided (Fig. 1); and 1 pair of vestigial pleurobranchiae on eighth thoracic somite above fifth pereopod (Fig. 2).

Shield about as broad as long, or broader than long; dorsal surface usually with irregularly-shaped, weakly calcified areas. Corneae weakly to moderately dilated.

Fourth segment of antennal peduncle unarmed, or with small dorsodistal spine.

Maxillule with external lobe of endopod (Figs 1a₂-1₂) obsolete or moderately developed, not recurved; internal lobe with 1 or more long setae distally. Epistomial spine short and straight, or absent.

Right chela with rounded dorsomesial and dorsolateral margins, or sometimes operculate with well delimited dorsomesial and dorsolateral margins.

Left cheliped usually well calcified.

Ambulatory legs with dactyls evenly curved.

Fourth pereopod with propodal rasp consisting of 1 or more rows of corneous scales or spines.

Second abdominal somite with left pleuron terminating ventrally in small subtriangular lobe.

Males with moderately to well developed, paired first and second pleopods modified as gonopods.

DISTRIBUTION. — Atlantic, Pacific and Indian Oceans, 80-2537 m (Fig. 34).

SPECIES INCLUDED. — (See “species list” above).

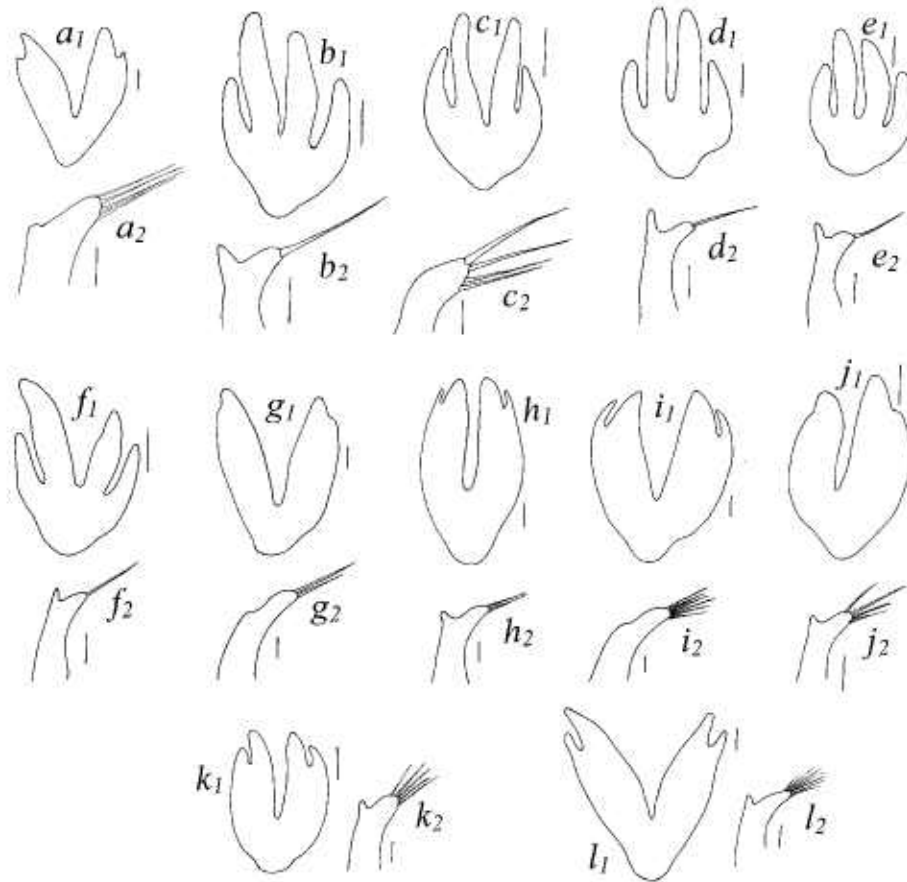


FIG. 1. Lamella (a_{1-1}) of posterior arthrobranch (midportion) of fourth pereopod, and distal end of endopod (a_{2-2}) of left maxillule (internal view) of *Sympagurus* species. a_{1-2} , *S. poupini* Lemaître, 1994; b_{1-2} , *S. acinops* Lemaître, 1989; c_{1-2} , *S. dimorphus* (Studer, 1883); d_{1-2} , *S. soela* Lemaître, 1996; e_{1-2} , *S. planimanus* (de Saint Laurent, 1972); f_{1-2} , *S. affinis* (Henderson, 1888); g_{1-2} , *S. pictus* Smith, 1883; h_{1-2} , *S. brevipes* (de Saint Laurent, 1972); i_{1-2} , *S. dofleini* (Balss, 1912); j_{1-2} , *S. burkenroadi* Thompson, 1943; k_{1-2} , *S. villosus* Lemaître, 1996; l_{1-2} , *S. trispinosus* (Balss, 1911). Scales = 0.5 mm (a_{1-2} , c_{1-2} , g_{1-1} , g_{2-2}), and 0.25 mm (b_{1-2} , d_{1-2} , f_{1-2} , h_{1-2} , i_{1-2} , j_{1-2} , k_{1-2} , l_{1-2}).

FIG. 1. Lamelles (a_{1-1}) de l'arthrobranchie postérieure (partie centrale) du quatrième péréiopode et extrémité distale de l'endopode (a_{2-2}) du maxillule gauche (vue interne) chez les espèces de *Sympagurus*. a_{1-2} , *S. poupini* Lemaître, 1994; b_{1-2} , *S. acinops* Lemaître, 1989; c_{1-2} , *S. dimorphus* (Studer, 1883); d_{1-2} , *S. soela* Lemaître, 1996; e_{1-2} , *S. planimanus* (de Saint Laurent, 1972); f_{1-2} , *S. affinis* (Henderson, 1888); g_{1-2} , *S. pictus* Smith, 1883; h_{1-2} , *S. brevipes* (de Saint Laurent, 1972); i_{1-2} , *S. dofleini* (Balss, 1912); j_{1-2} , *S. burkenroadi* Thompson, 1943; k_{1-2} , *S. villosus* Lemaître, 1996; l_{1-2} , *S. trispinosus* (Balss, 1911). Échelles = 0,5 mm (a_{1-2} , c_{1-2} , g_{1-1} , g_{2-2}), et 0,25 mm (b_{1-2} , d_{1-2} , f_{1-2} , h_{1-2} , i_{1-2} , j_{1-2} , k_{1-2} , l_{1-2}).

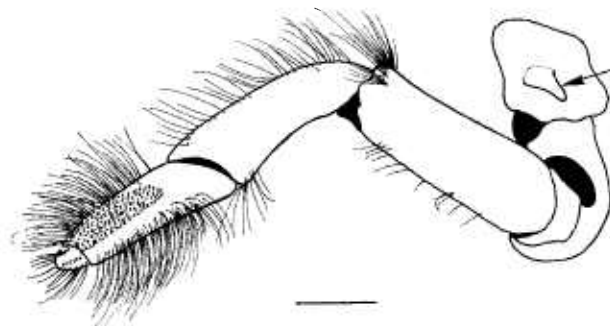


FIG. 2. Left fifth pereopod and side wall of body with vestigial pleurobranch (arrow) of *Sympagurus pictus* Smith 1883, male, sl 14.5 mm, Gulf of Mexico (USNM 265286). Scale = 2 mm.

FIG. 2. Cinquième péréiopode gauche et flanc du corps avec la pleurobranchie vestigiale (flèche) de *Sympagurus pictus* Smith 1883, male, sl 14,5 mm, Golfe de Mexico (USNM 265286). Echelle = 2 mm.

REMARKS. — The presence of a vestigial pleurobranch on the last thoracic somite in *Sympagurus* species is unique in the Section Paguridea (cf. Forest 1987). Although the function of this vestigial structure has not yet been fully explored, it can be interpreted as the remnant of a former, fully functional pleurobranch. Fully developed pleurobranches on the last thoracic somite are known to occur in genera of other families of the Paguridea such as *Coenobita* Latreille, 1829 of the Coenobitidae; all genera of Pylochelidae; and at least *Allodardanus* Haig & Provenzano, 1965, *Petrochirus* Stimpson, 1858, *Ciliopagurus* Forest, 1995, *Strigopagurus* Forest, 1995, *Trizopagurus* Forest, 1952, *Aniculus* Dana, 1852, *Cancellus* H. Milne Edwards, 1836,

Dardanus Paulson, 1875, and *Tisea* Morgan & Forest, 1991, of the Diogenidae. Thus, it would appear that the presence of a vestigial pleurobranch in *Sympagurus* species represents a process of evolutionary reduction of this gill that is still under way.

KEY TO SPECIES OF *SYMPAGURUS*

1. Third to fifth pleopods paired, asymmetrical (left biramous, right consisting of small buds) juveniles (sl < 5.0 mm) of *Sympagurus* species [juveniles have been documented for: *S. spinimanus* Balss, 1911 (this study, Fig. 3); *S. pictus* Smith, 1883 (see Lemaitre 1989); *S. dimorphus* (Studer, 1883) (see Lemaitre & McLaughlin 1992); *S. brevipes* (de Saint Laurent, 1972) (see Lemaitre 1996)].
 - Third to fifth pleopods unpaired, present on left side. 2
2. Uropods and telson symmetrical or nearly so 3
 - Uropods and telson distinctly asymmetrical 4
3. Terminal margin of telson with corneous spines; shield distinctly longer than broad; antennal acicles reaching at most to mid-length of corneae *S. symmetricus* n. sp.
 - Terminal margin of telson without spines; shield distinctly broader than long; antennal acicles exceeding distal margin of corneae *S. poupini* Lemaitre, 1994
4. Gills with lamellae deeply divided (Figs 1b₁-f₁) 5
 - Gills with lamellae at most distally divided (Figs 1a₁,g₁-l₁) 10
5. Corneae subconical, terminating bluntly or sharply (Figs 9a-c) *S. acinops* Lemaitre, 1989
 - Corneae not subconical, rounded 6
6. Carpi of first and second ambulatory legs each with row of spines on dorsal margin; epistomial spine present *S. dimorphus* (Studer, 1883)
 - Carpi of first and second ambulatory legs each without spines on dorsal margin except for dorsodistal spine; epistomial spine absent 7
7. Palms of right and left chelae each armed dorsally with numerous spines. *S. soela* Lemaitre, 1996
 - Palms of right and left chelae each unarmed dorsally or at most with scattered small spines or tubercles 8
8. Ocular acicles simple; dactylus of fourth pereopod terminating in long, slender claw considerably longer and slenderer in females (Fig. 13f) than in males (Fig. 13g). *S. planimanus* (de Saint Laurent, 1972)
 - Ocular acicles bifid or multifid; dactylus of fourth pereopod terminating in short claw. 9
9. Dactyls of first and second ambulatory legs each with 10 or more corneous spinules on ventromesial margin; right chela less than 2 x as long as broad *S. affinis* (Henderson, 1888)
 - Dactyls of first and second ambulatory legs each with less than 10, often minute corneous spinules on ventromesial margin; right chela 2-3 x as long as broad *S. andersoni* (Henderson, 1896)
10. Ventral surface of right chela armed with strong, corneous-tipped spines obscured by dense setae; ventromesial margin of merus of right cheliped with dense fringe of long, bristle-like setae (usually yellow) *S. aurantium* n. sp.
 - Ventral surface of right chela unarmed or at most with scattered small tubercles or spines, and moderately dense setae; ventromesial margin of merus of right cheliped without fringe of bristle-like setae 11
11. Shield distinctly broader than long 12
 - Shield about as broad as long 14
12. Ventromesial margins of dactyls of first and second ambulatory legs each unarmed or at most with few microscopically small corneous spinules; dactylus of fourth pereopod straight, distinctly longer than propodal rasp, and with weak subterminal corneous claw (specimens sl > 5.0 mm, Fig. 24g) *S. pictus* Smith, 1883
 - Ventromesial margins of dactyls of first and second ambulatory legs each armed with 20 or more corneous spinules; dactylus of fourth pereopod curved, shorter than propodal rasp, and with strong terminal corneous claw 13

13. Telson strongly asymmetrical, terminal margin with strong corneous spines on left rounded projection (Fig. 25h); propodal rasp of fourth pereopod with ovate scales (4-6 rows)..... *S. brevipes* (de Saint Laurent, 1972)
 – Telson weakly asymmetrical, terminal margin with weak corneous spines on left rounded projection (Fig. 27g); propodal rasp of fourth pereopod with conical scales (3 or 4 rows). *S. dofleini* (Balss, 1912)
14. Propodal rasp of fourth pereopods with ovate scales (2 rows) *S. chani* n. sp.
 – Propodal rasp of fourth pereopods with conical scales (2 or more rows)..... 15
15. Telson with left anterior ventrolateral margin with long, slender corneous spines and bristle-like setae (denser and stronger in females than in males, Fig. 30g).... *S. burkenroadi* Thompson, 1943
 – Telson with left anterior ventrolateral margin without corneous spines or bristles, at most with long setae..... 15
16. Ocular acicles simple; first and second ambulatory legs with numerous long bristle-like setae dorsally on 4 distal segments *S. villosus* Lemaitre, 1996
 – Ocular acicles bifid or multifid; first and second ambulatory legs without numerous long bristle-like setae dorsally on 4 distal segments..... *S. trispinosus* (Balss, 1911)

Sympagurus spinimanus (Balss, 1911)

Figs 3, 34

Parapagurus spinimanus Balss, 1911: 1, fig. 1

Parapagurus spinimanus – Balss 1912: 100, figs 10, 23, pl. 9, fig. 2. — Gordan 1956: 338. — de Saint Laurent 1972: 107.

Sympagurus spinimanus – Lemaitre 1989: 37; 1994: 412. — Zhadan 1999: 738, fig. 3a-j; in press.

Paragiopagurus spinimanus – Lemaitre 1996: 207.

TYPE MATERIAL. — Eastern Africa. *Valdivia*: stn DTE-254, 00°29'S, off Kenya, 42°47.6'E, 977 m, 25.03.1899: holotype ♂ sl 4.3 mm (ZMB 16460).

MATERIAL EXAMINED. — The holotype (see above).

DESCRIPTION (of holotype) (Fig. 3).— Gills with lamellae at most distally divided. Shield length 4.3 mm, distinctly longer than broad, dorsal surface weakly calcified posteromedially, anterior margins straight; lateral projections broadly subtriangular, terminating in small spine. Rostrum subtriangular, terminating in blunt apex, with low dorsal ridge.

Ocular peduncles more than 0.5 x shield length, with dorsal row of setae. Ocular acicles subtriangular, terminating in simple spine. Corneae slightly dilated.

Antennular peduncle exceeding distal margin of cornea by nearly full length of ultimate segment.

Antennal peduncle not exceeding distal margin of cornea. Fourth segment unarmed. Acicle reaching slightly beyond base of cornea; mesial margin setose, armed with 5 small spines. Flagellum with some articles having long setae about 4 flagellar articles in length, and some articles with short setae about 1 flagellar article in length.

Maxillule with external lobe moderately developed, not recurved; internal lobe with long distal seta. Sternite of third maxillipeds with strong spine on each side of midline. Epistomial spine absent.

Chelipeds markedly dissimilar; with moderately dense long, simple setae on dorsal surfaces. Right cheliped with chela about 2.0 x as long as broad, and scattered tubercles on ventral surface. Palm with mesial and lateral surfaces rounded, dorsomesial and dorsolateral margins each with row of spines, dorsal surface with several longitudinal rows of spines. Carpus with several longitudinal rows of spines on dorsal surface.

Left cheliped well calcified. Palm with 2 longitudinal rows of small spines on dorsal surface, several small spines on lateral margin proximally. Carpus with irregular row of spines on dorsal margin, and strong spine near dorsodistal margin mesially.

Ambulatory legs with long simple setae, right and left similar except for longer segments on right. Dactylus 1.7 x (first leg) or 1.9 x (second leg) as long as propodus; ventromesial margin with row of 5 long, slender corneous spines; with dorsal

and dorsomesial distal rows of long simple setae. Carpus with small dorsodistal spine. Merus 3.1 x (first leg) or 3.5 x (second leg) as long as high, unarmed. Anterior lobe of sternite of second legs setose, armed with 1 submarginal spine.

Fourth pereopod semichelate. Propodal rasp consisting of 2 rows of ovate scales.

Fifth pereopod semichelate. Propodal rasp extending to mid-length of segment.

Uropods asymmetrical, left exopod 2.6 x as long as broad. Telson (Fig. 3b) nearly symmetrical, longer than broad, with weak lateral indentations; posterior margin divided into 2 lobes by shallow, rounded (U-shaped) median cleft; lobes armed distally with 4 (left) or 3 (right) small corneous spines.

First pleopods paired, consisting of minute buds. Second to fifth pleopods paired, asymmetrical; second pleopod biramous on left, uniramous on right; third to fifth pleopods biramous on left, and consisting of minute setose buds on right.

Colour in life unknown (preserved holotype white, with some iridescence).

HABITAT AND SYMBIOTIC ASSOCIATIONS.— According to Balss (1911), the holotype was found inhabiting a *Dentalium* shell. Balss (1912) subsequently reported this shell as *Fissidentalium chuni* Plate.

DISTRIBUTION. — Off Kenya, 977 m (Fig. 34).

REMARKS.— Based on information from the literature, Lemaitre (1989) assigned Balss' (1911) *Parapagurus spinimanus* to *Sympagurus*. Subsequently, Lemaitre (1996) transferred this taxon to *Paragiopagurus*. However, Zhadan (in press) examined the holotype and only known specimen of *S. spinimanus*, and noticed the presence of vestigial pleurobranchs on the last thoracic somite. Based on this unique diagnostic feature, Zhadan correctly reassigned Balss' taxon to *Sympagurus*.

During this study the holotype of *Parapagurus spinimanus* was examined. As Zhadan (in press) suggested, the holotype is clearly a young, sexually immature individual. The holotype of *S. spinimanus* exhibits typical characters seen in juveniles of *Sympagurus* species: gonopores not yet open; rostrum broadly and obtusely subtriangular, well exceeding lateral projections of shield; antennal acicles short, just reaching the bases of the corneae; setation of chelipeds and ambulatory legs consisting of simple rather than plumose setae; first pleopods barely developed as buds, and vestigial right pleopods still apparent as buds on somites II-V; telson nearly symmetrical, with weakly armed terminal margin; and iridescent coloration. A similar juvenile morphology was documented by Lemaitre (1996) for *S. brevipes*. However, the juveniles of

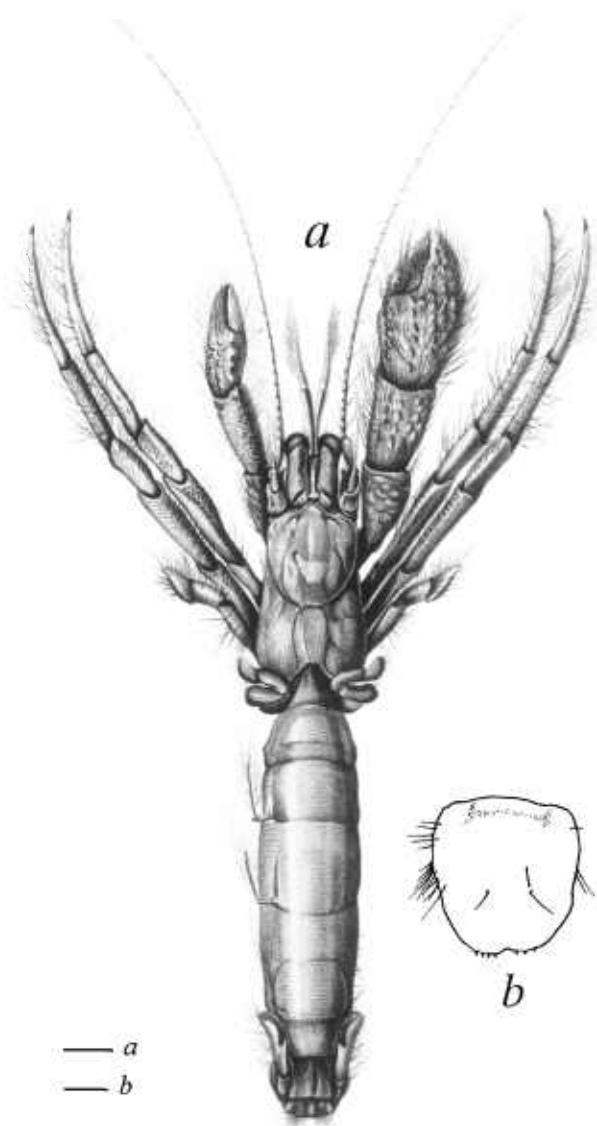


FIG. 3. *Sympagurus spinimanus* (Balss, 1911), holotype, male, sl 4.3 mm, off Kenya (ZMB 16460): a, dorsal view (from Balss 1912: pl. 9, fig. 2); b, telson, dorsal view. Scales = 2 mm (a), and 0.5 mm (b).

FIG. 3. *Sympagurus spinimanus* (Balss, 1911), holotype, mâle, sl 4,3 mm, côtes du Kenya (ZMB 16460) : a, vue dorsale (extrait de Balss 1912 : pl. 9, fig. 2) ; b, telson, vue dorsale. Échelles = 2 mm (a), et 0,5 mm (b).

S. brevipes differ from Balss' holotype in several important features: the rostrum is broader basally in *S. brevipes* than in Balss' holotype; the margin between rostrum and lateral projection forms a shallow, rounded (U-shaped) sinus in *S. brevipes*, whereas it is angled (V-shaped) in Balss' holotype; the lateral projections terminate bluntly in *S. brevipes*, whereas they terminate in a spine in Balss' holotype; and the right chela is armed with many more spines dorsally in *S. brevipes* than in Balss' holotype. The morphology of adult *S. spinimanus* remains unknown.

Balss (1912, pl. 9, fig. 2) depicted the right uropod slightly larger than the left, but in fact the left uropod is larger than the right.

***Sympagurus symmetricus* n. sp.**

Figs 4-7, 34

TYPE MATERIAL. — New Caledonia (holotype and paratypes). MUSORSTOM 4: stn CP 241, 22°09'S, 167°12.20'E, 470-480 m, 03.10.1985: holotype ♀ sl 11.7 mm (MNHN-Pg 6050). — (no expedition name): stn Dr 3, 22°17'S, 167°12'E, 390 m, 23.05.1978: 1 ♂ sl 8.1 mm (USNM 1000005). — BIOCAL: stn CP 109, 22°10.03'S, 167°15.22'E, 495-515 m, 09.09.1985: 1 ♂ sl 11.5 mm (USNM 1000004). — MUSORSTOM 5: stn DW 301, 22°06.9'S, 159°24.6'E, 487-610 m, 12.10.1986: 1 ♂ sl 10.4 mm, 1 ♀ sl 8.9 mm (MNHN Pg 6051). — MUSORSTOM 6: stn CP 467, 21°05.13'S, 167°32.11'E, 575 m, 21.02.1989: 1 ♂ sl 9.4 mm (USNM 1000003); stn DW 471, 21°08'S, 167°54.10'E, 460 m: 1 ♂ sl 9.5 mm (MNHN Pg 6052). — BERYX 11: stn CP 21, 24°44.35'-24°45.03'S, 168°06.72'-168°06.80'E, 430-450 m, 17.10.1992: 2 ♂ sl 6.7 and 8.0 mm (MNHN Pg 6022). — SMIB 8: stn DW 178, 23°45'S, 168°17'E, 400 m, 30.01.1993: 1 ♀ sl 10.4 mm (MNHN Pg 6023). — BATHUS 3: stn CP 811, 23°41'S, 168°15'E, 383-408 m, 28.11.1993: 1 ♂ sl 10.5 mm (MNHN Pg 6024), 1 ♂ sl 8.9 mm, 3 ovig. ♀ sl 9.7-10.6 mm (MNHN Pg 6025); stn CP 812, 23°43'S, 168°15'E, 391-440 m, 28.11.1993: 1 ♂ sl 11.0 mm (MNHN Pg 6026); stn DW 817, 23°42'S, 168°15'E, 405-410 m, 28.11.1993: 2 ♂ sl 8.0 and 10.2 mm, 2 ♀ sl 8.9 and 9.0 mm (MNHN Pg 6027); stn DW 818, 23°43'S, 168°16'E, 394-401 m, 28.11.1993: 1 ♂ sl 11.3 mm (MNHN Pg 6028); stn DW 838, 23°00'S, 166°55'E, 400-402 m, 30.11.1993: 1 ♂ sl 7.7 mm, 1 ♀ sl 8.4 mm (MNHN Pg 6029). — BATHUS 4: stn CP 909, 18°57'S, 163°10'E, 516-558 m, 04.08.1994: 2 ♂ sl 9.8 and 10.5 mm (MNHN Pg 6030); stn CP 910, 18°59'S, 163°08'E, 560-608 m, 05.08.1994: 2 ♂ sl 10.4 and 11.1 mm (MNHN Pg 6031); stn CP 911, 18°57'S, 163°08'E, 566-558 m, 05.08.1994: 1 ♂ sl 10.9 mm (MNHN Pg 6032).

Vanuatu. MUSORSTOM 8: stn CP 963, 20°20'S, 169°49'E, 400-440 m, 21.09.1994: 1 ♀ sl 9.0 mm (MNHN Pg 6033); stn DW 978, 19°23'S, 169°27'E, 413-408 m, 22.09.1994: 2 ♀ sl 6.6 and 8.7 mm (MNHN Pg 6034); stn CP 1047, 16°53'S, 168°10'E, 486-494 m, 30.09.1994: 1 ♀ sl 12.8 mm (MNHN Pg 6035); stn CP 1049, 16°39'S, 168°02'E, 469-525 m, 01.10.1994: 1 ♀ sl 12.6 mm (MNHN Pg 6036); stn CP 1136, 15°40'S, 167°01'E, 398-400 m, 11.10.1994: 1 ♀ sl 14.1 mm (MNHN Pg 6037).

MATERIAL EXAMINED. — The type material (see above).

DESCRIPTION. — Gills with lamellae at most distally divided (Fig. 4a). Shield length in males 6.6-11.5 mm, females 8.4-14.1 mm, ovigerous females 9.7-10.6 mm. Shield (Fig. 4b) distinctly longer than broad, dorsal surface weakly calcified medially, with pair of oblique rows of setae on anterior half and pair of longitudinal rows of setae on posterior half; linea d moderately marked; anterior margins weakly concave; lateral projections broadly rounded, or broadly subtriangular; anterolateral margins slightly sloping; posterior margin broadly rounded. Rostrum rounded or subtriangular, overreaching lateral projections, with short mid-dorsal ridge. Anterodistal margin of branchiostegite broadly rounded, unarmed, setose.

Ocular peduncles long, about 0.7 x length of shield, constricted medially, weakly calcified laterally and mesially, with row of long setae dorsally. Corneae moderately dilated. Ocular acicles subtriangular, terminating in strong spine; separated basally by about basal width of 1 acicle.

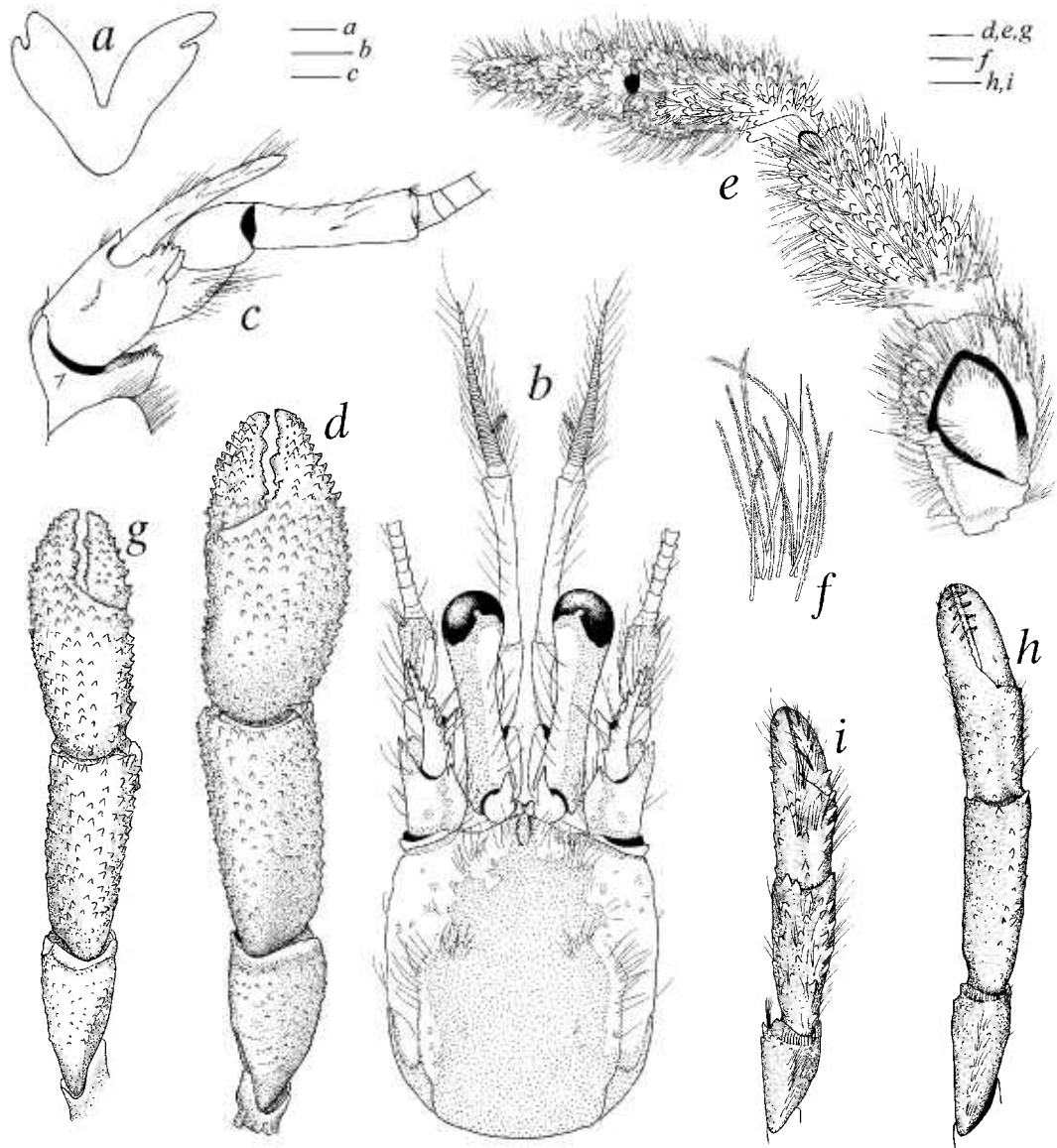


FIG. 4. *Sympagurus symmetricus* n. sp.: a, h, paratype, male, sl 9.5 mm, MUSORSTOM 6 stn DW 471, New Caledonia (MNHN Pg 6052); b-g, paratype, male, sl 10.4 mm, MUSORSTOM 5 stn DW 301, New Caledonia (MNHN Pg 6051); i, paratype, female, sl 8.9 mm, MUSORSTOM 5 stn DW 301 (MNHN Pg 6051): a, Lamella of posterior arthrobranch (midportion) of fourth pereopod; b, shield and cephalic appendages; c, right antennal peduncle, lateral view; d, denuded right cheliped, dorsal view; e, same lateral view; f, setae of same; g-i, left cheliped, dorsal view. Scales = 0.5 mm (a), 2 mm (b), 1 mm (c), 3 mm (d, e, g, h, i), and 0.25 mm (f).

FIG. 4. *Sympagurus symmetricus* n. sp.: A, H, paratype, mâle, sl 9,5 mm, MUSORSTOM 6 stn DW 471, Nouvelle-Calédonie (MNHN Pg 6052); B-G, paratype, mâle, sl 10,4 mm, MUSORSTOM 5 stn DW 301, Nouvelle-Calédonie (MNHN Pg 6051); I, paratype, femelle, sl 8,9 mm, MUSORSTOM 5 stn DW 301 (MNHN Pg 6051): A, lamelle de l'arthrobranchie postérieure (partie médiane) du quatrième péréopode; B, bouclier et appendices céphaliques; C, pédoncule antennaire droit, vue latérale; D, chélopède droit dénudé, vue dorsale; E, le même en vue latérale; F, soies du même chélopède; G-I, Chélopède gauche, vue dorsale. Echelles = 0,5 mm (A), 2 mm (B), 1 mm (C), 3 mm (D, E, G, H, I), et 0,25 mm (F).

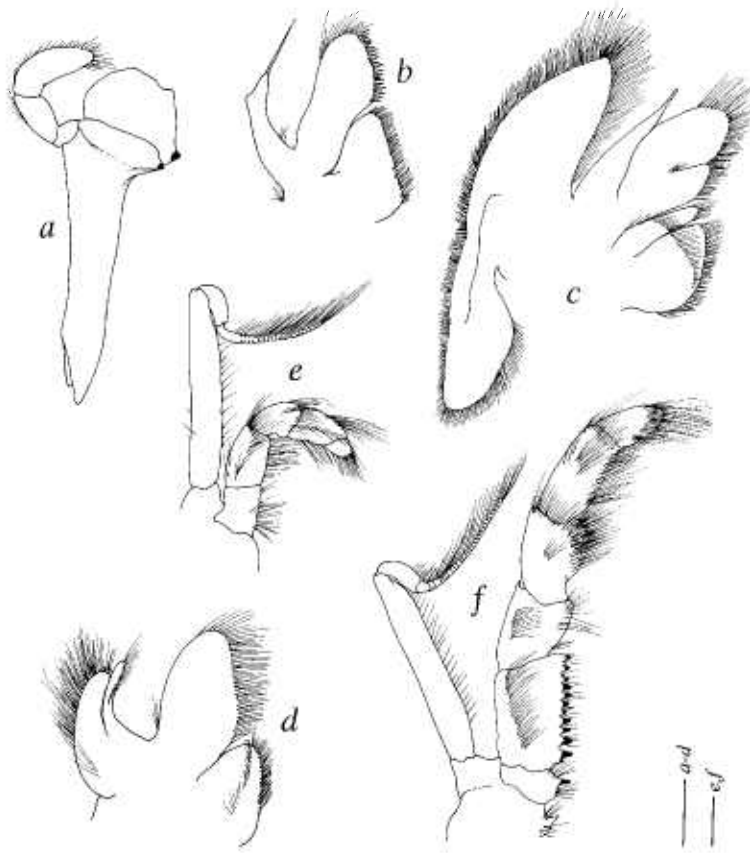


FIG. 5. *Sympagurus symmetricus* n. sp., paratype, male, sl 9.5 mm, MUSORSTOM 6 stn DW 471, New Caledonia (MNHN Pg 6052). Left mouthparts, internal view: a, mandible; b, maxillule; c, maxilla; d, first maxilliped; e, second maxilliped; f, third maxilliped. Scales = 1 mm.

FIG. 5. *Sympagurus symmetricus* n. sp., paratype, mâle, sl 9,5 mm, MUSORSTOM 6 stn DW 471, Nouvelle-Calédonie (MNHN Pg 6052). Pièces buccales gauches, vue interne : a, mandibule ; b, maxillule ; c, maxille ; d, premier maxillipède ; e, second maxillipède ; f, troisième maxillipède. Échelles = 1 mm.

of endopod weakly developed, internal lobe with long terminal seta. Maxilla (Fig. 5c) with endopod at most reaching to distal margin of scaphognathite. First maxilliped (Fig. 5d) with endopod slightly exceeding exopod in distal extension. Second maxilliped (Fig. 5e) without distinguishing characters. Third maxilliped (Fig. 5f) with crista dentata of about 14 corneous-tipped teeth; coxa and basis each with small mesial tooth. Sternite of third maxillipeds with spine on each side of midline. Epistomial spine absent.

Chelipeds markedly dissimilar, with dense, simple and plumose setae (Fig. 4f). Right cheliped (Figs 4d, e) spinose. Fingers straight, each terminating in small corneous claw; cutting edges with irregularly-sized calcareous teeth, and rows of tufts of setae dorsally and ventrally near cutting edges; dorsal surfaces with strong spines (stronger proximally); ventral surfaces with small spines or tubercles. Dactylus nearly parallel to longitudinal axis of palm, slightly shorter than length of mesial margin of palm; mesial surface rounded, spinose distally, naked proximally. Fixed finger with dorsal and ventral surfaces similar to dactyl. Palm longer than broad; dorsolateral and dorsomesial margins with row of spines; mesial surface abruptly sloping ventrally, with small blunt or sharp spines; dorsal surface with numerous strong spines; ventral surface with small blunt spines distally and laterally, nearly smooth proximally. Carpus distinctly longer than broad, with numerous strong spines dorsally; dorsodistal margin with row of spines; mesial surface strongly sloping; ventromesial and ventrolateral distal margins each with row of spines; ventral surface with small tubercles. Merus with small tubercles on

Antennular peduncle exceeding distal margin of cornea by full length to 0.7 x length of ultimate segment. Ultimate segment about 2.0 x as long as penultimate segment, with scattered setae. Basal segment with strong ventromesial spine; lateral surface with distal subrectangular lobe armed with 2 spines, and strong spine proximally. Ventral flagellum usually with about 8 articles.

Antennal peduncle (Fig. 4c) not exceeding distal margin of cornea. Fifth segment with setae on lateral and mesial margins. Fourth segment unarmed. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong, bifid or multifid spine; mesial margin with small setose tubercle or spine on dorsodistal angle. First segment with small spine on lateral surface (spine sometimes absent on 1 side); ventromesial angle produced, with row of spines laterally. Acicle short, at most reaching to about midlength of cornea, terminating in strong spine; mesial margin armed with 3-6 spines and with long setae. Flagellum long, exceeding extended right cheliped and ambulatory legs; with setae > 1-3 flagellar articles in length.

Mandible (Fig. 5a) with 3-segmented palp. Maxillule (Fig. 5b) with external lobe

dorsal surface, and transverse dorsodistal row of setae; ventromesial margin with row of spines. Ischium with 1 or 2 small tubercles dorsally, and row of about 3 small tubercles ventromesially. Coxa with 1 ventromesial and 1 ventrolateral spine; ventral surface often with cluster of small spines proximally; with ventromesial row of long setae.

Left cheliped (Figs 4g-i) well calcified, with dense simple and plumose setae; occasionally with abnormal left cheliped (Fig. 4g, see "remarks"). Fingers each terminating in sharp corneous claw; dorsal and ventral surfaces with tufts of setae. Dactylus about as long as or slightly longer than length of mesial margin of palm; cutting edge with row of closely-spaced small corneous teeth; dorsal surface usually with proximal spine. Fixed finger with 1 or 2 small lateroproximal spines; cutting edge consisting of irregularly-spaced, small, calcareous teeth interspersed with small corneous teeth. Palm with row of often strong spines (Fig. 4i) on dorsomesial margin, and irregular rows of small spines on dorsolateral surface. Carpus with irregular rows of often strong spines on dorsal margin, and scattered small spines on dorsolateral surface. Merus unarmed except for setae dorsally; ventromesial and ventrolateral margins each with row of spines. Coxa and ischium each with row of setae on ventromesial margin.

Ambulatory legs (Figs 6a-c) similar except for slightly longer segments on right; usually not exceeding extended right cheliped; meri, carpi, and propodi, with long simple setae on dorsal and ventral margins. Dactylus about 2.0 x as long as propodus, terminating in sharp corneous claw; with dorsal and dorsomesial rows of long simple setae, and ventromesial row of about 11-16 corneous spinules increasing in size distally (Fig. 6b). Propodus with transverse rows of short setae on dorsolateral and ventrolateral surfaces. Carpus with small dorsodistal spine; lateral surface sparsely setose, or with transverse row of short setae. Merus armed with spines on ventrodistal margin (first leg) or lacking spines (second leg). Coxa and ischium with setose ventromesial margins. Anterior lobe of sternite of second legs (Fig. 6d) narrow, with bifid submarginal spine.

Fourth pereopod (Fig. 7a) semichelate. Dactylus subtriangular, terminating in sharp corneous claw; with ventrolateral row of small corneous spinules. Propodal rasp longer than propodus height; rasp consisting of 2 or 3 rows of ovate scales. Carpus with long setae dorsally. Merus with long setae dorsally and ventrally.

Fifth pereopod (Fig. 7b) semichelate. Dactylus with row of ovate scales on lateral surface. Propodal rasp extending posteriorly to about mid-length or more of segment.

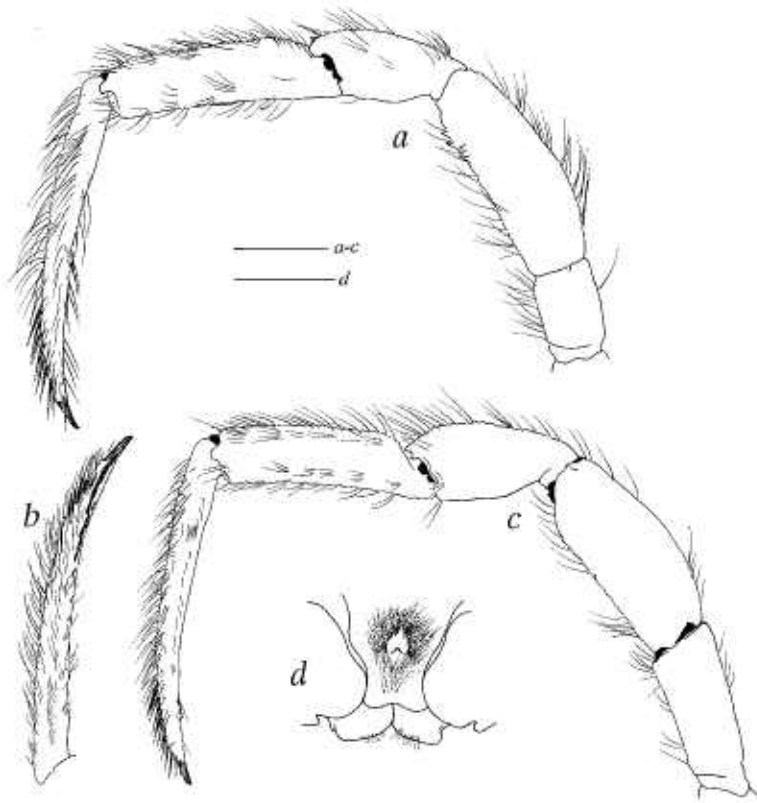


FIG. 6. *Sympagurus symmetricus* n. sp., paratype, male, sl 10.4 mm, MUSORSTOM 5 stn DW 301, Nouvelle-Calédonie (MNHN Pg 6051): a, left first ambulatory leg, lateral view; b, dactylus of same, mesial view; c, left second ambulatory leg, lateral view; d, sternite of second ambulatory legs. Scales = 5 mm (a-c), and 2 mm (d).

FIG. 6. *Sympagurus symmetricus* n. sp., paratype, mâle, sl 10,4 mm, MUSORSTOM 5 stn DW 301, Nouvelle-Calédonie (MNHN Pg 6051): a, première patte marcheuse gauche, vue latérale, côté externe; b, dactyle de la même patte, vue latérale, côté interne; c, deuxième patte marcheuse gauche, vue latérale; d, sternite des deuxièmes pattes marcheuses. Echelles = 5 mm (a-c), and 2 mm (d).

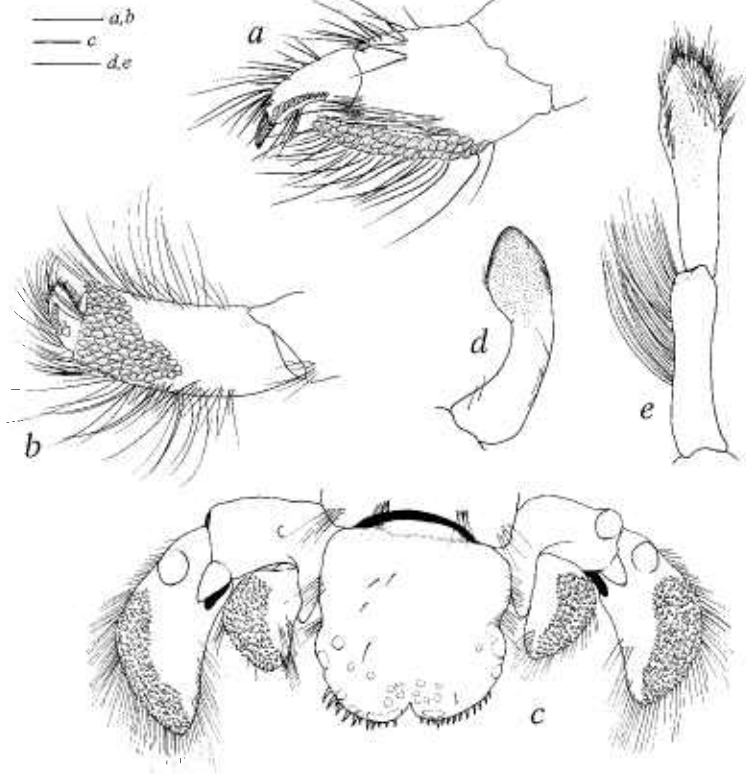


FIG. 7. *Sympagurus symmetricus* n. sp., paratype, male, sl 10.4 mm, MUSORSTOM 5 stn DW 301, New Caledonia (MNHN Pg 6051): a, propodus and dactylus of left fourth pereopod, lateral view; b, propodus and dactylus of left fifth pereopod, lateral view; c, uropods and telson, dorsal view; d, left first pleopod, mesial view; e, left second pleopod, anterior view. Scales = 1 mm.

FIG. 7. *Sympagurus symmetricus* n. sp., paratype, mâle, sl 10,4 mm, MUSORSTOM 5 stn DW 301, Nouvelle-Calédonie (MNHN Pg 6051): a, propode et dactyle du quatrième périopode gauche, vue latérale; b, propode et dactyle du cinquième périopode gauche, vue latérale; c, uropodes et telson, vue dorsale; d, premier pléopode gauche, vue latérale, côté interne; e, second pléopode gauche, vue antérieure. Echelles = 1 mm.

REMARKS. — This new species is unique among *Sympagurus* species in the symmetry of uropods and telson, the short antennal acicles, relatively long eyes, and narrow anterior lobe of the sternite of the second ambulatory legs. Although *S. poupini* also has symmetrical uropods and telson, that is where the similarity with *S. symmetricus* ends. The two species differ in numerous other characters, such as shape of the shield, relative length of the antennal acicles, ambulatory legs, fourth pereopods, and telson armature.

Some abnormalities were detected in specimens of *S. symmetricus*. A male (sl 10.4 mm) has a left cheliped (Fig. 4g) similar in finger armature and shape to that of the right cheliped (Fig. 4d). A female from the same station (sl 8.9 mm) has no right antenna, and the right antennule arises from where the antenna would normally be.

ETYMOLOGY. — From the Greek *symmetros* (symmetrical), in reference to the symmetrical condition of the uropods and telson.

Uropods and telson (Fig. 7c) symmetrical or nearly so. Exopods of uropod slightly more than 2.0 x as long as wide; anterior margin broadly rounded; with broad rasp. Telson with sparse setae dorsally, and long setae on lateral margin of anterior half; with weak lateral indentations; dorsal surface with low, blister-like tubercles on posterior half; posterior margin divided into 2 lobes by angled (V-shaped) cleft; each lobe armed distally with about 12-20 corneous spines.

Males with paired first and second gonopods moderately developed. First gonopod (Fig. 7d) with short distal lobe and weakly concave mesial surface. Second gonopod (Fig. 7e) with distal segment having rounded tip and weakly concave anterior surface; distal segment with row of short bristles on distal half of lateral margin, and long setae on distal half of mesial margin and anterior surface; basal segment with long setae on posterior surface. Females with vestigial second right pleopod.

Color in life unknown.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — In gastropod shells that sometimes support an actinian.

DISTRIBUTION. — Off New Caledonia and Vanuatu, 383-610 m (Fig. 34).

Sympagurus poupini Lemaitre, 1994

Figs 1a₁, 2, 8, 34

Sympagurus poupini Lemaitre, 1994: 402, figs 20-23, 27k, 28h.

Parapagurus dofleini – Poupin *et al.* 1990: 94 (in part not Balss 1912), pl. 2f.

Sympagurus n. sp. – Poupin 1993: 51.

Sympagurus poupini – Lemaitre 2000: 211. — Poupin 1996a: 20, pl. 9d; 1996b: 96.

TYPE MATERIAL. — Tuamotu Archipelago. *Makemo*: stn 309, 16°34.2'S, 143°38.7'W, 580 m, 07.10.1990: holotype ♂ sl 18.5 mm (MNHN-Pg 5150). Paratypes recorded by Lemaitre (1994).

MATERIAL EXAMINED. — The type material (see above)

DESCRIPTION.— Gills with lamellae at most distally divided (Fig. 1a₁). Shield length in males 8.6-21.1 mm, only known female 13.4 mm (ovigerous female unknown). Shield (Fig. 8a) distinctly broader than long, dorsal surface weakly and irregularly calcified, anterior margins weakly concave; lateral projections broadly subtriangular, with small terminal spine. Rostrum triangular, with short mid-dorsal ridge. Anterodistal margin of branchiostegite rounded, unarmed.

Ocular peduncle less than half shield length, naked. Cornea weakly dilated. Ocular acicles subtriangular, terminating in strong spine.

Antennular peduncle slender, exceeding distal margin of cornea by length of ultimate segment.

Antennal peduncle exceeding distal margin of cornea by about 0.3 x length of fifth segment. Fourth segment unarmed. Second segment with dorsolateral distal angle produced, terminating in strong, bifid or multifid spine (usually trifid); mesial margin unarmed. First segment unarmed. Acicle nearly straight, exceeding distal margin of cornea by about 0.5 x length of acicle, terminating in strong spine; mesial margin setose, armed with row of small blunt or sharp spines. Flagellum naked or with scattered short setae < 1 article in length.

Maxillule with external lobe of endopod weakly developed, internal lobe with 4 long setae distally (Fig. 1a₂). Sternite of third maxillipeds with small spine on each side of midline. Epistome unarmed or with short, straight spine.

Chelipeds markedly dissimilar, with dense plumose setae on merus, carpus, palm, and proximal halves of fingers. Right cheliped (Fig. 8b) elongated. Fingers inwardly curved at tips. Dactylus straight. Palm about 1.6 x as long as broad; mesial and lateral surfaces rounded, armed with small spines; dorsal and ventral surfaces smooth except for few scattered small tubercles. Carpus with dorsal, lateral, and mesial surfaces armed with small, well-spaced spines. Merus with transverse row of setae near dorsodistal margin; surfaces unarmed except for few small tubercles on dorsolateral surface.

Left cheliped (Fig. 8c) well calcified. Palm smooth, except for few scattered small tubercles on lateral surface proximally. Carpus with well-spaced, small spines on dorsal margin and dorsomesial surface.

Ambulatory legs (Fig. 8d) similar except for slightly longer segments on right. Dactylus about 1.7 x (first leg) or 2.2 x (second leg) as long as propodus; ventral margin armed with irregular row of about 25-30 small corneous spinules; dorsal margin with row of bristle-like setae. Carpus with small dorsodistal spine. Merus with distinct ventrolateral fringe of long setae, and row of blunt to sharp tubercles on ventral margin (tubercles more numerous on first leg). Anterior lobe of sternite of second legs, setose, armed with 1 or 2 strong submarginal spines.

Fourth pereopod (Fig. 8e) semichelate. Dactylus terminating in sharp, short corneous claw. Propodus elongate, more than 2.0 x as long as wide; rasp consisting of 7-12 well-spaced, corneous spines.

Fifth pereopod (Fig. 8f) semichelate. Propodus long, more than 3 x as long as wide; rasp consisting of 10-15 well-spaced, small corneous spines on distal third of segment.

Uropods and telson (Fig. 8g) symmetrical or nearly so. Uropods with endopods and exopods very elongated, exopods approximately 7.5 x as long as wide, endopods approximately 4.5 as long as wide; rasps of exopod and endopod consisting of 3 or 4 rows of small corneous spinules. Telson lacking lateral indentations; posterior margin weakly divided into 2 broadly rounded, unarmed lobes by broad shallow sinus.

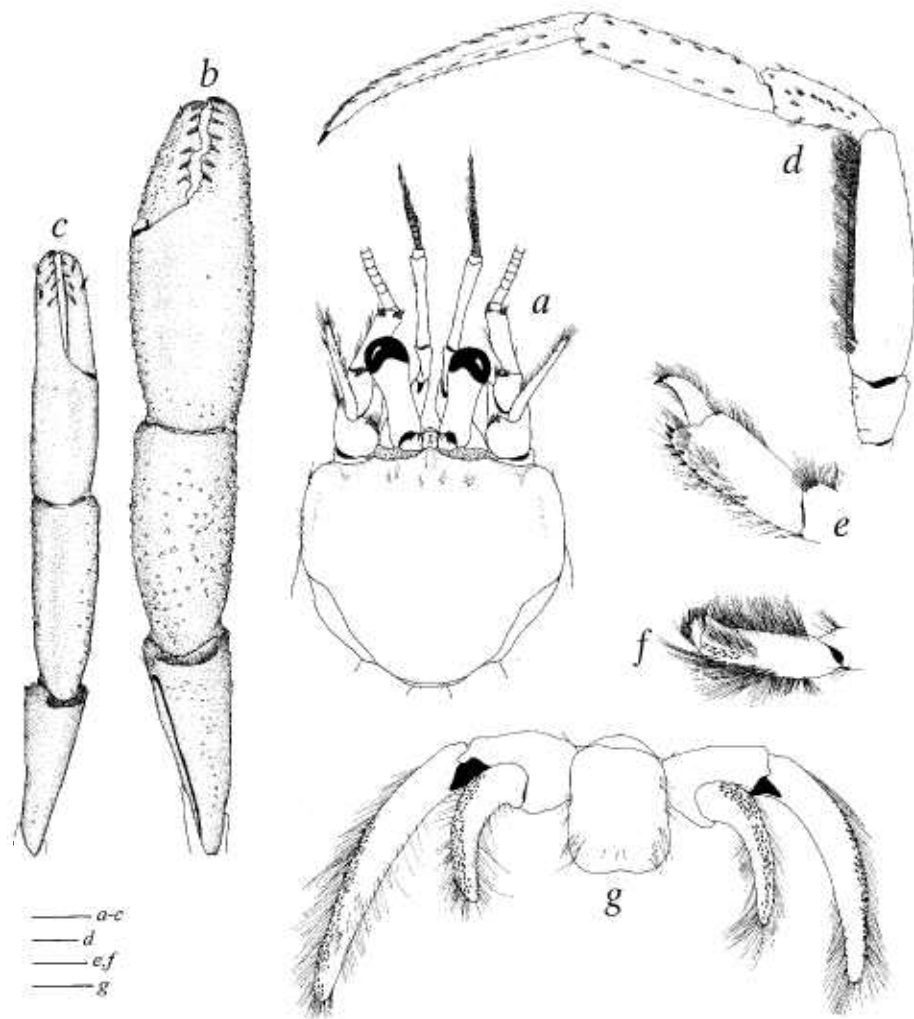


FIG. 8. *Sympagurus poupini* Lemaître, 1994, Marara stn 309, Tuamotu Archipelago: a, d-g, holotype, male, sl 18.5 mm (MNHN Pg 5150); b, c, paratype, male, sl 15.9 mm (USNM 265395): a, shield and cephalic appendages; b, denuded right cheliped, dorsal view; c, denuded left cheliped, dorsal view; d, left first ambulatory leg, lateral view; e, propodus and dactylus of left fourth pereopod, lateral view; f, propodus and dactylus of left fifth pereopod, lateral view; g, uropods and telson, dorsal view (from Lemaître 1994). Scales = 5 mm (a-d), and 3 mm (e-g).

FIG. 8. *Sympagurus poupini* Lemaître, 1994, Marara stn 309, archipel des Tuamotu : a, d-g, holotype, mâle, sl 18,5 mm (MNHN Pg 5150) ; b, c, paratype, mâle, sl 15,9 mm (USNM 265395) : a, bouclier et appendices céphaliques ; b, chélicèpe droit dénudé, vue dorsale ; c, chélicèpe gauche dénudé, vue dorsale ; d, patte marcheuse gauche, vue latérale ; e, propode et dactyle du quatrième péréiopode gauche, vue latérale ; f, propode et dactyle du cinquième péréiopode gauche, vue latérale ; g, uropodes et telson, vue dorsale (d'après Lemaître 1994). Échelles = 5 mm (a-d), and 3 mm (e-g).

Male first gonopod with moderately concave distal lobe. Second gonopod usually with small exopod on left side; distal segment setose on lateral and mesial margins.

Female often with paired rudimentary first pleopods.

Color (after Lemaître 1994: 419, fig. 28h): overall cream yellow, dactyls and propodi of walking legs with faint white stripe.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — All known specimens have been found living with an undetermined species of actinian that entirely covers the abdomen of the hermit crab (Lemaître 1994).

DISTRIBUTION. — French Polynesia, Western Samoa and Wallis Island, 300-600 m (Fig. 34).

REMARKS. — As indicated by Lemaitre (1994), the specimens reported by Poupin *et al.* (1990) as *Parapagurus dofleini* are actually *S. poupini*. Individuals of this species can attain up to 170 mm in extended body length (from tip of dactyls of ambulatory legs to distal margin of telson).

Symmetry of the uropods and telson of *Sympagurus poupini* is also a character state of *S. symmetricus* n. sp., but, as mentioned under that species, the shape of the uropods and armature of the telson are markedly different.

Sympagurus acinops Lemaitre, 1989

Figs 1b₁, 2, 9, 10, 34

Sympagurus acinops Lemaitre, 1989: 52, figs 24-27.

Sympagurus acinops – Lemaitre 1990: 229; 1994: 412; 1996: 169; 2000: 211. — García Raso 1996: 739. — Udekem d'Acoz 1999: 177.

TYPE MATERIAL. — Bahamas. *Columbus Iselin*: stn 356, Tongue of the Ocean, 24°23.2'N, 77°25.5'W, 1561 m, 20.08.1975: holotype sl 5.0 mm (USNM 228519). Paratypes recorded by Lemaitre (1989: 52).

OTHER MATERIAL EXAMINED — New Caledonia. BIOCAL: stn CP 30, 23°09.65'S, 166°40.85'E, 1140 m, 29.08.1985: 1 ♂ sl 1.7 mm (MNHN Pg 6053); stn CP 61, 24°11.67'S, 167°31.37'E, 1070 m, 02.09.1985: 2 ♂ sl 2.8 and 5.1 mm, 1 ovig. ♀ sl 3.6 mm (MNHN Pg 6054); stn CP 62, 24°19.06'S, 167°48.65'E, 1395-1410 m, 02.09.1985: 1 ♂ sl 2.9 mm, 1 ♀ sl 3.5 mm (USNM 1000006). — MUSORSTOM 5: stn 323, 21°18.52'S, 157°57.62'E, 970 m, 14.10.1986: 1 ♀ sl 2.2 mm (MNHN Pg 6055). BIOGEOCAL: stn CP 238, 21°27.64'S, 166°23.41'E, 1300-1260 m, 13.04.1987: 1 ♂ sl 2.9 mm (MNHN Pg 6056). — HALI-PRO 1: stn CC 856, 21°44'S, 166°37'E, 311-365 m, 20.03.1994: 1 ♂ sl 3.5 mm (MNHN Pg 5949).

DESCRIPTION. — Gills with lamellae deeply divided (Fig. 1b₁). Shield length in males 1.7-6.5 mm, females 2.2-5.6 mm, ovigerous females 3.0-4.6 mm. Shield (Fig. 9a) about as broad as long, dorsal surface well calcified except for narrow median region extending posteriorly from tip of rostrum for about 0.3 x length of shield, and small irregular regions on posterior half; linea of dehiscence well marked; lateral projections broadly rounded. Rostrum rounded, slightly overreaching lateral projections; with short mid-dorsal ridge.

Ocular peduncles about half shield length, inflated ventrobasally, with row of long setae dorsally. Cornea (Figs 9b, c) reduced, subconical, terminating in blunt to sharp distal tip; more darkly pigmented distally than proximally. Ocular acicles subtriangular, terminating in strong spine; separated basally by less than basal width of 1 acicle.

Antennular peduncle exceeding distal margin of cornea by half length of penultimate segment.

Antennal peduncle exceeding distal margin of cornea by full length of fifth segment. Fourth segment unarmed. Second segment with dorsolateral distal angle produced, terminating in strong, usually simple spine; mesial margin with spine on dorsodistal angle. First segment with small spine on lateral surface. Acicles curved outwardly (dorsal view), exceeding distal margin of corneae by 0.3-0.5 length of acicle, terminating in strong spine; mesial margin densely setose, armed with 4-10 usually strong spines (sometimes unarmed or with fewer than 4 spines in small specimens sl < 2.5 mm). Flagellum with numerous setae 1-4 flagellar articles in length.

Maxillule with external lobe of endopod weakly developed, internal lobe with 4 long setae distally (Fig. 1b₂). Sternite of third maxillipeds with spine on each side of midline. Epistomial spine short and straight.

Chelipeds markedly dissimilar, with sparse to moderately dense simple and plumose setae. Right cheliped (Fig. 9d) massive. Fingers curved ventromesially. Dactylus set at strongly oblique angle to longitudinal axis of palm, dorsomesial margin well delimited by row of spines, ventromesial surface weakly concave. Fixed finger very broad basally. Palm about as long as broad (males) or broader than long (females), dorsolateral and dorsomesial margins well delimited by row of spines; mesial surface rounded, with numerous blunt to sharp spines or tubercles; dorsal surface with irregular rows of

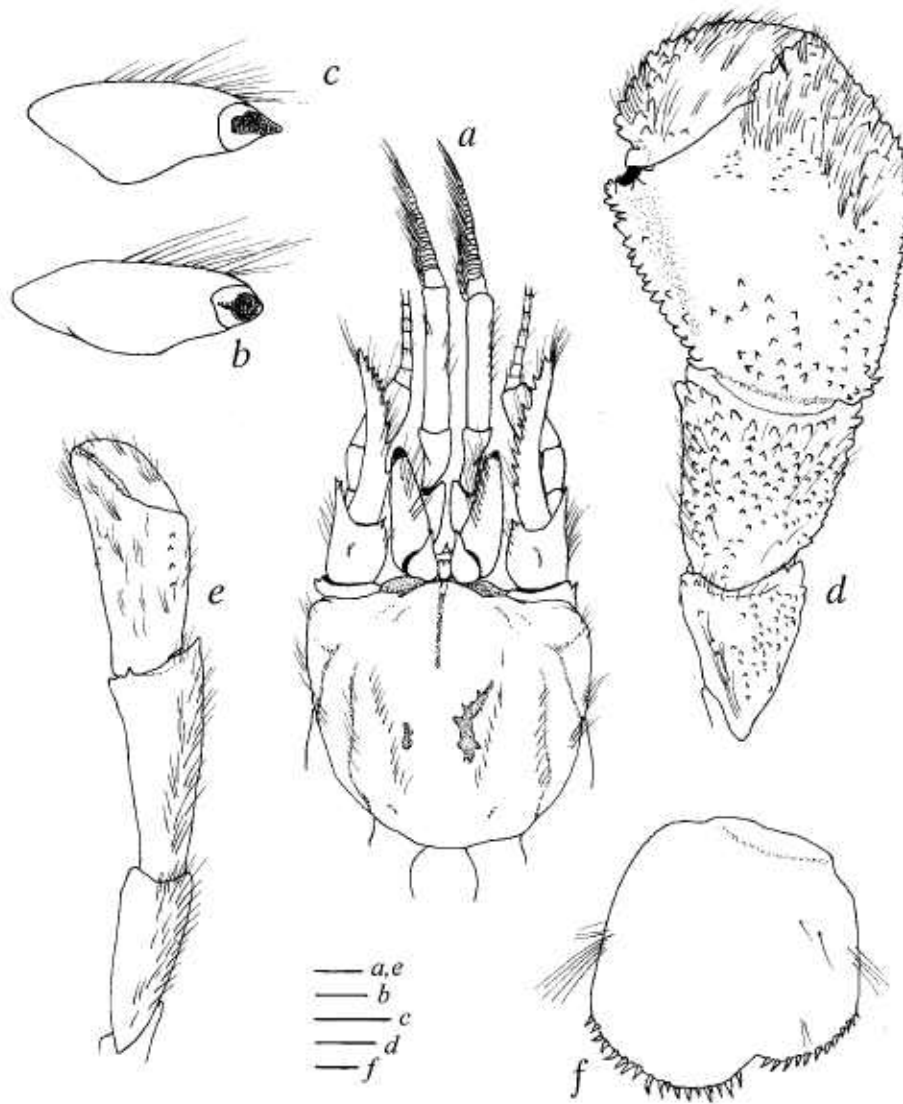


FIG. 9. *Sympagurus acinops* Lemaitre, 1989, BIOCAL stn CP 61, New Caledonia: a, b, e, male, sl 5.1 mm (MNHN Pg 6054); c, male, sl 2.8 mm (MNHN Pg 6054); d, f, ovig. female, sl 3.6 mm (MNHN Pg 6054). a, shield and cephalic appendages; b, c, right ocular peduncle, lateral view; d, right cheliped, dorsal view; e, left cheliped, dorsal view; f, telson, dorsal view. Scales = 1 mm (a, e, d), 0.5 mm (b, c), and 0.25 mm (f).

FIG. 9. *Sympagurus acinops* Lemaitre, 1989, BIOCAL stn CP 61, Nouvelle-Calédonie : a, b, e, mâle, sl 5,1 mm (MNHN Pg 6054) ; c, mâle, sl 2,8 mm (MNHN Pg 6054) ; d, f, femelle ovigère, sl 3,6 mm (MNHN Pg 6054). a, bouclier et appendices céphaliques ; b, c, pédoncule oculaire droit, vue latérale ; d, chélopède droit, vue dorsale ; e, chélopède gauche, vue dorsale ; f, telson, vue dorsale. Echelles = 1 mm (a, e, d), 0,5 mm (b, c), and 0,25 mm (f).

small spines or tubercles on proximal half; ventral surface unarmed or with scattered small tubercles. Carpus with dense spines or tubercles dorsally, mesial margin strongly sloping.

Left cheliped (Fig. 9e) well calcified. Dactylus about as long as mesial margin of palm. Palm with dorsomesial row of few small spines or tubercles. Carpus with strong dorsodistal spine, and small lateral spine on dorsodistal margin.

Ambulatory legs (Figs 10a, b) similar except for slightly longer segments on right. Dactylus about 2.0 x as long as propodus, with dorsal and dorsomesial rows of long setae, and ventromesial row of about 5-7 small, well-spaced corneous spinules. Carpus with small dorsodistal spine. Anterior lobe of sternite of second legs setose, usually with small, blunt submarginal spine.

Fourth pereopod (Fig. 10c) semichelate. Dactylus terminating in short, usually sharp corneous claw. Propodal rasp consisting of single row of ovate scales distally, and 2 rows on proximal third.

Fifth pereopod semichelate. Dactylus considerably overreaching ventrodistal angle of propodus. Propodal rasp extending to about mid-length of segment.

Uropods and telson strongly asymmetrical. Left exopod of uropod about 1.8 x as long as broad; anterior margin broadly rounded, with broad or narrow rasp. Telson (Fig. 9f) lacking or at most with weakly marked lateral indentations, posterior margin divided into 2 lobes by angled (V-shaped) cleft, lobes armed distally with corneous spines (often curved).

Males with paired first and second gonopods well developed. First gonopod with distal lobe elongate. Second gonopod with distal segment having row of short bristles on distal half of lateral margin, and long setae on distal half of mesial margin and anterior surface; basal segment with long setae on posterior surface.

Color in life unknown.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — Gastropod shells, occasionally with one or more small actinian or zoanthid polyps, or completely overgrown by a zoanthid.

DISTRIBUTION. — Tongue of the Ocean, Bahamas; Canary Islands and New Caledonia, 311-2537 m (Fig. 34).

REMARKS. — This species was previously known only from the western and eastern Atlantic (Lemaitre 1989, 1990). Morphologically it is a relatively stable species that exhibits minor, predictable variations related to size, such as the armature of the mesial margin of the antennal acicles (unarmed or with up to 10 spines), and shape of the tip of the cornea (blunt to sharp); or related to sex, such as the proportions of the carpus and palm of the right cheliped (as broad as long in males, and broader than long in females). The variations observed in the New Caledonia specimens fall well within the range documented for the Atlantic specimens (Lemaitre 1989).

Among parapagurids, subconical corneae similar to those of *Sympagurus acinops* are known only in *Oncopagurus minutus* (Henderson, 1896), a species distributed in the Indo-Pacific (Lemaitre 1996). Such corneal condition can be considered a case of convergence.

***Sympagurus dimorphus* (Studer, 1883)**

Figs 1c_{1, 2}, 11, 34, 35a

Eupagurus dimorphus Studer, 1883: 24, figs 11, 12.

Parapagurus brevimanus Balss, 1911: 4, fig. 5.

?*Eupagurus modicellus* Stebbing, 1914: 255, pl. 26, fig. D.

Sympagurus arcuatus johnstoni Hale, 1941: 279, fig. 13a-d.

Sympagurus arcuatus mawsoni Hale, 1941: 280, fig. 14a-c.

Parapagurus dimorphus — Henderson 1888: 86, pl. 10, fig. 1. — Murray 1895: 395; 1896: 434. — Alcock 1905: 172. — Stebbing 1910: 356. — Balss 1912: 97; 1924: 768. — Carlgren 1923: 265, pl. 1, figs 1, 13, 14, pl. 2, fig. 10. — Barnard 1950: 452, fig. 83c, d. — Haig 1955: 18. — Gordan 1956: 338. — Füller 1958: 164. — Forest & de Saint Laurent 1968: 115, pl. 1, figs 5, 6. — Coelho & Araújo-ramos 1972: 164. — de Saint Laurent 1972: 108. — Scelzo 1973: 166. — de Saint Laurent 1973: 791, fig. 6. — Hand 1975: 513. — Probert

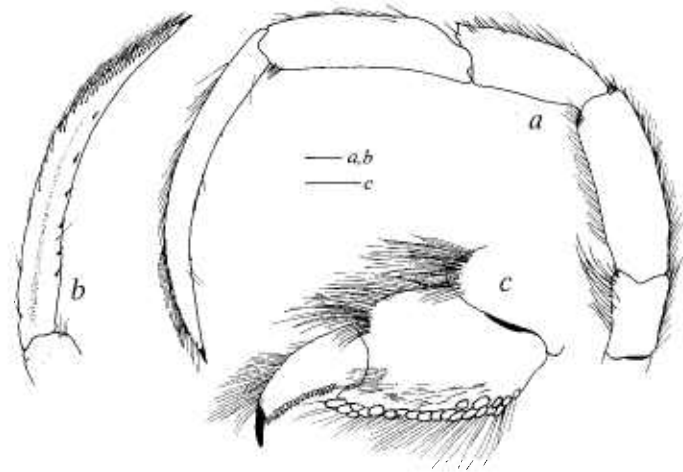


FIG. 10. *Sympagurus acinops* Lemaitre, 1989, male, sl 5.1 mm, BIOCAL stn CP 61, New Caledonia (MNHN Pg 6054): a, left first ambulatory leg, lateral view; b, dactylus of same, mesial view; c, propodus and dactylus of left fourth pereopod, lateral view. Scales = 1 mm (a, b), and 0.5 mm (c).

FIG. 10. *Sympagurus acinops* Lemaitre, 1989, mâle, sl 5,1 mm, BIOCAL stn CP 61, Nouvelle-Calédonie (MNHN Pg 6054): a, patte marcheuse gauche, vue latérale, côté externe; b, dactyle de la même patte, vue latérale, côté interne; c, propode et dactyle de quatrième péréiopode gauche, vue latérale. Échelles = 1 mm (a, b), and 0,5 mm (c).

et al. 1979: 381. — Coêlho & Santos 1980: 143. — Kensley 1981: 33. — Schembri 1982: 860. — Macpherson 1983a: 12; 1983b: 472. — Schembri & McLay 1983: 28, fig. 6a, b. — Zarenkov 1990: 238.
Parapagurus brevipanus – Bals 1912: 100, fig. 9. — Forest & de Saint Laurent 1968: 116. — de Saint Laurent 1973: 791.
Sympagurus arcuatus johnstoni – Gordan 1956: 341. — Forest & de Saint Laurent 1968: 116.
Sympagurus arcuatus mawsoni – Gordan 1956: 341. — Forest & de Saint Laurent 1968: 116.
 ?not *Parapagurus dimorphus* – Milne-Edwards & Bouvier 1893: 32.
 ?*Parapagurus* sp. 2 – de Saint Laurent-Dechancé 1964: 15, figs 2, 7, 11-19.
 ?Species S.A. 1 – Williamson & von Levetzow 1967: 181, figs 2a-m, 3a-g.
Parapagurus dimorphus – Williamson & von Levetzow 1967: 184. — Bacardit 1987: 79.
Sympagurus dimorphus – Lemaitre 1989: 71, figs 36-38, 40E-H; 1990: 229; 1994: 412; 1996: 176, fig. 7; 2000: 214, fig. 68, pl. 7. — Branch *et al.* 1991: 6, 36 (key, unnumbered fig.). — Lemaitre & McLaughlin 1992: 747, figs 1-5. — Melo 1999: 154, figs 93, 94. — Zhadan 1999: 735, fig. 1b, 2c-f; in press. — Boschi 2000: 128.
 ?*Sympagurus dimorphus* – Manning & Chace 1990: 40, fig. 22.

TYPE MATERIAL. — *Eupagurus dimorphus*. South Africa. Off Cape of Good Hope, 34°13.6'S, 15°00.7'W, 211 m: syntypes (ZMB - not seen); *Parapagurus brevipanus*. Valdivia stn 167: New Amsterdam. 37°47'S, 77°33'E, 496 m, 4.1.1899: syntypes – 3 ♂ 2.0-4.7 mm, 4 ovig. ♀ 2.7-3.3 mm (ZMB 16459); *Sympagurus arcuatus johnstoni*. Tasmania. BANZARE: stn 115, 41°03'S, 148°42'E, 128 m: syntypes (SAMA C4095 - not seen); *Sympagurus arcuatus mawsoni*. Macquarie Island. BANZARE: stn 83, 54°42'S, 158°54'E, 69 m: syntypes (SAMA C4094 - not seen).

OTHER MATERIAL EXAMINED. — Tasmania. *Southern Surveyor*: stn SS03/99-62, NW side of St. Helens seamount, 41°12.7'S, 148°45.1'E, 850 m, 27.07.1999: 1 ♀ sl 10.0 mm, 1 ovig. ♀ sl 12.8 mm (SAMA C5952). 54°42.7-41.9'S, 158°46.1-45.9'E, 100-300 m, 22.01.1999: 1 ♂ sl 9.3 mm, 1 ♀ sl 7.3 mm, 5 ovig. ♀ sl 4.8-7.3 mm (SAMA C5951). South Africa. *Gazelle*: Agulhas Bank (no other data): 2 ♀ sl 9.4 and 10.5 mm (ZMB 6377).

Macquarie Island. *Southern Surveyor*: stn SS01/99-69, W coast,

DESCRIPTION. — Gills with lamellae (Fig. 1c₁) deeply divided. Shield length in males 2.2-29.5 mm, females 2.2-22.0 mm, ovigerous females 3.9-29.5 mm. Shield (Fig. 11a) usually as broad as long, dorsal surface often weakly calcified medially, anterior margins concave; lateral projections subtriangular, with small terminal spine. Rostrum rounded, with broad low dorsal ridge

Ocular peduncles more than half shield length. Ocular acicles subtriangular, terminating in strong simple or occasionally bifid spine. Corneae weakly dilated.

Antennular peduncle exceeding distal margin of cornea by nearly full length of ultimate segment.

Antennal peduncle at most slightly exceeding distal margin of cornea. Fourth segment with small dorsolateral distal spine. Second segment with dorsolateral distal angle produced, terminating in strong bifid or multifid spine. Acicle curved outwardly (dorsal view), usually not exceeding distal margin of cornea; mesial margin setose, armed with 13-19 strong spines. Flagellum with numerous short setae < 1 to 2 articles in length.

Maxillule with external lobe obsolete or weakly developed, internal lobe with usually 4 long setae distally (Fig. 1c₂). Epistomial spine short and straight, sometimes absent. Sternite of third maxillipeds with strong spine on each side of midline.

Chelipeds markedly dissimilar, covered with moderately dense simple and plumose setae. Right cheliped massive. Chela usually operculate (Fig. 11b), proportions and armature strongly affected by size and sexual dimorphism; dorso-lateral margin in dorsal view evenly convex or semicircular in females and males of similar size, or straight in large males (sl > 9.0 mm); armature of dorsal surface consisting of numerous sharp to blunt spines or small tubercles. Fingers strongly curved ventromesially. Dactylus with ventromesial surface concave. Palm with dorsomesial and dorsolateral margins each well delimited by row of spines.

Left cheliped (Fig. 11c) well calcified. Palm with dorsomesial, dorsolateral, and often dorsomedian rows of small tubercles or spines. Carpus with dorsal row of spines.

Ambulatory legs (Figs 11d-f) similar except for longer segments on right, and for armature on meri, carpi and propodi frequently more developed on right. Dactylus (Fig. 11e) shorter than propodus, with ventromesial row of 15-20 strong

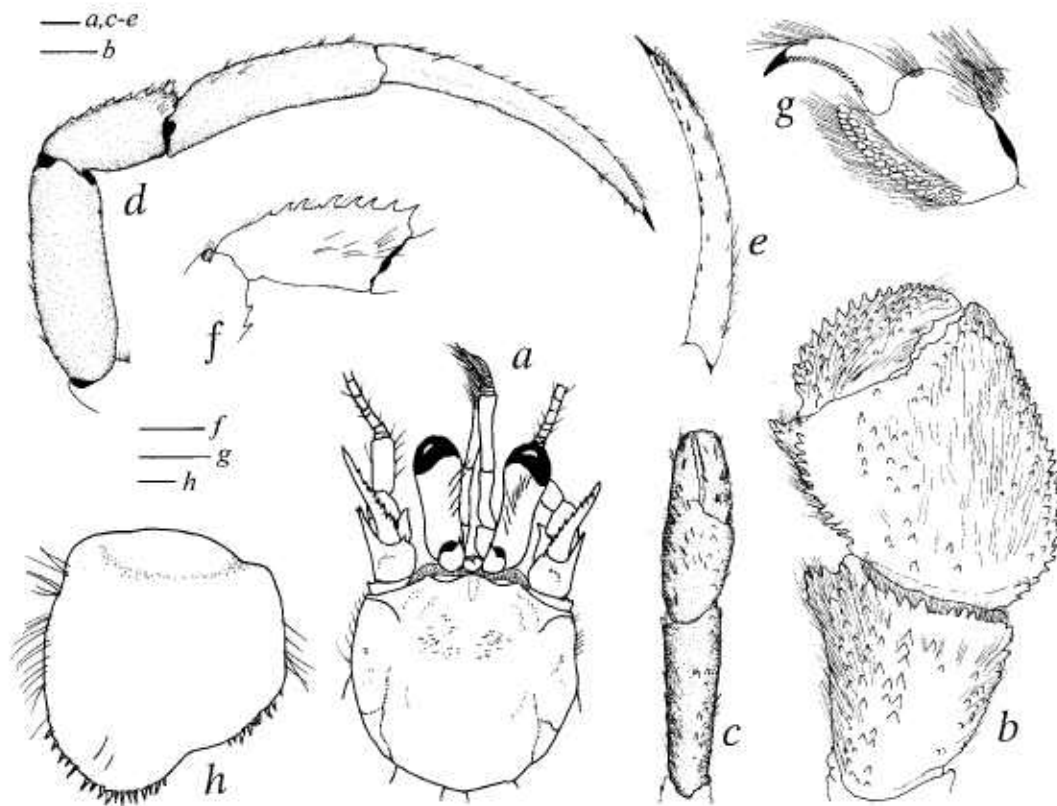


FIG. 11. *Sympagurus dimorphus* (Studer, 1883): a, c-e, h, mâle, sl 10,0 mm, *Eltanin* stn 740, Drake Passage (USNM 155045); b, f, femelle, sl 8,1 mm, Nouvelle-Zélande (NMNZ Cr 3204); g, mâle, sl 9,2 mm, Nouvelle-Zélande (NMNZ Cr 8472): a, bouclier et appendices céphaliques, vue dorsale; b, propode et pince du chélopède gauche, vue dorsale; c, propode et pince du chélopède droit, vue dorsale; d, première patte marcheuse droite, vue latérale, côté externe; e, dactyle de la même patte, vue latérale, côté interne; f, carpe de la première patte droite, vue latérale; g, propode et dactyle du quatrième péréiopode gauche, vue latérale; h, telson, vue dorsale (a, c-e, h, d'après Lemaitre 1989; b, f, g, from Lemaitre 1996). Scales = 2 mm (a-f), and 1 mm (g, h).

FIG. 11. *Sympagurus dimorphus* (Studer, 1883): a, c-e, h, mâle, sl 10,0 mm, *Passage de Drake* (USNM 155045); b, f, femelle, sl 8,1 mm, Nouvelle-Zélande (NMNZ Cr 3204); g, mâle, sl 9,2 mm, Nouvelle-Zélande (NMNZ Cr 8472): a, bouclier et appendices céphaliques, vue dorsale; b, propode et pince du chélopède droit, vue dorsale; c, propode et pince du chélopède gauche, vue dorsale; d, première patte marcheuse droite, vue latérale, côté externe; e, dactyle de la même patte, vue latérale, côté interne; f, carpe de la première patte droite, vue latérale; g, propode et dactyle du quatrième péréiopode gauche, vue latérale; h, telson, vue dorsale (a, c-e, h, d'après Lemaitre 1989; b, f, g, d'après Lemaitre 1996). Echelles = 2 mm (a-f), and 1 mm (g, h).

spinules, dorsal row of long setae, and 3 or 4 short, dorsomesial oblique rows of setae distally. Carpus (Fig. 11f) with dorsal row of spines. Anterior lobe of sternite of second legs with 1-3 small submarginal spines, setose.

Fourth pereopod (Fig. 11g) semichelate. Dactylus terminating in sharp corneous claw. Propodal rasp with 2-5 irregular rows of ovate scales.

Uropods and telson strongly asymmetrical. Telson (Fig. 11h) with weak lateral indentations; terminal margin divided into 2 lobes by wide, shallow, rounded (U-shaped) cleft; lobes armed distally with short corneous spines.

Male first gonopod with moderately concave distal lobe. Second gonopod with distal segment spatulate, basal segment occasionally with short exopod.

Females lacking first pleopods, or occasionally with rudimentary paired or unpaired first pleopods; with vestigial right second pleopod.

Color (Fig. 35a). Lemaitre (2000: 217, pl. 7) indicated that the overall color of the body is cream. Based on additional photographs obtained during this study, and color patterns still present in formalin-preserved specimens, a more detailed account of coloration is now possible. Shield with light orange-red areas on calcified portions. Ocular peduncles with orange-red stripe on dorsal faces, ventral faces orange-red. Antennal peduncle with light orange-red spot on lateral face of

second segment, and orange stripe on lateral faces of fourth and fifth segments. Right cheliped orange-red with cream spines or tubercles, orange coloration becoming lighter or cream on dorsomedian areas of carpus and chela. Left cheliped orange-red except for white or cream spines, tips of fingers, dorsomesial surface of palm, and dorsomedian and mesial surfaces of carpus; merus with orange-red ventral surface and dorsomesial and dorsolateral stripes. Ambulatory legs with orange-red dorsal and ventral surfaces, and cream-white on lateral and mesial surfaces. Abdomen, uropods and telson orange.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — Commonly found living in gastropod shells, usually with an actinian or zoanthid polyp attached to the shell. Also found in colonies of *Epizoanthus* species. Young individuals are sometimes found living in scaphopod shells (Zhadan 1999).

DISTRIBUTION. — Southern hemisphere from 22°S to 57°S and possibly as far north as Ascension Island, 91-1995 m (Fig. 34).

REMARKS. — As indicated by Lemaitre (1989: 77), it is questionable whether the specimen reported by Milne-Edwards & Bouvier (1893) from the Caribbean as *Parapagurus dimorphus* is actually that species, since it is known only from high latitudes of the southern hemisphere.

In his description of *Parapagurus brevimanus*, Balss (1911) listed two specimens, a male and a female, which are syntypes, since he did not select a holotype. Examination of the syntype lot (ZMB 16459), reveals that it actually comprises seven specimens, all of which are *S. dimorphus*. Hale's (1941) two subspecies of *Sympagurus arcuatus* (*S. a. johnstoni*, and *S. a. mawsoni*) were determined by de Saint Laurent (1972) to be synonyms of *S. dimorphus*, and based on Hale's descriptions, Lemaitre (1989) concurred.

Manning & Chace (1990) believed *Eupagurus modicellus* Stebbing, 1914, from Ascension Island, to be *Sympagurus dimorphus*, but as stated by Lemaitre & McLaughlin (1992), the specimen used and illustrated by Stebbing (1914, pl. 26, fig. D) (apparently lost), is likely to be a juvenile that can only be questionably identified as *S. dimorphus*.

Since larval development of parapagurid species remains unknown, published assignments of planktonic larvae to *S. dimorphus* are speculative (de Saint Laurent-Dechancé 1964, as *Parapagurus* sp. 2; Williamson & von Levetzow 1967, as "Species S.A. 1"; Bacardit 1987, as *Parapagurus dimorphus*).

Variation was described by Lemaitre (1989), and Lemaitre & McLaughlin (1992).

Sympagurus soela Lemaitre, 1996

Figs 1d₁, 2, 12, 34

Sympagurus soela Lemaitre, 1996: 186, figs 12-14a.

Sympagurus affinis – Lemaitre 1994: 381 (in part not Henderson 1888).

Sympagurus soela – Lemaitre 2000: 211.

TYPE MATERIAL. — Queensland. *Soela*: stn 685-30, Marion Plateau, 19°32.85'S, 152°34.8'E, 477-470 m, 23.11.1985: holotype ♂ sl 6.5 mm (NTM Cr. 006854). Paratypes listed by Lemaitre (1996: 186).

OTHER MATERIAL EXAMINED. — Coral Sea. MUSORSTOM 5: stn 363, 19°47.90'S, 158°44.30'E, 700-685 m, 19.10.1986: 1 / sl 3.2 mm (infested with rhizocephalan) (MNHN Pg 6057). For additional records see Lemaitre (1996).

DESCRIPTION. — Gills with lamellae (Fig. 1d₁) deeply divided. Shield length in males 4.3-7.3 mm, females 3.2-5.2 mm, ovigerous females 3.7-5.4 mm. Shield (Fig. 12a) as broad as long, dorsal surface weakly calcified medially, anterior margins weakly concave, lateral projections broadly rounded. Rostrum broadly triangular, with short mid-dorsal ridge.

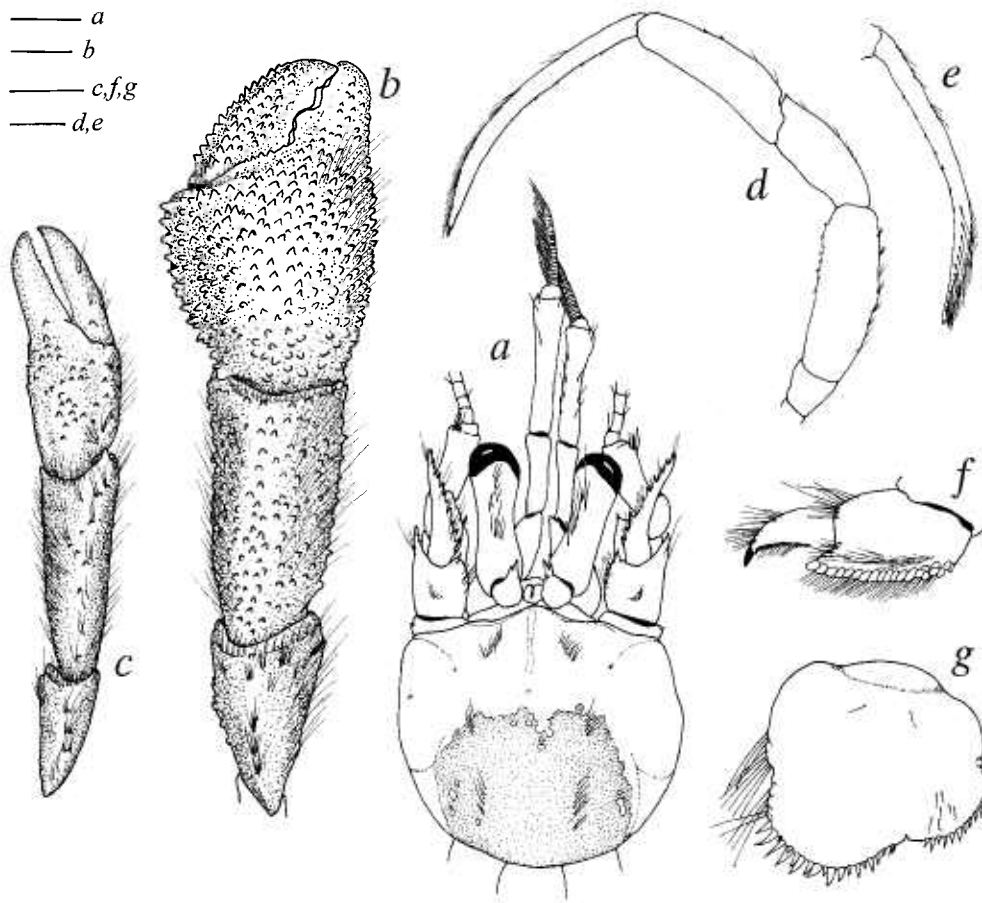


FIG. 12. *Sympagurus soela* Lemaître, 1996: a, d-g, holotype, mâle, sl 6.5 mm, Soela stn 0685-30, Marion Plateau, Queensland (NTM Cr 6854); b, c, paratype, off Newcastle, New South Wales (USNM 270113): a, shield and cephalic appendages, dorsal view; b, right cheliped, dorsal view; c, left cheliped, dorsal view; d, left first ambulatory leg, lateral view; e, dactylus of same, mesial view; f, propodus and dactylus of left fourth pereopod, lateral view; g, telson, dorsal view (A, D, G, from Lemaître 1996). Scales = 2 mm (a, b), 1 mm (c, f, g), and 3 mm (d, e).

FIG. 12. *Sympagurus soela* Lemaître, 1996 : a, d-g, holotype, mâle, sl 6,5 mm, Soela stn 0685-30, Marion Plateau, Queensland (NTM Cr 6854) ; b, c, paratype, au large de Newcastle, New South Wales (USNM 270113) : a, bouclier et appendices céphaliques, vue dorsale ; b, chélopède droit, vue dorsale ; c, chélopède gauche, vue dorsale ; d, première patte marcheuse gauche, vue latérale, côté externe ; e, dactyle de la même patte, vue latérale, côté interne ; f, propode et dactyle du quatrième péréopode gauche propodus ; g, telson, vue dorsale (a, d, g, d'après Lemaître 1996). Échelles = 2 mm (a, b), 1 mm (c, f, g), and 3 mm (d, e).

Ocular peduncles more than half shield length, with dorsal row of setae. Corneae slightly dilated. Ocular acicles subtriangular, terminating in strong bifid or multifid spines.

Antennular peduncle exceeding distal margin of corneae by length of ultimate segment.

Antennal peduncle slightly exceeding distal margin of cornea. Fourth segment usually unarmed or occasionally with small spine on dorsolateral distal angle. Second segment with dorsolateral distal angle produced, terminating in strong, simple to bifid spine (often with small additional spine dorsally); mesial margin with spine on dorsodistal angle. First segment with small spine on lateral surface. Acicle slightly curved outwardly (dorsal view), at most slightly exceeding distal margin of cornea, terminating in strong spine; mesial margin setose, armed with row of 9-12 strong spines. Flagellum with scattered short setae < 1 article in length.

Maxillule with external lobe of endopod moderately developed, internal lobe with long seta distally (Fig. 1d₂). Sternite of third maxillipeds with spine on each side of midline. Epistomial spine absent.

Chelipeds markedly dissimilar. Right cheliped (Fig. 12b) with moderately dense setae. Fingers weakly curved ventromesially. Dactylus set at oblique angle to longitudinal axis of palm, ventromesial surface weakly concave. Palm with mesial

and lateral surfaces rounded, dorsomesial and dorsolateral margins delimited by irregular rows of spines, dorsal and ventral surfaces densely covered with sharp or blunt spines (less dense on ventral surface and often on dorsal surface in small specimens sl < 5.0 mm). Carpus with surfaces densely covered with sharp or blunt spines (less dense on ventral surface). Merus with row of small tubercles on dorsal margin, dorsolateral surface with scattered small tubercles.

Left cheliped (Fig. 12c) well calcified, with dense (ventral surfaces) to moderately dense setae (dorsal surfaces). Palm with numerous spines on dorsal surface. Carpus with small dorsodistal spine, and small spine at laterodistal angle; dorsolateral surface with scattered small, blunt spines; dorsal margin with row of 3 or 4 small spines.

Ambulatory legs (Figs 12d, e) similar except for longer segments on right. Dactylus about 2 x as long as propodus, ventral margin armed with row of 7-11 small corneous spines, with dorsodistal and dorsomesial rows of long setae. Carpus with small dorsodistal spine. Meri occasionally with dorsal row of small spines in specimens sl < 5.0 mm, merus of first leg with row of blunt to sharp tubercles on ventral margin distally, merus of second leg unarmed. Anterior lobe of sternite of second legs unarmed, setose.

Fourth pereopod (Fig. 12f) semichelate. Dactylus terminating in short corneous claw. Propodal rasp consisting of 1 row of ovate scales (at least distally).

Fifth pereopod semichelate. Propodal rasp extending to mid-length of segment.

Uropods and telson strongly asymmetrical. Telson (Fig. 12g) with weak lateral indentations, terminal margin divided into 2 lobes by angled (V-shaped) cleft, lobes armed distally with strong corneous spines.

Male first gonopod with concave distal lobe. Second gonopod with distal segment nearly flat.

Colour in life unknown.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — Gastropod shells.

DISTRIBUTION. — Coral Sea and Australia, 274-704 m (Fig. 34).

REMARKS. — *Sympagurus soela* can be easily separated from the similar species *S. affinis* by differences in the armature of the right and left chelae, the dorsal surface of which has numerous spines in *S. soela*, but is unarmed in *S. affinis*.

Specimens reported from French Polynesia recorded as *S. affinis* by Lemaitre (1994) are actually *S. soela* Lemaitre (1996).

Sympagurus planimanus (de Saint Laurent, 1972)

Figs 1e_{1, 2}, 13, 34, 35b

Parapagurus planimanus de Saint Laurent, 1972: 109, figs 4, 22.

Sympagurus planimanus — Lemaitre 1989: 37; 1994: 387, figs 9, 10; 1996: 185; 2000: 211. — Poupin 1993: 51; 1996b: 96.

TYPE MATERIAL. — Indonesia. *Siboga*: stn 45, Flores Sea, 07°24'S, 118°15.2'E, 794 m, 06.04.1899: holotype ♂ sl 6.3 mm (ZMA De103.111).

OTHER MATERIAL EXAMINED. — Taiwan. TAIWAN 2000: stn CP 20, 22°21.0'N, 120°04.3'E, 720 m, 29.07.2000: 1 ♂ sl 6.0 mm, 1 ovig. ♀ sl 4.8 mm (NTOU 2000-20).

New Caledonia. BIOCAL: stn DW 51, 23°05'S, 167°45'E, 680-700 m, 31.08.1985: 2 ♂ sl 3.7 and 4.0 mm (MNHN Pg 6058). — MUSORSTOM 5: stn DW 313, 22°24.31'S, 159°32.53'E, 780-930 m, 13.10.1986: 1 ♀ sl 4.2 mm (MNHN Pg 6059). — CHALCAL 2: stn CC 2, 24°55.48'S, 168°21.29'E, 500-610 m, 28.10.1986: 1 ♀ sl 2.8 mm (MNHN Pg 6060). — CORAIL 2: stn DE 13, 21°02.77'S, 160°55'E, 700-705 m, 21.07.1988: 1 ♀ sl 3.4 mm (MNHN Pg 6061). — VOLSMAR: stn DW 55, 20°59.2'S, 170°01.90'E, 710 m, 05.07.1989: 1 ♂ sl

2.2 mm, 2 ♀ sl 2.7 and 2.8 mm, 1 megalopa (MNHN Pg 6062). —

BATHUS 1: stn CP 709, 21°41'S, 166°37'E, 650-800 m, 19.03.1993: 2 ♂ sl 3.4 and 5.2 mm (MNHN Pg 5950). —

BATHUS 2: stn CP 743, 22°35'S, 166°26'E, 713-950 m, 14.05.1993: 1 ♂ sl 4.0 mm (MNHN Pg 5951); stn CP 767, 22°10'S, 165°59'E, 1060-1450 m, 17.05.1993: 2 ♀ sl 2.9 and 3.1 mm (MNHN Pg 5952); stn CP 771, 22°09'S, 166°01'E, 610-800 m, 18.05.1993: 2 ♀ sl 3.0 and 3.2 mm, 1 ovig. ♀ sl 4.0 mm (MNHN Pg 5953). — BATHUS 3: stn DW 776, 24°44'S, 170°08'E, 770-830 m, 24.11.1993: 2 ♂ sl 3.7 and 5.0 mm (MNHN Pg 5954); stn DW 777, 24°43'S, 170°06'E, 770-800 m, 24.11.1993: 1 ♀ sl 2.7 mm (MNHN Pg 5955); stn DW 789, 23°50'S, 169°48'E,

671-674 m, 25.11.1993: 1 ♀ sl 4.6 mm (MNHN Pg 5956); stn DW 793, 23°47'S, 169°48'E, 731-751 m, 26.11.1993: 1 ♀ sl 4.7 mm (MNHN Pg 5957); stn DW 794, 23°48'S, 169°49'E, 751-755 m, 26.11.1993: 1 ♀ sl 3.5 mm (MNHN Pg 5958); stn CP 842, 23°05'S, 166°47'E, 830 m, 01.12.1993: 1 ♂ sl 3.7 mm (MNHN Pg 5959); stn CP 844, 23°06'S, 166°45'E, 908 m, 01.12.1993: 1 ♀ sl 4.5 mm (MNHN Pg 5960) — BATHUS 4: stn CP 913, 18°56'S, 163°04'E, 777-820 m, 05.08.1994: 7 ♂ sl 1.5-3.5 mm, 6 ♀ sl 2.5-4.5 mm, 5 ovig. ♀ sl 3.1-4.5 mm (MNHN Pg 5961). — SMIB 10: stn DW 208, 24°48.381'S, 168°09.232'E, 270 m, 10.01.1995: 1 ♀ sl 4.4 mm (MNHN Pg 5962).

Wallis and Futuna islands. MUSORSTOM 7: stn DW 534, 12°23'S, 176°42'W, 440-500 m, 16.05.1992: 1 ♂ sl 3.4 mm (MNHN Pg 6063); stn DW 535, 12°30'S, 176°41'W, 340-470 m, 16.05.1992: 1 ♀ sl 3.2 mm (MNHN Pg 6064); stn DW 540,

12°27'S, 177°28'W, 600 m, 17.05.1992: 1 ♂ sl 3.8 mm, 1 ♀ sl 2.7 mm (MNHN Pg 6065); stn CP 552, 12°16'S, 177°28'W, 786-800 m, 18.05.1992: 1 ♀ sl 4.2 mm (USNM 1000007); stn DW 557, 11°48'S, 178°18'W, 600-608 m, 19.05.1992: 2 ♂ sl 1.7 and 5.7 mm, 1 ovig. ♀ sl 4.7 mm (USNM 1000008); stn CP 562, 11°48'S, 178°22'W, 775-777 m, 19.05.1992: 1 ♀ sl 3.3 mm, 1 ovig. ♀ sl 3.7 mm (USNM 1000009); stn 571, 12°31'S, 176°52'W, 502-508 m, 21.05.1992: 1 ♂ sl 1.9 mm (MNHN Pg 6066); stn DW 575, 12°31'S, 176°52'W, 425 m, 21.05.1992: 1 ♂ sl 2.8 mm (USNM 1000010); stn DW 578, 13°08'S, 176°16'W, 640-730 m, 22.05.1992: 1 ♂ sl 3.7 mm (MNHN Pg 6067).

Vanuatu. MUSORSTOM 8: stn CP 1074, 15°48'S, 167°24'E, 775-798 m, 04.10.1994: 1 ♂ sl 4.1 mm (MNHN Pg 5963).

For additional records see Lemaitre (1994, 1996).

DESCRIPTION. — Gills with lamellae (Fig. 1e₁) deeply divided. Shield length in males 1.5-6.3 mm, females 2.5-5.1 mm, ovigerous females 3.1-5.1 mm. Shield (Fig. 13a) about as long as broad, dorsal surface weakly calcified medially, anterior margin straight; lateral projections broadly subtriangular, terminating bluntly. Rostrum broadly rounded, with low dorsal ridge.

Ocular peduncles more than 0.5 x length of shield. Ocular acicles subtriangular, terminating in strong spine. Corneae weakly dilated.

Antennular peduncle exceeding distal margin of cornea by length of penultimate segment.

Antennal peduncle at most exceeding distal margin of cornea by 0.2 x length of fifth segment. Fourth segment with dorso-lateral distal spine. Second segment with dorsolateral distal angle produced, terminating in strong spine. Acicle reaching distal margin of cornea, mesial margin armed with 7-10 spines. Flagellum with numerous setae 1-3 flagellar articles in length.

Maxillule with external lobe of endopod moderately developed, straight; internal lobe with usually 2 long setae distally (Fig. 1e₂). Sternite of third maxillipeds with small spine on each side of midline. Epistomial spine absent.

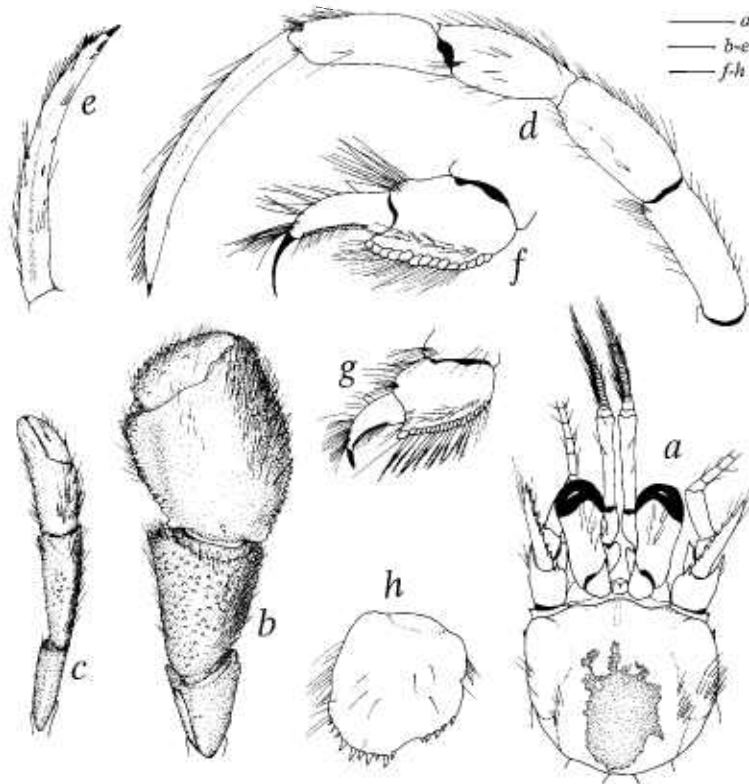


FIG. 13. *Sympagurus planimanus* (de Saint Laurent, 1972): a-e, g, h, male, sl 2.9 mm, Marara stn D32, Society Islands (MNHN Pg 5132); f, paratype, female, sl 4.2 mm, Siboga stn 45, Indonesia (ZMA De 103.110): a, shield and cephalic appendages, dorsal view; b, right cheliped, dorsal view; c, left cheliped, dorsal view; d, left second ambulatory leg, lateral view; e, dactylus of same, mesial view; f, propodus and dactylus of left fourth pereopod (female), lateral view; g, propodus and dactylus of left fourth pereopod (male), lateral view; h, telson, dorsal view (from Lemaitre 1994). Scales = 1 mm (a-e), and 0.5 mm (f-h).

FIG. 13. *Sympagurus planimanus* (de Saint Laurent, 1972): a-e, g, h, mâle, sl 2,9 mm, Marara stn D32, îles de la Société (MNHN Pg 5132); f, paratype, femelle, sl 4,2 mm, Siboga stn 45, Indonésie (ZMA De 103.110): a, bouclier et appendices céphaliques, vue dorsale; b, chélopède droit, vue dorsale; c, chélopède gauche, vue dorsale; d, deuxième patte marcheuse gauche, vue latérale, côté externe; e, dactyle de la même patte, vue latérale, côté interne; f, propode et dactyle du quatrième péréopode gauche (femelle), vue latérale; g, propode et dactyle du quatrième péréopode gauche (mâle), vue latérale; h, telson, vue dorsale (d'après Lemaitre 1994). Echelles = 1 mm (a-e), and 0,5 mm (f-h).

Chelipeds markedly dissimilar, with moderately dense setation. Right cheliped (Fig. 13b) with chela operculate and less than 2.0 x as long as wide; dorsolateral margin sharp, curved (dorsal view). Fingers strongly curved ventromesially. Dactylus with concave ventromesial surface. Palm with dorsal and ventral surfaces smooth; dorsomesial and dorsolateral margins well delimited by row of spines; mesial surface rounded. Carpus with numerous small tubercles or spines on dorsal surface. Merus with small tubercles on dorsolateral surface.

Left cheliped (Fig. 13c) with chela unarmed, usually well calcified. Carpus with dorsodistal spine.

Ambulatory legs (Figs 13d, e) similar except for longer segments on right. Dactylus about 2 x as long as propodus; with ventromesial row of about 5 well spaced, small corneous spinules, and dorsal and dorsomesial rows of long bristle-like setae. Carpus with small dorsodistal spine. Anterior lobe of sternite of second legs unarmed.

Fourth pereopod (Figs 13f, g) semichelate. Dactylus terminating in slender, curved corneous claw usually longest in large females sl > 4.0 mm (Fig. 13f). Propodal rasp consisting of 1 row of ovate scales.

Fifth pereopods semichelate. Propodal rasp extending to mid-length of segment.

Uropods and telson strongly asymmetrical. Left exopod of uropods about 2.5 x as long as broad. Telson (Fig. 13h) with weak lateral indentations; terminal margin divided into 2 lobes by broad shallow, rounded (U-shaped) sinus; lobes armed distally with strong corneous spines.

Male first gonopod with concave distal lobe. Second gonopod with distal segment nearly flat.

Color (Fig. 35b): shield with light orange areas on cream-white background. Ocular, antennular, and antennal peduncles light orange with some cream-white. Right cheliped and left chela whitish on dorsal surfaces, carpus of left cheliped light orange. Ambulatory legs light orange except for whitish dorsal surfaces of carpi. Abdomen transparent.

DISTRIBUTION. — South China Sea, Indonesia, Australia, French Polynesia and Western Australia, 100-1450 m (Fig. 34).

REMARKS. — See Lemaitre (1996) and “remarks” on *S. soela* (above).

Sympagurus affinis (Henderson, 1888)

Figs 1f₁, 2, 14, 34, 35c

Parapagurus affinis Henderson, 1888: 90, pl. 9, fig. 4.

Parapagurus affinis – Alcock 1905: 172. — Gordan 1956: 337. — de Saint Laurent 1972: 105.

Sympagurus affinis – Lemaitre 1989: 37; 1994: 379, figs 3, 4, 28a; 1996: 169; 2000: 211. — Poupin 1993: 51; 1996b: 96. — Parin *et al.* 1997: 163. — Zhadan 1997: 70, figs 10-12. — Spiridonov & Zhadan 1999: 630.

TYPE MATERIAL. — Meangis Islands (North of New Guinea). *Challenger*: stn 214, 04°33'N, 127°6'E, 914, 10.02.1875: holotype ovig. ♀ sl 9.0 mm (BMNH 1888:33).

OTHER MATERIAL EXAMINED. — Japan. *Tansei-maru*: stn KT92-11/ME-10, E of Miyake Island, Izu Islands, 34°05.60'N, 139°38.55'E, 532-712 m, 29.07.1992: 1 ♂ sl 7.2 mm (CBM-ZC 5706).

Taiwan. TAIWAN 2000: stn CP 55, 24°26.9'N, 122°18.1'E, 638 m, 04.08.2000: 1 ♂ sl 9.6 mm (NTOU T2000-55).

Hawaiian Islands. Stn TC 33-30, 20°38.6'N, 156°53'W, 380-420 m, 05.11.1967: 1 ovig. ♀ sl 4.2 mm (BPBM S10959); stn TC 33-34, 20°02.7'N, 155°53.9'W, 344-356 m, 08.11.1967: 1 ♂ sl 6.7 mm (BPBM S11000); stn TC 35-15, 21°05'N, 156°32'W, 360 m, 01.04.1968: 1 ♂ sl 6.1 mm, 5 ♀ sl 3.7-5.4 mm, 7 ovig. ♀ sl 4.0-5.4 mm (BPBM S11017); 2 ♂ sl 5.7 and 6.0 mm (BPBM

S11003); 1 ♂ sl 5.2 mm (USNM 1000137); stn TC 35-17, 21°10.6'N, 156°33.2'W, 512 m, 01.04.1968: 1 ♀ sl 4.8 mm (BPBM S10998); stn TC 40-73, 21°04.2'N, 156°27'W, 329 m, 21.11.1968: 1 ♂ sl 5.7 mm (BPBM S10994); stn TC 40-76, 21°06.8'N, 156°31.9'W, 439 m, 22.11.1968: 2 ♂ sl 5.7 and 6.0 mm (USNM1000135); stn TC 40-89, 21°01.7'N, 156°43.2'W, 210 m, 17.11.1968: 4 ♂ sl 5.2-7.2 mm, 3 ovig. ♀ sl 5.1-6.9 mm (USNM 1000136); stn TC 52-94, 21°04.7'N, 156°24.12'W (no depth), 12.03.1971: 1 ♂ sl 4.3 mm, 1 ♀ sl 6.9 mm (BPBM S10949).

Indonesia. *Siboga*: stn 173, 03°27'S, 131°0.5'E, 567 m, 28.08.1899: 2 ♂ sl 5.4 and 7.0 mm (ZMK); stn 262, 05°53.8'S,

132°48.8'E, 560 m, 18.12.1899: 1 ovig. ♀ sl 6.0 mm (ZMK).

Wallis and Futuna. MUSORSTOM 7: stn DW 539, 12°62.7'S, 177°27'W, 700 m, 17.05.1992: 1 ♂ sl 5.7 mm (MNHN Pg 6071); stn DW 571, 12°31'S, 176°52'W, 502-508 m, 21.05.1992: 1 ♀ sl 3.9 mm (MNHN Pg 6072).

New Caledonia. BIOCAL: stn DW 33, 23°10'S, 167°10'E, 675-680 m, 29.08.1985: 1 ♂ sl 4.7 mm (USNM 1000012); stn DW 36, 23°09'S, 167°11'E, 650-680 m, 29.08.1985: 1 ♀ sl 6.0 mm (USNM 1000011); stn DW 51, 23°05'S, 167°45'E, 680-700 m, 31.08.1985: 1 ♂ sl 3.4 mm (MNHN Pg 6068). — CHALCAL 2: stn DW 73, 24°39.9'S, 168°38.1'E, 573 m, 29.10.1986: 2 ♂ sl 4.5 and 5.8 mm, 1 ♀ sl 4.6 mm, 1 ovig. ♀ sl 4.3 mm (USNM 1000014); stn DW 74, 24°40.36'S, 168°38.38'E, 650 m, 29.10.1986: 2 ♂ sl 3.0 and 4.3 mm, 1 ♀ sl 4.6 mm (MNHN Pg 6069); stn DW 75, 24°39.31'S, 168°39.67'E, 600 m, 29.10.1986: 1 ♂ sl 3.3 mm, 1 ♀ sl 3.0 mm, 2 ovig. ♀ sl 4.0 and 4.9 mm (USNM 1000013). — CORAIL 2: stn DE 13, 21°02.77'S, 160°55.00'E, 700-705 m, 21.07.1988: 1 ovig. ♀ sl 6.4 mm (MNHN Pg 6070). — SMIB 8: stn DW 164, 24°49'S, 168°09'E, 300-350 m, 28.01.1993: 1 ♀ sl 3.6 mm (MNHN Pg 5964). — BATHUS 2: stn CP 738, 23°02'S, 166°56'E, 558-647 m, 13.05.1993: 1 ovig. ♀ sl 4.4 mm (MNHN Pg 5965); stn CP 741, 22°35'S, 166°26'E, 700-900 m, 14.05.1993: 1 ♂ sl 5.1 mm (MNHN Pg 5966); stn CP 743, 22°35'S, 166°26'E, 713-950 m, 14.05.1993: 1 ♂ sl 4.4 mm, 1 ovig. ♀ sl 4.9 mm (MNHN Pg 5967); stn CP 767, 22°10'S, 165°59'E, 1060-1450 m, 17.05.1993: 2 ♂ sl 3.0 and 5.1 mm, 1 ♀ sl 4.3 mm (MNHN Pg 5968); stn CP 771, 22°09'S, 166°01'E, 610-800 m, 18.05.1993: 1 ♂ sl 5.5 mm, 2 ♀ sl 2.7 and 2.8 mm (MNHN Pg 5969). — BATHUS 3: stn DW 776, 24°44'S, 170°08'E, 770-830 m, 24.11.1993: 1 ♂ sl 2.6 mm, 3 ♀ sl 2.9-4.1 mm, 2 ovig. ♀ sl 4.2 and 4.3 mm (MNHN Pg 5970); stn DW 781, 23°53'S, 169°46'E, 625-640 m, 25.11.1993: 1 ♂ sl 6.1 mm, 1 ♀ sl 4.5 mm (MNHN Pg 5971); stn 787, 23°53'S, 169°48'E, 695-702 m, 25.11.1993: 2 ♂ sl 4.6 and 4.7 mm (MNHN Pg 5972); stn DW 794, 23°48'S, 169°49'E, 751-755 m, 26.11.1993: 1 ♂ sl 4.9 mm, 1 ♀ sl 4.8 mm (MNHN Pg 5973); stn

DW 798, 23°34'S, 169°36'E, 657-660 m, 26.11.1993: 1 ♂ sl 3.0 mm (MNHN Pg 5974); stn DW 799, 23°31'S, 169°36'E, 697-744 m, 26.11.1993: 1 ♂ sl 5.6 mm (MNHN Pg 5975); stn CP 821, 23°19'S, 167°58'E, 864-880 m, 29.11.1993: 1 ♀ sl 4.0 mm (MNHN Pg 5976); stn CP 842, 23°05'S, 166°47'E, 830 m, 01.12.1993: 2 ♂ sl 5.4 and 5.9 mm, 1 ♀ sl 3.2 mm (MNHN Pg 5977); stn 844, 23°06'S, 166°45'E, 908 m, 01.12.1993: 1 ♂ sl 5.1 mm (MNHN Pg 5978); stn CC 848, 23°02'S, 166°52'E, 680-700 m, 01.12.1993: 1 ovig. ♀ sl 5.8 mm (MNHN Pg 5979). — HALIPRO 1: stn CP 854, 21°40'S, 166°38'E, 650-780 m, 19.03.1994: 1 ♂ sl 6.9 mm (MNHN Pg 5980). — BATHUS 4: stn CP 922, 18°48'S, 163°18'E, 600 m, 06.08.1994: 1 ♂ sl 5.6 mm (MNHN Pg 5981).

Vanuatu. MUSORSTOM 8: stn CP 993, 18°48'S, 168°54'E, 780-783 m, 24.09.1994: 2 ♂ sl 5.0 and 5.2 mm (MNHN Pg 5982); stn CP 1075, 15°53'S, 167°27'E, 956-944 m, 04.10.1994: 1 ♀ sl 6.9 (MNHN Pg 5983); stn DW 1115, 15°09'S, 166°53'E, 147-150 m, 09.10.1994: 1 ♂ sl 3.6 mm (MNHN Pg 5984).

Madagascar. *Vauban*: stn CH 5, 12°44.8'S, 48°10.6'E, 570-563 m, 05.03.1971: 2 ♂ sl 3.9 and 4.6 mm (MNHN Pg 5714); stn CH 21, 12°27'S, 48°12.5'E, 600-605 m, 19.01.1972: 2 ♂ sl 5.8 and 6.8 mm (MNHN Pg 5715); stn CH 30, 12°40'S, 48°09.5'E, 595-605 m, 13.09.1972: 11 ♂ sl 4.2-11.3 mm, 4 ♀ sl 2.9-3.5 mm (MNHN Pg 5716); stn CH 37, 12°51'S, 48°06.3'E, 675-705 m, 14.09.1972: 1 ♂ sl 5.4 mm, ♀ sl 5.5 mm (MNHN Pg 5717); stn CH 38, 12°50'S, 48°09.1'E, 580-585 m, 14.09.1972: 3 ♂ sl 4.3-5.1 mm, ♀ sl 5.5 mm (MNHN Pg 5718); stn CH 66, 23°36.4'S, 43°31.1'E, 450-460 m, 29.02.1973: 1 ovig. ♀ sl 4.4 mm (MNHN Pg 5719); stn CH 103, 22°18.2'S, 43°00.5'E, 880-920 m, 29.11.1973: 1 ♂ sl 3.0 mm (MNHN Pg 5720); stn CH 112, 22°18'S, 43°02.2'E, 640-660 m, 01.12.1973: 1 ♀ sl 4.0 mm (MNHN Pg 5721); stn CH 135, 13°01'S, 48°01'E, 1075-1110 m, 21.01.1975: 1 ♀ sl 3.1 mm (MNHN Pg 5722); stn CH 142, 13°45.6'S, 47°34.2'E, 1250-1300 m, 29.02.1975: 1 ♀ sl 4.1 mm (MNHN Pg 5723).

Additional material recorded by Lemaitre (1994).

DESCRIPTION. — Gills with lamellae (Fig. 1f₁) deeply divided. Shield length in males 2.6-11.3 mm, females 2.7-6.9 mm, ovigerous females 4.0-9.0 mm. Shield (Fig. 14a) about as broad as long, dorsal surface weakly calcified medially, lateral projections broadly rounded. Rostrum broadly rounded, with low dorsal ridge. Anterior margins straight.

Ocular peduncles more than 0.5 x shield length, slightly constricted medially, with irregular row of setae dorsally; corneae weakly dilated. Ocular acicles subtriangular, terminating in bifid or multifid spine.

Antennular peduncle exceeding distal margin of cornea by full length or slightly more than length of ultimate segment.

Antennal peduncle exceeding distal margin of cornea by as much as 0.5 x length of fifth segment. Fourth segment unarmed or with small spine on dorsolateral distal angle. Second segment with dorsolateral distal angle produced, terminating in strong bifid or multifid spine. Acicle at most slightly exceeding distal margin of cornea; mesial margin setose, armed with 9-11 strong spines. Flagellum with setae < 1 to 3 flagellar articles in length.

Maxillule with external lobe of endopod moderately developed, not recurved, internal lobe with long distal seta (Fig. 1f₂). Sternite of third maxillipeds with strong spine on each side of midline. Epistomial spine absent.

Chelipeds markedly dissimilar, with dense plumose setae on carpi and chelae dorsally. Right cheliped (Fig. 14b) with chela less than 2.0 x as long as broad. Fingers weakly curved ventromesially. Dactylus set at oblique angle to longitudinal axis of palm; with weakly concave ventromesial surface. Palm with dorsal and ventral surfaces smooth or with scattered

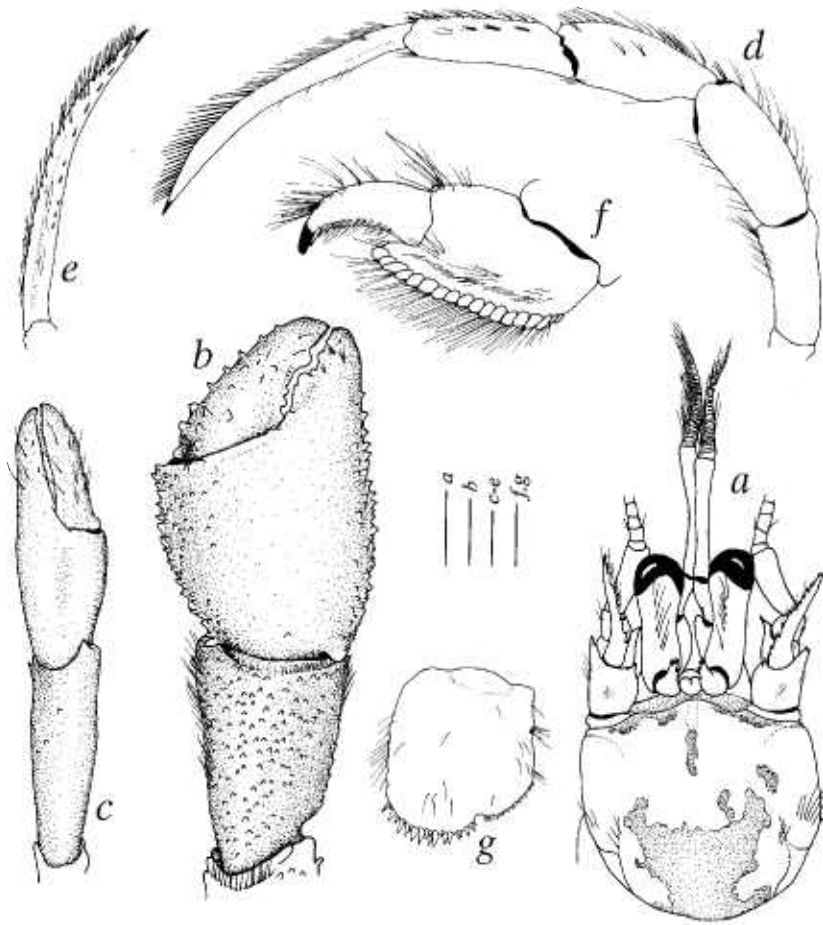


FIG. 14. *Sympagurus affinis* (Henderson, 1888), ovig. femelle, sl 5.7 mm, Marara stn 339, Rurutu, Austral Islands (MNHN Pg 5136): a, shield and cephalic appendages; b, carpus and chela of right cheliped, dorsal view; c, carpus and chela of left cheliped, dorsal view; d, left third pereopod, lateral view; e, dactylus of same, mesial view; f, propodus and dactylus of left fourth pereopod, lateral view; g, telson, dorsal view (from Lemaitre 1994). Scales = 2 mm (a-e), and 0.5 mm (f, g).

FIG. 14. *Sympagurus affinis* (Henderson, 1888), femelle ovigère, sl 5,7 mm, Marara stn 339, Rurutu, îles Australes (MNHN Pg 5136): a, bouclier et appendices céphaliques; b, carpe et pince du chélopède droit, vue dorsale; c, carpe et pince du chélopède gauche, vue dorsale; d, troisième périopode gauche, vue latérale, côté externe; e, dactyle de la même patte, vue latérale, côté interne; f, propode et dactyle du quatrième périopode gauche, vue latérale; g, telson, vue dorsale (d'après Lemaitre 1994). Echelles = 2 mm (a-e), and 0,5 mm (f, g).

small tubercles, irregular rows of spines on dorsomesial and dorsolateral margins, mesial and lateral surfaces evenly rounded. Carpus with numerous small tubercles or spines on dorsal surface.

Left cheliped (Fig. 14c) usually well calcified. Dactylus about as long or slightly longer than mesial margin of palm. Palm unarmed. Carpus with dorsodistal spine.

Ambulatory legs (Figs 14d, e) similar except for longer segments on right. Ischium, merus, carpus, and propodus unarmed on mesial and lateral surfaces; with row of bristle-like setae on dorsal margins. Dactylus (Fig. 14e) about 2 x as long as propodus, with ventromesial row of about 10 corneous spinules, and dorsal and dorsomesial rows of long, bristle-like setae. Carpus with small dorsodistal spine. Anterior lobe of sternite of second legs unarmed.

Fourth pereopod (Fig. 14f) semichelate. Dactylus terminating in short, corneous claw. Propodal rasp consisting of 1 row of ovate scales.

Fifth pereopod semichelate. Propodal rasp extending to about mid-length of segment.

Uropods and telson strongly asymmetrical. Telson (Fig. 14g) with obsolete lateral indentations, terminal margin divided into 2 lobes by rounded (U-shaped) median cleft, lobes armed distally with corneous spines.

Male first gonopod with concave distal lobe. Second gonopod with distal segment nearly flat.

Color (Fig. 35c): body mostly cream-yellow except for orange proximally on meri of chelipeds, and on faces of meri, carpi and propodi of ambulatory legs (see also Lemaitre 1994: 381, fig. 28a).

HABITAT AND SYMBIOTIC ASSOCIATIONS. — In gastropod shells usually with one actinian polyp attached.

DISTRIBUTION. — Eastern Japan, New Caledonia, Vanuatu, Wallis and Futuna, Indonesia, New Guinea, Australia, Philippines, Hawaii, French Polynesia, Madagascar, and Nazca and Sala y Gómez ridges, 147-1450 m (Fig. 34).

REMARKS — See *S. soela*.

Sympagurus andersoni (Henderson, 1896)

Figs 15-18, 34

Parapagurus andersoni Henderson, 1896: 529.

Parapagurus andersoni var. *brevimanus* Alcock, 1901: 221.

Parapagurus andersoni — Alcock & Anderson 1897: pl. 32, fig. 2. — Alcock 1901: 220; 1905: 102, pl. 10, fig. 2. — Balss 1912: 97, fig. 5. — Laurie, 1926: 160. — Carlgren 1928b: 168. — Thompson, 1943: 418. — Gordan 1956: 337. — de Saint Laurent 1972: 105. — Doumenc 1975: 163. — Lemaitre 1986: 526; 1989: 11; 1994: 376.

Parapagurus andersoni var. *brevimanus* — Alcock 1905: 103. — Kemp & Sewell 1912: 25. — Stubbings 1940: 384. — Gordan 1956: 337.

Parapagurus pilosimanus — Balss 1912: 96 (in part not *P. pilosimanus* Smith, 1879).

Sympagurus andersoni — Lemaitre 1994: 412; 1996: 169; 2000: 211. — Spiridonov & Zhadan 1999: 629, fig. 3; in press.

TYPE MATERIAL. — *Parapagurus andersoni* — North Maldive Atoll (holotype and paratypes). *Investigator*: stn 150, 07°05'45"N, 75°04'E, 1315 m, 29.11.1893: holotype ♂ sl 12 mm (Henderson 1896: 530), 1 ♂ and 1 ♀ (probably in Indian Museum, Calcutta - not seen); *Parapagurus andersoni* var. *brevimanus* — Arabian Sea. *Investigator*: various stations, 786-1315 m (probably in Indian Museum, Calcutta - not seen).

MATERIAL EXAMINED. — Andaman Sea. *Anton Bruun*: stn 17, 07°40'N, 97°09'E, 512-503 m, 21.03.1963: 1 ♂ sl 6.9 mm (USNM 309741).

Laccadive Sea. *Investigator*: stn 232, 7°17.5'N, 76°54.5'E, 786 m, 19.10.1897: 1 ♂ sl 9.2 mm (BMNH 1903.4.6.39, ex Indian Museum).

Maldives. *Mabahiss*: stn 143, 5°15.8'S, 73°22.8'E, 797 m, 30.3.1934: 1 ♂ sl 3.7 mm, 1 ovig. ♀ sl 4.5 mm (BMNH 1952.6.17.40-43).

Zanzibar. *Mabahiss*: stn 122, 5°21.4'S, 39°23'E, 745 m, 22.1.1934: 1 ovig. ♀ sl 4.2 mm (BMNH 1952.6.17.40-43).

Madagascar. *Vauban*: stn CH 99, 22°17.4'S, 43°02.1'E, 650 m, 28.11.1973: 1 ♂ sl 5.0 mm (MNHN Pg 5780); CH 108, 22°18.9'S, 43°01.1'E, 735-760 m, 30.11.1973: 1 ♂ sl 5.0 mm (USNM 1000016, ex MNHN Pg 5724); CH 124, 17°40'S, 43°12'E, 1075-1115 m, 15.01.1975: 1 ♀ sl 5.0 mm (USNM 1000015, ex MNHN Pg 5781); CH 139, 13°50'S, 47°37'E, 850-1125 m, 27.02.1975: 3 ♂ sl 6.9-7.4 mm (MNHN Pg 5725), 3 ovig. ♀ sl 4.5-6.5 mm (MNHN Pg 5782).

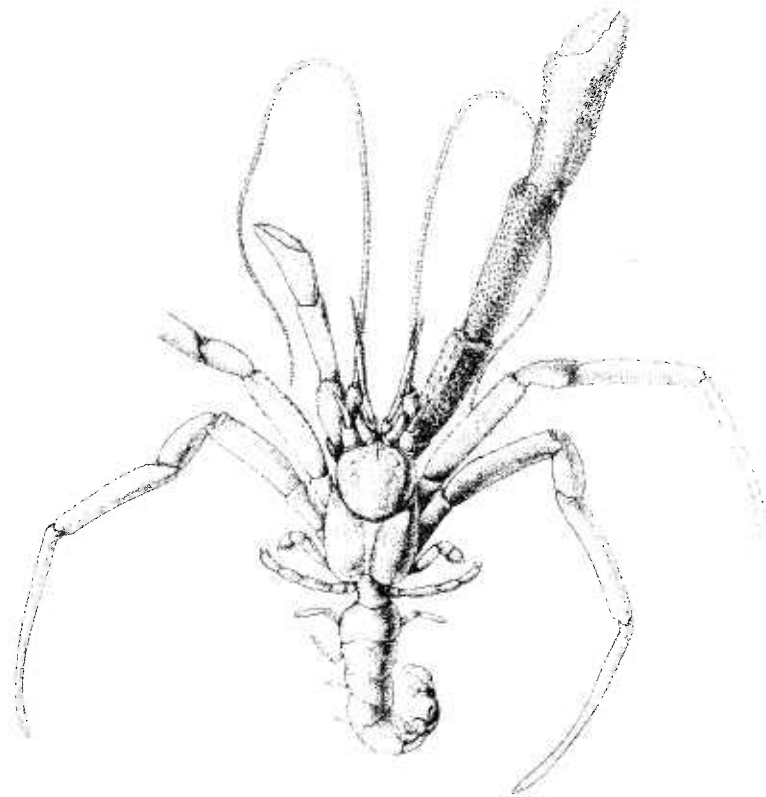


FIG. 15. *Sympagurus andersoni* (Henderson, 1896), probable holotype, male, sl 12 mm, *Investigator* stn 150, off northern Maldive Atoll (probably Indian Museum, Calcutta) (from Alcock & Anderson 1897, pl. 32, fig. 2).

FIG. 15. *Sympagurus andersoni* (Henderson, 1896), holotype supposé, mâle, sl 12 mm, *Investigator* stn 150, au large de l'atoll nord des Maldives (probablement Indian Museum, Calcutta) (d'après Alcock & Anderson 1897, pl. 32, fig. 2).

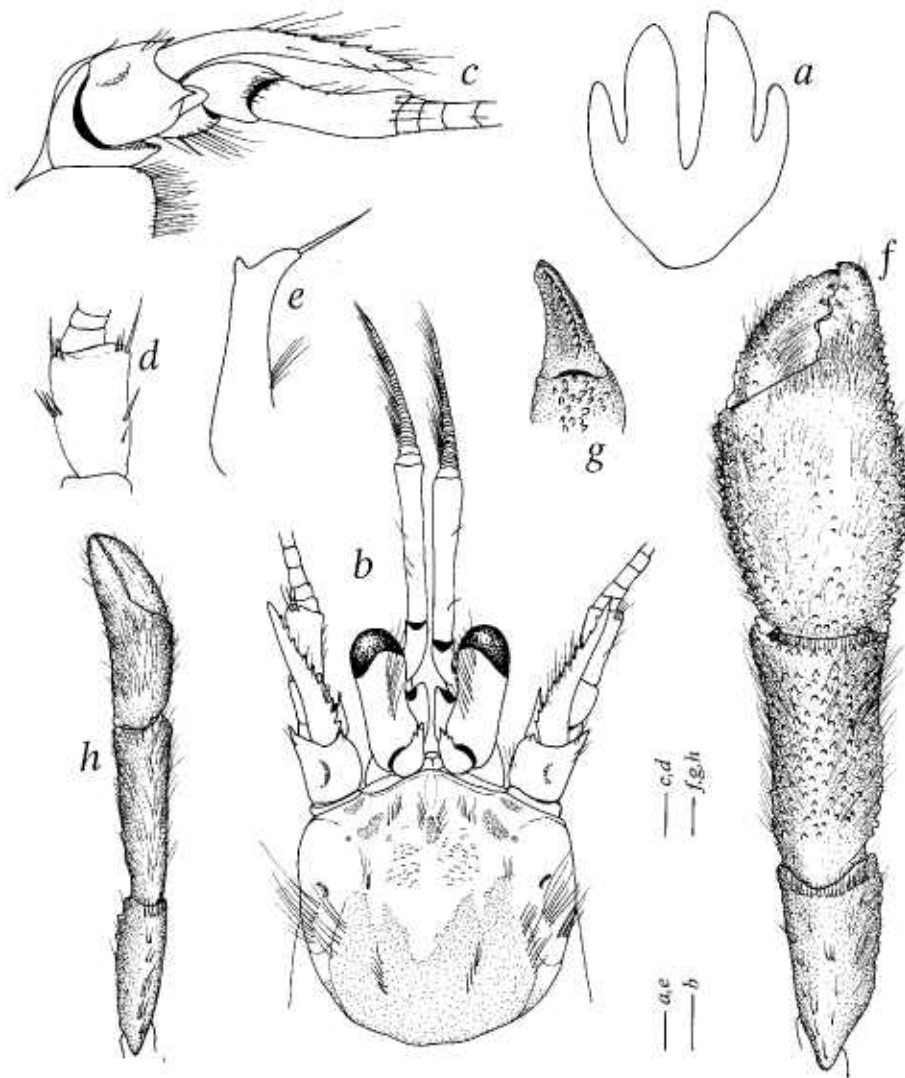


FIG. 16. *Sympagurus andersoni* (Henderson, 1896): a, e, male, sl 6.9 mm, Anton Bruun stn 17, Andaman Sea (USNM 309741); b-d, f-h, male, sl 5.0 mm, Vauban stn CH 99, Madagascar (MNHN Pg 5780): a, lamella of posterior arthrobranch (midportion) of fourth pereopod; b, shield and cephalic appendages, dorsal view; c, right antennal peduncle, lateral view; d, fifth segment of same, dorsal view; e, distal end of endopod of left maxillule, internal view; f, right cheliped, dorsal view; g, left cheliped, dorsal view. Scales = 0.25 mm (a, e), 1 mm (b, f-h), and 0.5 mm (c, d).

FIG. 16. *Sympagurus andersoni* (Henderson, 1896): a, e, mâle, sl 6,9 mm, Anton Bruun stn 17, mer des Andaman (USNM 309741); b-d, f-h, mâle, sl 5,0 mm, Vauban stn CH 99, Madagascar (MNHN Pg 5780): a, lamelle de l'arthrobranchie postérieure (partie centrale) du quatrième péréopode; b, bouclier et appendices céphaliques, vue dorsale; c, pédoncule antennaire droit, vue latérale; d, cinquième segment du même appendice, vue dorsale; e, partie distale de l'endopode du maxillule gauche, vue interne; f, chélopède droit, vue dorsale; g, chélopède gauche, vue dorsale. Échelles = 0,25 mm (a, e), 1 mm (b, f-h), et 0,5 mm (c, d).

DESCRIPTION. — Gills with lamellae (Fig. 16a) deeply divided. Shield length in males 3.7-4.2 mm, females 3.6-5.5 mm, ovigerous females 4.2-6.5 mm. Shield (Figs 15, 16b) about as broad as long, usually with weakly calcified regions medially; lateral projections broadly triangular, frequently with small terminal spine. Rostrum broadly triangular, rounded distally, with low dorsal ridge.

Ocular peduncles about 0.5 x or slightly more length of shield, with row of long setae dorsally. Ocular acicles terminating in bifid or multifid spines (usually trifid). Corneae weakly dilated.

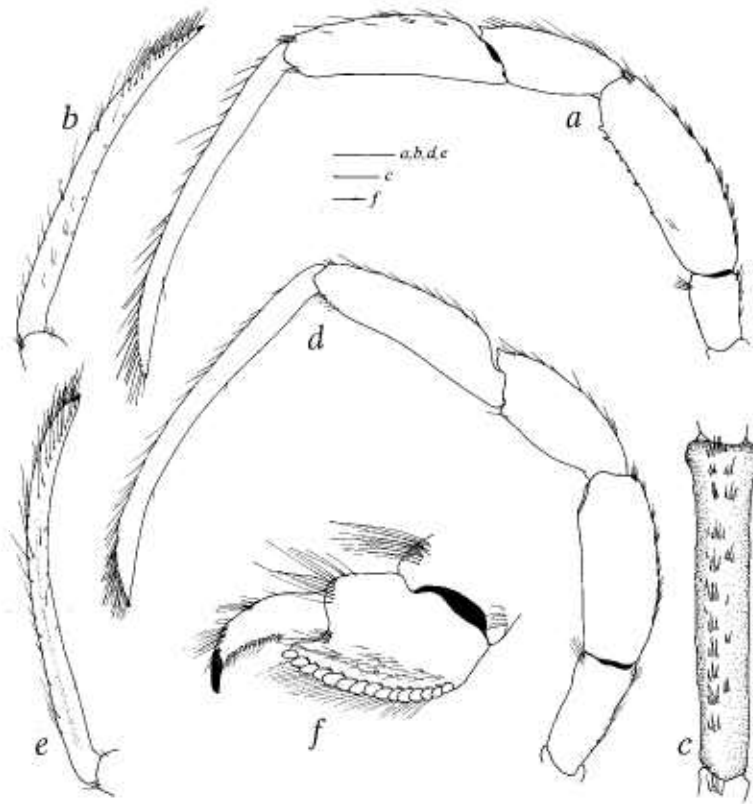


FIG. 17. *Sympagurus andersoni* (Henderson, 1896), male, sl 5.0 mm, Vauban stn CH 99, Madagascar (MNHN Pg 5780): a, left first ambulatory leg, lateral view; b, dactylus of same, mesial view; c, merus of same, dorsal view; d, left second ambulatory leg, lateral view; e, dactylus of same, mesial view; f, propodus and dactylus of left fourth pereopod, lateral view. Scales = 2 mm (a, b, d, e), 1 mm (d), and 0.25 mm (f).

FIG. 17. *Sympagurus andersoni* (Henderson, 1896), mâle, sl 5,0 mm, Vauban stn CH 99, Madagascar (MNHN Pg 5780) : a, première patte marcheuse gauche, vue latérale, côté externe ; b, dactyle de la même patte, vue latérale, côté interne ; c, mérus de la même patte, vue dorsale ; d, deuxième patte marcheuse gauche, vue latérale, côté externe ; e, dactyle de la même patte, vue latérale, côté interne ; f, propode et dactyle du quatrième péréiopode gauche, vue latérale. Échelles = 2 mm (a, b, d, e), 1 mm (d), et 0,25 mm (f).

Antennular peduncle exceeding cornea by about 0.3 x or more length of penultimate segment.

Antennal peduncle (Fig. 16c) exceeding cornea by about 0.5 x length of fifth segment. Fifth segment (Fig. 16d) relatively short and wide (in dorsal view), about 1.3-1.5 x as long as wide; with bristles on mesial and lateral margins. Fourth segment unarmed. Second segment with dorsolateral distal angle produced, terminating in short, simple or frequently bifid or multifid spine. First segment with lateral surface unarmed. Acicle exceeding distal margin of cornea by at least 0.3-0.5 x length of acicle, mesial margin armed with 4-10 spines. Antennal flagellum with short setae > 1 flagellar article in length.

Maxillule with external lobe of endopod moderately developed, not recurved, internal lobe with long seta distally (Fig. 16e). Sternite of third maxillipeds with strong spine on each side of midline. Epistomial spine absent.

Chelipeds markedly dissimilar, with moderate setation. Right cheliped (Figs 15, 16f, g) in large males (sl \geq 6.5 mm) long and slender, exceeding extended left cheliped by as much as 0.3 x length of carpus of right cheliped; in females exceeding extended left cheliped by length of right chela. Chela 2.0-3.0 x as long as broad. Fingers straight, set nearly parallel to longitudinal axis of chela. Dactylus with mesial margin well defined by row of calcareous spines. Chela and carpus proportions considerably affected by size and sexual dimorphism. Palm in males varying from 1.2 to nearly 2.0 x as long as wide, in females about as long as broad; with dorsomesial and dorsolateral margins armed with small spines; dorsal surface with scattered small spines. Carpus in males varying from 3.0-3.5 x as long as wide, in females about 2.0 x as long as wide, numerous spines on dorsal surface.

Left cheliped (Figs 15, 16h) well calcified. Chela unarmed, or with short dorsolateral row of small spines proximally. Carpus with long, simple bristles and dense, finely plumose setae on dorsal surface; with dorsodistal spine, and frequently row of small spines on distal half of dorsal margin.

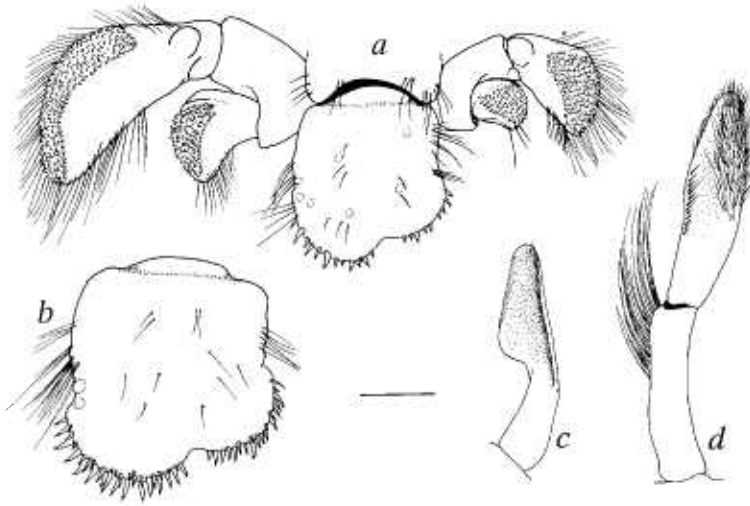


FIG. 18. *Sympagurus andersoni* (Henderson, 1896), Madagascar: a, male, sl 5.0 mm, Vauban stn CH 99 (MNHN Pg 5780); b-d, male, sl 7.4 mm, Vauban stn CH 139 (MNHN Pg 5725): a, uropods and telson, dorsal view; b, telson, dorsal view; c, left first pleopod, mesial view; d, left second pleopod, anterior view. Scale = 1 mm.

FIG. 18. *Sympagurus andersoni* (Henderson, 1896), Madagascar: a, mâle, sl 5,0 mm, Vauban stn CH 99 (MNHN Pg 5780); b-d, mâle, sl 7,4 mm, Vauban stn CH 139 (MNHN Pg 5725): a, uropodes et telson, vue dorsale; b, telson, vue dorsale; c, premier pléopode gauche, vue latérale, côté interne; d, deuxième pléopode gauche, vue antérieure. Échelle = 1 mm.

lobes by unarmed, rounded (U-shaped) cleft; lobes armed with distal and subdistal corneous spines, more numerous in females.

Male first gonopod (Fig. 18c) with concave distal lobe. Second gonopod (Fig. 18d) distal segment with numerous setae distally, and row of short bristles on lateral margin.

Color in life unknown.

HABITAT. — Usually found living in gastropod shells, occasionally with a zoanthid colony (*Epizoanthus* sp.) or an actinian polyp (sp. indet.) attached.

DISTRIBUTION. — Gulf of Aden, Maldives, Laccadive Sea, off eastern Africa from Somalia to Mozambique, Madagascar, Seychelles and Straits of Malacca, 80-1840 m (Fig. 34).

REMARKS. — Henderson's (1896) description and figures of this species were based on a male collected off the Maldives (*Investigator* stn 150), although he did mention two other "small individuals (male and female)" from the same locality, which he considered "undeveloped". Henderson's material has not been examined, and is probably deposited in the Indian Museum, Calcutta. A male specimen of this species (BMNH, labeled "compared with types"), also collected off the Maldives (*Investigator* stn 232), was examined and confirmed to represent Henderson's taxon.

Henderson (1896) described *Parapagurus andersoni* without including illustrations. Although he mentioned the multifid condition of the ocular acicles of his species, the subsequent illustrations of the male holotype published by Alcock & Anderson (1897, pl. 32, fig. 2), and Alcock (1905, pl. 10, fig. 2), show simple ocular acicles. Henderson's types have not been available for examination, but it appears that the simple condition of the ocular acicles was inaccurately depicted in the illustrations.

The cirriped *Pagurolepas conchicola* Stubbings, 1940 was described based on specimens found living in shells inhabited by *Parapagurus andersoni* var. *brevimanus* collected in the Zanzibar area during the *John Murray* Expedition (*Mabahiss*,

Ambulatory legs (Figs 15, 17a-e) similar except for longer segments on right. Dactylus about twice as long as propodus, with ventromesial row of about 4-7 minute corneous spinules (often inconspicuous). Carpus with small dorsodistal spine. Merus (Fig. 17c) with simple bristles dorsally arranged in short, transverse rows of 2-6 bristles; ventral margin with row of small calcareous spines distally (first leg), or unarmed (second leg). Anterior lobe of sternite of second legs setose, unarmed or with small subdistal spine.

Fourth pereopod (Fig. 17f) with dactylus terminating in corneous claw. Propodal rasp consisting of 1 row of ovate scales.

Uropods and telson (Figs 18a, b) asymmetrical. Left exopod of uropod about 2.0 x as long as wide, rasp well developed. Telson with weak lateral indentations and scattered low, blister-like tubercles on dorsal surface; terminal margin divided into 2

1933-34, stn 122). This hermit crab material, subsequently reported by Thompson (1943) as *Parapagurus andersoni*, has been examined and is in fact *S. andersoni*. Zhadan (in press) found that some of the specimens reported by Balss (1912) as *Parapagurus pilosimanus* are also *S. andersoni*.

***Sympagurus aurantium* n. sp.**

Figs 19-23, 34

TYPE MATERIAL. — New Caledonia. (holotype and paratypes). SMIB 4: stn DW 44, 24°46.0'S, 168°08.2'E, 300 m, 08.03.1989: holotype ♂ sl 6.3 mm (MNHN Pg 6074); 1 ♂ sl 5.2 mm; 1 ♀ sl 4.9 mm (MNHN Pg 6075); 3 ♂ sl 2.5-3.6 mm; 3 ♀ sl 3.1-4.8 mm (MNHN Pg 6076); stn DW 49, 24°45.5'S, 168°08.5'E, 300 m, 08.03.1989: 2 ♂ sl 4.9 and 5.8 mm (MNHN Pg 6077), 2 ♂ sl 2.5 and 5.5 mm (USNM 1000023); stn DW 53, 23°40.1'S, 167°59.9'E, 270 m, 09.03.1989: 1 ♂ sl 3.0 mm (USNM 1000024). — MUSORSTOM 5: stn 301, 22°06.90'S, 159°24.60'E, 487-610 m, 12.10.1986: 1 ♂ sl 2.2 mm, 1 ♀ sl 5.1 mm (USNM 1000025). — MUSORSTOM 6 (Loyalty Islands) (no stn number), 1 ♂ sl 6.7 mm (MNHN Pg 6073); stn DW 398, 20°47.19'S, 167°05.65'E, 370 m, 13.02.1989: 1 ♂ sl 3.6 mm, 1 ♀ sl 4.5 mm (USNM 1000026); stn DW 472, 21°08.60'S, 167°54.70'E, 300 m, 22.02.1989: 1 ♂ sl 5.5 mm (USNM 1000028); stn DW 479, 21°09.13'S, 167°54.95'E, 22.02.1989, 310 m: 1 ♀ sl 3.8 mm (USNM 1000027). — SMIB 3: stn DW 20, 23°39.70'S, 167°59.70'E, 280 m, 23.05.1987: 1 ovig. ♀ sl 4.6 mm (USNM 1000029). — SMIB 5: stn DW 70, 23°40.60'S, 168°01.10'E, 270 m, 07.09.1989: 1 ♂ sl 6.3 mm, 1 ♀ sl 3.3 mm (USNM 1000022); stn DW 71, 23°41.3'S, 168°00.7'E, 265 m, 07.09.1989: 2 ♀ sl 4.5 and 4.9 mm (USNM 1000021); stn DW 74, 23°40.20'S, 168°00.90'E, 245 m, 07.09.1989: 1 ♂ sl 4.0 mm, 1 ovig. ♀ sl 3.7 mm (MNHN Pg 6078), 1 ♂ sl 6.6 mm (USNM 1000018); stn DW 79, 23°41.30'S, 168°01.10'E, 285 m, 7.09.1989: 1 ovig. ♀ sl 3.4 mm (USNM 1000019); stn DW 97, 23°01.10'S, 168°18.00'E, 300 m, 14.09.1989: 1 ovig. ♀ sl 2.8 mm (USNM 1000020); stn DW 98, 23°01.70'S, 168°16.10'E, 335 m, 14.09.1989: 1 ♂ sl 3.2 mm (USNM 1000017). — SMIB 8: stn DW 156, 24°46'S, 168°08'E, 275-300 m, 28.01.1993: 2 ♂ sl 4.1 and 5.6 mm (MNHN Pg 6038); stn DW 158, 24°46'S, 168°02'E, 262-290 m, 28.01.1993: 1 ♂ sl 5.6 mm (MNHN Pg 6039); stn DW 160, 24°46'S, 168°08'E, 280-282 m, 28.01.1993: 1 ♂ sl 4.6 mm (MNHN Pg 6040); stn DW 163, 24°49'S, 168°09'E, 310-460 m, 28.01.1993: 1 ♀ sl 4.0 mm (MNHN Pg 6041); stn DW 173, 23°41'S, 168°00'E, 234-242 m, 29.01.1993: 4 ♂ sl 3.5-6.0 mm, 1 ♀ sl 5.2 mm (MNHN Pg 6042); stn DW 174, 23°40'S, 168°01'E, 235-240 m, 29.01.1993: 2 ♂ sl 2.6 and 2.7 mm, 2 ♀ sl 3.1 and 4.4 mm (MNHN Pg 6043); stn DW 175, 23°41'S, 168°00'E, 235-240 m, 29.01.1993: 2 ♂ sl 4.2 and 5.0 mm, 1 ♀ sl 5.1 mm (MNHN Pg 6044). — SMIB 10: stn DW 209, 24°49.137'S, 168°08.841'E, 329-560 m, 01.10.1995: 1 ♀ sl 5.4 mm (MNHN Pg 6045); stn DW 210, 24°49.097'S, 168°08.920'E, 308-510 m, 01.10.1995: 3 ♂ sl 3.4-5.2 mm (MNHN Pg 6046). — BATHUS: stn DW 690, 20°32'S, 165°00'E, 352 m, 16.03.1993: 1 ♂ sl 3.7 mm (MNHN Pg 6047).

MATERIAL EXAMINED. — The type material (see above).

DESCRIPTION. — Gills with lamellae (Fig. 19a) at most distally divided. Shield length in males 2.2-6.7 mm, females 3.1-5.4 mm, ovigerous females 2.8-4.6 mm. Shield (Fig. 19b) about as long as broad, with pair of oblique rows of setae on anterior half and pair of longitudinal rows of setae on posterior half, dorsal surface weakly calcified medially, linea d moderately marked, anterior margins weakly concave; lateral projections broadly subtriangular, with small terminal spine; anterolateral margins slightly sloping, weakly concave; posterior margin broadly rounded. Rostrum broadly rounded, not overreaching lateral projections, with short mid-dorsal ridge. Anterodistal margin of branchiostegite broadly rounded, unarmed, setose.

Ocular peduncles more than 0.5 x length of shield, with row of setae dorsally. Cornea moderately dilated. Ocular acicles subtriangular, each terminating in strong spine, separated basally by less than basal width of 1 acicle.

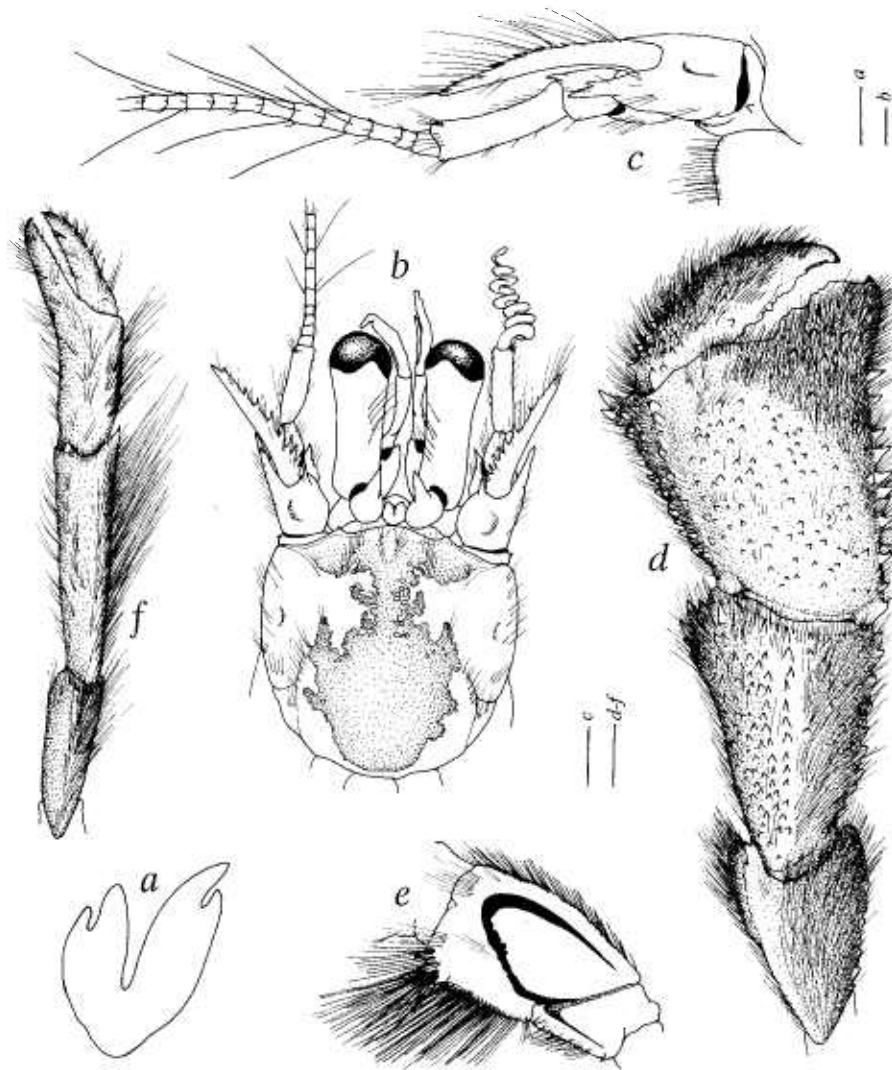


FIG. 19. *Sympagurus aurantium* n. sp., New Caledonia: a, paratype, male, sl 6.7 mm, MUSORSTOM 6 (no stn number), Loyalty Islands (MNHN Pg 6073); b-f, holotype, male, sl 6.3 mm, SMIB 4 stn DW 44 (MNHN Pg 6074): a, lamella of posterior arthrobranch (midportion) of fourth pereopod; b, shield and cephalic appendages (right antennal flagellum regenerating), dorsal view; c, left antennal peduncle, lateral view; d, right cheliped, dorsal view; e, merus of same, mesial view; f, left cheliped, dorsal view. Scales = 0.5 mm (a), 1 mm (b), and 2 mm (c-f).

FIG. 19. *Sympagurus aurantium* n. sp., Nouvelle-Calédonie: a, paratype, mâle, sl 6,7 mm, MUSORSTOM 6 (pas de n° de station), îles Loyauté (MNHN Pg 6073); b-f, holotype, mâle, sl 6,3 mm, SMIB 4 stn DW 44 (MNHN Pg 6074): a, lamelle de l'arthrobranchie postérieure (partie médiane) du quatrième périopode; b, bouclier et appendices céphaliques (flagelle de l'antennule droite régénéré), vue dorsale; c, pédoncule antennaire gauche, vue latérale; d, chélopède droit, vue dorsale; e, mérus de la même patte, vue latérale, côté interne; f, chélopède gauche, vue dorsale. Échelles = 0,5 mm (a), 1 mm (b), and 2 mm (c-f).

Antennular peduncle (ultimate and penultimate segments regenerating in holotype, Fig. 19b) exceeding distal margin of cornea by nearly full length of ultimate antennular segment. Ultimate segment 2 or more times as long as penultimate segment, with scattered setae. Basal segment with strong ventromesial spine; lateral surface with distal subrectangular lobe armed with 1 spine, and strong spine proximally. Ventral flagellum usually with about 10 articles.

Antennal peduncle (Fig. 19c) reaching to about distal margin of cornea. Fifth segment unarmed, with setae on lateral and mesial margins. Fourth segment with dorsodistal spine. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong, usually bifid spine; mesial margin with strong spine on dorsodistal angle. First segment with small spine on lateral surface; ventromesial angle produced, with row of small spines laterally. Antennal acicle reaching to distal margin of cornea, terminating in strong spine; mesial margin setose, armed with 9-11 strong spines. Flagellum (right regenerating in holotype, Fig. 19b) long, exceeding extended right cheliped and ambulatory legs; with very short setae < 1 flagellar article in length, and long setae about 6 flagellar articles in length (Fig. 19c).

Mandible (Fig. 20a) with 3-segmented palp. Maxillule (Fig. 20b) with external lobe of endopod moderately developed, not recurved and slender, internal lobe with 2 long setae distally. Maxilla (Fig. 20c) with endopod slightly exceeding distal margin of scaphognathite. First maxilliped (Fig. 20d) with endopod slightly exceeding exopod in distal extension. Second maxilliped (Fig. 20e) without distinguishing characters. Third maxilliped (Fig. 20f) with crista dentata of about 14 corneous-tipped teeth; coxa and basis each with mesial tooth. Sternite of third maxillipeds with small spine on each side of midline. Epistomial spine short and straight.

Chelipeds markedly dissimilar. Right cheliped (Figs 19d-e, 21) with dorsal and ventral surfaces of fingers, and ventral surface of palm densely covered with simple or plumose setae hiding armature; dorsal surface of palm sparsely setose except for dense, plumose setae distolaterally. Fingers strongly curved ventromesially, each terminating in small corneous claw; cutting edges each with irregularly-sized calcareous teeth, and rows of tufts of setae dorsally and ventrally near cutting edges; dorsal and ventral surfaces with strong spines.

Dactylus set at strongly oblique angle to longitudinal axis of palm, subequal in length to mesial margin of palm; mesial margin with strong spines diminishing in size distally. Fixed finger very broad basally, lateral margin with spines (often with corneous tips). Palm longer than broad, dorsolateral and dorsomesial margins well delimited by row of strong spines; mesial surface (Fig. 21c) rounded, covered with small spines; dorsal surface with numerous blunt or sharp small spines; ventral surface (Figs 21a, b) with numerous spines, some often strong and with corneous tips. Carpus distinctly longer than broad, with dorsolateral surface densely setose; with numerous strong spines dorsally; dorsodistal margin with row of spines; mesial margin strongly sloping; ventromesial and ventrolateral distal margins each with row of spines; ventral surface with small tubercles. Merus (Fig. 19e) with dorsolateral surface densely setose, unarmed except for small dorsodistal simple or bifid spine; ventromesial margin with row of small spines distally, and fringe of dense, long bristle-like setae (yellowish in color in preservative); ventrolateral margin with row of small spines. Ischium setose dorsally and ventrally; ventromesial margin with 1 small spine distally and 1 proximally. Coxa with 1 ventromesial and several ventrolateral spines on distal margin; with ventromesial row of long setae.

Left cheliped (Fig. 19f) well calcified, with moderately dense and often long simple setae. Fingers terminating in sharp corneous claws; dorsal surfaces unarmed except for tufts of setae, and sometimes small proximal spine on dorsal surface of dactyl. Dactylus about as long as mesial margin of palm; cutting edge with row of closely-spaced, small corneous teeth.

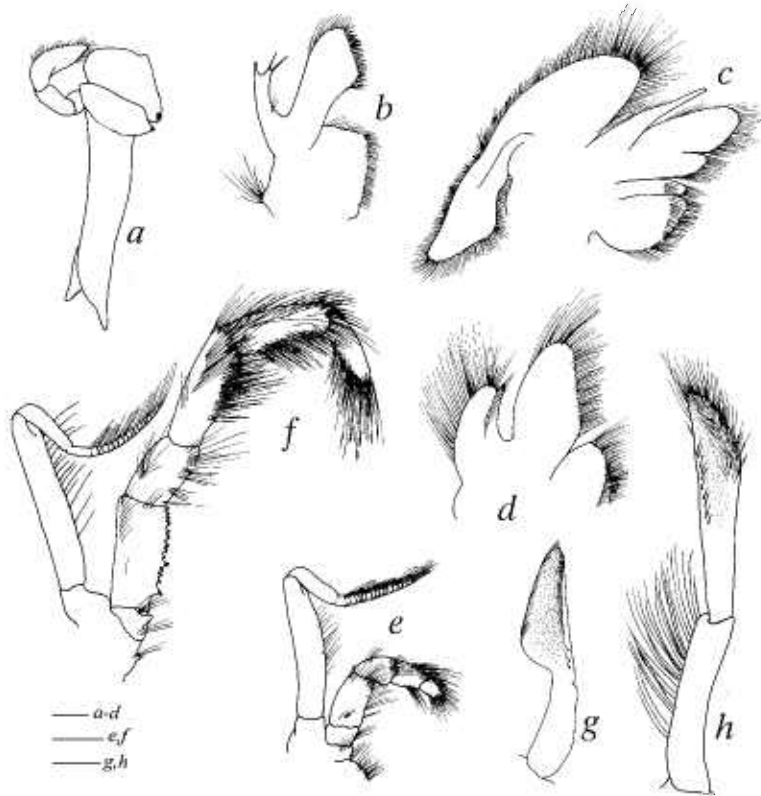


FIG. 20. *Sympagurus aurantium* n. sp., paratype, male, sl 6.7 mm, MUSORSTOM 6 (no str number), Loyalty Islands (MNHN Pg 6073). Left mouthparts, internal view: a, mandible; b, maxillule; c, maxilla; d, first maxilliped; e, second maxilliped; f, third maxilliped; g, left first pleopod, mesial view; h, left second pleopod, anterior view. Scales = 0.5 mm (a-d, g, h), and 1 mm (e, f).

FIG. 20. *Sympagurus aurantium* n. sp., paratype, male, sl 6,7 mm, MUSORSTOM 6 (pas de n° de station), îles Loyauté (MNHN Pg 6073). Pièces buccales gauche, vue interne : a, mandibule ; b, maxillule ; c, maxille ; d, premier maxillipède ; e, second maxillipède ; f, troisième maxillipède ; g, premier pléopode gauche, vue latérale, côté interne ; h, deuxième pléopode gauche, vue antérieure. Echelles = 0,5 mm (a-d, g, h), and 1 mm (e, f).

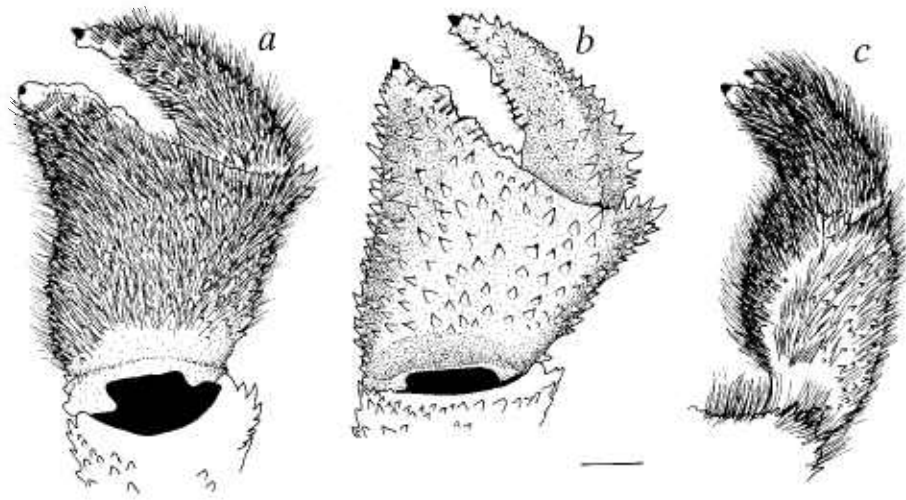


FIG. 21. *Sympagurus aurantium* n. sp.: a, c, holotype, male, sl 6.3 mm, SMIB 4 stn DW 44, New Caledonia (MNHN Pg 6074); b, paratype, male, sl 6.7 mm, MUSORSTOM 6 (no stn number), Loyalty Islands (MNHN Pg 6073). Right chela: a, ventral view; b, denuded, ventral view; c, mesial view. Scale = 2 mm.

FIG. 21. *Sympagurus aurantium* n. sp. : a, c, holotype, mâle, sl 6,3 mm, SMIB 4 stn DW 44, Nouvelle-Calédonie (MNHN Pg 6074) ; b, paratype, mâle, sl 6,7 mm, MUSORSTOM 6 (pas de n° de station), île Loyauté (MNHN Pg 6073). Pince droite : a, vue ventrale ; b, vue ventrale sans les soies ; c, vue latérale, côté interne. Echelle = 2 mm.

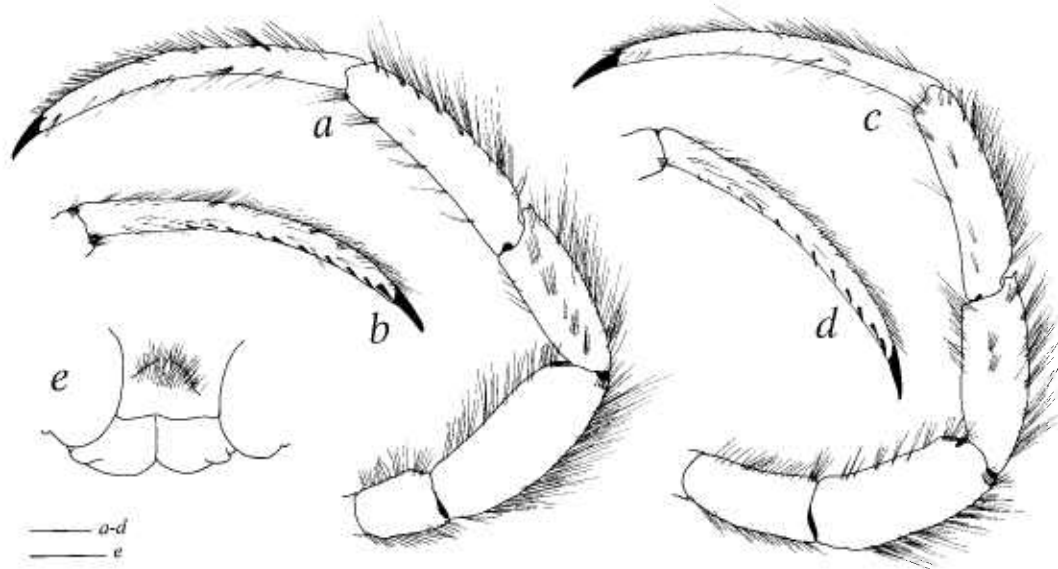


FIG. 22. *Sympagurus aurantium* n. sp., holotype, male, sl 6.3 mm, SMIB 4 stn DW 44, New Caledonia (MNHN Pg 6074): a, left first ambulatory leg, lateral view; b, dactylus of same, mesial view; c, left second ambulatory leg, lateral view; d, dactylus of same, mesial view; e, sternite of second ambulatory legs, ventral view. Scales = 2 mm (a-d), 1 mm (e).

FIG. 22. *Sympagurus aurantium* n. sp., holotype, mâle, sl 6,3 mm, SMIB 4 stn DW 44, Nouvelle-Calédonie (MNHN Pg 6074) : a, première patte marcheuse gauche, vue latérale, côté externe ; b, dactyle de la même patte, vue latérale, côté interne ; c, deuxième patte marcheuse gauche, vue latérale, côté externe ; d, dactyle de la même patte, vue latérale, côté interne ; e, sternite des deuxièmes pattes marcheuses, vue ventrale. Echelles = 2 mm (a-d), 1 mm (e).

Fixed finger with cutting edge consisting of regularly-spaced small calcareous teeth interspersed with small corneous teeth. Palm unarmed except for long setae dorsomesially. Carpus and merus with long setae dorsally. Carpus with dorsodistal and laterodistal spines. Merus unarmed dorsally; ventromesial margin with row of long setae; ventrolateral margin with row of small spines. Coxa and ischium each with row of setae on ventromesial margins.

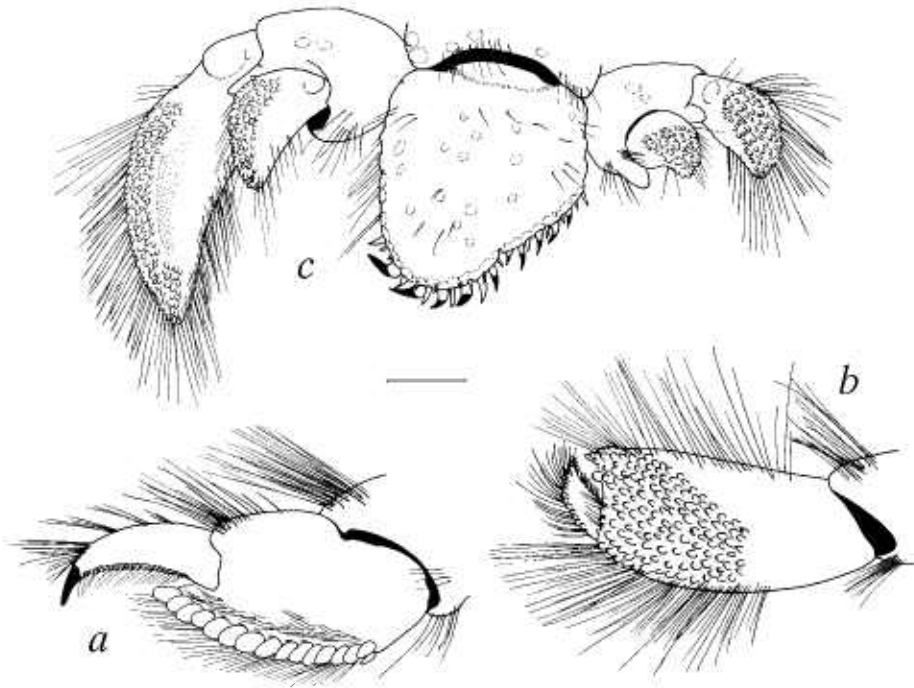


FIG. 23. *Sympagurus aurantium* n. sp., holotype, male, sl 6.3 mm, SMIB 4 stn DW 44, New Caledonia (MNHN Pg 6074): a, propodus and dactylus of left fourth pereopod, lateral view; b, propodus and dactylus of left fifth pereopod, lateral view; c, uropods and telson, dorsal view. Scales = 0.5 mm (a, b), and 1 mm (c).

FIG. 23. *Sympagurus aurantium* n. sp., holotype, mâle, sl 6,3 mm, SMIB 4 stn DW 44, Nouvelle-Calédonie (MNHN Pg 6074) : a, propode et dactyle du quatrième péréiopode gauche, vue latérale; b, propode et dactyle du cinquième péréiopode gauche, vue latérale; c, uropodes et telson, vue dorsale. Échelles = 0,5 mm (a, b), and 1 mm (c).

Ambulatory legs (Figs 22a-d) similar except for longer segments on right, usually not exceeding extended right cheliped. Dactylus about 2.0 x as long as propodus, terminating in sharp corneous claw, with dorsal and dorsomesial row of long setae, and ventromesial row of about 10-13 corneous spinules (Figs 22b-d) diminishing in size proximally. Propodus with long setae dorsally and row of tufts of setae ventrally. Carpus with small dorsodistal spine, with long setae dorsally, and short, transverse rows of setae on lateral surface. Merus with long setae dorsally and ventrally. Coxa and ischium with ventromesial margins setose. Anterior lobe of sternite of second legs (Fig. 22e) rounded, setose, with submarginal spine.

Fourth pereopod (Fig. 23a) semichelate. Dactylus subtriangular, terminating in sharp corneous claw; with ventrolateral row of small corneous spinules. Propodal rasp longer than propodal height, rasp consisting of 1 row of ovate scales. Carpus with long setae dorsally, merus with long setae dorsally and ventrally.

Fifth pereopod (Fig. 23b) semichelate. Dactylus with row of ovate scales on lateral surface. Propodal rasp extending posteriorly to about mid-length or more of segment.

Uropods and telson (Fig. 23c) strongly asymmetrical. Exopod of left uropod about 3 x as long as wide; anterior margin broadly rounded; with moderately broad rasp. Telson with sparse setae dorsally, and long setae on lateral margin of anterior half; lacking or at most with weak lateral indentations; dorsal surface with low, blister-like tubercles; posterior margin divided into 2 lobes by narrow, angled (V-shaped) cleft; lobes armed with about 18 (left) or 10 (right) distal and subdistal corneous spines of which 3-5 on left lobe are strongly curved and with dark tips.

Males with paired first and second gonopods moderately developed. First gonopod (Fig. 20g) with short distal lobe and moderately concave mesial surface. Second gonopod (Fig. 20h) terminating in rounded tip, distal segment with weakly concave anterior surface, row of short bristles medially on lateral margin, and long setae distally on mesial margin and anterior surface; basal segment with long setae on posterior surface. Females with vestigial second right pleopod.

Color in life unknown. In alcohol distal half of ocular peduncles a shade of orange that persists for several years.

HABITAT. — Gastropod shells.

DISTRIBUTION. — Off New Caledonia, 234-610 m (Fig. 34).

REMARKS. — This species can be easily distinguished from other *Sympagurus* species by the dense setation and armature of strong spines (some with corneous tips) on the ventral surface of the right palm (Figs 21a, b), and also by the dense tuft of long, bristle-like yellow setae on the ventromesial margin of the merus of the right cheliped (Fig. 19e).

ETYMOLOGY. — From the Latin *aurantium* (orange), referring to the distinctive orange coloration of the ocular peduncles of this species when in a preserved state.

***Sympagurus pictus* Smith, 1883**

Figs 1g₁, 2, 2, 24, 34

Sympagurus pictus Smith, 1883: 37, pl. 5, figs 3, 3a, 5-8 (in part: figs 2, 2a = *Parapagurus pilosimanus* Smith, 1879).

Eupagurus pilimanus Milne-Edwards, 1880: 43 (in part).

Parapagurus n. sp. — Verrill 1882: 225.

Sympagurus pictus — Verrill 1883: 50, pl. 8, fig. 4; 1885: 554. — Smith 1884: 354, pl. 4, fig. 3; Smith 1886: 615. — Milne-Edwards & Bouvier 1893: 60; 1894: 67; 1897: 133; 1899: 56. — Alcock 1905: 172. — Fowler 1912: 582. — Edmondson 1925: 29. — Gordan 1956: 342. — Bullis & Thompson 1965: 10. — Lemaitre 1989: 38, figs 15-17, 18B, 19, 39C-D, 40D; 1994: 412; 1996: 169; 2000: 211.

Eupagurus (Sympagurus) pilimanus — Milne-Edwards & Bouvier 1893: 63. [Not *Paragiopagurus pilimanus* (A. Milne-Edwards, 1880)].

Parapagurus pictus — Bals 1924: 767. — Gordan 1956: 338. — Füller 1958: 164, fig. 100. — de Saint Laurent 1972: 104. — Williams *et al.* 1989: 32.

Parapagurus pilimanus — Takeda 1983: 104, unnumbered fig. (Not *P. pilimanus*).

Not *Parapagurus pictus* — Hazlett 1966: 88 (= *P. pilimanus*).

TYPE MATERIAL. — Western Atlantic (lectotype and paralectotypes). U. S. Fish Commission: stn 924, off Martha's Vineyard, 39°57.30'N, 70°46'W, 288 m, 16.07.1881: lectotype (Lemaitre 1989) ♂ sl 9.2 mm (USNM 39980). *Citation*: stn WC8/4516, Gulf of Mexico, off Louisiana, 27°51.43'N, 90°45.49'W, 472-486 m, 23.05.1985: 4 ♂ sl 6.3-16.3 mm, 4 ♀ sl 4.5-12.0 mm, 1 ovig. ♀ sl 11.1 mm (USNM 265286).

MATERIAL EXAMINED. — The type material (see above), and additional material recorded by Lemaitre (1989).

DESCRIPTION. — Gills with lamellae (Fig. 1g₁) at most distally divided. Shield length in males 3.8-17.3 mm, females 3.5-11.2 mm, ovigerous females 8.4-14.5 mm. Shield (Fig. 24a) distinctly broader than long (about as broad as long in small specimens sl < 5.0 mm), dorsal surface usually weakly calcified medially; lateral projections broadly rounded, frequently terminating in small tubercle. Rostrum subtriangular, reaching beyond lateral projections, rounded distally, with low dorsal ridge.

Ocular peduncles more than 0.5 x shield length, with setae dorsally. Ocular acicles subtriangular, terminating in strong spine. Corneae dilated.

Antennular peduncle exceeding cornea by full length of ultimate segment.

Antennal peduncle usually not exceeding distal margin of cornea. Fourth segment unarmed. Second segment with dorsolateral distal angle produced, terminating in strong, bifid or multifid spine; mesial margin with small spine or tubercle on dorsodistal angle. First segment with lateral surface unarmed. Antennal acicle at most slightly exceeding distal margin of cornea; mesial margin setose, with small tubercles or spines. Antennal flagellum naked or at most with scattered short setae < 1 article in length.

Maxillule with external lobe of endopod weakly developed, internal lobe with 1-5 long setae distally (Fig. 1g₂). Sternite of third maxillipeds with strong spine on each side of midline. Epistome usually unarmed or occasionally with 1 or 2 short, straight spines.

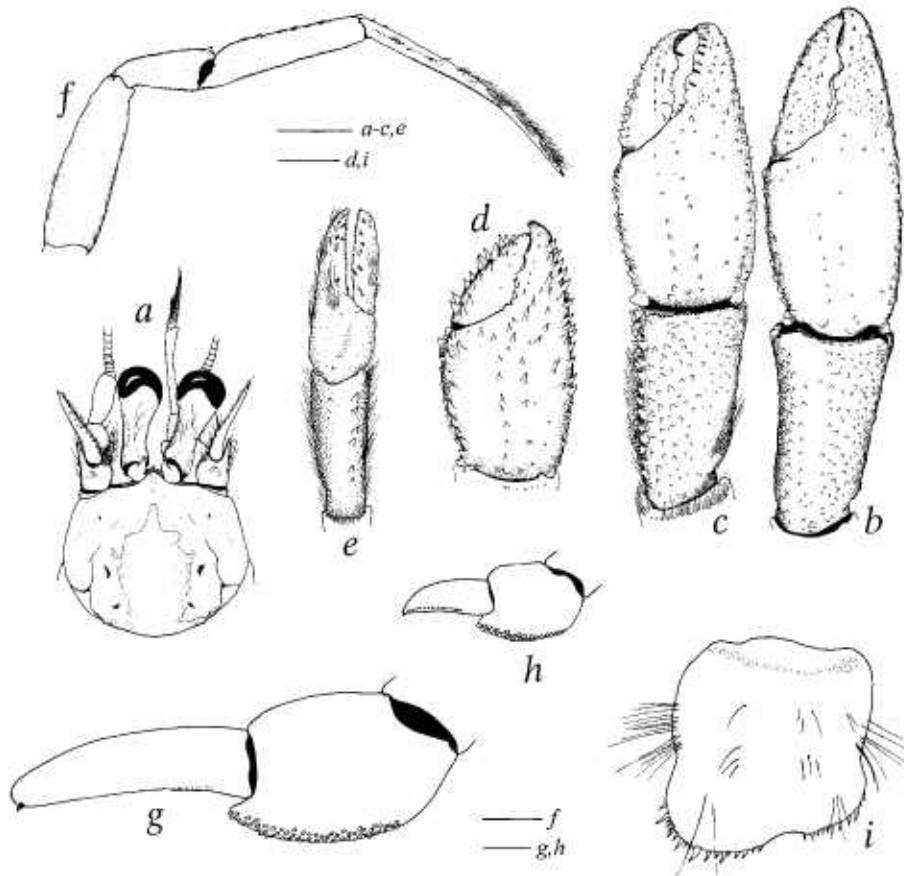


FIG. 24. *Sympagurus pictus* Smith, 1883: a, b, f, g, i, femelle, sl 10.5 mm, Alaminos stn 71-7, Golfe de Mexico (TAMU); c, e, lectotype, mâle, sl 9.2 mm, U. S. Fish Commission stn 924, NW Atlantic (USNM 39980); d, paralectotype, juv. femelle, sl 6.8 mm, U. S. Fish Commission stn 924 (USNM 39980); h, paralectotype, juv. mâle, sl 4.8 mm, U. S. Fish Commission stn 939, NW Atlantic (USNM 7306): a, bouclier et appendices céphaliques, vue dorsale; b, c, carpe et pince dénudés du chélopède droit femelle (b) et mâle (c), vue dorsale; d, pince droite; e, carpe et pince du chélopède gauche, vue dorsale; f, première patte marcheuse droite, vue latérale; g, h, quatrième péripode gauche, vue latérale; i, telson, vue dorsale (d'après Lemaitre 1989). Échelles = 5 mm (a-c, e, f), and 2 mm (d, g-i).

FIG. 24. *Sympagurus pictus* Smith, 1883: a, b, f, g, i, femelle, sl 10.5 mm, Alaminos stn 71-7, Golfe de Mexico (TAMU); c, e, lectotype, mâle, sl 9.2 mm, U. S. Fish Commission stn 924, Atlantique NO (USNM 39980); d, paralectotype, femelle juv., sl 6.8 mm, U. S. Fish Commission stn 924 (USNM 39980); h, paralectotype, mâle juv., sl 4.8 mm, U. S. Fish Commission stn 939, Atlantique NO (USNM 7306): a, bouclier et appendices céphaliques, vue dorsale; b, c, carpe et pince dénudés du chélopède droit femelle (b) et mâle (c), vue dorsale; d, pince droite; e, carpe et pince du chélopède gauche, vue dorsale; f, première patte marcheuse droite, vue latérale; g, h, quatrième péripode gauche, vue latérale; i, telson, vue dorsale (d'après Lemaitre 1989). Échelles = 5 mm (a-c, e, f), and 2 mm (d, g-i).

Chelipeds markedly dissimilar, with dense plumose setae on chelae, carpi, and distal half of meri. Right cheliped (Figs 24b-d) elongate; proportions and armature affected by size and sexual dimorphism (see Lemaitre 1989); in large specimens (sl > 10.0 mm) chela about 3 x as long as broad, and armed with small spines or tubercles on dorsal surface (Figs 24b, c); in small specimens (sl < 4.0 mm) chela about 1.8 x as long as broad, and armed with sharp spines on dorsal surface (Fig. 24d). Dactylus set at weakly oblique angle to longitudinal axis of chela. Palm with dorsomesial and dorsolateral margins weakly delimited by row of small spines or tubercles. Carpus with numerous small spines on dorsal surface.

Left cheliped (Fig. 24e) well calcified. Chela unarmed, or with few small spines on dorsal surface proximally. Carpus with row of spines on dorsal margin.

Ambulatory legs (Fig. 24f) similar except for longer segments on right. Dactylus 1.3-1.7 x as long as propodus; with dorsodistal row of long setae, several short, oblique rows of setae on dorsomesial distal margin; ventromesial margin

unarmed or with row of minute, inconspicuous spinules. Carpus with small dorsodistal spine. Merus of first leg with row of small spines on ventral margin; merus of second leg unarmed ventrally. Anterior lobe of sternite of second legs setose, unarmed.

Fourth pereopod (Figs 24g, h) semichelate. Dactylus nearly straight, distinctly longer than propodus, with small subterminal corneous claw (Fig. 24g); dactylus of small specimens (sl < 5.0 mm) subequal to length of propodal rasp, with terminal corneous claw (Fig. 24h). Propodal rasp consisting of 2-4 rows of small ovate scales.

Fifth pereopod semichelate. Propodal rasp extending to or beyond mid-length of propodus.

Uropods and telson asymmetrical. Left exopod of uropod 3.1-3.3 x as long as broad. Telson (Fig. 24i) with weak lateral indentations; terminal margin divided into 2 lobes by unarmed, rounded (U-shaped) cleft; lobes armed distally with short corneous spines.

Male first gonopod distal lobe with weakly concave mesial surface. Second gonopod with distal segment spatulate, and frequently with rudimentary exopod.

Female occasionally with paired or unpaired rudimentary first pleopods.

Color [based on Smith (1883) and Takeda (1983) (as *Parapagurus pilimanus*), and pers. obs.]: shield orange-red medially, white marginally. Ocular peduncles white except for vermilion ventral surface. Corneae black. Antennular and antennal peduncles white, flagella pale orange. Chelipeds cream-white with weak tint of orange-red on dorsal surface of meri and carpi. Ambulatory legs white except for vermilion tip of dactylus, narrow lateroventral vermilion stripe on propodi, and broad vermilion stripe on most of lateral surfaces of meri. Posterior carapace and abdomen translucent or whitish with orange-red specks (darker hue on first 2 tergites). Uropods and telson with orange-red specks.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — Found almost exclusively living symbiotically with the large actinian *Sagartia consors* (Verrill, 1882), which serves as shelter for the hermit crab. The actinian secretes a chitinous pseudo-shell or carcinoecia (Carlgren 1928a, b) that covers the interior walls of the shelter. Juvenile specimens (sl < 4.9 mm) are sometimes found using a different type of shelter (Lemaitre 1989).

DISTRIBUTION. — Western Atlantic Ocean from off Martha's Vineyard to the Gulf of Mexico, Caribbean Sea and off French Guiana, 180-2322 m (Fig. 34); most frequently at 200-800 m (Lemaitre 1989).

REMARKS. — The description of *Eupagurus pilimanus* A. Milne-Edwards, 1880 was based on three specimens from the Antilles. Subsequently, Milne-Edwards & Bouvier (1893) transferred *E. pilimanus* to *Sympagurus*, and considered that one of the specimens used in the original description was really *S. pictus*. As noted by Lemaitre (1989), Milne-Edwards's (1880) confusion originated from the similarity of young *S. pictus* to *S. pilimanus*, a species transferred by Lemaitre (1996) to *Paragiopagurus* Lemaitre, 1996.

The legends for Smith's (1883, pl. 5, figs 2, 2a, 3) illustrations of branchial elements were evidently inverted: figs 2 and 2a actually depict *Parapagurus pilosimanus* Smith, 1879, whereas fig. 3 represents *S. pictus*.

The specimen identified as *Parapagurus pilimanus* in the color photograph published by Takeda (1983: 104, unnumbered fig.) is actually *S. pictus*.

Sympagurus brevipes (de Saint Laurent, 1972)

Figs 1h₁, 2, 25, 26a, b, 34, 35d

Parapagurus brevipes de Saint Laurent, 1972: 105, figs 2, 14.

Parapagurus arcuatus var. *monstrosus* – Balss 1912: 99, pl. 10, fig. 3 (not *Oncopagurus monstrosus* (Not Alcock, 1894)).

Sympagurus brevipes – Lemaitre 1989: 37; 1994: 412; 1996: 170, figs 2, 3a, b, 4, 5a, 6; 1997: 575; 2000: 211. — Spiridonov & Zhadan 1999: 629.

TYPE MATERIAL. — Indonesia. *Siboga*: stn 12, 07°15'S, 115°15.6'E, 289 m: holotype ♂ sl 12.9 mm (ZMA De103.103).

MATERIAL EXAMINED. — The holotype (see above).

Taiwan. I-Lan County from commercial trawler at Su-Aou fishing port, 500 m (no date): 1 ♂ sl 26.0 mm (photographed) (NTOU).

South China Sea. Stn 3/64/13, 16°10.1'N, 114°27.6'E, 311-298 m, 06.12.1964: 1 ♀ sl 12.5 mm (FRS).

New Caledonia. MUSORSTOM 4: stn CP 179, 18°56.60'S, 163°13.70'E, 480 m, 18.09.1985: 1 ovig. ♀ sl 14.0 mm (MNHN Pg 6079); stn 224, 22°55.20'S, 167°27.00'E, 575-595 m, 30.09.1985: 1 ♂ sl 3.3 mm (USNM 1000031); stn 226, 22°47.20'S 167°21.60'E, 390 m, 30.09.1985: 1 ♂ sl 9.2 mm (USNM 1000030). — CHALCAL 2: stn DW 75, 24°39.31'S, 168°39.67'E, 600 m, 29.10.1986: 1 ♂ sl 9.3 mm (USNM 1000033). — MUSORSTOM 6: stn CP 465, 21°03.55'S, 167°32.25'E, 480 m, 21.02.1989: 1 ♂ sl 8.2 mm (USNM 1000032). — BERYX 11: stn CP 53, 23°48.25'S, 168°17.10'E, 540-950 m, 21.10.1992: 1 ♀ sl 4.0 mm (MNHN Pg 5985). — SMIB 8: stn DW 197, 22°51'S, 168°12'E, 414-436 m, 01.02.1993: 1 ♀ sl 12.0 mm, 1 ovig. ♀ sl 12.3 mm (MNHN Pg 5986). — BATHUS 2: stn DW 719, 22°47'S, 167°14'E, 444-455 m, 11.05.1993: 1 ovig. ♀ sl 9.5 mm (MNHN Pg 5987); stn CP 735, 23°01'S, 166°56'E, 530-570 m, 13.05.1993: 1 ♂ sl 9.8 mm (MNHN Pg 5988); stn CP 738 23°02'S, 166°56'E, 558-647 m, 13.05.1993: 2 ♂ sl 4.0 and 4.6 mm, 1 ♀ sl 3.7 mm (MNHN Pg 5989); stn CP 771, 22°09'S, 166°01'E, 610-800, 18.05.1993: 1 ♂ sl 2.9 mm (MNHN Pg 5990). — BATHUS 3: stn CP 844, 23°06'S, 166°45'E, 908 m, 01.12.1993: 4 juv sex indet. 3.5-4.2 mm (MNHN Pg 5991). — HALIPRO 1: stn CP 869, 21°14'S, 165°55'E, 450-490 m, 23.03.1994: 1 ♂ sl 20.0 mm, 1 ovig. ♀ sl 12.6 mm (MNHN Pg 5992); stn CH 870, 21°15'S, 165°55'E, 450-500 m, 23.03.1994: 1 ♂ sl 15.2 mm (ZMUM). — BATHUS 4: stn CP 909, 18°57'S, 163°10'E, 516-558 m, 04.08.1994: 1 ♀ sl 5.2 mm (MNHN Pg 5993); stn CP 911, 18°57'S, 163°08'E, 566-558 m, 05.08.1994: 1 ♂ sl 10.6 mm (MNHN Pg 5994); stn CP 928, 18°54'S, 163°23'E, 452-420 m, 07.08.1994: 1 ♂ sl 9.4 mm (MNHN Pg 5995); stn CP 948, 20°33'S, 164°57'E, 533-610 m, 10.08.1994: 1 ovig. ♀ sl 9.4 mm (MNHN Pg 5996).

Vanuatu. MUSORSTOM 8: stn CP 974, 19°21'S, 169°28'E, 492-520 m, 22.09.1994: 1 ♂ sl 13.1 mm (MNHN Pg 5997); stn CP 1136, 15°40'S, 167°01'E, 398-400 m, 11.10.1994: 2 ovig. ♀ sl 12.2 and 12.4 mm (MNHN Pg 5998).

Madagascar. *Vauban*: stn CH 2, 12°53.3'S, 48°09.4'E, 480-520 m, 04.03.1971: 1 ♀ sl 7.1 mm (MNHN Pg 5726); stn CH 3,

12°52.3'S, 48°10.4'E, 415-403 m, 04.03.1971: 1 ♀ sl 7.6 mm (MNHN Pg 5727); stn CH 5, 12°44.8'S, 48°10.6'E, 570-563 m, 05.03.1971: 2 ♂ sl 5.0 and 11.4 mm, 1 ♀ sl 6.3 mm (MNHN Pg 5728); stn CH 9, 12°42'S, 48°13.5'E, 455-460 m, 14.04.1971: 1 ♂ sl 10.0 mm (MNHN Pg 5729); stn CH 11, 12°39.8'S, 48°15.2'E, 375-385 m, 14.04.1971: 2 ♂ sl 10.8 and 11.9 mm, 1 ♀ sl 11.4 mm (MNHN Pg 5730); stn CH 28, 12°49.2'S, 48°12.1'E, 445-455 m, 12.09.1972: 2 ♂ sl 13.0 and 13.7 mm, 1 ♀ sl 6.5-9.6 mm (MNHN Pg 5731); stn CH 29, 12°43.1'S, 48°11.1'E, 540 m, 13.09.1972: 2 ♂ sl 5.0 and 6.0 mm, 1 ovig. ♀ sl 11.0 mm (MNHN Pg 5732); stn CH 38, 12°50'S, 48°09.1'E, 580-585 m, 14.09.1972: 1 ♀ sl 7.2 mm (MNHN Pg 5733); stn CH 39, 12°46.5'S, 48°10.4'E, 495-500 m, 15.09.1972: 6 ♂ sl 5.0-12.4 mm, 3 ♀ sl 6.5-10.2 mm, 1 ovig. ♀ sl 11.0 mm (MNHN Pg 5734); stn CH 41, 12°43'S, 48°13.4'E, 350-360 m, 15.09.1972: 1 ♂ sl 11.0 mm (MNHN Pg 5735); stn CH 46, 15°19.1'S, 46°11.8'E, 400 m, 07.11.1972: 2 ♂ sl 9.7 and 12.6 mm (MNHN Pg 5736); stn CH 48, 15°18'S, 46°12.1'E, 480-510 m, 08.11.1972: 5 ♂ sl 6.3-12.7 mm (MNHN Pg 5737); stn CH 49, 15°18.3'S, 46°10.3'E, 500-550 m, 08.11.1972: 1 ♂ sl 5.7 mm, 2 ♀ sl 6.1 and 6.7 mm (MNHN Pg 5738); stn CH 58, 23°36.2'S, 43°30.5'E, 510 m, 27.02.1973: 1 ♂ sl 12.9 mm, 1 ♀ sl 7.6 mm, 1 ovig. ♀ sl 9.6 mm (MNHN Pg 5739); stn CH 61, 23°36.1'S, 43°31'E, 445-455 m, 27.02.1973: 1 ♂ sl 11.4 mm, 2 ovig. ♀ sl 12.4 and 13.2 mm (MNHN Pg 5740); stn CH 66, 23°36.4'S, 43°31.1'E, 450-460 m, 29.02.1973: 3 ♂ sl 11.5-12.5 mm (MNHN Pg 5741); stn CH 90, 21°24.5'S, 43°13.5'E, 640-720 m, 26.11.1973: 1 ♂ sl 7.0 mm (MNHN Pg 5742); stn CH 91, 21°25.5'S, 43°14.5'E, 425-550 m, 26.11.1973: 1 ♂ sl 6.8 mm (MNHN Pg 5743); stn CH 96, 22°21.3'S, 43°03.7'E, 480-500 m, 27.11.1973: 2 ♂ sl 5.3 and 7.8 mm (MNHN Pg 5744); stn CH 112, 22°18'S, 43°02.2'E, 640-660 m, 01.12.1973: 1 ♂ sl 5.4 mm (MNHN Pg 5745); stn CH 121, 12°40'S, 48°14'E, 410 m, 11.10.1974: 1 ♂ sl 9.5 mm (MNHN Pg 5746); stn CH 122, 12°43'S, 48°12'E, 500 m, 11.10.1974: 2 ♂ sl 14.6 and 15.1 mm, 4 ovig. ♀ sl 10.8-12.7 mm (MNHN Pg 5747); stn CH 139, 13°50'S, 47°37'E, 850-1125 m, 27.02.1975: 1 ♀ sl 5.4 mm (MNHN Pg 5748); stn CH 142, 13°45.6'S, 47°34.2'E, 1250-1300 m, 29.02.1975: 1 ♂ sl 2.9 mm (MNHN Pg 5749); stn CH 143, 13°45.8'S, 47°38.5'E, 430-700 m, 29.02.1975: 1 ♂ sl 12.4 mm (MNHN Pg 5750).

Additional material recorded by Lemaitre (1996).

DESCRIPTION. — Gills with lamellae (Fig. 1h₁) at most distally divided. Shield length in males 2.9-26.0 mm, females 3.7-15.9 mm, ovigerous females 9.5-18.0 mm, juveniles (sex indeterminate) 2.4-5.5 mm. Shield (Figs 25a, b) broader than long, dorsal surface weakly calcified medially, anterior margins straight; lateral projections broadly rounded, often nearly obsolete. Rostrum triangular, with low dorsal ridge.

Ocular peduncles more than 0.5 x length of shield. Ocular acicles subtriangular, terminating in spine (rarely bifid on 1 side). Corneae weakly dilated.

Antennular peduncle exceeding distal margin of cornea by full length of ultimate segment.

Antennal peduncle at most slightly exceeding distal margin of cornea. Fourth segment unarmed. Second segment with dorsolateral distal angle produced, terminating in strong spine, with 3 small spines dorsally. Acicle reaching at most distal

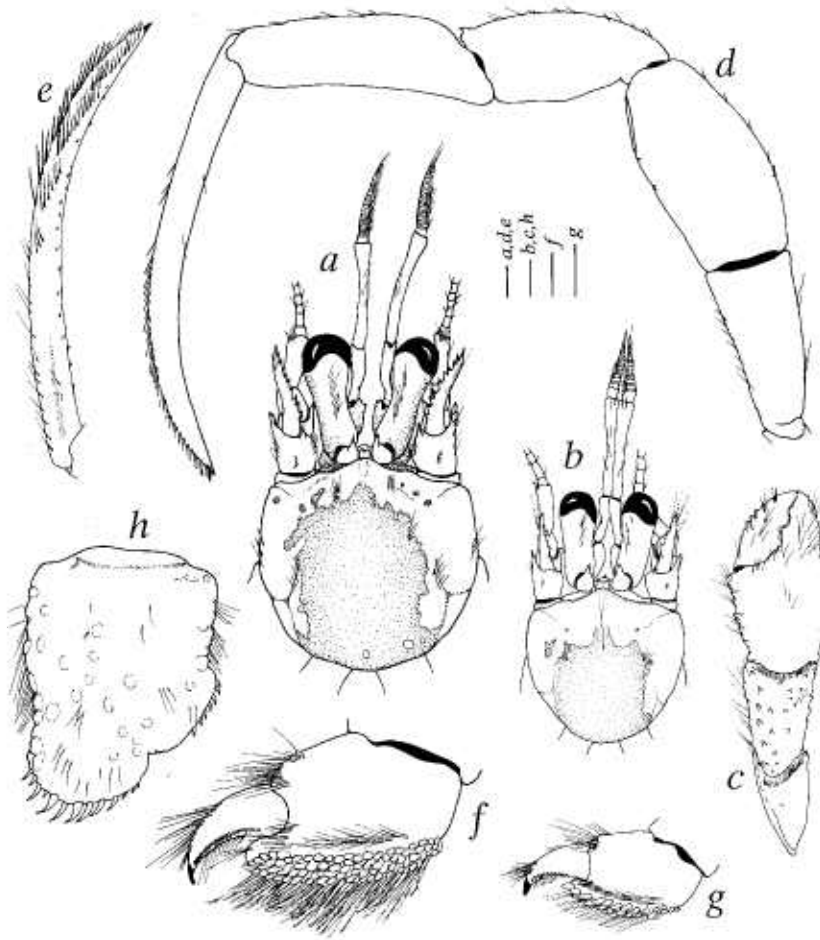


FIG. 25. *Sympagurus brevipes* (de Saint Laurent, 1972): a, paratype, femelle, sl 13.3 mm, Albatross stn 5221, Philippines (USNM 168914); b, c, g, juv. (sex indéterminé), sl 4.1 mm, Western Australia (USNM 270112); d-f, h, holotype, mâle, sl 12.9 mm, Indonésie (ZMA De103.103): a, b, bouclier et appendices céphaliques, vue dorsale; c, chélicède droit, vue dorsale; d, deuxième patte marcheuse gauche, vue latérale, côté externe; e, dactyle de la même patte, vue latérale, côté interne; f, g, propode et dactyle du quatrième périopode gauche, vue latérale; h, telson, vue dorsale. Echelles = 5 mm (a, d, e), 1 mm (b, c, f, h), and 0.5 mm (g).

FIG. 25. *Sympagurus brevipes* (de Saint Laurent, 1972): a, paratype, femelle, sl 13.3 mm, Albatross stn 5221, Philippines (USNM 168914); b, c, g, juv. (sexe indéterminé), sl 4.1 mm, Western Australia (USNM 270112); d-f, h, holotype, mâle, sl 12.9 mm, Indonésie (ZMA De103.103): a, b, bouclier et appendices céphaliques, vue dorsale; c, chélicède droit, vue dorsale; d, deuxième patte marcheuse gauche, vue latérale, côté externe; e, dactyle de la même patte, vue latérale, côté interne; f, g, propode et dactyle du quatrième périopode gauche, vue latérale; h, telson, vue dorsale. Echelles = 5 mm (a, d, e), 1 mm (b, c, f, h), and 0.5 mm (g).

margin of cornea; mesial margin setose, armed with 9-12 strong spines. Flagellum with few setae < 1 flagellar article in length.

Maxillule with external lobe of endopod moderately developed, not recurved; internal lobe with 2-4 long setae distally (Fig. 1h₂). Sternite of third maxillipeds with spine on each side of midline. Epistomial spine short and straight, often absent.

Chelipeds markedly dissimilar, with dense covering of plumose setae on carpi and chelae. Right cheliped (Fig. 26b) with chela varying from 1.5-2 x as long as broad. Fingers weakly curved ventromesially. Dactylus with weakly concave ventromesial surface. Palm with dorsal and ventral surfaces smooth except for tufts of setae, dorsomesial and dorsolateral margins defined by rows of spines, mesial and lateral surfaces of palm rounded. Carpus with numerous small tubercles or spines on dorsal surface.

Left cheliped (Fig. 26a) well calcified, chela unarmed. Carpus with dorsodistal spine, and dorsal row of 2-4 well-spaced, usually strong spines.

Ambulatory legs (Figs 25d, e) similar except for longer segments on right. Dactylus about 2.0 x as long as propodus, with ventromesial irregular row of 20-25 minute corneous spinules, dorsal row of long setae, and 3 dorsomesial oblique rows of long setae distally. Carpus with small dorsodistal spine. Merus of first leg with row of small tubercles or spines on ventral margin; merus of second left leg short, 2.0-2.3 x as long as high. Anterior lobe of sternite of second legs unarmed or with 1 submarginal spine, setose.

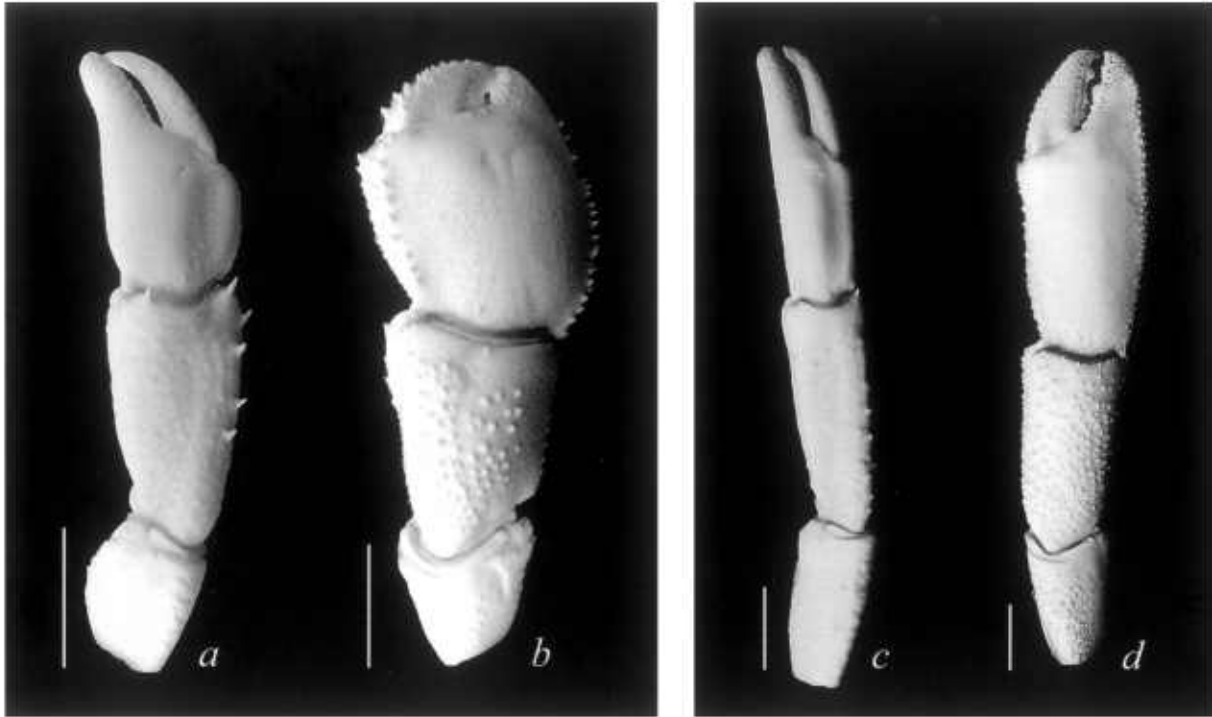


FIG. 26. a, b, *Sympagurus brevipes* (de Saint Laurent, 1972): ovig. female, sl 14.0 mm, MUSORSTOM 4 stn CP 179, New Caledonia (MNHN Pg 6079). c, d, *S. doffleini* (Bals, 1912): male, sl 20.5 mm, Radiale Apolima, Samoa (MNHN Pg 6086). Denuded left (a, c) and right (b, d) chelipeds. Scales = 10 mm.

FIG. 26. a, b, *Sympagurus brevipes* (de Saint Laurent, 1972) : femelle ovigère, sl 14,0 mm, MUSORSTOM 4 stn CP 179, Nouvelle-Calédonie (MNHN Pg 6079). c, d, *S. doffleini* (Bals, 1912): mâle, sl 20,5 mm, Radiale Apolima, Samoa (MNHN Pg 6086). Chélipèdes gauches (a, c) et droites (b, d) sans les soies. Echelles = 10 mm.

Fourth pereopod (Fig. 25f) semichelate, with dactylus terminating in corneous claw. Propodal rasp consisting of 4-6 rows of ovate scales.

Fifth pereopod semichelate; propodal rasp extending to mid-length of propodus.

Uropods and telson strongly asymmetrical. Left exopod of uropods about 2.4 x as long as broad. Telson (Fig. 25h) with weak lateral indentations; dorsal surface with low blister-like tubercles; posterior margin divided into 2 lobes by angled (V-shaped) cleft; lobes armed distally with strong, often long corneous spines, spines on left lobe strongly curved laterally (usually much longer in females than in males).

Male first gonopod with concave distal lobe. Second gonopod with distal segment nearly flat, rounded distally, often with rudimentary exopod.

Juvenile morphology (< 5.0 mm): vestigial pleurobranch on last thoracic somite occasionally obsolete or missing, maxillule internal lobe with 1 long seta; chelipeds nearly same length when fully extended, sparsely setose; right cheliped (Fig. 25c) with spines on dorsolateral and dorsomesial margins of palm, and dorsal surface of carpus; ambulatory legs with dactyls having ventromesial row of about 5 long, slender spinules; propodal rasp of fourth pereopod (Fig. 25g) with 1 or 2 rows of ovate scales.

Color (Fig. 35d): Mostly cream-white. Shield with light reddish-orange portions medially. Ocular peduncles with ventral surface reddish-orange. Antennules and antennal flagella light orange. Meri of chelipeds with reddish-orange band on dorsal surface. Ambulatory legs with reddish-orange stripe ventrolaterally on ischia; meri with reddish-orange stripe on lateral surface, stripe starting narrow proximally but widening distally; carpi and propodi with orange-reddish stripe on lateral surface; tip of dactylus orange.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — Commonly found living with an undetermined species of actinian (Lemaitre 1996: 174, fig. 5a), which secretes a carcinoecium similar to that produced by species of *Stylobates* (see Fautin Dunn *et al.* 1981; Fautin Dunn & Liberman 1983; Fautin 1987). Specimens of *S. brevipes* are occasionally found living in gastropod shells partially covered by an actinian, or with various invertebrates growing on the shell such as anthozoans, barnacles, and polychaetes (Zhadan in press).

DISTRIBUTION. — New Caledonia, Vanuatu, Indonesia, Philippines, Taiwan, South China Sea, Zanzibar, Madagascar, and Australia, 210-1300 m (Fig. 34).

REMARKS. — Individuals of this species grow to relatively large size. One male specimen (sl 26.0 mm) from off Western Australia (NTM Cr.006251), is the largest known parapagurid (Lemaitre 1996).

Sympagurus dofleini (Balss, 1912)

Figs 1i₁, 2, 26c, d, 27, 34

Parapagurus dofleini Balss, 1912: 96, fig. 4b

Parapagurus ijimai Terao, 1913: 383, fig. 4.

Parapagurus rectichela Zarenkov, 1990: 235, fig. 12. New synonymy.

“hermit crabs” – Dall 1903: 61; 1919: 79.

Parapagurus dofleini – Balss 1913: 50, pl. 1, fig. 5, pl. 2, fig. 3.

Parapagurus dofleini – Gordan 1956: 338. — de Saint Laurent 1972: 105. — Fautin Dunn *et al.* 1981: 380, fig. 1a, b. — Miyake 1982, 1991: 119, pl. 40, fig. 3. — Takeda 1982: 66, fig. 197. — Fautin Dunn & Liberman 1983: 158, fig. 1. — Fautin 1987: 6. — Poupin *et al.* 1990: 94 (in part, pl. 2-f = *Sympagurus poupini* Lemaitre, 1994). — Chave & Malahoff 1998: 55, fig. 141.

?Not *Parapagurus dofleini* – Miyake, 1978: 75, figs 27a, 28.

Sympagurus dofleini – Lemaitre 1989: 37; 1994: 384, figs 7, 8, 27c-f, 28d; 1996: 169; 2000: 211. — Poupin 1993: 51; 1996a: 20, pl. 9c; 1996b: 96. — Spiridonov & Zhadan 1999: 630.

Parapagiurus rectichela [sic] – Zarenkov 1990: 236, legend for fig. 12.

Sympagurus rectichela – Zhadan 1997: 71, figs 13, 14. — Parin *et al.* 1997: 163.

TYPE MATERIAL. — *Parapagurus dofleini*. Japan. Okinose, Sagami Bay, A. Owston, Doflein collection Nr. 2450: holotype ovig. ♀ sl 16.2 mm (ZSM 20010081, ex 315/1).

Parapagurus ijimai. Japan. Okinose, Sagami Bay, 530 m, 05.05.1899: holotype ♂ (UMUTZ - crust A Ppg-1).

Parapagurus rectichela. Sala y Gómez Ridge (holotype and paratypes). *Professor Stockman*: stn 1997: holotype ♂ sl 20.0 mm (ZMUM Ma 4856 - not seen, *fide* Zarenkov 1990; Zhadan 1997), 1 ♂ sl 19.9 mm, 1 ♀ sl 15.3 mm (MNHN Pg 5525).

OTHER MATERIAL EXAMINED. — Hawaiian Islands. Off Ewa, Oahu, 183 m (no date): 1 ovig. ♀ sl 17.7 mm (USNM 1000166). — Stn TC 33-30, 20°38.6'N, 156°53'W, 380-420 m, 05.11.1967: 1 ♂ sl 19.0 mm (USNM 1000168); stn TC 35-15, 21°05'N, 156°32'W, 360 m, 01.04.1968: 1 ♂ sl 19.2 mm (USNM 1000165); stn TC 35-16, 21°08'N, 156°32'W, 475 m, 01.04.1968: 1 ♀ sl 12.2 mm (BPBM S11016); stn TC 40-89, 21°01.7'N, 156°43.2'W, 210 m, 17.11.1968: 2 ovig. ♀ sl 17.6 and 18.8 mm (USNM 1000167); stn TC 67-138, 23°16'N, 161°50'W, 476 m, 22.11.1975: 1 ♂ sl 24.0 mm (BPBM S8559).

Mariana Islands. Guam, double reef, shrimp trap n° 80, 366 m, 30.07.1976: 1 ♂ sl 19.5 mm, 1 ovig. ♀ sl 17.5 mm (BPBM S10484).

Wallis and Futuna. MUSORSTOM 7: stn DW 541, 12°27'S, 177°28'W, 500-505 m, 17.05.1992: 1 ♂ sl 17.0 mm (USNM 1000034); stn CP 544, 12°26'S, 177°29'W, 580 m, 17.05.1992: 1 ♂ sl 11.2 mm (USNM 1000038); stn DW 591, 12°31'S, 174°19'W, 320 m, 23.05.1992: 1 ♂ sl 19.6 mm (MNHN Pg 6085); stn DW 629, 11°54'S, 179°32'W, 400-420 m, 29.05.1992: 1 ♂ sl 18.2 mm, 2 ovig. ♀ sl 15.7 and 15.9 mm (USNM 1000036).

Tonga. BORDAU 2: stn CP 1566, NW of Tongatapu, 21°01.66'S, 175°18.48'W, 530-531 m, 09.06.2000: 1 ♂ sl 20.1 mm (USNM 1000035).

Samoa. Radiale Apolima, 400 m, 17.11.1977: 1 ♂ sl 20.5 mm, 1 ovig. ♀ sl 18.6 mm (MNHN Pg 6086).

New Caledonia. Stn PRI R3, 200 m (no date): 2 ovig. ♀ sl 12.4 and 13.1 mm (MNHN Pg 6080). — Loyalty Islands: stn 40, 200 m, 18.06.1977: 1 ♂ sl 16.7 mm (MNHN Pg 6081). — Loyalty Islands, 600 m, 19.02.1977: 1 ♂ sl 12.4 mm, 1 ovig. ♀ sl 13.9 mm (MNHN Pg 6082). — Sandal Bay, 400 m, 05.11.1977: 2 ♂ sl 15.1 and 20.0 mm (MNHN Pg 6083). — MUSORSTOM 6: stn CP 466, 21°05.25'S, 167°32.20'E, 540 m, 21.02.1989: ♂ sl 19.3 mm, 1 ovig. ♀ sl 12.9 mm (USNM 1000037). — CHALCAL 2: stn CC 2, 24°55.48'S, 168°21.29'E, 500-610 m, 28.10.1986: 1 ♂ sl 5.1 mm (MNHN Pg 6084); stn DW 72, 24°54.50'S, 168°22.30'E, 527 m, 28.10.1986: 1 ♀ sl 13.5 mm (USNM 1000039). — BERYX 11: stn CP 53, 23°48.25'S, 168°17.10'E, 540-950, 21.10.1992: 1 ♀ sl 7.5 mm (MNHN Pg 5999).

Mozambique Channel. BENTHEDI: stn 122DS, 11°32'S, 47°23.2'E, SE Glorieuses Islands, 615-625 m, 12.04.1977: 1 ♂ sl

7.8 mm (MNHN Pg 5757); stn 123F, 11°31.8'S, 47°23.5'E, SE Glorieuses Islands, 700 m, 12.04.1977: 1 ♂ sl 19.4 mm (MNHN Pg 5758).

Madagascar. *Vauban*: stn CH 2, 12°53.3'S, 48°09.4'E, 480-520 m, 04.03.1971: 1 ♂ sl 12.9 mm (MNHN Pg 5751); stn CH 23, 12°28.2'S, 48°11.8'E, 600-605 m, 19.01.1972: 2 ♂ sl 13.2 and 19.9 mm (MNHN Pg 5752); stn CH 29, 12°43.1'S, 48°11.1'E, 540 m, 13.09.1972: 2 ♂ sl 8.5 and 10.5 mm (MNHN Pg 5753); stn CH 30, 12°40'S, 48°09.5'E, 595-605 m, 13.09.1972: 2 ♂ sl 11.8 and 16.0 mm, 2 ♀ sl 9.9 and 10.2 mm (MNHN Pg 5755); stn CH 38, 12°50'S, 48°09.1'E, 580-585 m, 14.09.1972: 3 ♂ sl 15.0-17.0 mm (MNHN Pg 5754).

Réunion. 350-500 m, 02.02.1974: 1 ovig. ♀ sl 17.5 mm (MNHN Pg 5756).

Additional material recorded by Lemaitre (1994).

DESCRIPTION. — Gills with lamellae (Fig. 1i₁) at most distally divided. Shield length in males 5.1-24.0 mm, females 7.5-19.5 mm, ovigerous females 12.4-18.6 mm. Shield (Fig. 27a) broader than long; dorsal surface usually with irregularly-shaped, weakly calcified areas; anterior margins straight; lateral projections broadly subtriangular, terminating acutely or bluntly. Rostrum broadly triangular, with low dorsal ridge.

Ocular peduncles less than 0.5 x shield length, naked, or with scattered setae dorsally. Ocular acicles subtriangular, terminating in strong spine (rarely bifid on 1 side). Corneae weakly dilated.

Antennular peduncle exceeding distal margin of cornea by about 0.3 x length of penultimate segment.

Antennal peduncle exceeding distal margin of cornea by about 0.5 x length of fifth segment. Fourth segment unarmed. Antennal acicle at most slightly exceeding distal margin of cornea; mesial margin setose, armed with 10-18 small spines. Flagellum long, articles with scattered short setae < half length of 1 article.

Maxillule with external lobe of endopod obsolete, internal lobe with 3-8 long setae distally (Fig. 1i₂). Sternite of third maxillipeds with small spine on each side of midline. Epistomial spine short and straight.

Chelipeds dissimilar, slender; right and left each with dense, plumose setae obscuring surfaces of chela and carpus, and on left also distal half of merus. Right cheliped (Fig. 26d) with chela about 2.0 x (♀) or 2.5 x (♂) as long as broad. Palm with dorsomesial and dorsolateral margins well defined by irregular rows of spines; mesial surface rounded, with small spines; dorsal surface unarmed; ventral surface smooth, or with many small tubercles or spines. Carpus with numerous small tubercles or spines on dorsal and ventral surfaces.

Left cheliped (Figs 26c, 27b) well calcified. Chela unarmed. Carpus with irregular row of small spines (in large specimens sl "e 20.0 mm usually on crest-like dorsal margin).

Ambulatory legs (Figs 27c-e) similar except for longer segments on right. Dactylus about 1.3 x (first leg) or 1.7 x (second leg) as long as propodus; with irregular row of 20-45 small corneous spines on ventromesial margin. Carpi each with small dorsodistal spine. Merus (Fig. 27c) and ischium of first leg with irregular rows of small spines on ventral margin. Anterior lobe of sternite of second legs unarmed, or with 1 or 2 submarginal spines.

Fourth pereopod (Fig. 27f) semichelate. Propodal rasp consisting of 3 or 4 irregular rows of conical scales.

Fifth pereopod semichelate. Propodal rasp extending to mid-length of propodus.

Uropods asymmetrical, telson terminal lobes weakly so. Exopod of left uropod 3.0 or more times as long as broad. Telson (Fig. 27g) with lateral indentations; posterior margin separated into 2 lobes by rounded, deep (U-shaped) cleft; lobes armed distally with numerous weak corneous spines.

Male first gonopod with ovate, weakly concave distal lobe. Second gonopod with distal segment nearly flat.

Color (based on Lemaitre 1994: 419, fig. 28d): entire body cream-yellow.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — Dall (1903: 61) described specimens from the Hawaiian Islands of what he believed to be a new deep-water gastropod shell (*Stylobates aeneus*) with a "flexible, horny consistency", found occupied

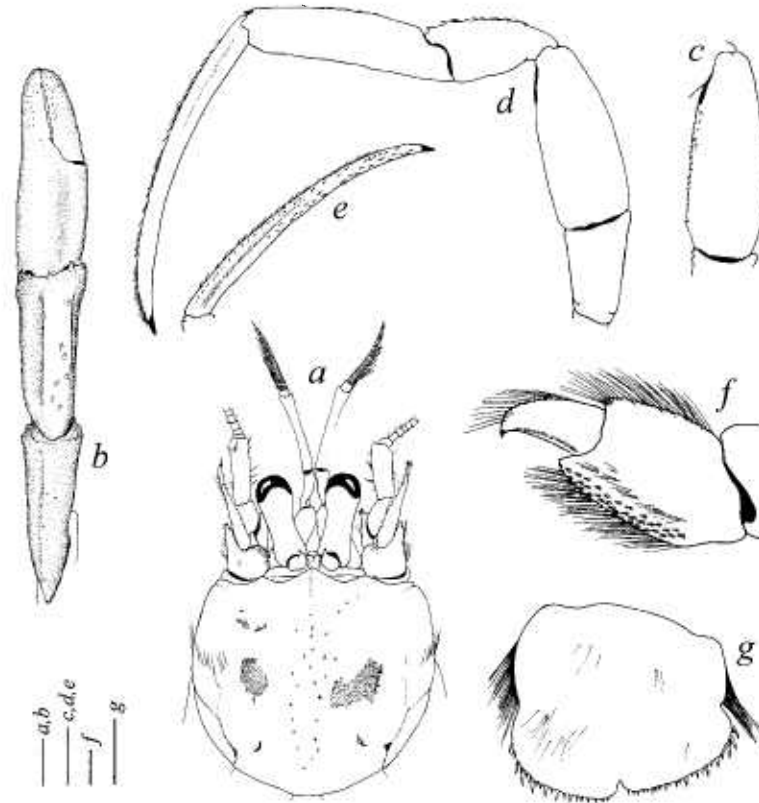


FIG. 27. *Sympagurus dofleini* (Balss, 1912), Marara stn 311, Gambier Archipelago (MNHN Pg 5139): a-f, male, sl 21.8 mm; g, male, sl 19.5 mm: a, shield and cephalic appendages, dorsal view; b, left cheliped, dorsal view; c, merus of left first ambulatory leg, lateral; d, left second ambulatory leg, lateral view; e, dactylus of same, mesial view; f, propodus and dactylus of left fourth pereopod, lateral view; g, telson, dorsal view (from Lemaitre 1994). Scales = 5 mm (a-e), 1 mm (f), and 2 mm (g).

FIG. 27. *Sympagurus dofleini* (Balss, 1912), Marara stn 311, archipel des Gambier (MNHN Pg 5139): a-f, mâle, sl 21,8 mm ; g, mâle, sl 19,5 mm : a, bouclier et appendices céphaliques, vue dorsale ; b, chélipède gauche, vue dorsale ; c, mérus de la première patte marcheuse gauche, vue latérale ; d, deuxième patte marcheuse gauche, vue latérale, côté externe ; e, dactyle de la même patte, vue latérale, côté interne ; f, propode et dactyle du quatrième péréiopode gauche, vue latérale ; g, telson, vue dorsale (d'après Lemaitre 1994). Échelles = 5 mm (a-e), 1 mm (f), and 2 mm (g).

Zarenkov (1990) described *Parapagurus rectichela* exclusively based on specimens from the Sala y Gómez Ridge, in the southeastern Pacific. He separated his taxon from *S. dofleini* on the basis of slight differences in length of the ocular peduncles, dilation of the corneae, and armature of the antennal acicles. Subsequently, Zhadan (1997) suggested that differences between these two taxa could represent only geographic intraspecific variations, but indicated that more specimens needed to be studied from the whole Indo-Pacific before the two could be synonymized. An evaluation of Zarenkov's (1990) description of *P. rectichela* Zarenkov, 1990, and a comparison of some of his paratypes with a large number of specimens of *S. dofleini* from throughout the Indo-Pacific region has confirmed that Zarenkov's and Balss' taxa are indeed conspecific. Characters similar to those described by Zarenkov (1990) for *P. rectichela* have been found in the extensive material herein examined of *S. dofleini*, and evidently are subject to intraspecific variation.

by "hermit crabs". He indicated that the shells were each "completely covered by the extended basal membrane of a large *Actinia*". Dall (1919) later admitted that he had committed a "blunder", and that the "shells" were actually produced as secretions by the anemone. The hermit crabs occupying these "shells" were most likely *S. dofleini*.

Balss (1913: 50) indicated that the type specimen of *Parapagurus dofleini* Balss, 1912 was in a shell of "Turbo", but the housing, still preserved with the holotype, is actually a pseudo-shell or carcinoecium produced by an anemone of the genus *Stylobates*. Examples of this species are commonly found living symbiotically with *S. aeneus* Dall, 1903 (see Fautin Dunn *et al.* 1981; Fautin & Liberman 1983; Fautin 1987). Lemaitre (1994) reported from French Polynesia specimens living in an unidentified zoanthid (probably *Epizoanthus* sp.).

DISTRIBUTION. — Japan, Indonesia (Borneo), Mariana Islands (Guam), Australia, New Caledonia, Wallis and Futuna, Samoa, Tonga, Hawaiian Islands, French Polynesia, Nazca, and Sala y Gómez ridges, Zanzibar, Mozambique Channel, Madagascar and Réunion, 183-950 m (Fig. 34).

REMARKS. — De Saint Laurent (1972) compared the holotype of *Sympagurus dofleini* with the description and figures of *Parapagurus ijimai* Terao, 1913 and concluded that the two were synonymous. Examination of the holotype of *P. ijimai* has confirmed this observation.

As indicated by Lemaitre (1994), Miyake's (1978) report and figures of *Parapagurus dofleini* appear to represent a species of *Strobopagurus* Lemaitre, 1996 rather than *S. dofleini*.

***Sympagurus chani* n. sp.**

Figs 28, 29, 34, 35e

TYPE MATERIAL. — Taiwan (holotype and paratype). TAIWAN 2000: stn CP 32, 22°01.7'N, 120°11.1'E, 910 m, 30.07.2000: holotype ♂ sl 6.4 mm (NTOU T2000-32); stn CP 23, 22°11.9'N, 120°02.9'E, 876 m, 29.07.2000: 1 ♂ sl 6.9 mm (MNHN).

MATERIAL EXAMINED. — The type material (see above).

DESCRIPTION. — Gills with lamellae (Fig. 28a) at most distally divided. Shield length (2 adult males) 6.4 and 6.9 mm (females unknown). Shield (Fig. 28b) about as long as broad, with scattered setae, dorsal surface well calcified except for small subcircular or ovate areas on posterior half, linea of dehiscence moderately marked, anterior margins weakly concave; lateral projections broadly subtriangular, with blunt apex; anterolateral margins slightly sloping, weakly concave; posterior margin broadly rounded. Rostrum bluntly subtriangular, overreaching lateral projections, with short mid-dorsal ridge. Anterodistal margin of branchiostegite broadly rounded, unarmed, setose.

Ocular peduncles more than 0.5 x length of shield, weakly constricted medially, with row of long setae dorsally. Cornea moderately dilated. Ocular acicles subtriangular, terminating in bifid spine; separated basally by less than basal width of 1 acicle.

Antennular peduncle exceeding distal margin of cornea by slightly more than length of ultimate antennular segment. Ultimate segment about 2.0 x as long as penultimate segment, with scattered setae. Basal segment with strong ventromesial spine; lateral surface with distal subrectangular lobe armed with 1 or 2 small spines, and strong spine proximally. Ventral flagellum with 7 articles.

Antennal peduncle (Fig. 28c) exceeding distal margin of cornea by 0.2-0.3 x length of fifth segment. Fifth segment unarmed, with scattered setae on lateral and mesial margins. Fourth segment unarmed. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in spine; mesial margin with strong spine on dorsodistal angle. First segment with small, blunt spine (left) or unarmed (right) on lateral surface; ventromesial angle produced, with row of small spines laterally. Antennal acicle reaching to distal margin of cornea, terminating in strong spine; mesial margin setose, armed with 5-7 spines. Flagellum (missing on right side) long, exceeding extended right cheliped and ambulatory legs; with scattered short setae > 1 flagellar article in length.

Mandible with 3-segmented palp. Maxillule with external lobe of endopod moderately developed, not recurved, internal lobe with 2 long setae distally. Maxilla with endopod slightly exceeding distal margin of scaphognathite. First maxilliped with endopod slightly exceeding exopod in distal extension. Second maxilliped without distinguishing characters. Third maxilliped with crista dentata having 11 corneous-tipped teeth; coxa and basis each with mesial tooth. Sternite of third maxillipeds with strong spine on each side of midline. Epistomial spine short and straight.

Chelipeds markedly dissimilar. Right cheliped (Fig. 28d) with moderately dense plumose setae on dorsal and ventral surfaces of fingers, and lateral and mesial margins of palm and carpus; ventral surfaces of merus and carpus densely setose. Fingers nearly straight, each terminating in small corneous claw; cutting edges each with irregularly-sized calcareous teeth, and rows of tufts of setae dorsally and ventrally near cutting edges. Dactylus set at weak angle relative to longitudinal axis of palm, subequal in length to mesial margin of palm; mesial margin with irregular rows of small spines. Fixed finger with weak row of spines on lateral margin. Palm slightly broader than long; dorsolateral and dorsomesial margins delimited by irregular rows of small spines; mesial surface rounded, with scattered small spines; dorsal surface smooth except for 2 small blunt spines proximomedially; ventral surface unarmed, smooth. Carpus distinctly longer than broad; with numerous small spines on dorsal surface; dorsodistal margin with row of small, blunt spines and fringe of setae; mesial surface

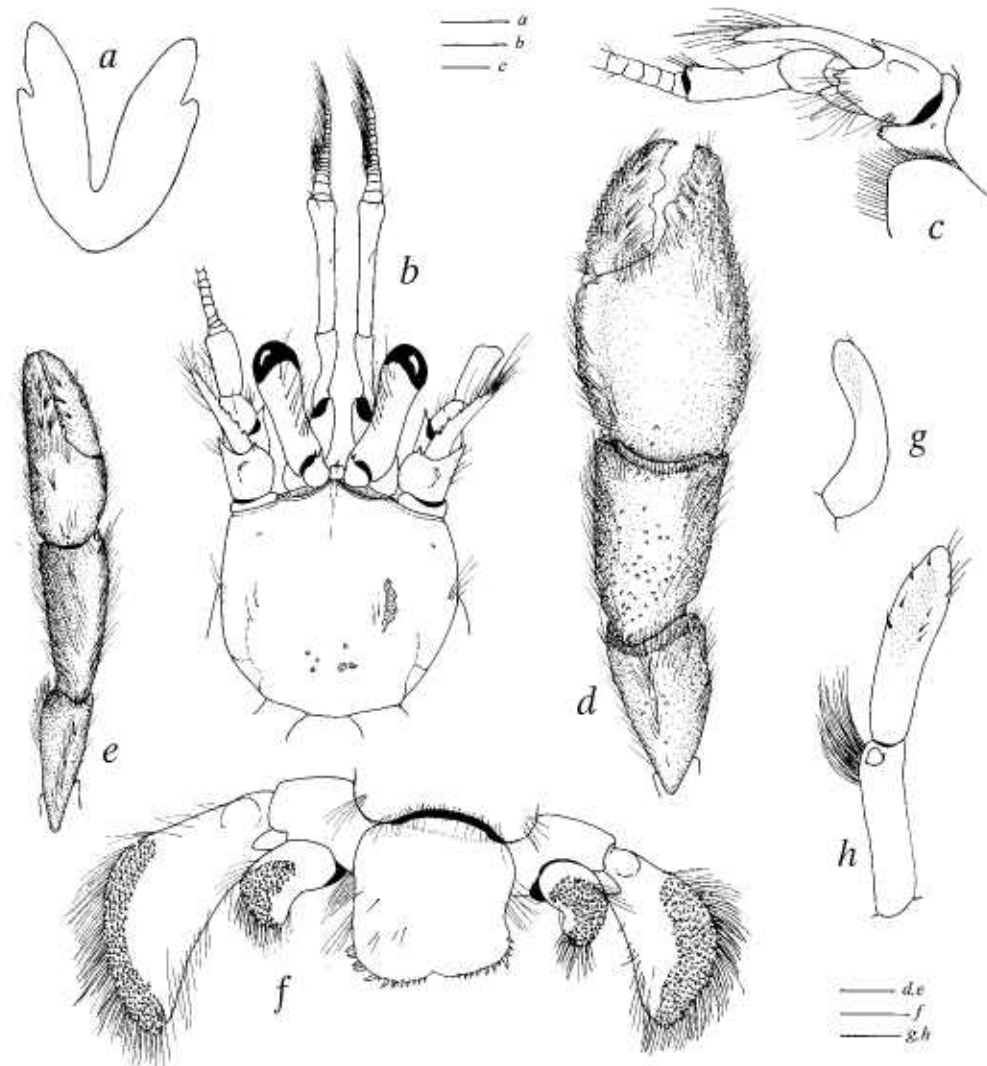


FIG. 28. *Sympagurus chani* n. sp., holotype, mâle, sl 6.4 mm, TAIWAN 2000 stn CP 32, Taiwan (NTOU T2000-32): a, lamelle of posterior arthrobranch (midportion) of fourth pereopod; b, shield and cephalic appendages (right antennal flagellum regenerating), dorsal view; c, left antennal peduncle, lateral view; d, right cheliped, dorsal view; e, left cheliped, dorsal view; f, uropods and telson, dorsal view; g, left first pleopod, mesial view; h, left second pleopod, anterior view. Scales = 0.5 mm (a, g, h), 2 mm (b, d, e), and 1 mm (c, f).

FIG. 28. *Sympagurus chani* n. sp., holotype, mâle, sl 6.4 mm, TAIWAN 2000 stn CP 32, Taiwan (NTOU T2000-32): a, lamelle de l'arthrobranchie postérieure (partie moyenne) du quatrième péréopode; b, bouclier et appendices céphaliques (flagelle de l'antennule droite régénérée), vue dorsale; c, pédoncule antennaire gauche, vue latérale; d, chélopède droit, vue dorsale; e, chélopède gauche, vue dorsale; f, uropodes et telson, vue dorsale; g, premier pléopode gauche, vue latérale, côté interne; h, second pléopode gauche, vue antérieure. Échelles = 0,5 mm (a, g, h), 2 mm (b, d, e), and 1 mm (c, f).

strongly sloping; ventromesial and ventrolateral distal margins each with row of small spines; ventral surface with few small, blunt spines. Merus with dorsal surface moderately setose, with scattered small, blunt spines on dorsal and dorsolateral surfaces; dorsodistal margin with fringe of setae; ventromesial margin with row of strong spines; ventrolateral margin with row of small spines. Ischium setose dorsally and ventrally; ventromesial margin with irregular row of small spines distally and 1 spine proximally. Coxa with row of small spines on setose ventrodistal margin.

Left cheliped (Fig. 28e) well calcified, with moderately dense, mostly plumose setae on merus, carpus and chela. Fingers terminating in sharp corneous claws; dorsal surfaces unarmed except for tufts of setae. Dactylus shorter than length of

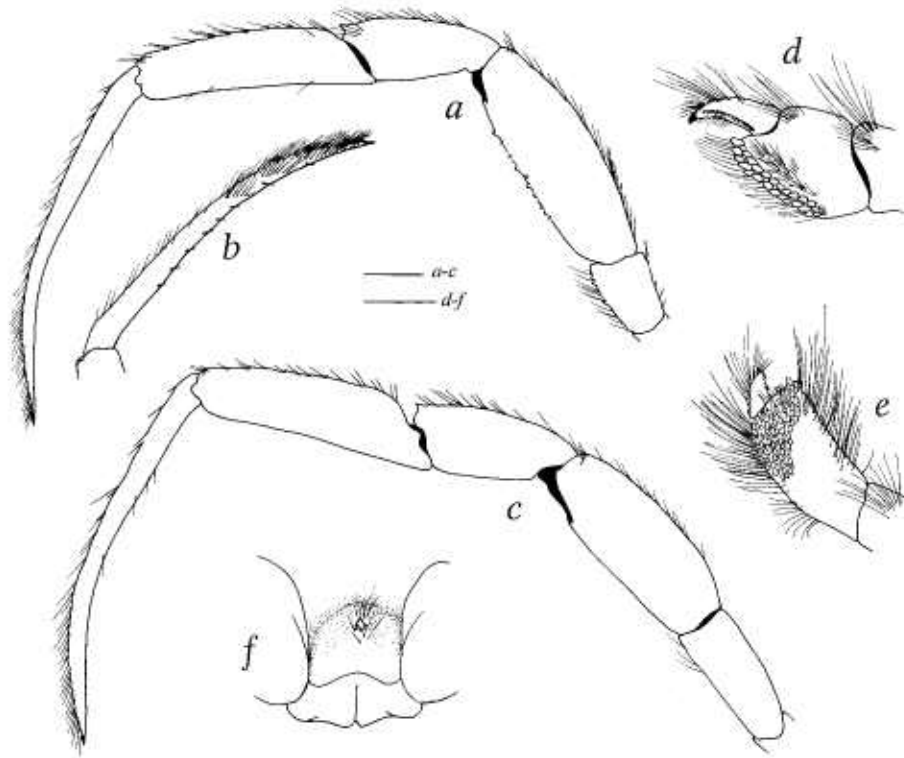


FIG. 29. *Sympagurus chani* n. sp., holotype, male, sl 6.4 mm, TAIWAN 2000 stn CP 32, Taiwan (NTOU T2000-32): a, left first ambulatory leg, lateral view; b, dactylus of same, mesial view; c, left second ambulatory leg, lateral view; d, propodus and dactylus of left fourth pereopod, lateral view; e, propodus and dactylus of left fifth pereopod, lateral view; f, sternite of second ambulatory legs, ventral view. Scales = 2 mm (a-c), and 1 mm (d-f).

FIG. 29. *Sympagurus chani* n. sp., holotype, mâle, sl 6,4 mm, TAIWAN 2000 stn CP 32, Taïwan (NTOU T2000-32) : a, première patte marcheuse gauche, vue latérale, côté externe ; b, dactyle de la même patte, vue latérale, côté interne ; c, deuxième patte marcheuse gauche, vue latérale ; d, propode et dactyle du quatrième péréiopode gauche, vue latérale ; e, propode et dactyle du cinquième péréiopode gauche, vue latérale ; f, sternite des deuxièmes pattes marcheuses, vue ventrale. Echelles = 2 mm (a-c), and 1 mm (d-f).

mesial margin of palm; cutting edge with row of closely-spaced, small corneous teeth. Fixed finger with cutting edge consisting of regularly-spaced small calcareous teeth interspersed with small corneous teeth. Palm unarmed. Carpus with small dorsodistal spine. Merus unarmed dorsally except for row of setae; ventromesial margin with row of long setae. Ischium with small spine on ventromesial margin proximally. Coxa and ischium each with row of setae on ventromesial margins.

Ambulatory legs (Figs 29a-c) similar except for longer segments on right, exceeding extended right cheliped. Dactylus nearly 2.0 x as long as propodus, terminating in sharp corneous claw; with dorsal and dorsomesial rows of long setae, and ventromesial row of 6-8 corneous spinules (Fig. 29b). Propodus with row of setae dorsally and scattered setae ventrally. Carpus with small dorsodistal spine, with setae dorsally. Merus with row of setae dorsally, ventral margin with row of small spines (first leg) or unarmed (second leg). Coxa and ischium with ventromesial margins setose. Anterior lobe of sternite of second legs (Fig. 29f) rounded, setose, with small submarginal spine.

Fourth pereopod (Fig. 29d) semichelate. Dactylus subtriangular, terminating in corneous claw; with ventrolateral row of small corneous spinules. Propodal rasp longer than propodal height; rasp consisting of 2 rows of ovate scales. Carpus with long setae dorsally, merus with long setae dorsally and ventrally.

Fifth pereopod (Fig. 29e) semichelate. Dactylus with row of ovate scales on lateral surface. Propodal rasp extending posteriorly to about mid-length of segment.

Uropods and telson (Fig. 28f) asymmetrical. Exopod of left uropod 2.5 x as long as wide; anterior margin broadly rounded; with moderately broad rasp. Telson with sparse setae dorsally, and long setae on lateral margin; with weak lateral

indentations; posterior margin divided into 2 lobes by narrow, angled (V-shaped) cleft; margins of lobes armed distally with 15 (left) or 11 (right) corneous spines.

First and second male gonopods moderately developed. First gonopod (Fig. 28g) with distal lobe having weakly concave mesial surface. Second gonopod (Fig. 28h) with rudimentary exopod (left side only), terminating in rounded tip; distal segment with weakly concave anterior surface, row of 4 short bristles on lateral margin medially, and sparse row of setae distally on mesial margin and anterior surface; basal segment with long setae on posterior surface.

Color (Fig. 35e): shield with reddish areas medially, laterally and posteriorly, otherwise white. Ocular peduncles white dorsally, reddish laterally and mesially. Antennules reddish. Antennae with flagella reddish. Posterior carapace reddish. Right cheliped white except for reddish areas lateroproximally on merus. Left cheliped white except for reddish areas on dorsomesial surfaces of fingers, and lateroproximally on merus. Ambulatory legs with meri, carpi, propodi and dactyls white on dorsal and dorsolateral surfaces, and reddish on ventral and ventrolateral surfaces. Fourth and fifth pereopods reddish. Abdomen transparent. Uropods and telson with white and reddish areas.

HABITAT. — Unknown.

DISTRIBUTION. — Off southwestern coast of Taiwan, 910 m (Fig. 34).

REMARKS. — This new species superficially resembles *S. affinis*. Both species have bifid or multifid ocular acicles, and the right chelipeds have similar shape and armature, but they differ markedly in other characters. In *S. chani* the gill lamellae are at most distally divided (Fig. 28a), the propodal rasp of the fourth pereopod has two rows of scales (Fig. 29d), and the ambulatory legs have a distinct reddish coloration (Fig. 35e) on the ventral and ventrolateral surfaces of the meri, carpi, propodi and dactyls. By contrast, in *S. affinis* the gill lamellae are deeply divided (Fig. 1f₁); the propodal rasp of the fourth pereopod has one row of scales (Fig. 14f); and the ambulatory legs have a light orange color on the lateral surfaces of the segments that are darker on the meri than on the carpi and propodi (Fig. 35c).

ETYMOLOGY. — This species is dedicated to Dr. Tin-Yam Chan (NTOU), who collected this and other parapagurids in collaboration with French colleagues, and in recognition of his outstanding contributions to the increase of knowledge of decapod crustaceans from Taiwan and other regions of the world oceans.

Sympagurus burkenroadi Thompson, 1943

Figs 1j₁, 2, 30, 34

Sympagurus burkenroadi Thompson, 1943: 419, fig. 1.

Sympagurus papposus Lemaitre, 1996: 180, figs 3c, d, 5b, 8-10. New synonymy.

Sympagurus burkenroadi – Gordan 1956: 341. — Lemaitre 1994: 387. — Zhadan in press.

Parapagurus dofleini – de Saint Laurent 1972: 105 (in part not *P. dofleini* Balss, 1912).

Sympagurus papposus – Lemaitre 1997: 576; 2000: 211, fig. 67. — Zhadan in press.

TYPE MATERIAL. — *Sympagurus burkenroadi*. Zanzibar (holotype and paratypes). *Mabahiss*: stn 115, 5°05'18"S, 39°22'12"E, 640-658 m, 15.01.1934: holotype ♂ sl 10.4 mm (BMNH 1952.6.17.56); 2 ovig. ♀ sl 5.8 and 9.8 mm (BMNH 1952.6.17.57-58).

Sympagurus papposus. New South Wales. *Kapala*: stn K75-01-02, East of Broken Bay, 33°34'S, 152°01'E, 786-804 m: holotype ovig. ♀ sl 14.3 mm (AMS P44482).

OTHER MATERIAL EXAMINED. — Japan. *Tansei Maru*: off Taito-saki, Boso Peninsula, 35°07.8'N, 140°49'E, 400-420 m, 26.04.1995: 1 ♂ sl 15.2 mm (USNM 1000040).

South China Sea. Tong-Sha Island (no depth), 23.04.1995: 1 ♀ sl 9.5 mm (NTOU).

New Caledonia. MUSORSTOM 5: stn 324, 21°15.01'S, 157°51.33'E, 970 m, 14.10.1986: 1 ovig. ♀ sl 9.3 mm (MNHN Pg 6087). — BATHUS 2: stn CP 767, 22°10'S, 165°59'E, 1060-1450 m, 17.05.1993: 1 ♂ sl 4.1 mm (MNHN Pg 6000); stn CP 771, 22°09'S, 166°01'E, 610-800 m, 18.05.1993: 1 ♂ sl 6.0 mm

(MNHN Pg 6001). — BATHUS 3: stn CC 841, 23°02'S, 166°53'E, 640-680 m, 30.11.1993: 1 ♀ sl 7.5 mm (MNHN Pg 6002); stn CP 842, 23°05'S, 166°47'E, 830 m, 01.12.1993: 1 ♀ sl 8.8 mm (MNHN Pg 6003). — HALIPRO 1: stn CH 874, 23°05'S, 166°48'E, 708-830 m, 30.03.1994: 2 ♂ sl 4.7 and 6.0 mm, 1 ovig. ♀ sl 8.4 mm (MNHN Pg 6004).

Mozambique. *Anton Bruun*: stn 398B, 22°25'S, 35°54'E, 740 m, 01.10.1964: 1 ♂ sl 9.2 mm, 1 ♀ sl 7.5 mm, 2 ovig. ♀ sl 9.5 and 9.7 mm (USNM 309742).

Madagascar. *Vauban*: stn CH 5, 12°44.8'S, 48°10.6'E, 570-563 m, 05.03.1971: 3 ♂ sl 8.2-11.0 mm, 1 ovig. ♀ sl 10.4 mm (MNHN Pg 5759).

DESCRIPTION. — Gills with lamellae (Fig. 1j₁) at most distally divided. Shield length in males 4.1-17.1 mm, females 6.1-13.9 mm, ovigerous females 5.8-14.7 mm. Shield (Fig. 30a) about as broad as long, dorsal surface sometimes weakly calcified medially; lateral projections broadly triangular, sometimes nearly obsolete. Rostrum broadly triangular, rounded or pointed distally, with short mid-dorsal ridge.

Ocular peduncles about 0.5 x length of shield. Corneae slightly dilated. Ocular acicles subtriangular, terminating in strong spine occasionally bifid or trifid on 1 or both sides, separated basally by less than basal width of 1 acicle.

Antennular peduncle exceeding distal margin of cornea by half length of penultimate segment.

Antennal peduncle exceeding distal margin of cornea by approximately 0.5 x to nearly full length of fifth segment. Fourth segment unarmed. Second segment with dorsolateral distal angle produced, terminating in strong, bifid or multifid spine; mesial margin with spine on dorsodistal angle. First segment unarmed or with small tubercle on lateral surface. Antennal acicle nearly straight (dorsal view), exceeding distal margin of cornea by 0.2-0.5 x length of acicle, terminating in strong spine; mesial margin setose, armed with 7-13 well-spaced spines. Flagellum naked or with inconspicuous short setae < half 1 flagellar article in length.

Maxillule with external lobe of endopod weakly developed, internal lobe with 2-5 long setae distally (Fig. 1j₂). Sternite of third maxillipeds with spine on each side of midline. Epistome unarmed or with short, sharp or blunt spine.

Chelipeds markedly dissimilar, covered with dense, plumose setae obscuring surfaces. Right cheliped (Fig. 30b) with fingers straight. Dactylus set at weakly oblique angle to longitudinal axis of palm; mesial surface rounded, with irregular rows of small spines. Palm about as long as broad; lateral and mesial surfaces rounded, with irregular rows of well-spaced, small spines; dorsal and ventral surfaces smooth or with longitudinal, irregular rows of small spines or tubercles medially. Carpus with small, well-spaced tubercles or spines on dorsal surface, dorsodistal margin unarmed. Merus with dorsal surface similar to that of carpus; ventromesial margin with row of small spines.

Left cheliped (Fig. 30c) well calcified. Dactylus about 1.3 x as long as palm. Palm unarmed dorsally or occasionally with dorsomesial row of small tubercles or spines. Carpus with dorsal surface unarmed, or occasionally with row of small tubercles or spines on dorsal margin. Merus with dorsal surface unarmed or at most with small, low tubercles on dorsal margin.

Ambulatory legs (Figs 30d, e) similar except for longer segments on right. Dactylus about 1.4 x as long as propodus; with dorsomesial row of long setae, and ventromesial row of about 17-30 small corneous spines (Fig. 30e). Carpus with small dorsodistal spine (often blunt). Merus of first leg usually with row of small spines on ventral margin. Anterior lobe of sternite of second legs with strong submarginal spine (sometimes bifid).

Fourth pereopod (Fig. 30f) semichelate. Propodal rasp consisting of 2 or 3 rows of conical scales at least distally.

Fifth pereopod semichelate. Propodal rasp extending to mid-length of segment.

Uropods and telson strongly asymmetrical. Telson (Fig. 30g) with lateral indentations separating anterior and posterior lobes; female with ventrolateral margin of left anterior lobe (sometimes also right lobe) with cluster of slender, corneous spines and long bristles, dorsal surface sometimes with numerous short bristles on posterior half; male with ventrolateral margins of anterior lobes usually only with long setae; both sexes with distal margin of posterior lobes separated by rounded (U-shaped) or angled (V-shaped) cleft, lobes armed with corneous spines.

Males with paired first and second gonopods well developed. First gonopod with weakly concave distal lobe. Second gonopod occasionally with rudimentary exopod on left or right; distal segment nearly flat, with row of short bristles on lateral margin medially, and short setae on distal half of mesial margin and anterior surface; basal segment with long setae on posterior surface. Females rarely with rudimentary paired first pleopods, and vestigial second right pleopod.

Color in life unknown.

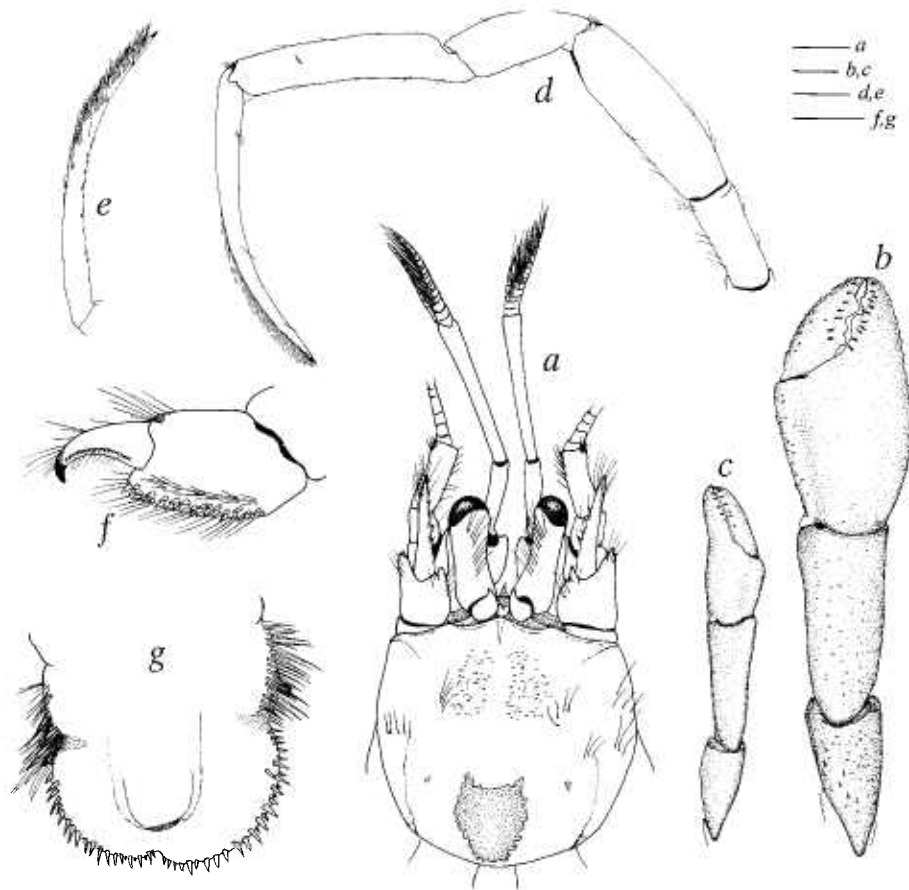


FIG. 30. *Sympagurus burkenroadi* Thompson, 1943: a, f, g, ovig. female, sl 9.3 mm, MUSORSTOM 5 stn 324, New Caledonia (MNHN Pg 6087); b-e, male, sl 12.1 mm (paratype of *S. papposus* Lemaître, 1996), Western Australia (NTM Cr 6863) (from Lemaître 1996): a, shield and cephalic appendages; b, right cheliped, dorsal view; c, left cheliped, dorsal view; d, left first ambulatory leg, lateral view; e, dactylus of same, mesial view; f, propodus and dactylus of left fourth pereopod, lateral view; g, telson, ventral view. Scales = 2 mm (a), 5 mm (b, c), 4 mm (d, e), and 1 mm (f, g).

FIG. 30. *Sympagurus burkenroadi* Thompson, 1943 : a, f, g, femelle ovigère, sl 9,3 mm, MUSORSTOM 5 stn 324, Nouvelle-Calédonie (MNHN Pg 6087); b-e, male, sl 12,1 mm (paratype de *S. papposus* Lemaître, 1996), Western Australia (NTM Cr 6863) (d'après Lemaître 1996) : a, bouclier et appendices céphaliques ; b, chélopède droit, vue dorsale ; c, chélopède gauche, vue dorsale ; d, première patte marcheuse gauche, vue latérale, côté externe ; e, dactyle de la même patte, vue latérale, côté interne ; f, propode et dactyle du quatrième péréiopode gauche, vue latérale ; g, telson, vue ventrale. Échelles = 2 mm (a), 5 mm (b, c), 4 mm (d, e), and 1 mm (f, g).

HABITAT AND SYMBIOTIC ASSOCIATIONS. — Usually found living in large zoanths (*Epizoanthus* sp.). A number of invertebrates such as hydroids, turbellarian worms, and copepods, have been found living inside the zoanths occupied by this hermit crab (Zhadan in press).

DISTRIBUTION. — Japan, South China Sea, New Caledonia, Indonesia, Australia, Mozambique Channel and Madagascar, 205-1120 m (Fig. 34).

REMARKS. — *Sympagurus burkenroadi* is most similar to *S. dofleini*. The morphological differences that exist between these two species were summarised by Lemaître (1996: 184) under his description of *S. papposus* (= *S. burkenroadi*). Occasionally, specimens of *S. burkenroadi* with bifid or trifid ocular acicles are encountered, which bear some resemblance to *S. trispinosus*. In such cases, the two species can be separated primarily by differences in the segments of the ambulatory legs, and armature of the telson. The meri, carpi and propodi of the ambulatory legs are more elongated in *S. burkenroadi* than

in *S. trispinosus*. The ventrolateral margin of the left anterior lobe of the telson in females has slender, corneous spines and bristles in *S. burkenroadi*, whereas there are only long setae in *S. trispinosus*. In addition, *S. burkenroadi* usually lives using a zoanthid as shelter, whereas *S. trispinosus* uses an actinian of the genus *Stylobates* (see Fautin Dunn *et al.* 1981; Fautin 1987).

De Saint Laurent (1972) considered *Sympagurus burkenroadi* Thompson, 1943 to be a junior synonym of *Parapagurus dofleini* Balss, 1912 (= *Sympagurus dofleini*), although Lemaitre (1994) questioned that synonymy on the basis of Thompson's (1943) description and figures alone. Subsequently, Zhadan (in press) examined the types of Thompson's *Sympagurus burkenroadi* and concluded that it is a valid species widely distributed in the western Indian Ocean. Zhadan (in press) also suggested that *S. papposus* Lemaitre, 1996 might be synonymous with *S. burkenroadi*. During the present study, a re-examination of the type material confirmed that *S. papposus* is indeed a junior synonym of *S. burkenroadi*.

***Sympagurus villosus* Lemaitre, 1996**

Figs 1*k*_{1, 2}, 31, 32, 34

Sympagurus villosus Lemaitre, 1996: 191, figs 14b-c, 15, 16.

Sympagurus villosus – Lemaitre 2000: 211.

TYPE MATERIAL. — Queensland. *Soela*: stn 685-09, Marion Plateau, 22°57'S, 154°25.5'E, 678-695 m, 18.11.1985: holotype ♂ sl 13.8 mm (NTM Cr 010912). Paratypes listed by Lemaitre (1996: 191).

MATERIAL EXAMINED. — New Caledonia. MUSORSTOM 5: stn CP 364, 19°45.30'S, 158°46.50'E, 675 m, 19.10.1986: 1 ♀ sl 8.6 mm (USNM 1000042). — MUSORSTOM 6: stn CP 427, 20°23.35'S, 166°20'E, 800 m, 17.02.1989: 1 ♀ sl 6.4 mm (USNM 1000041). — BATHUS 3: stn DW 800, 23°55'S, 169°36'E, 655 m, 26.11.1993: 1 ovig. ♀ sl 11.7 mm (MNHN Pg 6005). Wallis and Futuna. MUSORSTOM 7: stn CP 559, 11°47.8'S, 178°19.1'W, 552-547 m, 19.05.1992: 2 ♂ sl 11.2 and 11.5 mm (MNHN Pg 6088); stn CP 631, 11°54'S, 179°32'W, 600 m, 29.05.1992: 1 ovig. ♀ sl 14.3 mm, in large zoanthid (MNHN Pg 6089). Additional material recorded by Lemaitre (1996).

DESCRIPTION. — Gills with lamellae (Fig. 1*k*₁) at most distally divided. Shield length in males 11.2-13.8 mm, females 6.4-8.6 mm, ovigerous female (1 known) sl 11.7 mm. Shield (Fig. 31*a*) about as broad as long, dorsal surface weakly calcified, anterior margins sinuous, lateral projections broadly rounded, anterolateral margins slightly concave. Rostrum broadly triangular, rounded distally, with short mid-dorsal ridge.

Ocular peduncles about 0.5 x shield length, with row of setae dorsally. Corneae weakly dilated. Ocular acicles subtriangular, terminating in strong spine.

Antennular peduncle exceeding distal margin of cornea by 0.5 x length of penultimate segment.

Antennal peduncle exceeding distal margin of cornea by about half length of fifth segment. Second segment with dorsolateral distal angle produced, terminating in bifid or multifid spine; mesial margin with spine on dorsodistal angle. First segment unarmed or with 1 or 2 small spines on lateral surface. Antennal acicle exceeding distal margin of cornea by 0.3-0.5 x length of acicle, terminating in strong spine; mesial margin setose, armed with row of 6-10 spines. Flagellum with scattered setae < 1-2 articles in length.

Maxillule with external lobe of endopod weakly developed, internal lobe with 4 long setae (Fig. 1*k*₂). Sternite of third maxillipeds with strong spine on each side of midline. Epistomial spine short.

Chelipeds markedly dissimilar; mesial and ventral surfaces of meri, and all surfaces on carpi and chelae, covered with dense mat of short plumose setae mixed with long simple, bristle-like setae. Right cheliped (Fig. 31*b*) with fingers nearly straight, terminating in small corneous claws. Dactylus set at weakly oblique angle to longitudinal axis of palm; mesial surface rounded. Palm slightly longer than broad (males) or as long as broad (females); lateral and mesial surfaces rounded, with irregular rows of small blunt to sharp spines; dorsal surface with scattered small spines; ventral surface with scattered

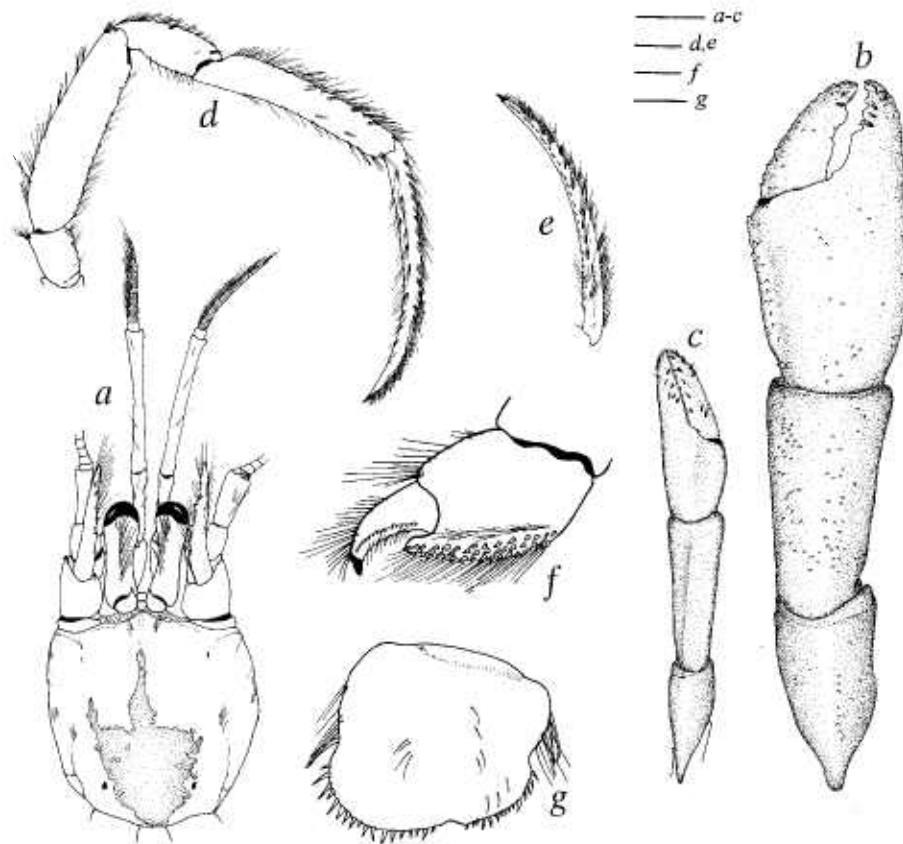


FIG. 31. *Sympagurus villosus* Lemaitre, 1996, Queensland: a, d-g, holotype, male, sl 13.8 mm (NTM Cr 10912); b, c, paratype, male, sl 13.7 mm (QM W16516). a, shield and cephalic appendages, dorsal view; b, right cheliped, dorsal view; c, left cheliped, dorsal view; d, right first ambulatory leg, lateral view; e, dactylus of same, mesial view; f, propodus and dactylus of left fourth pereopod, lateral view; g, telson, dorsal view (from Lemaitre 1996). Scales = 5 mm (a-e), 1 mm (f), and 2 mm (g).

FIG. 31. *Sympagurus villosus* Lemaitre, 1996, Queensland : a, d-g, holotype, mâle, sl 13,8 mm (NTM Cr 10912) ; b, c, paratype, mâle, sl 13,7 mm (QM W16516). a, bouclier et appendices céphaliques, vue dorsale ; b, chélopède droit, vue dorsale ; c, chélopède gauche, vue dorsale ; d, première patte marcheuse droite, vue latérale, côté externe ; e, dactyle de la même patte, vue latérale, côté interne ; f, propode et dactyle du quatrième péréiopode gauche, vue latérale ; g, telson, vue dorsale (d'après Lemaitre 1996). Echelles = 5 mm (a-e), 1 mm (f), and 2 mm (g).

small tubercles. Carpus with moderately dense spines or tubercles on dorsal and ventral surfaces. Merus with scattered small tubercles on lateral surface.

Left cheliped (Fig. 31c) well calcified. Palm unarmed. Carpus unarmed except for small dorsodistal spine.

Ambulatory legs (Figs 31d, e) generally similar except for slightly longer segments on right; meri, carpi, propodi, and dactyls with numerous bristle-like setae (more numerous on dactyl). Dactylus (Fig. 31e) approximately 1.4 x as long as propodus; with dorsal and dorsomesial rows of long setae (setae arranged in tufts on proximal 0.6), and ventromesial row of more than 20 corneous spines. Carpus usually with blunt dorsodistal angle, or small, blunt dorsodistal spine. Merus of first leg with row of small spines on ventral margin; merus of second leg unarmed ventrally. Anterior lobe of sternite of second legs setose, armed with strong submarginal spine.

Fourth pereopod (Fig. 31f) semichelate. Propodal rasp consisting of 2 or 3 irregular rows of conical scales.

Fifth pereopod semichelate. Propodal rasp extending to mid-length of segment.

Uropods and telson strongly asymmetrical. Left exopod of uropod about 3 x as long as broad. Telson (Fig. 31g) with weak lateral indentations; posterior margin divided into 2 lobes by shallow, rounded (U-shaped) cleft; lobes armed distally with weakly curved corneous spines.

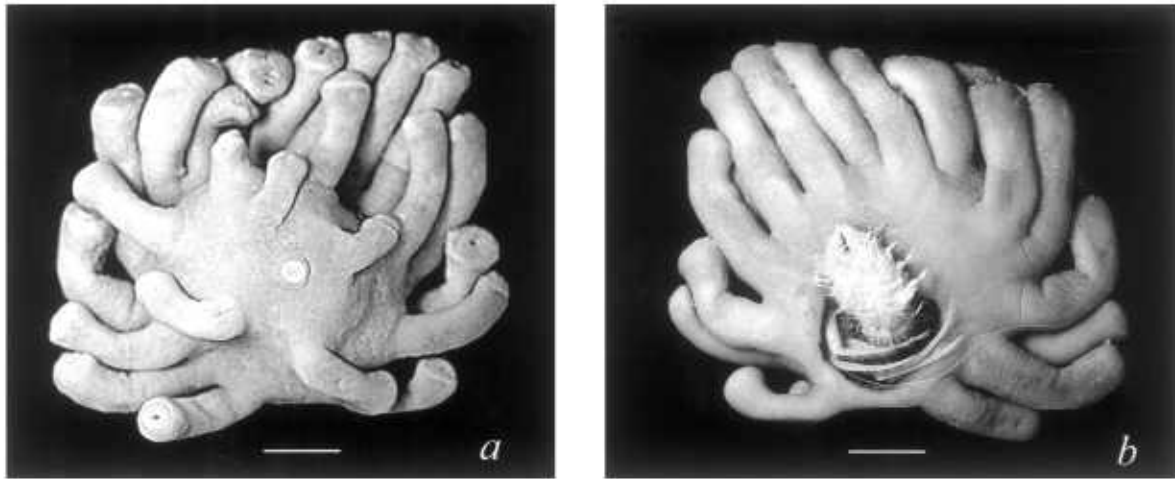


FIG. 32. Zoanthid symbiont of *Sympagurus villosus* Lemaitre, 1996, MUSORSTOM 7 stn CP 631, New Caledonia (MNHN Pg 6089): a, dorsal view; b, ventral view showing hermit crab (ovig. female sl 14.3 mm). Scales = 20 mm.

FIG. 32. Zoanthaire symbiotique de *Sympagurus villosus* Lemaitre, 1996, MUSORSTOM 7 stn CP 631, Nouvelle-Calédonie (MNHN Pg 6089) : a, vue dorsale ; b, vue ventrale montrant le "Bernard l'ermite" (femelle ovigère sl 14,3 mm). Échelles = 20 mm.

Male first gonopod with moderately concave distal lobe. Second gonopod with distal segment nearly flat.

Color in life unknown.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — In zoanthids (*Epizoanthus* sp.) (Fig. 32).

DISTRIBUTION. — New Caledonia and Australia, 490-800 m (Fig. 34).

REMARKS. — *Sympagurus villosus* is most similar to *S. trispinosus*. The two can be separated by features of the ocular acicles, cheliped pilosity, and setation and armature of ambulatory legs. Pilosity of both right and left chelipeds is very dense, consisting of a mat of short plumose setae mixed with numerous long, simple bristle-like setae in *S. villosus*. Pilosity of chelipeds is also dense in *S. trispinosus* but consists of a mat of only short plumose setae. The ocular acicles are simple in *S. villosus*, whereas they are bifid or multifid in *S. trispinosus*. The ventromesial margin of the dactyls of the ambulatory legs each have about 32 spines in *S. villosus*, whereas there are only about 18 spines in *S. trispinosus*. Additionally, *S. villosus* uses zoanthid (*Epizoanthus* sp.) as shelter, whereas *S. trispinosus* typically uses the actinian *Stylobates cancrisocia* (Carlgren) (see Fautin Dunn *et al.* 1981).

Sympagurus trispinosus (Balss, 1911)

Figs 11_{1, 2}, 33, 34

Parapagurus arcuatus var. *trispinosa* Balss, 1911: 3.

Parapagurus arcuatus var. *trispinosa* – Balss 1912: 100, fig. 8, pl. 7, fig. 2, pl. 10, fig. 4.

Parapagurus armatus var. *trispinosus* – Carlgren 1928a: 168, fig. 7, 9G; 1928b: 167, fig. 1b. — Lemaitre 1999: 329.

"*Parapagurus armatus*" – Ross 1967: 306. — McLaughlin 1974: 378. — Lemaitre 1999: 329.

Parapagurus trispinosus – de Saint Laurent 1972: 105. — Fautin Dunn *et al.* 1981: 386, fig. 6. — Fautin 1987: 6.

Sympagurus trispinosus – Lemaitre 1989: 37; 1994: 390, figs 11, 12, 28e; 1996: 190; 1999: 329; 2000: 211. — Spiridonov & Zhadan 1999: 629, fig. 2. — Poupin 1996a: 20, pl. 9e; 1996b: 96. — Zhadan in press.

TYPE MATERIAL. — Zanzibar (lectotype and paralectotype). *Valdivia*: stn DTE-246, Pemba Canal, 05°24'S, 39°19.8'E, 818 m, 22.03.1899: lectotype (Zhadan in press) ♀ sl 9.5 mm (ZSM 313/1 - not seen, *fide* Zhadan in press); ♀ sl 7.6 mm (ZMB 16464 - not seen).

MATERIAL EXAMINED. — South China Sea. Tong-Sha Islands, 23.04.1995 (no depth): 3 ♂ sl 11.2-16.3 mm, 1 ♀ sl 11.1 mm (NTOU). — (No station data) 2 ♂ sl 15.4 and 15.5 mm (NTOU).

New Caledonia. MUSORSTOM 5: stn CP 323, 21°18.52'S, 157°57.62'E, 970 m, 14.10.1986: 1 ♂ sl 6.0 mm (USNM 1000045); stn CP 324, 21°15.01'S, 157°51.33'E, 970 m, 14.10.1986: 1 ovig. ♀ sl 13.9 mm (USNM 1000046); stn CP 364, 19°45.30'S, 158°46.50'E, 675 m, 19.10.1986: 1 ♂ sl 15.8 mm (USNM 1000043); stn CC 365, 19°42.82'S, 158°48'E, 710 m, 19.10.1986: 1 ♂ sl 16.8 mm, 1 ♀ sl 13.9 mm (USNM 1000044); stn CC 383, 19°40.85'S, 158°46.10'E, 615-600 m, 21.10.1986: 1 ♂ sl 16.5 mm (MNHN Pg 6090). — SMIB 8: stn DW 150, 24°54'S, 168°22'E, 519-530 m, 27.01.1993: 1 ♂ sl 2.7 mm (MNHN Pg 6006). — BATHUS 1: stn CP 709, 21°41'S, 166°37'E, 650-800 m, 19.03.1993: 1 ovig. ♀ sl 11.7 mm (MNHN Pg 6007). — BATHUS 2: stn CP 743, 22°35'S, 166°26'E, 713-950 m, 14.05.1993: 1 ♀ sl 2.9 mm (MNHN Pg 6008); stn CP 751, 22°24'S, 166°12'E, 1300-1500 m, 15.05.1993: 1 ovig. ♀ sl 10.3 mm (MNHN Pg 6009); stn CP 755, 22°21'S, 166°13'E, 495 m, 16.05.1993: 2 ♂ sl 12.4 and 14.3 mm, 2 ♀ sl 6.1 and 12.2 mm, 2 ovig. ♀ sl 10.5 and 11.9 mm (MNHN Pg 6010); stn CP 764, 22°09'S, 166°02'E, 560-570 m, 17.05.1993: 1 ♀ sl 10.3 mm, 1 ovig. ♀ sl 10.9 mm (MNHN Pg 6011); stn CP 765, 22°09'S, 166°02'E, 600-630 m, 17.05.1993: 1 ♀ sl 2.5 mm (MNHN Pg 6012); stn CP 767, 22°10'S, 165°59'E, 1060-1450 m, 17.05.1993: 1 ♂ sl 6.7 mm (MNHN Pg 6013), 4 ♂ sl 4.0-11.3 mm, 6 ♀ sl 4.6-7.9 mm, 2 ovig. ♀ sl 10.9 and 11.1 mm; stn CP 771, 22°09'S, 166°01'E, 610-800 m, 18.05.1993: 2 ♂ sl 4.9 and 7.5 mm, 2 ♀ sl 4.4 and 9.4 mm (MNHN Pg 6014). — BATHUS 3: stn CP 842, 23°05'S, 166°47'E, 830 m, 01.12.1993: 1 ovig. ♀ sl 11.5 mm (MNHN Pg 6015); stn CC 848, 23°02'S, 166°52'E, 680-700 m, 01.12.1993: 1 ♂ sl 10.2 mm, 3 ♀ sl 7.3-11.0 mm, 1 ovig. ♀ sl 10.0 mm (MNHN Pg 6016). — HALIPRO 1: stn CP 854, 21°40'S, 166°38'E, 650-780 m, 19.03.1994: 1 ♂ sl 11.8 mm (MNHN Pg 6017). — BATHUS 4: stn CP 950, 20°31'S, 164°56'E, 705-750 m, 10.08.1994: 1 ♀ sl 12.4 mm (MNHN Pg 6018).

Vanuatu. MUSORSTOM 8: stn CC 996, 18°52'S, 168°56'E, 764-786 m, 24.09.1994: ♀ sl 8.5 mm (MNHN Pg 6019); stn CP 1074, 15°48'S, 167°24'E, 775-798 m, 04.10.1994: 1 ♂ sl 14.4 mm (MNHN Pg 6020); stn CP 1080, 15°57'S, 167°27'E, 799-850 m, 05.10.1994: 1 ♂ sl 8.5 mm (MNHN Pg 6021).

Madagascar. *Vauban*: stn CH 22, 12°27'S, 48°07.8'E, 680-700 m, 19.01.1972: 4 ♂ sl 16.8-17.6 mm, 1 ovig. ♀ sl 12.3 mm

(MNHN Pg 5760); stn CH 23, 12°28.2'S, 48°11.8'E, 600-605 m, 19.01.1972: 1 ♂ sl 13.8 mm (MNHN Pg 5761); stn CH 37, 12°51'S, 48°06.3'E, 675-705 m, 14.09.1972: 3 ♂ sl 11.5-13.5 mm, 2 ♀ sl 6.9 and 8.0 mm, 5 ovig. ♀ sl 9.4-11.0 mm (MNHN Pg 5762); stn CH 48, 15°18'S, 46°12.1'E, 480-510 m, 08.11.1972: 2 ♂ sl 10.5 and 11.5 mm (MNHN Pg 5763); stn CH 49, 15°18.3'S, 46°10.3'E, 500-550 m, 08.11.1972: 4 ♂ sl 9.5-12.0 mm (MNHN Pg 5764); stn CH 59, 23°26'S, 43°29.6'E, 600-610 m, 27.02.1973: 1 ♀ sl 12.4 mm (MNHN Pg 5765); stn CH 60, 23°36.5'S, 43°28.8'E, 710 m, 27.02.1973: 2 ♂ sl 10.0 and 14.2 mm (MNHN Pg 5766); stn CH 66, 23°36.4'S, 43°31.1'E, 450-460 m, 29.02.1973: 1 ovig. ♀ sl 9.6 mm (MNHN Pg 5767); stn CH 89, 21°18'S, 43°17.4'E, 620 m, 26.11.1973: 1 ♂ sl 10.0 mm (MNHN Pg 5768); stn CH 90, 21°24.5'S, 43°13.5'E, 640-720 m, 26.11.1973: 1 ♀ sl 10.8 mm (MNHN Pg 5769); stn CH 99, 22°17.4'S, 43°02.1'E, 650 m, 28.11.1973: 1 ovig. ♀ sl 9.0 mm (MNHN Pg 5770); stn CH 100, 22°19'S, 43°02'E, 650 m, 28.11.1973: 1 ♂ sl (dry) 8.0 mm (MNHN Pg 5771); stn CH 104, 22°15.7'S, 43°01.5'E, 750-810 m, 29.11.1973: 1 ovig. ♀ sl 8.7 mm (MNHN Pg 5772); stn CH 107, 22°16.6'S, 43°01.9'E, 695-710 m, 30.11.1973: 1 ovig. ♀ sl 8.5 mm (MNHN Pg 5773); stn CH 108, 22°18.9'S, 43°01.1'E, 735-760 m, 30.11.1973: 2 ♂ sl 7.7 and 9.0 mm, 1 ♀ sl 4.5 mm, 6 ovig. ♀ sl 8.8-11.5 mm (MNHN Pg 5774); stn CH 112, 22°18'S, 43°02.2'E, 640-660 m, 01.12.1973: 10 ♂ sl 7.1-12.5 mm, 3 ovig. ♀ sl 7.9-8.7 mm (MNHN Pg 5775); stn CH 116, 22°13.6'S, 43°02.1'E, 670-710 m, 02.12.1973: 1 ovig. ♀ sl 9.8 mm (MNHN Pg 5776); stn CH 135, 13°01'S, 48°01'E, 1075-1110 m, 21.01.1975: 4 ♂ sl 7.0-11.9 mm, 1 ♀ sl 12.0 mm (MNHN Pg 5777); stn CH 139, 13°50'S, 47°37'E, 850-1125 m, 27.02.1975: 4 ♂ sl 3.7-9.8 mm, 7 ♀ sl 3.7-8.4 mm (MNHN Pg 5778).

Réunion. Trap, 350-500 m, 2.02.1974: 2 ♂ sl 14.0 and 15.0 mm, 4 ♀ sl 11.5-12.0 mm (MNHN Pg 5779).

Mozambique. *Anton Bruun*: stn 398B, 22°25'S, 35°54'E, 740 m, 01.10.1964: 11 ♂ sl 4.7-14.1 mm, 2 ♀ sl 7.0 and 7.1 mm (USNM 309744); stn 399B, 22°30'S, 36°07'E, 850-960 m, 01.10.1964: 2 ♂ sl 7.5 and 14.5 mm, 1 ♀ sl 6.8 mm, 1 ovig. ♀ sl 8.9 mm (USNM 309743).

South Africa. *Mering Naude*: stn SM 83, off Natal, 28°00'S, 32°46'E, 810-600 m, 22.05.1976: 5 ♂ sl 4.5-13.3 mm, 1 ♀ sl 5.7 mm, 4 ovig. ♀ sl 8.8-11.4 mm (SAM A15337).

Additional material recorded by Lemaitre (1994).

DESCRIPTION. — Gills with lamellae (Fig. 11₁) at most distally divided. Shield length in males 2.7-20.5 mm, females 2.5-14.7 mm, ovigerous females 7.9-19.0 mm. Shield (Fig. 33a) about as long as broad or slightly broader than long, dorsal surface weakly calcified medially, anterior margins straight; lateral projections broadly subtriangular, terminating acutely or bluntly. Rostrum broadly subtriangular, rounded distally, with low mid-dorsal ridge.

Ocular peduncles 0.5 x or slightly more shield length, with dorsal row of setae. Ocular acicles subtriangular, terminating in bifid or multifid spine. Corneae slightly dilated.

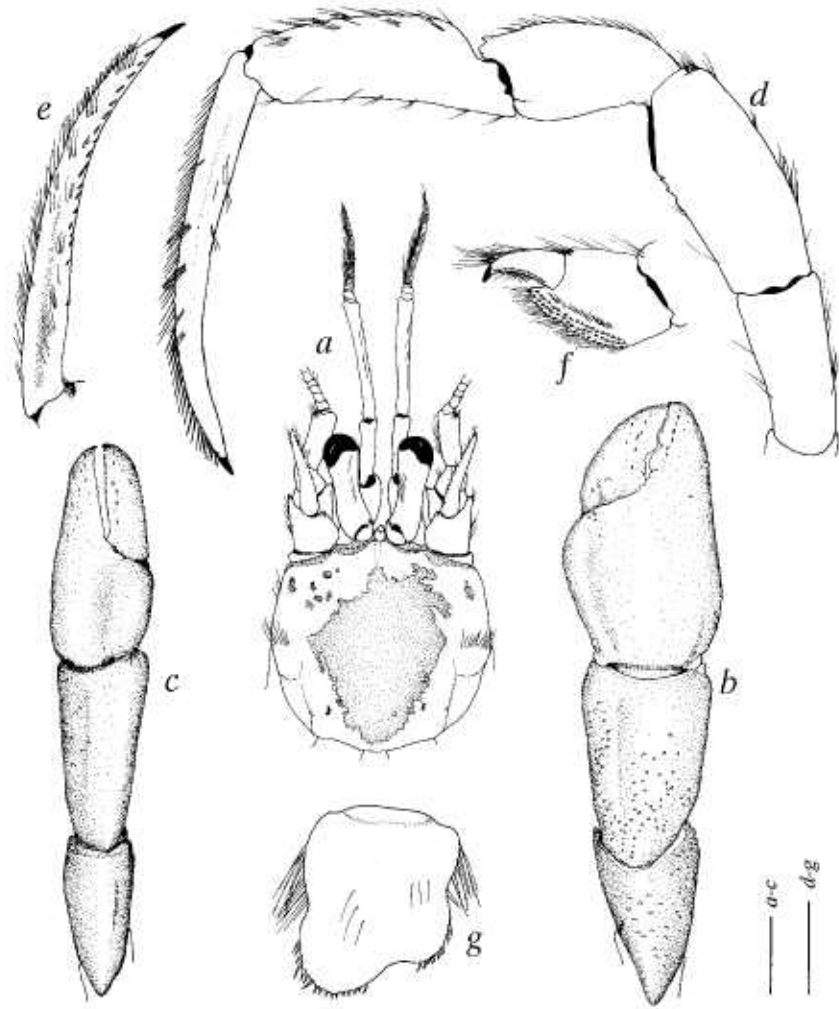


FIG. 33. *Sympagurus trispinosus* (Balss, 1911), ovig. female, sl 11.9 mm, Marara stn 309, Tuamotu Archipelago (MNHN Pg 5143): a, shield and cephalic appendages, dorsal view; b, right cheliped, dorsal view; c, left cheliped, dorsal view; d, left second ambulatory leg, lateral view; e, dactylus of same, mesial view; f, propodus and dactylus of left fourth pereopod, lateral view; g, telson, dorsal view (from Lemaitre 1994). Scales = 5 mm (a-c), and 10 mm (d-g).

FIG. 33. *Sympagurus trispinosus* (Balss, 1911), femelle ovigère, sl 11,9 mm, Marara stn 309, archipel des Tuamotu (MNHN Pg 5143) : a, bouclier et appendices céphaliques, vue dorsale ; b, chélopède droit, vue dorsale ; c, chélopède gauche, vue dorsale ; d, deuxième patte marcheuse gauche, vue latérale, côté externe ; e, dactyle de la même patte, vue latérale, côté interne ; f, propode et dactyle du quatrième périopode gauche, vue latérale ; g, telson, vue dorsale (d'après Lemaitre 1994). Échelles = 5 mm (a-c), and 10 mm (d-g).

Antennular peduncle exceeding distal margin of cornea by about 0.3 x length of penultimate segment.

Antennal peduncle exceeding distal margin of cornea by about 0.5 x length of fifth segment. Fourth segment unarmed. Acicle slightly exceeding distal margin of cornea; mesial margin setose, armed with 9-13 small spines. Flagellum naked or with scattered short setae < 1 article in length.

Maxillule with external lobe moderately developed, not recurved; internal lobe with usually 6 or 7 long distal setae (Fig. 11₂). Sternite of third maxillipeds with small spine on each side of midline. Epistomial spine short and straight.

Chelipeds markedly dissimilar; with dense plumose setae on chelae, carpi, and distal halves of meri. Right cheliped (Fig. 33b) with chela less than 2.0 x as long as wide, dorsal and ventral surfaces smooth. Palm with mesial and lateral surfaces rounded; dorsomesial and dorsolateral margins weakly delimited, unarmed or with irregular rows of small spines. Carpus with numerous small tubercles or spines on proximal half of dorsal surface.

Left cheliped (Fig. 33c) well calcified. Chela unarmed. Carpus unarmed or with irregular row of tubercles or spines on dorsal margin.

Ambulatory legs (Figs 33d, e) similar except for longer segments on right. Dactylus (Fig. 33e) about 1.7 x as long as propodus; with ventromesial row of less than 20, often minute corneous spinules; with several short, oblique rows of bristles on mesial surface distally. Carpus with small dorsodistal spine, and on first leg usually also with row of small spines

on dorsal margin. Merus of first leg with row of small often obsolete spines on ventral margin; merus of second leg unarmed ventrally, left about 2.3 x or more as long as high. Anterior lobe of sternite of second legs setose, unarmed or with 1 submarginal spine.

Fourth pereopod (Fig. 33f) semichelate. Propodal rasp consisting of 3 or 4 irregular rows of conical or lanceolate scales.

Fifth pereopod semichelate. Propodal rasp extending to mid-length of segment.

Uropods and telson strongly asymmetrical. Left exopod of uropod about 3 or more times as long as broad. Telson (Fig. 33g) with weak lateral indentations; posterior margin divided into 2 lobes by broad, shallow, rounded (U-shaped) median cleft; lobes armed distally with numerous corneous spines.

Male first gonopod with ovate, weakly concave distal lobe. Second gonopod with distal segment nearly flat.

Color (based on Lemaitre 1994: 419, fig. 28e): body cream-yellow, tips of dactyls of ambulatory legs pinkish.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — Living symbiotically with the anemone *Stylobates cancrisocia* (Carlgren, 1928) (see Fautin Dunn *et al.* 1981; Fautin 1987).

DISTRIBUTION. — Philippines, New Caledonia, Vanuatu, Indonesia, South China Sea, Australia, French Polynesia, Zanzibar, South Africa, Madagascar and Réunion, 350-1500 m (Fig. 34).

REMARKS. — The confusion with the name "*Parapagurus armatus*", a manuscript name used by J. E. Benedict on museum labels, was discussed by McLaughlin (1974: 378). Subsequently, Lemaitre (1999: 329) determined that the name *Parapagurus armatus* var. *trispinosus* used by Carlgren (1928a, b) in his studies on actinians from the *Valdivia* Expedition, and the reference to the same taxon by Ross (1967) as *Parapagurus armatus*, actually refer to *Sympagurus trispinosus*. See "remarks" on *S. burkenroadi* and *S. villosus* for additional comments.

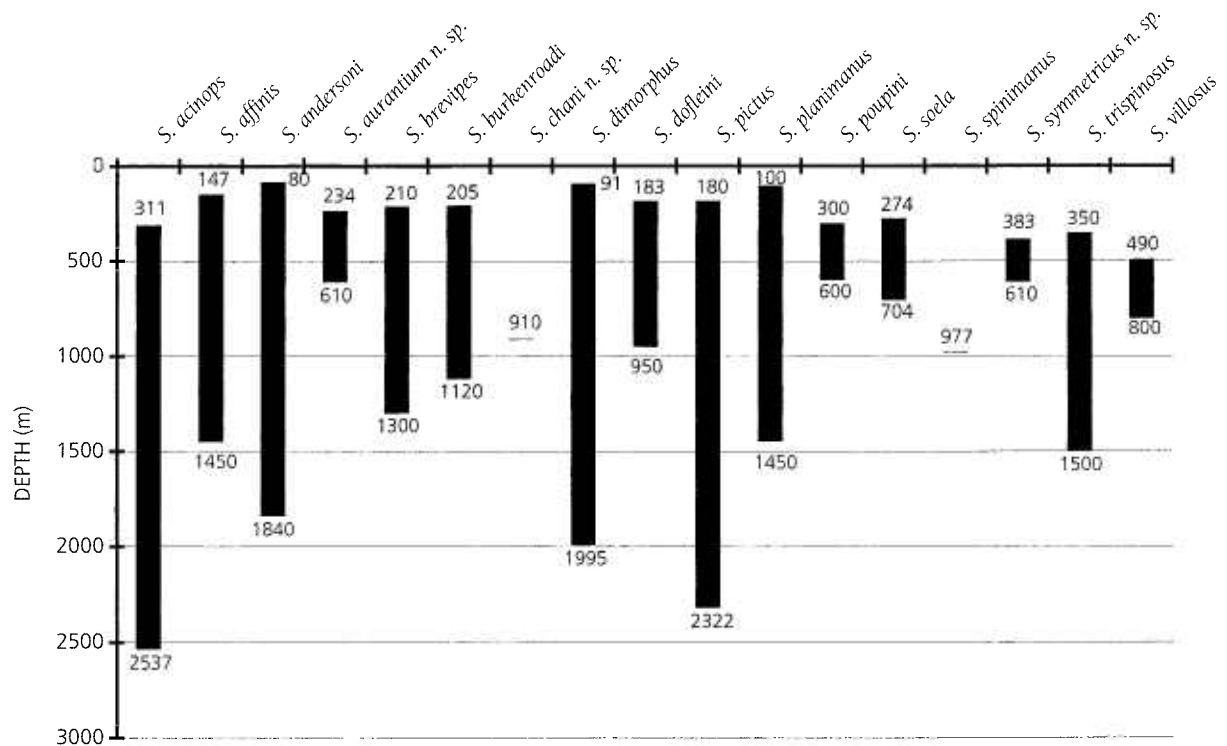


FIG. 34. Bathymetric distribution of *Sympagurus* species from the world, with minimum and maximum depths indicated for each.

FIG. 34. Distribution bathymétrique des espèces de *Sympagurus* dans le monde, avec les profondeurs minimales et maximales indiquées pour chacune.

BATHYMETRIC AND GEOGRAPHIC DISTRIBUTION OF SYMPAGURUS SPECIES

Compared with other parapagurids such as members of the genus *Parapagurus*, which can be found at depths in excess of 5000 m (Lemaitre 1999), *Sympagurus* species occur at moderate depths. Although most *Sympagurus* species are found between 500 and 1000 m (Fig. 34), they are not restricted to these shallower depths. Nine species have been found at or below 1000 m: *S. acinops*, *S. affinis*, *S. andersoni*, *S. brevipes*, *S. burkenroadi*, *S. dimorphus*, *S. pictus*, *S. planimanus*, and *S. trispinosus*; and two species at or below 2000 m: *S. acinops*, and *S. pictus*. The shallowest depth at which a *Sympagurus* species has been found is 80 m, for *S. andersoni*; and the deepest is 2537 m, for *S. acinops*.

The geographic distribution of the 17 known species of *Sympagurus* is summarised (Table 1). All but one species are found in the Indo-Pacific region, the exception being *S. pictus*, which occurs only in the western Atlantic Ocean. Fourteen (82%) species occur in the Pacific Ocean, nine in the Indian Ocean, and three in the Atlantic Ocean. The region with the highest concentration of species is New Caledonia and adjacent islands (including the Coral Sea), where 12 species have been found. The western Indian Ocean is also quite rich in number of species, with 8 (47%) occurring in the area that includes eastern Africa, Madagascar, and Réunion. One species, *S. dimorphus*, is found exclusively at high latitudes (22°-57°S) of the southern hemisphere, and one, *S. acinops*, has a relatively broad distribution that includes the western Pacific and both sides of the Atlantic Ocean. Only two species, *S. affinis* and *S. dofleini*, are known so far from the Hawaiian Islands, and both have ample distributions across the Pacific to the western Indian Ocean. So far, the two new species described herein as *S. aurantium* and *S. symmetricus*, have been found only in the New Caledonia area. *Sympagurus poupini* is known only from French Polynesia, Samoa, and Wallis Island; and *S. soela* only from Australia and the Coral Sea.

TABLE 1. Summary of geographical distribution of species *Sympagurus* Smith, 1883 from the world (* includes Vanuatu, Wallis and Futuna, and Coral Sea.)
TABLEAU 1. Distribution géographique des espèces *Sympagurus* Smith, 1883 dans le monde (* inclut Vanuatu, Wallis et Futuna et la mer de Corail.)

	Indian Ocean	Japan	Taiwan	Mariana Is.	South China Sea	Philippines	Indonesia	New Guinea	Australia	Tasmania	New Caledonia *	New Zealand	Samoa	Tonga	Hawaiian Is.	French Polynesia Nazca, and Sala y Gómez Ridges	eastern Atlantic	western Atlantic	
<i>S. acinops</i>	◆										◆						◆		
<i>S. affinis</i>	◆	◆	◆			◆	◆	◆			◆				◆	◆	◆		
<i>S. andersoni</i>	◆										◆								
<i>S. aurantium</i> n. sp.											◆								
<i>S. brevipes</i>	◆				◆	◆	◆		◆		◆								
<i>S. burkenroadi</i>	◆	◆			◆		◆		◆		◆								
<i>S. chani</i> n. sp.			◆		◆														
<i>S. dimorphus</i>	◆								◆	◆		◆					◆		
<i>S. dofleini</i>	◆	◆		◆			◆				◆		◆	◆	◆	◆			
<i>S. pictus</i>																		◆	
<i>S. planimanus</i>	◆		◆		◆		◆				◆					◆			
<i>S. poupini</i>											◆		◆		◆				
<i>S. soela</i>								◆	◆		◆								
<i>S. spinimanus</i>	◆										◆								
<i>S. symmetricus</i> n. sp.											◆								
<i>S. trispinosus</i>	◆				◆	◆	◆				◆				◆				
<i>S. villosus</i>								◆			◆								
Total number of species	9	3	3	1	5	3	6	1	5	1	12	1	2	1	2	5	2	2	1

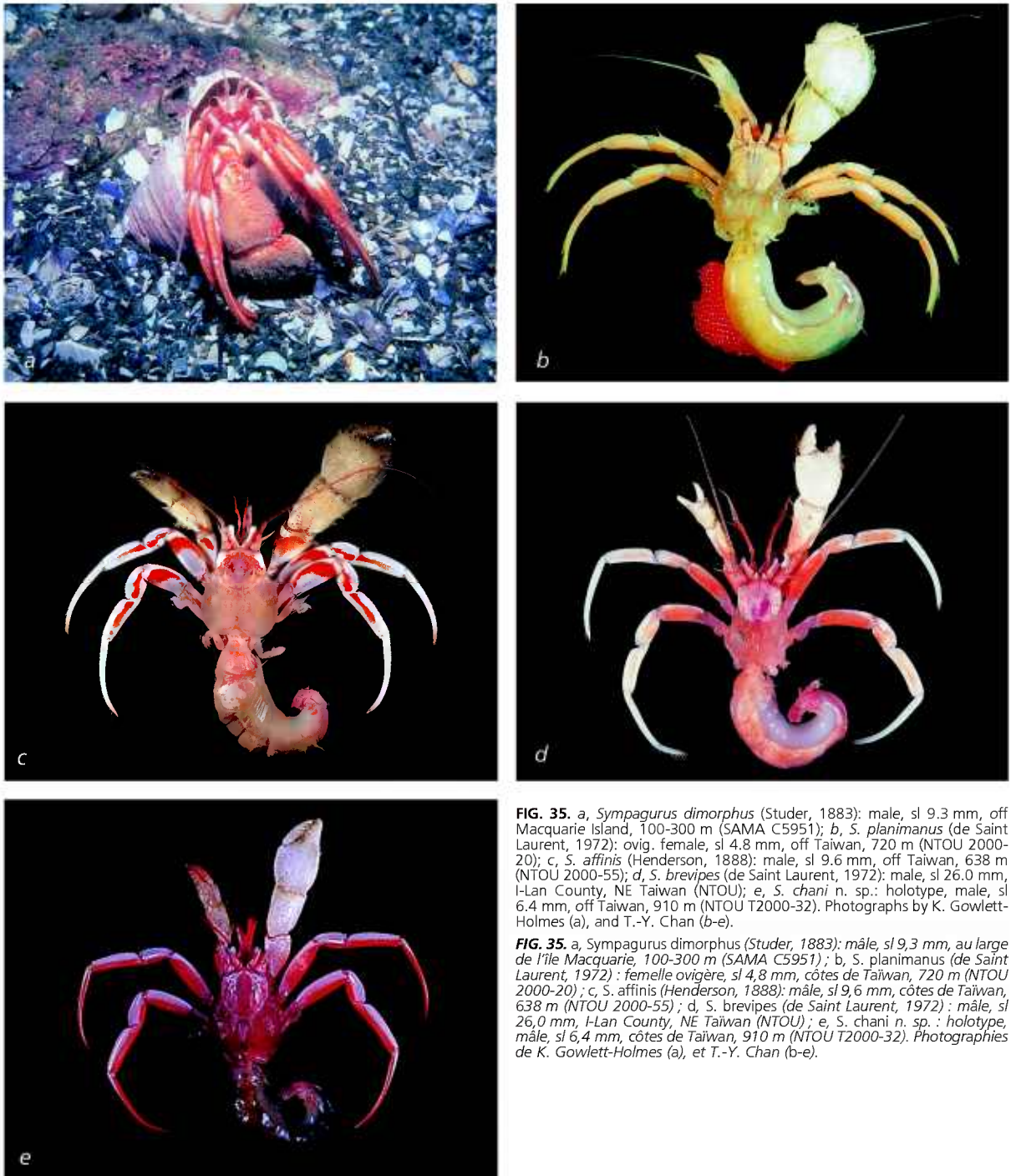


FIG. 35. a, *Sympagurus dimorphus* (Studer, 1883): male, sl 9.3 mm, off Macquarie Island, 100-300 m (SAMA C5951); b, *S. planimanus* (de Saint Laurent, 1972): ovig. female, sl 4.8 mm, off Taiwan, 720 m (NTOU 2000-20); c, *S. affinis* (Henderson, 1888): mâle, sl 9.6 mm, off Taiwan, 638 m (NTOU 2000-55); d, *S. brevipes* (de Saint Laurent, 1972): mâle, sl 26.0 mm, I-Lan County, NE Taiwan (NTOU); e, *S. chani* n. sp.: holotype, mâle, sl 6.4 mm, off Taiwan, 910 m (NTOU T2000-32). Photographs by K. Gowlett-Holmes (a), and T.-Y. Chan (b-e).

FIG. 35. a, *Sympagurus dimorphus* (Studer, 1883): mâle, sl 9,3 mm, au large de l'île Macquarie, 100-300 m (SAMA C5951); b, *S. planimanus* (de Saint Laurent, 1972): femelle ovigère, sl 4,8 mm, côtes de Taïwan, 720 m (NTOU 2000-20); c, *S. affinis* (Henderson, 1888): mâle, sl 9,6 mm, côtes de Taïwan, 638 m (NTOU 2000-55); d, *S. brevipes* (de Saint Laurent, 1972): mâle, sl 26,0 mm, I-Lan County, NE Taïwan (NTOU); e, *S. chani* n. sp.: holotype, mâle, sl 6,4 mm, côtes de Taïwan, 910 m (NTOU T2000-32). Photographies de K. Gowlett-Holmes (a), et T.-Y. Chan (b-e).

ACKNOWLEDGMENTS

As in previous studies of parapagurids published in this series, I am indebted to Alain Crosnier for allowing me to study the rich collections obtained during the numerous French campaigns to various regions of the Pacific and Indian Oceans. His help and guidance while working at his laboratory at MNHN, and while studying the specimens and writing the report at my home base, has been invaluable. No less gratitude is owed to the monumental efforts of Bertrand Richer de Forges and colleagues for their outstanding efforts in collecting parapagurid specimens, and their meticulous methods of preserving and sorting the material.

I wish to express my gratitude to Nguyen Ngoc-Ho, and Danièle Guinot for placing at my disposal their collections, and patiently cataloguing the specimens during my visit to MNHN. I also gratefully acknowledge the invaluable help provided by colleagues from other museums who collected specimens, arranged loans, searched for type material and other comparative material, and provided needed information: these include Michael Apel (Senckenberg Museum, Frankfurt); Keiji Baba (Kumamoto University, Japan); Beatrice L. Burch (BPBM); Tin-Yam Chan (NTOU); Ch. Oliver Coleman (Museum für Naturkunde, Berlin); Stefan Friedrich (ZSM); Karen Gowlett-Holmes (Sandy Bay, Tasmania); Tomoyuki Komai (CBM); Wolfgang Zeidler and Thierry Laperousaz (SAMA); and Dmitry Zhadan (ZMUM).

I am most grateful to Tin-Yam Chan and Karen Gowlett-Holmes for allowing publication of color photographs taken by them. Thanks to Akira Asakura and Patsy A. McLaughlin for their valuable criticism and suggestions regarding the manuscript. Last but not least, I thank Rose A. Gulledge and Molly K. Ryan for their assistance in preparing the photographic plates, table and graphs. Molly K. Ryan also prepared most of the ink illustrations for *Sympagurus aurantium* n. sp.

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