

The Indo-Pacific scyllarine lobsters (Crustacea, Decapoda, Scyllaridae)

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ABSTRACT

A revision is provided of the Indo-Pacific species of the subfamily Scyllarinae. All of these species were formerly placed in the genus *Scyllarus* Fabricius, 1775, but a closer study revealed that several genera could be distinguished within the subfamily. The 13 new genera now recognized in the Indo-Pacific biogeographic region are as follows: *Acantharctus* n. gen., *Antarctus* n. gen., *Antipodarctus* n. gen., *Bathyarctus* n. gen., *Biarctus* n. gen., *Chelarctus* n. gen., *Crenarctus* n. gen., *Eduarctus* n. gen., *Galearctus* n. gen., *Gibbularctus* n. gen., *Petrarctus* n. gen., *Remiarctus* n. gen. and *Scammarctus* n. gen. Diagnoses and keys are provided for all the genera and their species. New and insufficiently known species have been described extensively, for the others additional morphological details are given. New species are: *Bathyarctus chani* n. gen., n. sp., *B. steatopygus* n. gen., n. sp., *Petrarctus veliger* n. gen., n. sp., *Chelarctus crosnieri* n. gen., n. sp., *Eduarctus pyrrhonotus* n. gen., n. sp., *E. marginatus* n. gen., n. sp., *E. perspicillatus* n. gen., n. sp. and *E. reticulatus* n. gen., n. sp. Furthermore efforts were made to provide each species with a complete synonymy, a description of the colour, its biology, habitat and geographical distribution. All the material examined is listed in detail. Where appropriate, remarks are provided on nomenclature, published data on the larval development and other topics.

KEY WORDS

Crustacea,
Decapoda,
Scyllarinae,
Indo-Pacific,
new genera,
new species.

RÉSUMÉ

Les cigales scyllarines indo-pacifiques (Crustacea, Decapoda, Scyllaridae).

Une révision des espèces appartenant à la sous-famille Scyllarinae est proposée. Auparavant toutes ces espèces étaient classées dans le genre *Scyllarus* Fabricius, 1775 mais une étude plus précise a montré que plusieurs genres pouvaient être distingués dans la sous-famille. Les 13 nouveaux genres reconnus maintenant dans la région indo-pacifique sont les suivants : *Acantharctus* n. gen., *Antarctus* n. gen., *Antipodarctus* n. gen., *Bathyarctus* n. gen., *Biarctus* n. gen., *Chelarctus* n. gen., *Crenarctus* n. gen., *Eduarctus* n. gen., *Galearctus* n. gen., *Gibbularctus* n. gen., *Petrarctus* n. gen., *Remiarctus* n. gen. et *Scammarctus* n. gen. Des diagnoses sont données pour tous les genres ainsi que des clés pour leurs espèces. Les espèces nouvelles ou mal connues ont été décrites en détails ; pour les autres, des détails morphologiques complémentaires ont été fournis. Les nouvelles espèces sont : *Bathyarctus chani* n. gen., n. sp., *B. steatopygus* n. gen., n. sp., *Petrarctus veliger* n. gen., n. sp., *Chelarctus crosnieri* n. gen., n. sp., *Eduarctus pyrrhonotus* n. gen., n. sp., *E. marginatus* n. gen., n. sp., *E. perspicillatus* n. gen., n. sp. et *E. reticulatus* n. gen., n. sp. De plus on s'est efforcé de donner la synonymie complète de chaque espèce, sa coloration, sa biologie, son habitat et sa distribution géographique. Tout le matériel examiné est mentionné avec les détails complets relatifs aux récoltes. Quand cela s'est avéré nécessaire des remarques ont été faites sur la nomenclature, le développement larvaire ainsi que d'autres sujets.

MOTS CLÉS

Crustacea,
Decapoda,
Scyllarinae,
Indo-Pacifique,
nouveaux genres,
nouvelles espèces.

INTRODUCTION

Forty years ago, in 1960, during a year's stay at the U. S. National Museum in Washington, D. C., I started a study intended to revise the family Scyllaridae Latreille, 1825. I had not finished the job when I returned to my position at the Leiden Museum. Again in Leiden, so many chores had accumulated during my absence that I did not have the opportunity to immediately continue my work on the Scyllarid lobsters. In 1985 finally the revision of the Ibacinae could be published. Unfinished manuscripts of the other subfamilies remained in an advanced state of preparation. Then Alain Crosnier of the Paris Museum offered me for study the Scyllarid material collected by the French MUSORSTOM expeditions in the Philippines, New Caledonia and other areas. This gave me the incentive to take up again the study of the subfamily Scyllarinae. Thanks to the continuous encouragement and help by Alain

Crosnier, I can now present the results of this work. The long period over which this study was made is the cause that several inconsistencies in the treatment do occur for which I apologize. For the same reason the illustrations are of very diverse origin: many different artists have provided the drawings of the complete animals, the photographs were made mostly at the Muséum national d'Histoire naturelle, Paris, and most of the simple line drawings were made by the author. I hope that nonetheless the present paper will form a worthwhile contribution to the study of the Indo-Pacific members of the subfamily Scyllarinae.

The general morphology of the Scyllarinae and their place among the other subfamilies of Scyllaridae have been extensively dealt with in my 1985 paper, which also carries a schematic figure showing the terms used for ridges, tubercles and other anatomical features of carapace and cephalon. In the lists of material examined, the names of the cruises are in capital letters and the names of

the vessels in italic letters. The measurements, unless otherwise specified, refer to the carapace length.

Some of the figures, drawn a long time ago, have no scale bar.

Readers requiring details on the French cruises carried out in the south-west Pacific since 1976 can refer to the web site: <http://www.tropical-deepseabenthos.org>.

There is a rather extensive literature on Scyllarine larvae, but most of the material studied there was obtained from the plankton, so that the specific identity often could not or only tentatively be ascertained. This is quite understandable as the number of scyllarine species is quite extensive and new species are still being discovered. Some authors managed to describe the complete series of larvae of a certain species from plankton material (e.g., *Eduarctus martensii* (Pfeffer, 1881) n. comb. by Phillips & McWilliam 1986). Ritz (1977) managed to obtain all larval stages of *Petrarctus demani* (Holthuis, 1946) n. comb. by culturing the species in the laboratory.

Where larval stages have been (correctly or incorrectly) definitely assigned to a species, they usually are listed in the present paper. But "*Scyllarus* spec. A.", "*Scyllarus* spec. B.", etc., are usually not included even when they were accompanied by a vague guess as to the identity of the species.

ABBREVIATIONS

AHF	Allan Hancock Foundation, University of Southern California, Los Angeles (at present housed in the Los Angeles County Museum);
AM	Australian Museum, Sydney;
ANS	Academy of Natural Sciences, Philadelphia;
BM	The Natural History Museum (formerly British Museum (Natural History)), London;
BPBM	Bernice Pauahi Bishop Museum, Honolulu;
Mbgor	Zoological Museum, Bogor;
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge;
MG	Muséum d'Histoire naturelle, Geneva;
MNHN	Muséum national d'Histoire naturelle, Paris;
MS	Senckenberg Museum, Frankfurt am Main;
MT	Afrika Museum, Tervuren;
NTOU	National Taiwan Ocean University, Keelung;
PN	collection P. Naiyanetr, Department of Biology, Chulalongkorn University, Bangkok;

RMNH	Rijksmuseum van Natuurlijke Historie (National Museum of Natural History), Leiden;
SUF	Shimonoseki University of Fisheries, Shimonoseki;
USNM	National Museum of Natural History, Washington D. C.;
UZM	Universitetets Zoologiske Museum, Copenhagen;
VNIRO	All-Russia Research Institute of Marine Fisheries and Oceanography, Moscow;
WAM	Western Australian Museum, Perth;
ZLK	Zoological Laboratory of Kyushu University, Fukuoka;
ZMA	Zoological Museum, Amsterdam;
ZMB	Zoologisches Museum der Humboldt Universität, Berlin;
ZMH	Zoologisches Museum, Hamburg;
ZMM	Zoological Museum, Moscow;
ZRC	Zoological Reference Collection, Raffles Museum, University of Singapore;
ZSM	Zoologische Staatssammlung, Munich;
cl.	carapace length;
juv.	juvenile;
ov.	ovigerous;
P.1-P.5	first to fifth pereopods;
tl.	total length.

SYSTEMATICS

Order DECAPODA Latreille, 1802

Suborder PLEOCYEMATA

Burkenroad, 1963

Family SCYLLARIDAE Latreille, 1825

Subfamily SCYLLARINAE Latreille, 1825

Scyllarides Latreille, 1825: 278.

Scyllarinae – Holthuis 1985: 3, 10, 12.

The family Scyllaridae is such a well-defined and homogeneous entity that only as late as 1985 a proposal was published to subdivide it into subfamilies. The subfamily Scyllarinae was then considered to consist of a single genus *Scyllarus* Fabricius, 1775, and only the study of the present very extensive material showed that the old genus can be subdivided. Suggestions that groups of species can be recognized within the old genus *Scyllarus* have already been made by previous authors like Ortmann (1897: 270) and Bouvier (1917: 105, 106), but the outlines of these

groups were not very sharp and no names were suggested for them. Bouvier's remarks did not incite later authors to further explore the possibilities for subdividing the genus. In studying the present very extensive material, I believed to be able to recognize sharply delimited natural groups, and have treated these as full genera.

As all the synonyms published so far of the generic name *Scyllarus* s.l. are objective synonyms of that name, none of these can be used for a subdivision of the old genus and all the genera introduced here have to have a new name. In order to show the close affinity of these genera, I have used for all new names the suffix *-arctus* to indicate this relation. I chose this suffix as the name *Arctus* is the best known of the synonyms of *Scyllarus* and lends itself much better for such a use than the generic name *Scyllarus* itself.

Until now the history of the subfamily Scyllarinae has been practically the same as that of the genus *Scyllarus*. *Scyllarus* was proposed by Fabricius (1775) with *Cancer arctus* Linnaeus, 1758 as its type species by monotypy. The names *Scyllarus arctus* (Linnaeus, 1758) or *Cancer arctus* at that time were used for practically all scyllarid species. By the end of the 18th century, several new species of scyllarids had been recognised: *Scyllarus aequinoctialis* Lund, 1793 (now in *Scyllarides*), *Scyllarus antarcticus* Lund, 1793 (now in *Parribacus*), *Scyllarus orientalis* Lund, 1793 (now in *Thenus*), and *Scyllarus guineensis* Spengler, 1799 (now in *Arctides*). In the early 19th century, Latreille (1803) added the new species *Scyllarus latus* (now in *Scyllarides*) to the genus. The first new Scyllarid genera were introduced by Leach (1815), namely *Thenus* (for *Scyllarus orientalis*) and *Ibacus* (for his new species *Ibacus peronii*). In his fundamental monograph of

the Crustacea, H. Milne Edwards (1837) recognized three genera of Scyllaridae: *Scyllarus* (containing the species of *Scyllarus* s.l. and *Scyllarides*), *Ibacus* (containing the species of *Ibacus* and *Parribacus* of modern authors) and *Thenus* (with only the type species). A new change in the generic status of *Scyllarus* was introduced by De Haan (1849). He adopted the general system of H. Milne Edwards, but divided the genus *Scyllarus* into two genera: *Scyllarus* and *Arctus*. In *Scyllarus* he placed the species of *Scyllarides* of modern authors, and in *Arctus* the species of *Scyllarus* s.l. He divided *Ibacus* into *Ibacus* A (= *Parribacus*) and *Ibacus* B (= *Ibacus*). Dana (1852) followed De Haan, but gave the new name *Parribacus* to *Ibacus* A. Most subsequent authors followed Dana, even to such an extent that *Arctus* De Haan, 1849 usually was indicated as *Arctus* Dana, 1852. De Haan and most of the subsequent authors made the error that they used the name *Scyllarus* for the wrong genus, namely for one that does not contain the type species *Cancer arctus*. It was the ichthyologist Theodore Gill (1898) who recognized this error and corrected it. He synonymized *Arctus* with *Scyllarus* and proposed the new name *Scyllarides* for the genus that at that time had been incorrectly named *Scyllarus*. This correct nomenclature then became generally accepted. After 1852 numerous new species of Scyllaridae were described, but only two new genera: in 1869 the new genus *Evibacus* S. I. Smith (subfamily Ibacinae) was established and in 1960 the genus *Arctides* Holthuis (subfamily Arctidinae). In the following key the genus *Scyllarus*, although so far not known from the Indo-Pacific region, has been included to show its position among the other genera recognized here.

KEY TO THE GENERA OF INDO-PACIFIC SCYLLARINAE LATREILLE, 1825

Genera dealt with in this paper are in bold.

1. Posterior half of the dorsal surface of abdominal somites II to IV with a rather wide transverse groove over the middle, sometimes with tubercles on either side, but without an arborescent pattern of narrow grooves. Abdominal somites with a distinct median longitudinal carina sharply set off from the rest of the dorsal surface 2

- Posterior half of the dorsal surface of abdominal somites II to IV with an arborescent pattern of a narrow central transverse groove with side grooves, that often are branched 5
- 2. Anterior part of thoracic sternum gutter-like sunken and directed down, its anterior margin tapering anteriorly and ending in a median point, which is placed lower than the anterolateral angles of the sternum. P.4 and P.5 unusually long and slender, the fifth reaching the base of the antenna. Dactylus of P.3 to P.5 with a double dorsal fringe of setae. Fourth antennal segment without additional carina *Scammarctus* n. gen.
- Anterior margin of thoracic sternum V- or U-shapedly incised, truncate or convex, but in a horizontal plane, top not sunken. P.4 and P.5 not remarkably slender and without a double dorsal fringe of setae on the dactylus 3
- 3. Anterior margin of thoracic sternum truncate or convex, sometimes with a median tubercle but without median incision; this margin situated on about the same level as the anterolateral teeth of the rostrum. Propodus of P.1 to P.4 often with ventral setae *Bathyarctus* n. gen.
- Anterior margin of thoracic sternum either U- or V-shaped, not sunken; this margin with a median incision. Propodus of P.1, P.2 and P.4 without ventral hairs 4
- 4. Fourth segment of antenna with a distinct additional carina in outer half of upper surface, ending in the proximal tooth of the outer margin. Median dorsal carina of abdominal somites 2 to 4 of about the same height, none strongly elevated. Dactylus of P.4 without a dorsal fringe of hair *Antarctus* n. gen.
- Fourth segment of antenna with a single sharp carina; tubercles that sometimes are placed in a row, may be present on the outer half of the segment, but there is no true sharp ridge. Third abdominal somite with the median carina high, usually distinctly higher than that of the second somite. Dactylus of P.4 with a distinct dorsal fringe of long hairs. Carapace hard and stony *Petrarctus* n. gen.
- 5. Fourth segment of antenna with an additional carina or a row of tubercles outside the main oblique carina 6
- Fourth segment of antenna with a single oblique carina over its full length; no additional carina or rows of tubercles. Abdominal somites usually without a median carina 8
- 6. Anterior margin of thoracic sternum U-shapedly concave with a submedian tubercle at each side of the median incision 7
- Anterior margin of thoracic sternum V-shapedly concave, without submedian tubercles. Abdominal somites without dorso-median carina; dorsal outline of somite IV more convex than that of somite III. Rostral tooth present *Gibbularctus* n. gen.
- 7. Abdominal somites II to IV with a median dorsal carina, that of third somite usually

- highest. Rostral tooth absent or small. Fourth antennal segment with an additional row of tubercles *Eduarctus* n. gen.
- No median carina on abdominal somites. Rostral tooth present. Fourth antennal segment with an additional carina, which ends in the lower tooth of the outer margin of the segment *Antipodarctus* n. gen.
8. Last segment of thoracic sternum with a sharp median thorn *Acantharctus* n. gen.
- Last segment of thoracic sternum at most with a central tubercle 9
9. Propodus of P.3 with a distinct tooth in the distal part of the lower margin, forming a kind of subchela with the dactylus *Chelarctus* n. gen.
- Propodus of P.3 sometimes broadened but not with a distinct anteroventral tooth 10
10. Pleura of abdominal somites II to IV ending in a sharp posteriorly directed point 11
- Pleura of abdominal somites II to IV with the apex blunt or rectangularly rounded 12
11. Anterior margin of thoracic sternum truncate, thickened. Propodus of second leg as much flattened and as broad as that of third *Remiarctus* n. gen.
- Anterior part of thoracic sternum tongue-like produced forward, with the anterior margin a triangle with a minute median incision. Propodus of P.2 less broadened than that of P.3 *Galearctus* n. gen.
12. Anterior margin of thoracic sternum deeply V-shapedly incised, without additional tubercles. Pregastric tooth absent *Biartus* n. gen.
- Anterior margin of thoracic sternum U-shapedly incised with two small tubercles flanking the median incision. Pregastric tooth present 13
13. Pregastric and rostral teeth large, much larger than the gastric and cardiac teeth *Crenarctus* n. gen.
- Gastric, pregastric and rostral teeth all three well-developed and pointed *Scyllarus*

Genus *Bathyarctus* n. gen.

TYPE SPECIES. — *Arctus rubens* Alcock & Anderson, 1894 by present designation.

OTHER SPECIES. — The genus contains three other Indo-West Pacific species: *Bathyarctus steatopygus* n. sp., *B. formosanus* (Chan & Yu, 1992) n. comb. and *B. chani* n. sp.; furthermore there are two species

from the western Atlantic region, *B. faxoni* (Bouvier, 1917) n. comb. and *B. ramosae* (Tavares, 1997) n. comb.

ETYMOLOGY. — From the Greek *bathys* (meaning deep) and *Arctus* De Haan, 1849, a junior synonym of the generic name *Scyllarus* Fabricius, 1775. Three of the species of this genus, namely, are known only from great depths (320-)330-720(-810) m.

DIAGNOSIS. — Scyllaridae with the carapace in the midline provided with a pregastric, gastric and cardiac tooth; there is no sharp rostral tooth; the pregastric tooth is sometimes absent or reduced to a low and short transverse carina. Abdominal somites with prominent median carinae, that of the fourth somite slightly to distinctly higher than that of somite III; dorsal surface of abdomen without a clear and sharp arborescent arrangement of narrow grooves. Fourth segment of antenna with two oblique dorsal carinae.

Thoracic sternum with the anterior margin straight and transverse or arched, not incised in the middle. In most species the dactylus and merus of all pereopods and the propodus of legs 2-4 with ventral hairs; dorsal fringes may be found on the dactyli of P.1 to P.4 (often short and indistinct), on the propodi of P.1-P.4, on the carpi of P.1-P.5 and on the merus of P.1-P.5.

DISTRIBUTION. — Indo-West Pacific and Atlantic regions.

KEY TO THE INDO-WEST PACIFIC SPECIES OF *BATHYARCTUS* N. GEN.

Species dealt with in this paper are in bold.

1. Anterior margin of the sternum rounded. Upper surface of posterior half of abdominal somites I to IV with distinct tubercles on either side of the transverse groove. Median carina of fourth abdominal somite only slightly higher than that of somite III. Large species, cl. more than 20 mm 2
- Anterior margin of the sternum truncate or slightly concave. Upper surface of posterior half of abdominal somites I to IV practically smooth either side of the transverse groove, or with flattened indistinct tubercles. Median carina of abdominal somite IV distinctly higher than that of somite III. Small species, cl. 20 mm or less 3
2. Propodus of legs 1 to 4 with a thick pad of ventral hairs *B. chani* n. sp.
- Propodus of legs 1 to 4 without ventral hairs *B. formosanus* n. comb.
3. Pregastric tooth distinct. Tip of median carina of fourth abdominal somite rounded in dorsal view *B. rubens* n. comb.
- Pregastric tooth absent or visible as a low and short transverse carina. Tip of median carina of fourth abdominal somite incised in the middle, ending in two points *B. steatopygus* n. sp.

Bathyarctus rubens (Alcock & Anderson, 1894)
n. comb.
(Figs 1-3; 66A, B)

Arctus rubens Alcock & Anderson, 1894: 165. — Anderson 1896: 98. — Alcock 1899: 33; 1901: 182.

Scyllarus rubens — De Man 1916: 69. — Bouvier 1917: 105, 106; 1925: 447. — Prasad & Tampi 1969: 84. — George 1969: 434. — Burukovsky 1974: 107; 1983: 150. — Phillips *et al.* 1980: 70. — Holthuis 1991: 217.

TYPE MATERIAL. — The holotype is a female specimen from the *Investigator* stn 151. It forms (or formed) part

of the collection of the Zoological Survey of India, Calcutta.

TYPE LOCALITY. — Sri Lanka, Gulf of Manaar, 13.5 miles S, 64°E of Colombo Lighthouse, 260-732 m.

MATERIAL EXAMINED. — **Madagascar.** Off Majunga, RV *Vauban*, stn CH 50, 15°19.0'S, 46°11.8'E, 405 m, 8.XI.1972, A. Crosnier leg., 1 ♀ 22 mm (MNHN-Pa 575).

Philippines. Jolo Id, Sulu Archipelago, RV *Albatross*, stn D 5172, 6°03'15"N, 120°35'30"E, 582 m, fine sand and shells, 5.III.1908, 1 ♀ 17 mm (USNM).

Indonesia. Kai Ids, KARUBAR, stn CP 36, 6°05'S, 132°44'E, 210-268 m, 27.X.1991, 1 ♂ 13 mm (MNHN-Pa 1843).



FIG. 1. — *Bathyarctus rubens* (Alcock & Anderson, 1894) n. comb., Philippines, RV *Albatross*, stn D 5172, ♀ carapace length 17 mm, in dorsal view. Mrs P. Hogue del.

Australia. South-east of Botany Bay, New South Wales, FRV *Kapala*, New South Wales Fisheries, No. K.72-07-01, 34°00'–33°54'S, 151°43'–151°47'E, 732 m, 6.XI.1972, 3 ♂♂ 12–23 mm, 1 ov. ♀ 20 mm (AM P.18986).

Chesterfield Islands. CORAIL 2, stn CP 17, 20°48.14'S, 160°57.14'E, 500 m, bottom with pumice stone and pteropod shells, 21.VII.1988, 1 ♀ 17 mm (MNHN-Pa 1305).

New Caledonia. BIOCAL, stn CP 105, 21°31'S, 166°22'E, 330–335 m, 8.IX.1985, 2 ♂♂ 13 and 14 mm, 5 ♀♀ 12–19 mm (MNHN-Pa 1881).

MUSORSTOM 4, stn 193, 18°56.3'S, 163°23.2'E, 415 m, 19.IX.1985, 1 ♂ 18 mm (photographed) (MNHN-Pa 1155). — Stn 243, 22°02.8'S, 167°07.7'E, 435–450 m, 3.X.1985, 2 ♂♂ 10 and 11 mm (USNM 1000645).

LAGON, stn DW 1153, 18°58.4'S, 163°23.0'E, dredged, 330 m, 29.X.1989, 1 ♂ 9 mm (MNHN-Pa 1382).

SMIB 6, stn DW 112, 19°05.6'S, 163°30.2'E, 220–225 m, 2.III.1990, 1 ♂ 10 mm (RMNH D 48740). — Stn DW 126, 18°59.1'S, 163°22.7'E, 320–330 m, bottom with rocks and stylasterid corals, 3.III.1990, 1 juv. 10 mm (MNHN-Pa 1370).

BATHUS 1, stn CP 703, 20°54.6'S, 165°36'E, 720–810 m [on printed label; but on written label: 302–335 m, 20°57.5'S, 165°35.9'E; which are the data for stn 701], 18.III.1993, 1 ♂ 17 mm (MNHN-Pa 1883). BATHUS 3, stn CP 846, 23°03'S, 166°58'E, 500–514 m, 1.XII.1993, 1 ♀ 18 mm (photographed) (MNHN-Pa 1893).

BATHUS 4, stn DW 925, 18°54.55'S, 163°23.75'E, 370–405 m, 7.VIII.1994, 1 juv. ♂ 8 mm (MNHN-Pa 1838). — Stn DW 927, 18°55.48'S, 163°22.11'E, 452–444 m, 7.VIII.1994, 1 ♂ 16 mm (MNHN-Pa 1837). — Stn CP 928, 18°54.72'S, 163°23.73'E, 452–420 m, 7.VIII.1994, 2 ♂♂ 15 and 16 mm (RMNH D 48739; MNHN-Pa 1917).

HALICAL 1, stn 1, 20°47.30'S, 164°11.52'E, 658–690 m, 23.XI.1994, 1 ♀ 18 mm, 3 juv. 10–11 mm (USNM 1000646).

SMIB 8, stn DW 146, 24°55.20'S, 168°21.73'E, 514–522 m, 27.I.1993, 1 ♀ 17 mm (RMNH D 48737).

PALEO-SURPRISE, stn CP 1399, 18°29.0'S, 163°02.1'E, 325 m, 14.V.1999, 1 ♂ 6 mm (MNHN-Pa 1839), 1 ♂ 17 mm, 2 ♀♀ 11 and 18 mm, 1 juv. 6 mm (RMNH D 48736). — Stn CP 1392, 18°29.8'S, 163°02.7'E, 370 m, 12.V.1999, 2 ♀♀ 20 and 23 mm (MNHN-Pa 1882).

Loyalty Islands. MUSORSTOM 6, stn DW 391, 20°47.35'S, 167°05.70'E, 390 m, 13.II.1989, 1 ♂ 8 mm (MNHN-Pa 1353). — Stn DW 395, 20°47.57'S, 167°05.32'E, 400 m, 13.II.1989, 1 ♀ 14 mm (photographed) (MNHN-Pa 1348). — Stn DW 397, 20°47.35'S, 167°05.17'E, 380 m, 13.II.1989, 1 ♂ 11 mm (MNHN-Pa 1355). — Stn DW 398, 20°47.19'S, 167°05.65'E, 370 m, 13.II.1989, 2 ♀♀ 17 and 18 mm (photographed) (MNHN-Pa 1347 and 1349). — Stn DW 406, 20°40.65'S, 167°06.60'E, 373 m, 15.II.1989, 1 ♂ 11 mm (photographed) (MNHN-Pa 1351). — Stn DW 412, 20°40.60'S, 167°03.75'E, 437 m, 15.II.1989, 1 ♀ 15 mm (MNHN-Pa 1356). — Stn DW 416, 20°42.15'S, 166°59.60'E, 343 m, 16.II.1989, 2 ♀♀ (the largest ov.) 18 and 20 mm (MNHN-Pa 1354).

Vanuatu (New Hebrides). MUSORSTOM 8, stn CP 980, 19°21.02'S, 169°25.22'E, 450–433 m, 22.IX.1994, 2 ♂♂ 11 and 13 mm (photographed) (MNHN-Pa 1840 and 1841). — Stn CP 982, 19°21.80'S, 169°26.47'E, 408–410 m, 23.IX.1994, 1 juv. 10 mm (MNHN-Pa 1842).

Fiji Islands. BORDAU 1, Ride de Lau (no other data), 1 ♀ 19 mm (MNHN-Pa 1895). — Stn CP 1446, 17°11'S, 178°42'W, 350–367 m, 3.III.1999, 3 ♀♀ 19–22 mm (one specimen photographed MNHN-Pa 1885; others MNHN-Pa 1845). — Stn CP 1447, 16°45'S, 179°59'E, 420–513 m, 4.III.1999, 1 ♀ 18 mm (RMNH D 48738).

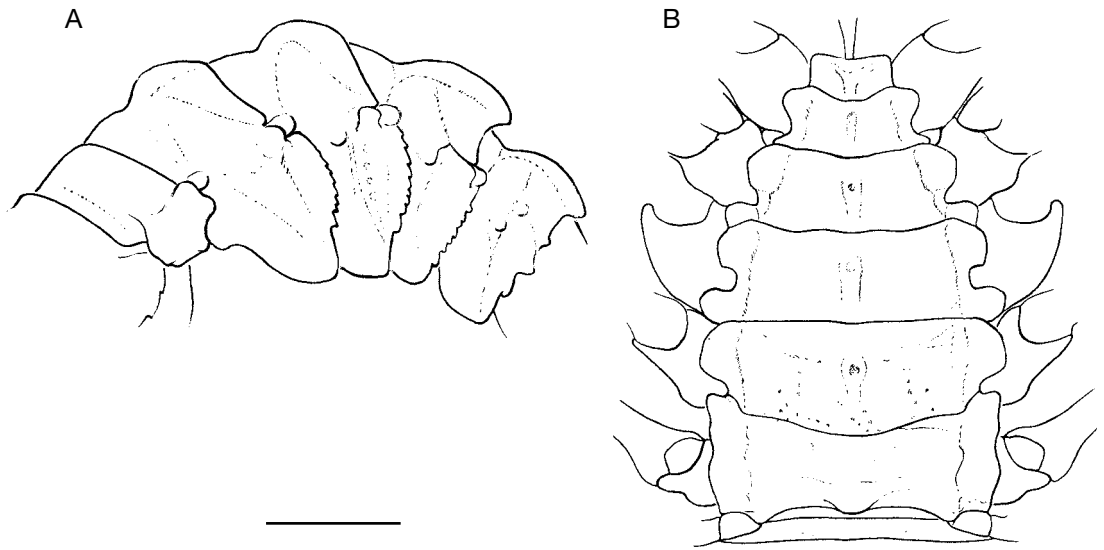


FIG. 2. — *Bathyarctus rubens* (Alcock & Anderson, 1894) n. comb.; **A**, Philippines, RV *Albatross*, stn D 5172, ♀ (USNM), abdomen in lateral view; **B**, New Caledonia, RV *Alis*, BATHUS 4, stn DW 927, ♂ (MNHN-Pa 1837), thoracic sternum. Scale bar: 2 mm.

DISTRIBUTION. — So far the species was known only from the Indian region. The type material was collected by the RV *Investigator* at stn 151, in the Gulf of Manaar, 13.5 miles S., 64°E of Colombo Lighthouse, Sri Lanka (Alcock & Anderson 1894). Later (Anderson 1896: 98) the species was reported from RV *Investigator* stn 204, off the west coast of Sri Lanka at 6°50'20"N, 79°36'20"E, 329–379 m, while George (1969: 434) reported it from the Arabian Sea off Cochin, India, 9°55'N, 75°35'E, 183 m. The present material shows that the species has a wide distribution in the Indo-West Pacific region from Mozambique to the Philippines and the New Caledonia area.

HABITAT. — It is a deep sea form. The holotype was collected at 260–732 m, the other published records are from 183 to 379 m. The present material was obtained between 210–268 and 582 m. The bottom at the type locality was reported to be “brown mud”; that of RV *Investigator* stn 204 “broken coral”, and of RV *Albatross* stn D 5172 it was “fine sand and shells”. In the present material the only bottom indications are “rocks and stylasterid coral” and “pumice stone and pteropod shells”. It seems that the species prefers a bottom of fine sediment mixed with coarser particles.

DESCRIPTION

The carapace is rather uneven, with deeply depressed areas. The rostrum is blunt and slightly elevated by a small dorsal ridge, but there is no

actual rostral tooth. Between the anterior margin of the carapace and the pregastric tooth the surface shows scattered tubercles which may be minute or larger, in the latter case they may form a transverse row of about 12 small tubercles extending at a short distance behind the anterior margin of the carapace. This row is evidently more conspicuous in males than in females. Before the cervical groove the median line of the carapace bears a pregastric and a gastric tooth. The pregastric tooth is broad, blunt and depressed, it is somewhat truncated or rounded at the tip. The gastric tooth is more elevated and more compressed, dorsally it bears three, sometimes inconspicuous, longitudinal rows of very small tubercles. The cardiac tooth, behind the cervical groove, is practically of the same shape and size as the gastric tooth; dorsally it bears four longitudinal, posteriorly somewhat diverging rows of indistinct squamiform tubercles. The anterior submedian carina bears numerous very small tubercles, a few may be larger and placed in an oblique row; behind the carina, just before the cervical groove, an isolated tubercle is visible. This submedian carina is separated by a rather deep groove from a

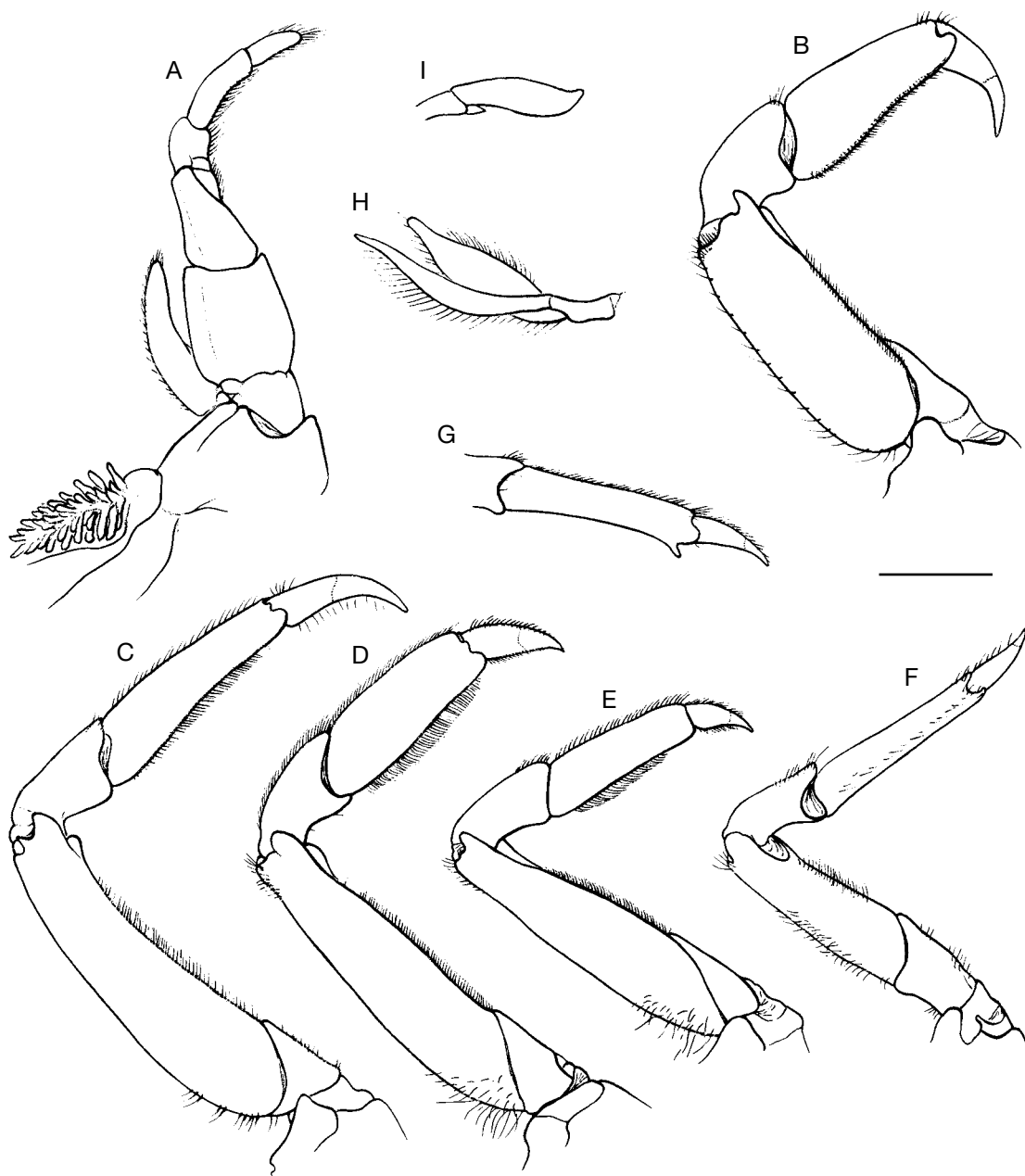


FIG. 3. — *Bathyarctus rubens* (Alcock & Anderson, 1894) n. comb., New Caledonia, BATHUS 4, stn DW 927, ♂ (MNHN-Pa 1837); **A**, third maxilliped; **B-F**, pereiopods 1 to 5; **G**, propodus and dactylus of pereopod 5; **H**, pleopod 1; **I**, pleopod 3. Scale bar: 2 mm.

row of two larger and several smaller tubercles between it and the anterior branchial carina. The branchial carina is widely interrupted by the cer-

vical groove; a minute, but distinct tubercle is visible in the gap. The anterior branchial carina ends in the inner margin of the orbit; anteriorly it

terminates in a large tooth, below which there is a much smaller second tooth. Behind the larger tooth the branchial carina is entire and smooth. A distinct but small single postorbital tubercle is placed behind the orbit. The inner part of the anterior orbital margin carries two small but distinct tubercles placed in a longitudinal row; the rest of the anterior margin has two or three slightly larger tubercles. The intercervical carina is usually swollen and bears up to 17 small tubercles, the posterior of which is largest; these tubercles may be arranged in one or two rows, but often are indistinct. The lateral margin is serrate. The cervical incision is narrow, the post-cervical wide, neither is very deep. There are three or four anterolateral teeth, one mediolateral and seven or eight posterolateral. The posterior submedian carina is somewhat swollen and has about five larger and several smaller tubercles, some or all of which may be indistinct; the larger often are in a longitudinal or slightly oblique row. There are about four to six large intermediate tubercles. Some three or four tubercles are placed on the posterior margin of the cervical groove between the intermediate tubercles and the posterior branchial carina. The posterior branchial carina bears about six to eight teeth, which sometimes are indistinct. Between the posterior branchial carina and the lateral margin of the carapace there are two to four longitudinal rows of tubercles, the largest lies closest to the lateral margin and consists of about seven to 11 tubercles; the other two are shorter and have two to eight tubercles. The marginal groove is deep and not very wide. Behind it there are about eight small tubercles placed in a transverse row on each half of the carapace. Before the groove a similar number of small tubercles is visible. A second groove, wider and interrupted by the posterior postrostral carina, is placed some distance before the marginal groove, it extends from the posterior postrostral to the posterior branchial carina, and its posterior margin bears eight to 10 larger tubercles. The posterior margin of the carapace is bluntly, but rather deeply, incised in the middle.

The first abdominal somite is rather smooth dorsally, but for an often very inconspicuous trans-

verse groove and six short and not very conspicuous longitudinal carinae in the median area of the posterior half. The anterior half of the next four somites is smooth and finely or distinctly pitted. The posterior part of the somites is higher than the anterior and bears a distinct median carina, which in the second and third somite shows a median groove; the carinae are not lobulated laterally. This median carina is highest in the fourth somite, the next highest is that of the fifth followed by those of the third and the second somites. In the fourth and fifth somites the carina is tooth-like, produced posteriorly and reaches beyond the posterior margin of each respective somite. The posterior margin of the first to third somites is deeply incised in the middle. The fourth and following somites lack this incision. The posterior half of each somite shows a transverse groove, sometimes distinct, sometimes rather faint; this groove may have side grooves, but there certainly is not the complicate arborescent sculpturing as found in e.g., *Scyllarus arctus*. The tips of the second to fifth pleura are bluntly rounded and are directed slightly backward. The pleuron of the second somite has a distinct tooth on the anterior and on the posterior margin; the third and fourth pleura show only a blunt tooth on the posterior margin, sometimes with one or more denticles above it. The pleura of the fifth somite are broadly rounded distally and posteriorly and bear a large blunt tooth in the basal part of the posterior margin. The posterior half of pleura II to V shows some transverse rows of small tubercles. The posterior margin of the sixth somite bears five large and two to four small teeth; some squamiform tubercles are present on the upper surface. Of the four teeth at the end of the calcified portion of the telson, the outer are pointed, the inner rounded.

The anterior margin of the antennular somite bears a broad low blunt tooth in the outer part, it shows no tubercle.

The anterior (sixth) segment of the antenna is convex, it bears six or seven teeth, the outer four or five have broadly rounded tips, the inner or inner two are narrower and more pointed. The upper surface of the segment bears scattered

minute tubercles, a larger tubercle stands near the base of the segment near the articulation with the fifth antennal segment. The anterior margin of this fifth segment bears two teeth in the outer lateral part, and one tooth in the inner; this inner tooth has a dorsal carina. The upper surface of the fourth segment bears two distinct carinae: one, the midrib, ending in the apex of the segment, the other, more external, ending in the middle tooth of the external margin; this latter carina bears some tubercles. The surface between the midrib and the inner margin of the segment shows scattered small tubercles. The outer margin of the fourth segment bears two or three teeth (not including the apical tooth), while an indication of a very small tooth may be seen in the basal part. The inner margin of the segment bears seven to 10 teeth, one of which, placed in about the middle, is the largest.

The epistome is deeply sunken and shows two faint or more distinct lobes at the anterior end.

The third maxillipeds are implanted practically on top of the sternum and therefore are more exposed than in other genera of the family. P.1 is the heaviest of the pereopods, but it is more slender than in most other species of the family, being only slightly more robust than P.2. The second leg (P.2) is the longest. From P.2 to P.4 the legs diminish in size; P.5 is again longer than P.4. P.5 is slightly twisted with the dactylus pointing dorsally. The dactylus of P.2 is longer than that of any other leg; the dactylus of P.4 is shorter than that of P.3 and slightly more than half as long as that of P.2. In the females the dactylus of P.5 forms a small chela with a prolongation of the propodus; this fixed finger is about half as long to almost as long as the dactylus; the males have no such chela, but the propodus still may show a small erect or distally directed spinule on the lower margin near the base of the dactylus. The propodus of P.3 is about as wide as the merus, it is broader than that of P.4 and also less slender than that of P.2. The dactyli of all legs have a ventral fringe of hairs. The dactyli of P.3 and P.4, sometimes also those of P.1 and P.2, bear longitudinal rows of short hairs on the upper, inner and lower margins. In all but P.5,

the lower margin of the propodus is provided with a longitudinal row of distinct hairs; in P.2, P.3 and P.4 such a row is also present on the upper margin of the propodus. The propodus of P.3 shows an indistinct hairy groove on the outer surface. In P.3 to P.5 the carpus has also a row of hairs on the dorsal surface (least distinct in P.5). In all legs the merus shows a short pubescence on the lower margin. On the outer surface of the merus there are two wide longitudinal grooves, one in the upper and one in the lower half; these grooves are distinct in the last three legs and often very vague in the first two.

The anterior margin of the sternum is squarely truncate or slightly sinuous, it is flat and not sunken, and shows no sharp median incision, although its median part may be shallowly concave. Slightly behind the anterior margin there is a distinct median triangular tubercle. A distinct tubercle is present in the anteromedian part of each of the somites of the sternum; in the anterior somites they are elongate, in the posterior more conical, or even bluntly spiniform, in the fifth somite it sometimes is tooth-like. Near the bases of the legs the sternum is elevated and shows longitudinal ridges.

In the male, the pleopods of the second and third somite have the exopod and endopod narrow and elongate, they are of about the same length. In the fourth and fifth somite the endopods of the pleopods are reduced to a small tubercle. In the females the pleopods of the second and third somite have both endopod and exopod broadly lamellar, in the two following pairs of pleopods, the endopod is much narrower than the exopod.

Size

Of the material examined here the females had cl. 12 to 22 mm; an ovigerous female had cl. 20 mm. The males had cl. 8 to 18 mm, and thus are smaller than the females. Alcock (1901) gave the cl. of one of his females as 26 mm, which is larger than in any of the present specimens.

Colour

Alcock & Anderson (1894) described the colour in life as "light rose madder above, white below".

The colour photographs made of some of the above listed specimens, as a rule show a pale brown dorsal surface with numerous small irregular dark brown spots, the tubercles often are very light. Sometimes the brown colour forms a rather dark transverse band somewhat before the middle of the carapace in the area of the cervical groove. There may be darker areas on the rest of the body, e.g., before the rostrum, the lateral part of the first abdominal somite and the posterolateral corners of the carapace, but these often are not or hardly visible. In all photographed specimens the anterior half of the first abdominal somite is conspicuous in having a dark purplish brown, almost black, colour over the full visible width. The tips of the median carinae of the fourth and fifth abdominal somites, often are somewhat darker than the rest. The pereiopods, at least the last three pairs, show a dark brown band in about the middle of the propodus, carpus and merus; the band of the propodus lies slightly proximal, that of the merus slightly distal of the middle. The tailfan is pale, slightly transparent and with hardly any dark brown markings. The specimen from Vanuatu, stn CP 980, is very dark, but has about the same colour pattern as the others: some of the tubercles are white or whitish; the tailfan and sixth abdominal somite are very light, contrasting strongly with the rest of the body; also the pleura of abdominal somite V are whitish distally. The colour on the first abdominal somite is rather persistent: in some specimens that have been preserved for about a year, there still is a distinct very narrow transverse reddish brown band over the anterior half of the somite.

REMARKS

As already pointed out by Bouvier (1917: 105, 106; 1925: 447), the present species is closely related to the Atlantic *Bathyarctus faxoni* (Bouvier, 1917) n. comb., from the West Central Atlantic (E Florida to Guadeloupe including the Gulf of Mexico). In *B. faxoni* n. comb. the pregastric tooth is less broad and flat and resembles more the gastric tooth. The ornamentation of the first abdominal somite consists of tubercles, not of ridges. The carinae of the abdominal somites

are less high and that of the fourth somite is not produced beyond the posterior margin of the somite. The distal margin of the pleuron of the fifth abdominal somite forms an acute angle or tooth; on its posterior margin there are two large teeth often with a small tooth in-between. The sternite bearing the first pereiopods does not have a tubercle in the posteromedian part, such a tubercle is present on all other sternites.

Bathyarctus chani n. sp. (Figs 4; 5; 66C)

TYPE MATERIAL. — Holotype: CHALCAL 2, stn CC1, ♂ 22 mm (MNHN-Pa 1884); paratypes: Su-Aou, 1 ♂ 20 mm, 1 ♀ 20 mm (RMNH D 49554).

TYPE LOCALITY. — South of New Caledonia, 24°54.96'S, 168°21.91'E, 500-580 m.

MATERIAL EXAMINED. — **South of New Caledonia.** CHALCAL 2, stn CC1, 24°54.96'S, 168°21.91'E, 500-580 m, 28.X.1986, 1 ♂ holotype 22 mm (MNHN-Pa 1884).

Taiwan. NE Coast, Su-Aou fishing port, I-Lan County, depth about 500 m, 17.VI.1993, T. Y. Chan leg., 1 ♂ paratype 20 mm, 1 ♀ paratype 20 mm; don. National Taiwan Ocean University (RMNH D 49554).

DISTRIBUTION AND HABITAT. — At present the species is only known from NE Taiwan and New Caledonia. The Taiwan material was taken at a depth of about 500 m, that of New Caledonia at 500-580 m.

ETYMOLOGY. — The species is named for Dr Tin-Yam Chan, who pointed out to me the differences between this species and *B. formosanus*.

DESCRIPTION

The rostrum bears a rather large single rounded tubercle and is only slightly constricted behind the top; it bears a low and blunt dorsal ridge with a few inconspicuous tubercles; but there is no true rostral tooth. The pregastric tooth is broad and blunt, with a distinct but very small double tubercle on its posterior slope. The gastric tooth is distinctly larger than the pregastric and has a broadly rounded top; its posterior slope shows two or three rows of two or three squamiform tubercles; these rows extend to the cervical groove. The cardiac tooth reaches over the cervical groove and is rounded or two-topped; its top is followed

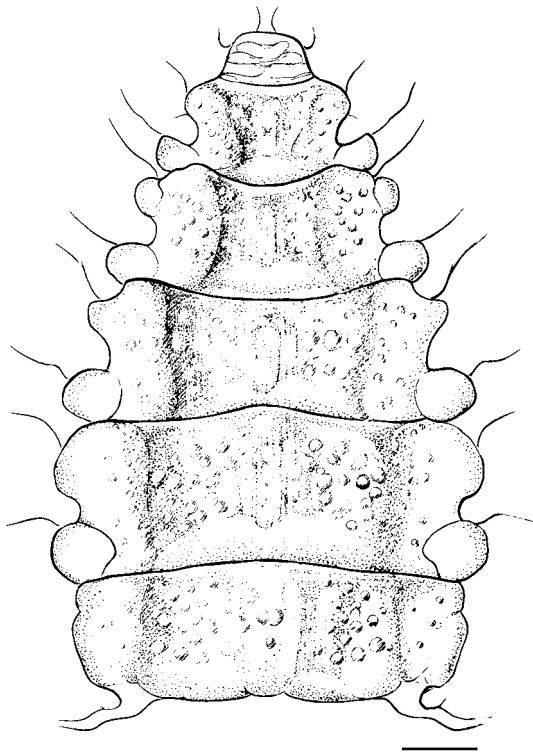


FIG. 4. — *Bathyarctus chani* n. gen., n. sp., New Caledonia, CHALCAL 2, stn CC 1, ♂ holotype (MNHN-Pa 1884), thoracic sternum. Scale bar: 2 mm.

by two submedian rows of five to nine squami-form tubercles. These two rows of submedian tubercles are sharp and straight and separated by an equally straight and clearly defined median groove. A divergent row of three tubercles is placed next to the anterior part of the submedian carinae. The anterior branchial carina ends anteriorly in two low blunt teeth, the posterior of which is the larger; the anterior being a mere tubercle placed below the posterior tooth. These teeth are placed on the inner part of the orbital margin, the rest of the anterior branchial carina is sharp, high and smooth. The lower margin of the orbit shows about three small tubercles. The anterior and posterior branchial carinae are separated by a very wide gap formed by the cervical groove; a sometimes indistinct tubercle is placed within or slightly outside the gap. The posterior branchial carina is high and carries six to eight squamiform

tubercles of various sizes. The area between the anterior postrostral carina and the anterior branchial carina shows small rounded tubercles in a rather narrow field along the anterior margin of the carapace. Just behind this field and nearer to the branchial carina is a pair of larger tubercles, probably representing the anterior submedian carina; at each side of the gastric tooth there is an oblique, diverging row of two or three similar tubercles. Between the posterior postrostral and posterior branchial ridges there is a distinct row of five or six intermediate tubercles, while two additional tubercles are placed between the intermediate row and the tip of the posterior branchial carina. The posterior submedian carina is short and carries two or three rounded tubercles; a few additional tubercles may be present.

The posterior orbital margin is smooth, merges at the inner end with the anterior branchial carina, and externally ends in a blunt tubercle. The anterior margin of the orbit shows three large tubercles. The postorbital surface is smooth but for a distinct single postorbital tubercle, which may be elongate in shape. The intercervical area is somewhat elevated and consists of a slightly curved row of closely placed tubercles.

The lateral margin of the carapace has four antero-lateral teeth (the anterior of which is largest), two mediolateral teeth (the posterior being quite small), and seven posterolateral teeth.

The posterior margin of the postcervical groove between the branchial and lateral carinae bears a row of three or four blunt tubercles. A row of six to eight tubercles is placed against the posterior lateral carina, which thereby gives the impression of carrying a double row of tubercles. More tubercles fill the posterior part of the area between posterior branchial and posterior lateral carinae, and extend along the anterior part of the posterior branchial carina.

The posterior margin of the carapace shows a blunt and wide median incision. A row of about 12 large, rounded tubercles and a few scattered small ones extends along the posterior margin. Before these tubercles is the rather wide and deep marginal groove. Before the marginal groove are two transverse rows of tubercles, the anterior row

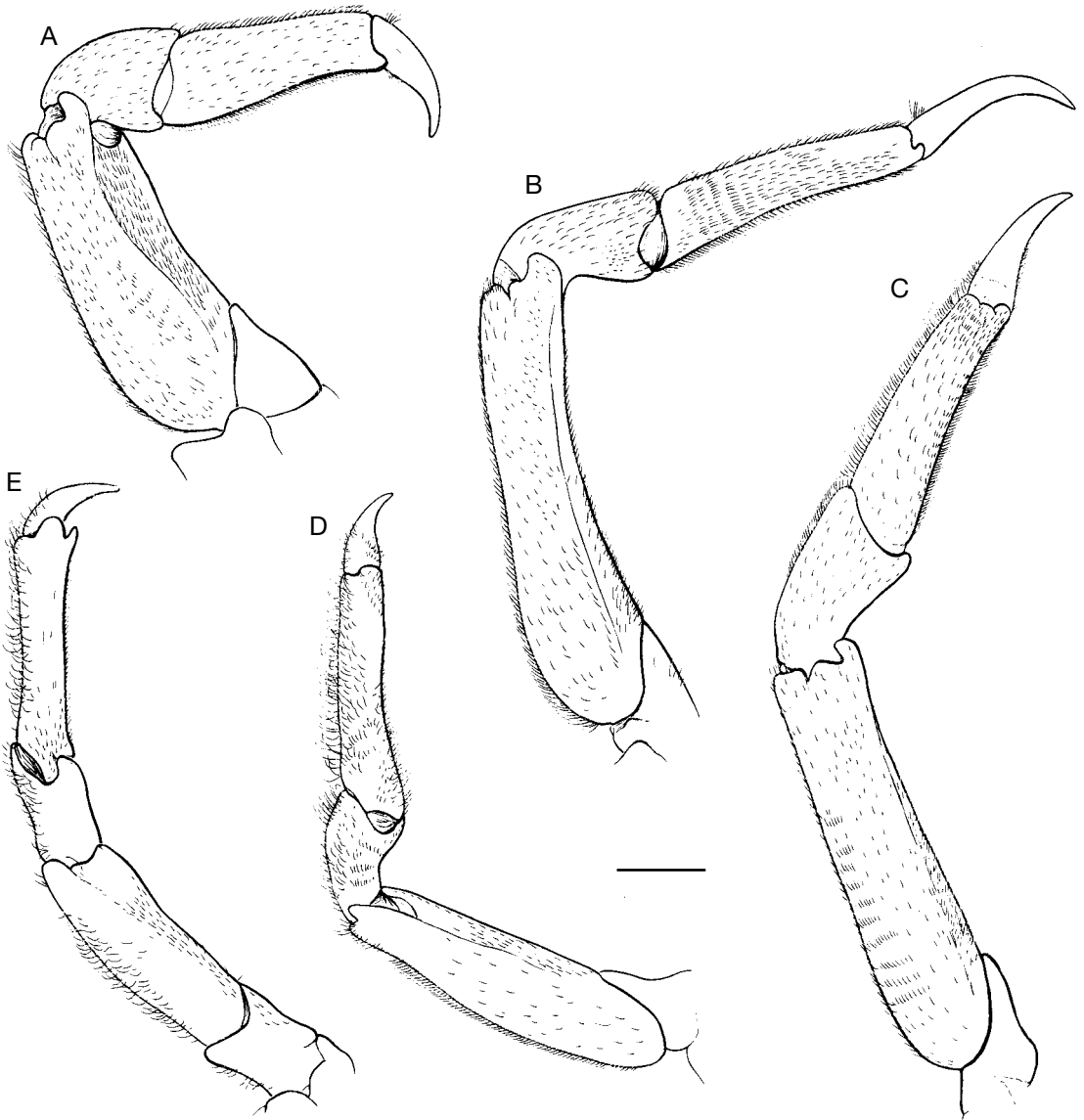


FIG. 5. — *Bathyarctus chani* n. gen., n. sp., New Caledonia, CHALCAL 2, stn CC 1, ♂ holotype (MNHN-Pa 1884); A-E, pereopods 1 to 5. Scale bar: 2 mm.

consists of 12 large, and the posterior of about 12 small, more irregularly arranged tubercles.

The first abdominal somite shows a transverse groove, behind which extends a row of about 20 tubercles, some double. Abdominal somites II to V have a median longitudinal carina, which are of about the same height, or those of somites II

and III are slightly lower than the others; the carinae of somites II to IV show a sharp median groove. The carinae are rather faintly lobulated laterally. Behind the transverse groove on the tergum of each half of somites II to IV there is a row of about seven tubercles of about equal size, some near the median carinae may be double. Before

the transverse groove there are tubercles that form two groups separated by a deep oblique groove; each group of tubercles is flattened and forms a plateau-like figure, the outer group being larger than the inner. The smooth anterior half of the abdominal somites shows no hairy groove, but there are a few irregular pits.

The lateral margin of the pleura of the first abdominal somite bears three tubercles. The pleuron of the second somite shows a wide X-shaped groove, a rather long row of tubercles behind it, and some larger tubercles elsewhere. The anterior margin of pleuron II has a conspicuous basal lobe with some blunt tubercles, the rest of the margin is smooth with some low tubercles behind it. The posterior margin shows a blunt incision behind the apex, above which is a row of tubercles diminishing in size dorsally. The pleura of the third and fourth somites have the anterior half flat with a smooth anterior margin; the posterior half shows two parallel rows of tubercles separated by a deep groove and with the posterior margin bluntly serrate. Somites I to IV show a distinct median incision in the posterior margin. The fifth abdominal somite has a distinct median longitudinal carina. The lateral surface and the pleura is as in somites III and IV, only the posterior margin of the pleura shows a blunt tooth in the middle. The upper surface of the sixth somite has three transverse rows of large tubercles; these rows are of different length; the anterior is interrupted in the middle. The firm part of the telson is provided with six longitudinal carinae: 1) two lateral carinae are placed on the lateral margin, they carry squamiform tubercles; 2) two submedian carinae, that are the shortest; and 3) a pair of intermediate carinae between the lateral and submedian carinae. A flat tubercle is placed between the posterior ends of the lateral and intermediate carinae.

The anterior margin of the antennular somite is incised in the middle and bears a blunt tooth in each half.

The sixth (last) antennal segment ends in seven rather slender teeth with blunt tops; one of the seven is placed on the inner margin of the segment. The upper surface of the segment bears

several small rounded tubercles. The fifth segment shows three blunt teeth on the anterior margin; the inner of these is the strongest and forms the end of a rather high carina. The fourth segment ends in a blunt tooth which forms the end of a curved oblique carina, which traverses the full length of the segment; this carina has a few distinct tubercles in the basal part, the rest is smooth. A second, shorter, parallel carina is seen on the outer half of the segment; it bears a row of small but distinct tubercles. On the base of the segment one or two high blunt teeth are present. The anterior margin shows a distinct blunt tooth just before the middle; between this tooth and the base of the margin three very small teeth are visible, and between the large tooth and the tip of the segment there are six similar small teeth. The outer margin of the segment has four or five teeth, the proximal two or three being indistinct. A few small round tubercles are visible on the upper surface of the segment. The third segment shows two large blunt teeth on the inner part of the anterior margin and some small tubercles on the rest of the surface.

The anterior margin of the epistome is incised in the middle and sharply angular at either lateral end.

P.1 is relatively slender. The propodus is 2.5 times as long as the dactylus and about twice as long as high. The dactylus shows a few hairs in the basal part of the upper margin. The lower margin bears a fringe of setae. The posterior surface of the merus has a longitudinal hairy groove in the upper half and some hairy depressions in the lower; hairs are also present on the lower margin. The dactylus of P.2 is longer than any of the other dactyli, it is two thirds as long as the propodus, which is about four times as long as high. Like in P.1 the dorsal margin of the dactylus shows some hairs in the basal part. The propodus of P.2 has a fringe of ventral hairs and some short hairs on the rest of the surface. The merus of P.2 to P.4 has both a dorsal and a ventral fringe of hairs, and a longitudinal hairy groove in the upper part of the posterior surface, the lower half has small irregular hairy depressions. The dactylus of P.3 and P.4 has a dorsal fringe of hairs and

also some hairs on the lower margin. The propodus of these two legs is rather shaggy with dorsal and ventral hair fringes, and short hairs in-between. Hairs are also visible in the dorsal part of the carpus. The fifth leg has dorsal hairs on propodus, carpus and merus. Its dactylus, together with that of the fourth leg, is the shortest of all. The propodus of P.5 bears a small antero-ventral tooth, which is less than one third as long as the dactylus.

The anterior margin of the thoracic sternum is convex or slightly sinuous without a trace of a median incision. The first sternite bears a median row of three rather indistinct tubercles. The entire surface of the sternum is regularly granulated and pitted, except in the grooves. Each sternite shows a low but distinct median tubercle in the posterior part. The posterior margin of the sternum shows no spines or teeth in either sex.

The second abdominal somite in our male specimens has distinct pleopods, with the endopod only slightly narrower and longer than the exopod. The second pleopods (on somite 3) resemble the first, are only smaller. The pleopods of somites 4 and 5 have the endopod reduced to a short finger-like lobe, while the exopod is similar to those of the previous pleopods, but smaller. The basal part of the uropods is smooth without tubercles, at most with a shallow groove.

Size

In the present male specimens cl. is 20 and 22 mm long, in the female cl. is 20 mm.

Colour

A coloured photograph of the type specimen shows an animal with a uniform dull pale reddish brown colour. The smooth anterior part of the second abdominal somite is pale bluish and the extreme anterior tips of the median carinae of abdominal somites II and III are white. The whole gives the impression that the animal may have been photographed some time after preservation. However, a colour photograph of a fresh specimen from Taiwan is likewise uniformly pale brown with the tubercles and ridges somewhat brighter than the rest; the sixth abdominal somite 9

is somewhat paler than the other somites and the tailfan is whitish in the basal part, transparent in the rest.

Bathyarctus formosanus (Chan & Yu, 1992) n. comb.

Scyllarus formosanus Chan & Yu, 1992: 121, pls 1, 2; 1993: 214, 2 figs. — Huang 1994: 564.

TYPE MATERIAL. — Holotype: ♀ 41 mm (NTOU).

TYPE LOCALITY. — Taiwan, NE coast, Tai-Shi fishing port, depth about 250 m.

MATERIAL EXAMINED. — **Taiwan**. NE coast, Tai-Shi fishing port, I-Lan County, depth about 350 m, commercial trawler, XI.2000, P. K. L. Ng leg., 1 ♀ 41 mm (NTOU).

DISTRIBUTION AND HABITAT. — The type locality is Tai-Shi, I-Lan County, NE Taiwan. The holotype was taken at a depth of about 250 m; the specimen was obtained at a fishmarket and the data were received from a fisherman. Huang's (1994) report of the occurrence of the species in Chinese waters is clearly based on the original record of the species from Taiwan. The specimen examined here also was obtained at Tai-Shi fishing port. It was said to be taken at a depth of about 350 m.

DESCRIPTION

Originally I had identified the previous species, *B. chani* n. sp., with the present. Dr Chan, however, pointed out differences between the two and sent me a specimen of the true *B. formosanus* n. comb. for comparison. The main differences between these two species are the following: 1) *B. formosanus* n. comb. is distinctly larger than *B. chani* n. sp., the former has cl. 31.5 to 40 mm, of the latter only specimens of cl. 20–22 mm are known; 2) one of the two submedian tubercles at the base of the telson is very high in *B. formosanus* n. comb., the two are both low and rounded in *B. chani* n. sp.; 3) in *B. formosanus* n. comb. the fourth antennal segment has three teeth on the outer margin, the lowest being quite small. The outer margin of the distal tooth shows some serrations. The anterior margin of the fourth antennal segment mediad of the large median tooth is smooth or with an indistinct broad tooth; 4) the main difference between the two species is found

in the legs. In *B. chani* n. sp. the propodus of legs 2 to 5 have a dorsal fringe of hairs, while in *B. formosanus* n. comb. such hairs are found only in the third leg; and 5) the dactylus of P.2 in *B. formosanus* n. comb. are longer than in *B. chani* n. sp. That of the second leg in *B. formosanus* n. comb. is as long as the propodus, while in *B. chani* n. sp. it is clearly shorter. In *B. formosanus* n. comb. the propodi of P.2 to P.5 have no ventral hairs.

Colour

The coloured plate of the female holotype (Chan & Yu 1992: pl. 1) shows a pale brown specimen marbled with dark brown. A dark brown spot is seen in the outer basal part of the fourth antennal segment, a transverse dark brown band extends in the middle of the carapace, while also the posterolateral angles of the carapace are dark brown. The first abdominal somite is dark brown with a strongly contrasting broad, almost quadrangular median light area which reaches the posterior margin; the anterior margin is bluish. Abdominal somites II to V are irregular dark brown, with a rather large pale patch above the bases of the pleura in somites II and III, and a median pale spot in somites IV and V. Abdominal somite VI and the tailfan are whitish with light brown spots in the basal part. A colour photograph of the present examined specimen has the carapace and antennae more of a greyish brown colour, with paler areas in the branchial and postrostral regions and on the fourth antennal segment. The pale median spot found in the middle of the first abdominal somite of the type is also present here, with a dark brown colour along the sides and the anterior, but not the posterior, margin. The abdomen is pale brown with three or five small dark spots on the posterior margin of somites I to III. The posterior margin of somite IV is rather dark. The tailfan is very pale greenish, somewhat transparent.

Bathyarctus steatopygus n. sp. (Figs 6-8)

TYPE MATERIAL. — Holotype: RV *Manihine*, cruise 320, dredge 3, ov. ♀ 11 mm (RMNH D 49553); paratype: RV *Manihine*, cruise 331, stn 19, dredge 4, 1 ♀ 11 mm (RMNH D 49552).

TYPE LOCALITY. — Kenya, Formosa Bay (Ungama Bay), 7°45'S, 40°28'E, 26 m.

ETYMOLOGY. — From the Greek *stear* (fat) and *pyge* (rump, buttocks). According to the Concise Oxford Dictionary, *steatopygia* is "the excessive development of fat on the buttocks, esp. of Hottentot women". The name refers to the enormous dorsal swelling on the fourth and fifth abdominal somites in this species. The name is to be treated as an arbitrary combination of letters and therefore not subject to change with eventual change of gender in the accompanying generic name.

MATERIAL EXAMINED. — **Western Indian Ocean, Kenya.** Formosa Bay (Ungama Bay), RV *Manihine*, cruise 320, dredge 3, 7°45'S, 40°28'E, 26 m, 25.II.1971, A. J. Bruce don., 1 ov. ♀ holotype 11 mm (RMNH D 49553). — Off northern Kenya, RV *Manihine*, cruise 331, stn 19, dredge 4, 2°20'S, 41°10'E, 176 m, stones and sponges, 9.X.1971, P. S. Sandher leg., A. J. Bruce don., 1 ♀ paratype 11 mm (RMNH D 49552).

DISTRIBUTION. — The two only known specimens of the species were both taken off the coast of Kenya.

HABITAT. — The types were found at depths of 26 and 176 m. The bottom at one of the stations where this species was taken was described as with stones and sponges.

DESCRIPTION

The rostrum has a rounded tip and is only slightly constricted at the base. No rostral tooth is present, but there is a low inconspicuous median dorsal longitudinal ridge which extends posteriorly and carries a few tiny tubercles. The pre-gastric tooth is likewise absent, but the gastric tooth is distinct and triangular in lateral view; behind the gastric tooth there are five short longitudinal rows of tubercles. The cardiac tooth is well-developed about as large as the gastric tooth and provided dorsally with two longitudinal ridges each with five or six low tubercles; these ridges are separated by a straight median longitudinal groove. Scattered tubercles are present on the sides of the cardiac tooth. The branchial carina is widely interrupted by the cervical groove. In the gap is a tubercle. The anterior branchial carina ends in two teeth placed on the inner orbital margin; the posterior tooth is the larger of the two and placed higher than the anterior. A thin short carina connects the top of the posterior tooth with the

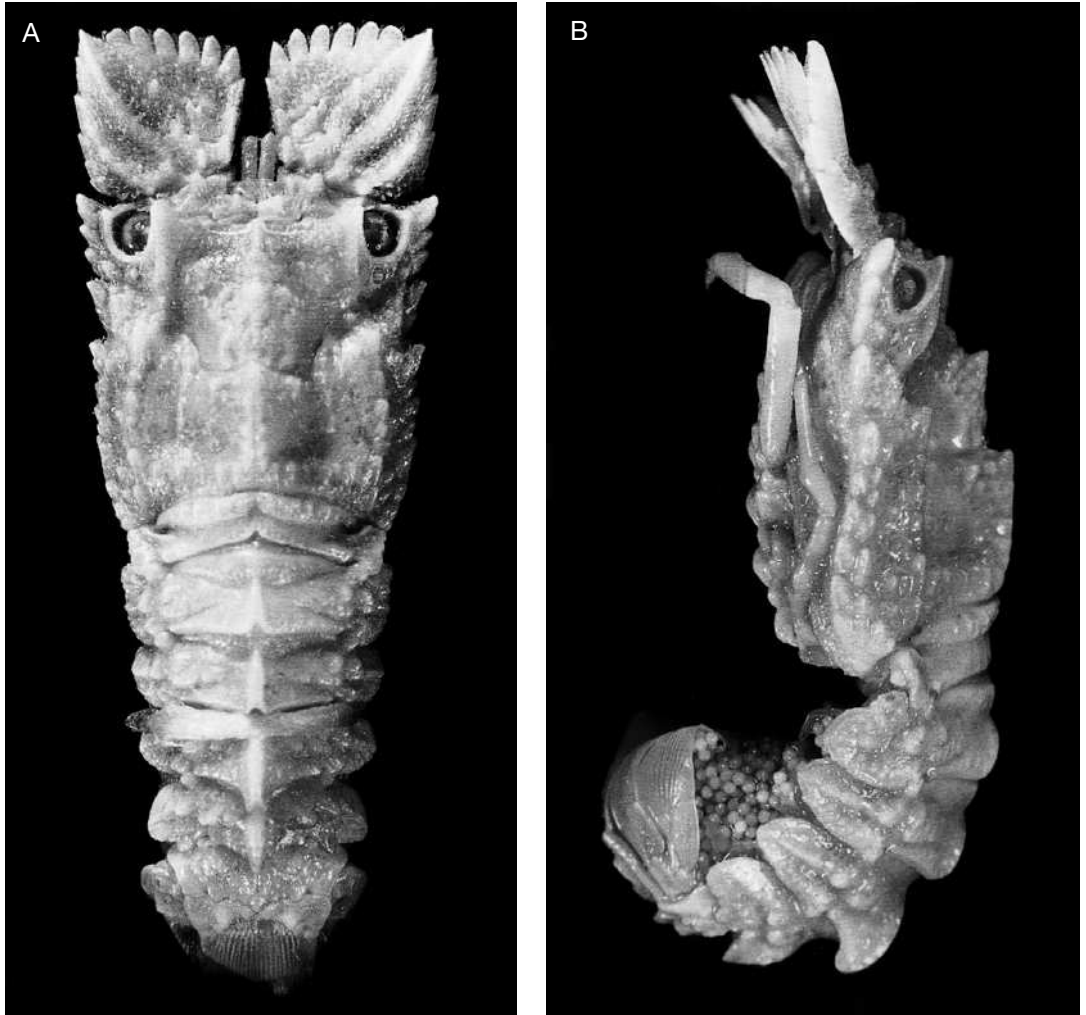


FIG. 6. — *Bathyarctus steatopygus* n. gen., n. sp., Kenya, Formosa Bay, ♀ holotype (RMNH D 49553); **A**, dorsal view; **B**, lateral view.

orbital carina, which bears no tubercles. The anterior branchial carina itself is slightly uneven. A distinct postorbital tubercle is present. The posterior branchial carina ends in a distinct anterior tooth that overhangs the cervical groove; it is followed by a row of five distinct and a few inconspicuous tubercles. There are very few tubercles between the anterior postrostral and the anterior branchial carinae. The intermediate row between the posterior postrostral and posterior branchial carinae consists of five to seven rounded tubercles, the anterior two or three of which

are placed on the posterior margin of the cervical groove. The lateral margin of the carapace has three anterolateral teeth (including the tip), one or two mediolateral and five or six large plus a few small posterolateral tubercles. The posterolateral carina ends anteriorly slightly above the posterior end of the mediolateral, the lateral margin forming an indistinct angle there. The intercervical carina shows tubercles; and the space between the posterolateral and posterior branchial carinae is filled by two more or less distinct rows of tubercles. The marginal groove along the

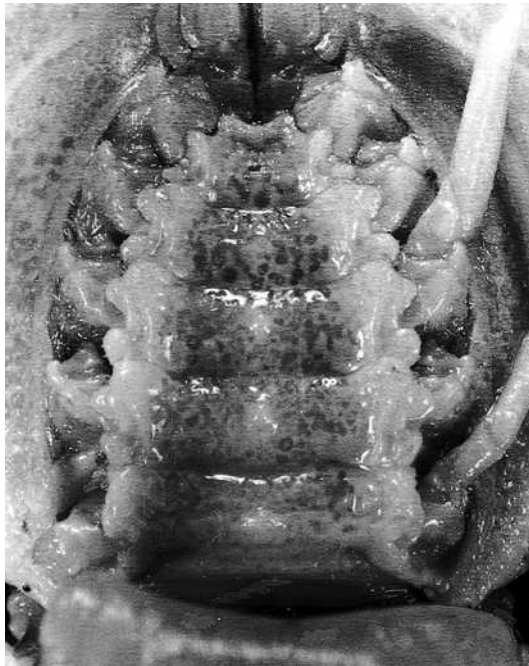


FIG. 7. — *Bathyarctus steatopygus* n. gen., n. sp., Kenya, Formosa Bay, ♀ holotype (RMNH D 49553), thoracic sternum.

posterior margin of the carapace is distinct, with a transverse row of distinct tubercles both before and behind it; the former are the larger. The posterior margin of the carapace shows a broadly rounded median incision.

The first abdominal somite shows a complete, but shallow transverse groove; there are about 10 short longitudinal ridges in the posterior half of the somite; the anterior half is smooth. Abdominal somites I to III have a distinct median incision in the posterior margin. The pleuron of the first somite has the lateral margin slightly concave in the middle; the antero- and posterolateral angles are broadly rounded. Above the middle of the lateral margin of the pleuron, and separated from it by a groove, is a large tubercle which is distinctly visible in lateral view. The second and third abdominal somites have their dorso-median carina smooth and somewhat V-shaped by the presence of a median groove in the posterior part. The carina of the third somite is somewhat higher than that of the second. The

anterior half of somites II to V show irregular grooves forming a rather indistinct reticular pattern, which is most distinct in the posterior somites. Each of the tergites of somites II to V shows an oblique groove with tubercles before and behind it; but there is no arborescent pattern of narrow grooves. The pleura of the somites II to V end in a wide bluntly triangular or rounded top, which points down. The anterior margin of pleuron II shows a distinct rounded lobe in the basal part, no such lobe is seen in the other pleura. The posterior margin of pleura II and III have a small tooth in the distal part. The posterior margin of pleuron V shows a distinct lobe in the basal part. The surface of the pleura of somites II to V have a median groove flanked by a carina and many distinct tubercles. In pleuron II the groove is very distinct, in pleura III to V the carina is higher than in pleuron II. The fourth somite has the median dorsal carina broad at the base and extremely high, it is about twice as high as the carina of somite III; posteriorly it ends in a broad bluntly rounded top that reaches far beyond the base of the fifth somite; this top is bluntly rounded in lateral view, but in dorsal view it shows a distinct V-shaped median incision. The dorso-median carina of somite V is slightly lower than that of the fourth and has the top not rounded, but ending in a triangular point, which clearly reaches over the base of the sixth somite and is not incised at the top. The posterior margin of the sixth somite shows a posterolateral tooth at each angle, between these there are three large and a few smaller tubercles. The upper surface of this somite shows two wide grooves that converge anteriorly the rest of the surface carries several tubercles. The upper surface of the basal hard part of the telson has two rounded submedian tubercles near the anterior margin and a somewhat larger pair more posteriorly and farther apart. The posterior margin of this hard part has a broad triangular tooth at either lateral end and a smaller narrower tooth nearer to the median line.

The anterior margin of the antennular somite shows on each half a distinct broad triangular tooth; these two teeth are separated by a wide

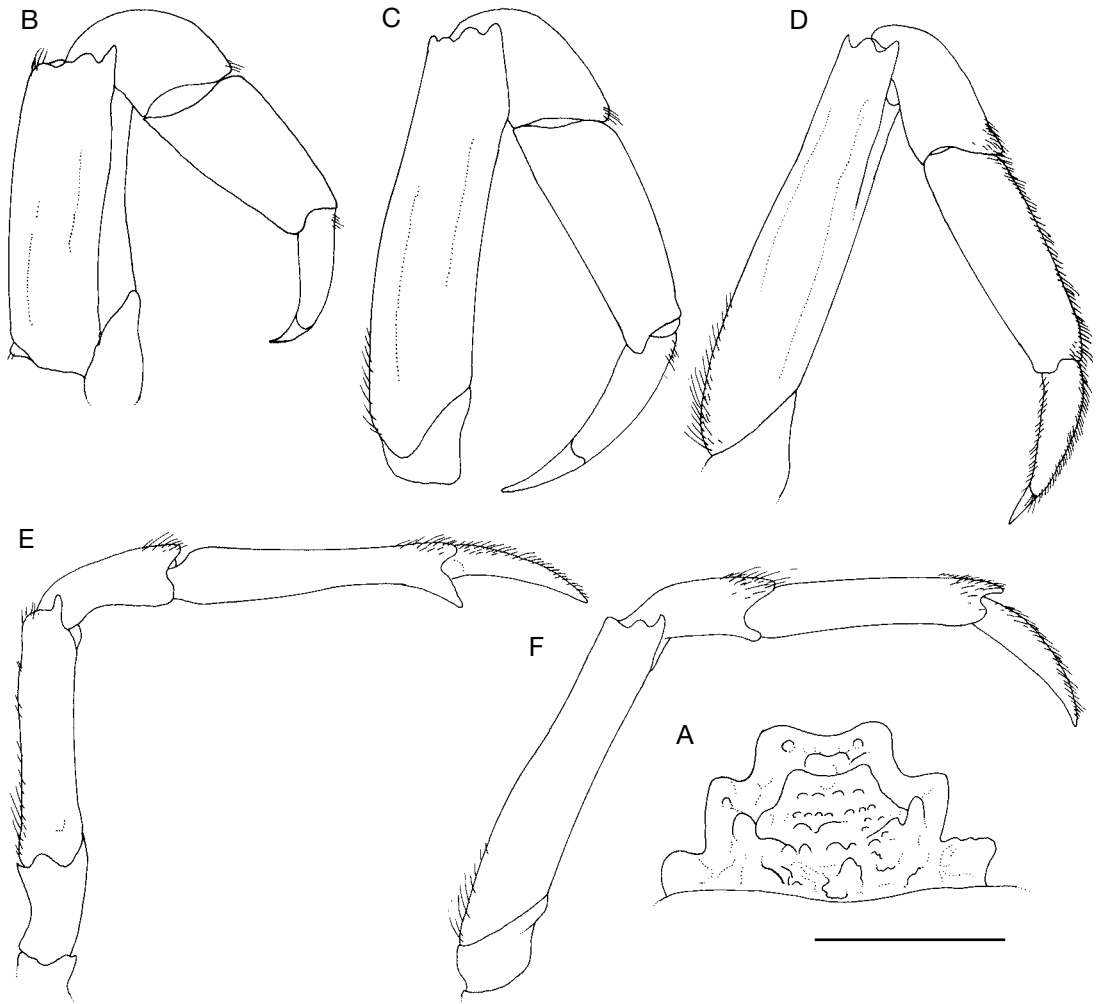


FIG. 8. — *Bathyarctus steatopygus* n. gen., n. sp., Kenya, Formosa Bay, ♀ holotype (RMNH D 49553); **A**, anterior part of thoracic sternum; **B-D**, pereiopods 1 to 3; **E**, pereiopod 5; **F**, pereiopod 4. Scale bar: 2 mm.

V-shaped median incision that is followed by a median groove.

The sixth segment of the antenna has the anterior margin rather straight and with six blunt teeth, the outer of these teeth is widest and has two incisions in the outer margin. The inner of the teeth is somewhat more pointed than the others. The inner margin of this segment shows a single appressed tooth. The anterior margin of the fifth antennal segment has a strong, dorsally carinate tooth at the inner angle and two much smaller

teeth on the outer. The fourth segment is triangular and reaches beyond the sixth. The inner part shows a blunt, carinated distinct tooth. The anterior margin of this segment is serrate: it has a rather distinct rounded tooth in the inner third, and between this tooth and the apex of the segment there are seven to nine serrations, which become smaller distally. The outer margin of this fourth segment has three rather large teeth (not including the apex of the segment) and two to four smaller teeth in-between. The upper surface

of the segment shows two distinct carinae: the normal oblique central carina ending in the apex of the segment, and a shorter in the outer half of the segment. The latter ends in the central of the lateral teeth and carries some small tubercles. A few scattered tubercles are present on the rest of the surface of the segment.

The anterior margin of the epistome is incised in the middle and has each half with a shallow median concave part.

The anterior margin of the thoracic sternum is narrow and slightly concave, there is no deep incision in the middle. Directly behind this margin is a distinct rounded carina with a rather irregular posterior margin. The carina merges with the carina along the lateral margin. The surface of the sternum is pitted and with short grooves. A median tubercle is found on somites II to V.

P.1 (in the females) is only slightly shorter and more robust than the others. The dactylus is somewhat shorter than the propodus, and about two thirds as long as the dactylus of P.2; it is practically as long as the dactyli of P.3 and P.4; the dactylus of P.5 is shorter. Apart from a few scattered hairs, no pubescence is seen on P.1 and P.2. The merus of P.1 to P.3 has two indistinct longitudinal grooves on the outer surface. The dactylus of P.3 has a fringe of short setae both on the dorsal and ventral margins, such a fringe is also present on the dorsal margin of the propodus, while some hairs are visible on the upper margin of the merus. P.4 has a continuous fringe of hairs on the dorsal margin of the dactylus, while both in P.4 and P.5 there are small pubescent patches in the upper distal part of propodus and carpus, as well as some hairs in the basal part of the upper margin of the merus. In the ovigerous female the dactylus of the fifth leg has a single dorsal fringe of hairs. The propodus has a rather wide tooth at the end of the lower margin; this tooth forms a subchela with the dactylus, of which, however, it does not reach the middle of its length.

Size

The two types, both being females (one ovigerous), have cl. 11 mm.

Genus *Scammarctus* n. gen.

TYPE AND ONLY SPECIES. — *Scyllarus batei* Holthuis, 1946 (= *Arctus orientalis* Bate, 1888) by present designation.

ETYMOLOGY. — From *skamma* (Greek, latinized to *scamma*), trench, gutter, and *Arctus* De Haan, 1849, a junior synonym of *Scyllarus* Fabricius, 1775; in reference to the characteristic gutter-like anterior part of the thoracic sternum.

DIAGNOSIS. — Carapace with only pregastric, gastric and cardiac teeth in the median line; rostral tooth absent. Few tubercles between the carapace ridges. Abdomen with a slightly elevated median carina, without narrow arborescent grooves. Fourth antennal segment with a single oblique dorsal carina. Pereiopods slender. Dactyli of P.3-P.5 with a pair of dorsal fringes of short hairs. No hairy fringe on the dorsal margin of propodus of P.4 and P.5. Anterior part of thoracic sternum gutter-like sunken and prolonged forward between the bases of the third maxillipeds; its anterior margin convex, sometimes with a small median tubercle, not incised in the median. No median tubercles on the sternum and no posterior teeth.

DISTRIBUTION. — Indo-West Pacific region.

Scammarctus batei (Holthuis, 1946) n. comb. (Figs 9-11; 66D, E)

Scyllarus batei Holthuis, 1946: 94; 1984: Scylr.2, fig.; 1991: 219, figs 415, 416. — Estampador 1959: 40. — Robertson 1968: 334. — Prasad & Tampi 1969: 82. — Burukovsky 1974: 107; 1983: 151. — Prasad *et al.* 1980: 89, fig. 12. — Prasad 1983: 144, fig. 3c. — Chan & Yu 1986: 155, pl. 4, pl. 9 figs A, B; 1993: 205, col. fig. — Sekiguchi 1986a: 1290; 1987a: 331; 1987b: 415, 417. — Huang 1994: 564.

Arctus orientalis Bate, 1888: 68, pl. 9 fig. 4. — Alcock & Anderson 1894: 165. — Alcock 1901: 181. — Lloyd 1907: 6. — Estampador 1937: 495 [non *Scyllarus orientalis* Lund, 1792 (= *Thenus orientalis*)].

Scyllarus orientalis – De Man 1916: 73. — Ramadan 1938: 126, fig. 2. — Sewell 1955: 200, 201, 203.

Scyllarus batei batei – Holthuis 1960: 149. — George 1969: 433. — Phillips *et al.* 1980: 69.

Scyllarus batei arabicus Holthuis, 1960: 149. — George 1969: 434. — Phillips *et al.* 1980: 69. — Fransen *et al.* 1998: 66.

TYPE MATERIAL. — Syntypes: RV *Challenger*, stn 209, 2 specimens (BM), primarily identified as *Arctus orientalis*.

TYPE LOCALITY. — Philippines, between Bohol and Cebu, at 10°14'N, 123°54'E, depth 174 m.

MATERIAL EXAMINED. — **Madagascar.** RV *Vauban*, stn CH 44, 15°25.7'S, 46°01.0'E, 200–210 m, 7.XI.1972, 1 badly damaged ♀ c. 12 mm (MNHN-Pa 572). — Stn CH 93, 22°17.3'S, 43°05.9'E, 350 m, 27.XI.1973, 1 ♀ (MNHN-Pa 568).

Mozambique. RV *Prof. Mesyatsev*, stn 66, 24°57.0'S, 35°07.1'E, 200–210 m, 25.I.1976, 2 ♀ ♀ (VNIRO). — RV *Anton Bruun*, cruise 8, stn 397A, 25°12'S, 34°04'E, shrimp trawl, 230–295 m, 29.IX.1964, 3 ♂ ♂ 24–30 mm, 1 ♀ 25 mm (USNM). — RV *Prof. Mesyatsev*, stn 94, 25°31.8'S, 34°49.8'E, 220–225 m, 3.II.1976, 2 ♂ ♂, 2 ♀ ♀ (VNIRO).

Kenya. RV *Anton Bruun*, cruise 8, stn 421G, 2°56'S, 40°28'E, shrimp trawl, 240 m, 8.XI.1964, 2 ♂ ♂ 25 and 35 mm, 2 ♀ ♀ 18 and 31 mm (USNM). — RV *Fridtjof Nansen*, stn 862, 3°26'S, 40°23'E, 484 m, 1 ♀ (RMNH D 33223). — RV *Manihine* cruise 377, stn 16, 3°08'S, 40°20.5'E–3°7.5'S, 40°21'E, 250–255 m, muddy sand, Agassiz trawl, 5.IX.1974, A. J. Bruce leg., 7 ♂ ♂, 2 ♀ ♀ (1 ov.) (RMNH D 30865). — RV *Prof. Mesyatsev*, 3°04'S, 40°13.7'E, 200 m, 16.III.1976, 1 ov. ♀ (VNIRO). — RV *Manihine*, cruise 331, stn 4, 3°01'S, 40°22.5'E–2°59.5'S, 40°24.6'E, 236–256 m, Agassiz trawl, 7.X.1971, A. J. Bruce and P. S. Sandhu leg., 1 ♀ (RMNH D 45643). **Gulf of Aden.** John Murray Expedition, stn 194, 13°16'–13°16'36"N, 46°20'24"–46°14'E, 220 m, 7.V.1934, 3 ♂ ♂, 2 ov. ♀ ♀ (USNM).

South coast of Arabia. RV *Investigator*, 17°59'N, 57°22'30"E, 285–366 m, 1 ♀ (USNM).

West coast of India (off Calicut) (= Kozhikode). RV *Investigator*, 183 m, 1 ov. ♀ (AM P.2639).

South China Sea. South of Hainan, RV *Cape St. Mary*, cruise 4/64, stn 34, trawl 189, 17°10.0'N, 109°51.0'E–17°12.5'N, 109°53.5'E, 205–212 m, fine mud, Granton trawl, 5.VIII.1964, A. J. Bruce leg., 1 ♀ (RMNH D 24947).

Taiwan. Tong-Kang, Ping-Tong County, 31.X.1984, T. Y. Chan leg., 1 ♀ (RMNH D 39340).

Philippines. Malavatuan Id, RV *Albatross*, S 23°E, 8.5 miles, stn D 5278, 14°00'10"N, 120°17'15"E, 146–187 m, fine sand or fine sand with mud and shells, 17.VII.1908, 1 ♀ (USNM).

Corregidor Light, N 26°E, 25.5 miles, stn D 5272, 14°N, 120°22'30"E, 216 m, mud, shells and coral sand, 14.VII.1908, 1 ♀.

Tayabas Light (outer), N 43°W, 6 miles, stn D 5371, 13°49'40"N, 121°40'15"E, 152 m, green mud, 24.II.1909, 2 ♂ ♂, 1 ov. ♀. — N 50°W, 8.8 miles, stn D 5369, 13°48'N, 121°43'E, 194 m, black sand, 24.II.1909, 1 ♂, 1 ♀. — N 9°E, 7.4 miles, stn D 5374, 13°46'45"N, 121°35'08"E, 348 m, grey mud, 2.III.1909, 1 ♀.

Sombrero Id, S 47°E, 10 miles, stn D 5118, 13°48'45"N, 120°41'51"E, 216–291 m, dark green mud, 21.I.1908, 1 ♀.

Matocot Point, Luzon, N 80°E, 33.30 miles, stn D 5265, 13°41'15"N, 120°00'50"E, 247 m, sand and mud, 6.VI.1908, 2 ♂ ♂, 2 ♀ ♀.

Legaspi Light, S 58°W, 4.5 miles, stn D 5453, 13°12'N, 123°49'18"E, 267 m, 7.VI.1909, 2 ♂ ♂.

Off SE Mindoro, Balanja Point, N 80°W, 6 miles, stn D 5261, 12°30'55"N, 121°34'24"E, 265 m, sand and mud, 6.VI.1908, 1 ♂.

Between Leyte and Cebu, Capitancillo Id Light, S 46°W, 15.7 miles, stn D 5403, 11°10'N, 124°17'15"E, 333 m, green mud, 16.III.1909, 1 ♂. — N 25°W, 20.8 miles, stn D 5408, 10°40'15"N, 124°15'E, 291 m, green mud, 18.III.1909, 4 ♂ ♂ (1 nisto).

Mindanao, Point Tagolo Light, S 80°W, 9.7 miles, stn D 5516, 8°46'N, 123°32'30"E, 320 m, globigerina, 9.VIII.1909, 1 ♂, 1 ♀ (USNM).

MUSORSTOM 1. Near Pulau Lubang, W of Luzon, stn 2, 14°02.0'N, 120°17.8'E, 182–187 m, 19.III.1976, 1 ♂ (MNHN-Pa 709). — Stn 3, 14°01.5'N, 120°15.3'E, 183–185 m, 19.III.1976, 1 ♂ (MNHN). — Stn 9, 13°59.5'N, 120°17.6'E, 180–194 m, 19.III.1976, 2 ♀ ♀ (MNHN-Pa 710). — Stn 11, 14°00.9'N, 120°21.5'E, 217–230 m, 20.III.1976, 3 ♂ ♂, 2 ♀ ♀ (MNHN-Pa 719). — Stn 12, 14°00.45'N, 120°17.2'E, 187–210 m, 20.III.1976, 7 ♂ ♂, 3 ♀ ♀ (2 ov.) (MNHN-Pa 693). — Stn 21, 14°02.8'N, 120°24.3'E, 174–223 m, 21.III.1976, 1 ♀ (MNHN-Pa 700). — Stn 24, 14°01.7'N, 120°20.2'E, 189–209 m, 22.III.1976, 3 ♂ ♂ (MNHN-Pa 704). — Stn 25, 14°02.0'N, 120°18.0'E, 191–200 m, 22.III.1976, 3 ♂ ♂, 2 ♀ ♀ (MNHN-Pa 703). — Stn 30, 13°59.7'N, 120°16.7'E, 177–186 m, 22.III.1976, 1 ♀ (MNHN-Pa 713). — Stn 32, 13°59.4'N, 120°18.0'E, 184–193 m, 23.III.1976, 1 ♀ (MNHN-Pa 724). — Stn 34, 13°59.2'N, 120°15.8'E, 188–191 m, 23.III.1976, 2 ♀ ♀ (MNHN-Pa 701). — Stn 36, 14°00.3'N, 120°17.0'E, 187–210 m, 23.III.1976, 5 ♂ ♂, 3 ♀ ♀ (MNHN-Pa 702 and 712). — Stn 40, 13°58.3'N, 120°29.4'E, 265–287 m, 24.III.1976, 1 ♂ (MNHN-Pa 711). — Stn 42, 13°54.1'N, 120°29.1'E, 379–407 m, 24.III.1976, 1 ♂, 1 ♀ (MNHN-Pa 705). — Stn 61, 13°59.7'N, 120°16.8'E, 184–202 m, 27.III.1976, 1 ♀ (MNHN-Pa 708). — Stn 65, 14°00.8'N, 120°16.2'E, 194–202 m, 27.III.1976, 1 ♀ (MNHN-Pa 698). — Stn 68, 13°58.8'N, 120°19.0'E, 183–199 m, 27.III.1976, 8 ♂ ♂, 4 ♀ ♀ (3 ov.) (MNHN-Pa 691–692). — Stn 69, 14°00.9'N, 120°19.0'E, 187–199 m, 27.III.1976, 1 ♂ (MNHN-Pa 699).

MUSORSTOM 2. Between Luzon, Pulau Lubang and Mindoro, stn 11, 14°00.1'N, 120°18.9'E, 194–196 m, 21.XI.1980, 4 ♂ ♂, 2 ♀ ♀ (1 ov.) (MNHN-Pa 689). — Stn 12, 14°02.0'N, 120°21.0'E, 197–210 m, 21.XI.1980, 1 ♂ (MNHN-Pa 715). — Stn 13, 13°59.7'N, 120°19.2'E, 193–200 m, 21.XI.1980, 2 ♂ ♂, 2 ♀ ♀ (1 ov.) (MNHN-Pa 688). — Stn 18, 14°00.2'N, 120°17.2'E, 188–195 m, 22.XI.1980, 1 ♂ (MNHN-Pa 717). — Stn 20, 13°59.5'N, 120°18.2'E,

185-192 m, 22.XI.1980, 2 ♂♂, 1 ♀ (MNHN-Pa 687). — Stn 21, 14°02.2'N, 120°17.4'E, 191-192 m, 22.XI.1980, 4 ♂♂ (MNHN-Pa 684). — Stn 51, 14°00.4'N, 120°17.6'E, 170-187 m, 27.XI.1980, 1 ♂ (MNHN-Pa 721). — Stn 52, 13°59.1'N, 120°18.8'E, 181-190 m, 27.XI.1980, 2 ♀♀ (1 ov.) (MNHN-Pa 722). — Stn 64, 14°00.1'N, 120°18.2'E, 191-195 m, 29.XI.1980, 1 ♀ (MNHN-Pa 716). — Stn 66, 14°00.1'N, 120°18.7'E, 192-209 m, 29.XI.1980, 1 ♂, 3 ♀♀ (MNHN-Pa 686). — Stn 67, 14°01.8'N, 120°19.3'E, 193-199 m, 29.XI.1980, 1 ♂, 1 ov. ♀ (MNHN-Pa 1919). — Stn 68, 14°00.5'N, 120°17.5'E, 195-199 m, 29.XI.1980, 1 ♂, 3 ♀♀ (1 ov.) (MNHN-Pa 685). — Stn 71, 14°01.2'N, 120°19.1'E, 189-197 m, 30.XI.1980, 2 ♂♂, 2 ov. ♀♀ (MNHN-Pa 690).

MUSORSTOM 3. Between Luzon, Pulau Lubang and Mindoro, stn CP 87, 14°00'N, 120°19'E, 191-197 m, 31.V.1985, 2 ♂♂ 25 and 26 mm (MNHN-Pa 1089). — Stn CP 97, 14°00'N, 120°18'E, 189-194 m, 1.VI.1985, 1 ♀ 14 mm (MNHN-Pa 1086). — Stn CP 98, 14°00'N, 120°18'E, 194-205 m, 1.VI.1985, 1 juv. 13 mm (MNHN-Pa 1078). — Stn CP 99, 14°01'N, 120°19'E, 196-204 m, 1.VI.1985, 1 ov. ♀ 26 mm (MNHN-Pa 1077). — Stn CP 100, 14°00'N, 120°18'E, 189-199 m, 1.VI.1985, 2 ♂♂ 20 and 25 mm (MNHN-Pa 1088). — Stn CP 101, 14°00'N, 120°19'E, 194-196 m, 1.VI.1985, 3 ♂♂ 14-26 mm (MNHN-Pa 1083). — Stn CP 103, 14°00'N, 120°18'E, 193-200 m, 1.VI.1985, 2 ♂♂ 13 and 25 mm (USNM 1000671 and MNHN-Pa 1081). — Stn CP 108, 14°01'N, 120°18'E, 188-195 m, 2.VI.1985, 2 ♂♂ 14 and 26 mm (MNHN-Pa 1080). Between Mindoro and Panay, stn CP 120, 12°06'N, 121°15'E, 219-220 m, 3.VI.1985, 5 ♂♂ 15-22 mm, 3 ♀♀ 15-24 mm (RMNH D 48731). — Stn CP 138, 11°54'N, 122°15'E, 252-370 m, 6.VI.1985, 1 ♂ 17 mm (MNHN-Pa 1085). — Stn CP 139, 11°53'N, 122°14'E, 240-267 m, 6.VI.1985, 3 ♂♂ 12-25 mm, 7 ♀♀ 16-23 mm (MNHN-Pa 1073).

Off Cebu, stn CP 145, 11°01'N, 124°04'E, 214-246 m, 7.VI.1985, 1 juv. ♂ 11 mm, 1 juv. ♀ 14 mm (MNHN-Pa 1082).

Between Cebu and Leyte, stn CP 143, 11°29'N, 124°11'E, 205-214 m, 7.VI.1985, 1 ♂ 24 mm (MNHN-Pa 1075).

West of Borneo. RV *Cape St. Mary*, cruise 7/64, stn 43, trawl 251, 5°28.9'N, 110°08.9'E-5°26.8'N, 110°11.0'E, 172-179 m, clayey mud, 7.XI.1964, A. J. Bruce leg., 1 ♂ (RMNH D 24948).

Indonesia. Makassar Strait, CORINDON, stn 267, 1°56.6'S, 119°16.7'E, 134-186 m, 7.XI.1980, 7 ♂♂, 1 ♀ (MNHN-Pa 723). — Stn 271, 1°57.8'S, 119°15.0'E, 215-252 m, 7.XI.1980, 22 specimens. — Stn 273, 1°56.0'S, 119°16.0'E, 180-220 m, 7.XI.1980, 33 ♂♂, 3 ♀♀ (MNHN-Pa 718).

Australia. Arafura Sea, FV *Noble Pearl*, 09°46'S, 130°00'E, 244-300 m, XI-XII.1987, T. Bradley leg., A. J. Bruce don., 1 ♂ (RMNH D).

New Caledonia. BIOCAL, stn CP 105, 21°31'S, 166°22'E, 330-335 m, 8.IX.1985, 1 ♂ 18 mm (MNHN-Pa 1160).

BATHUS 1, stn CP 670, 20°54.05'S, 165°53.38'E, 394-397 m, 14.III.1993, 1 ♀ 18 mm (MNHN-Pa 1866). — Stn CP 702, 30°55.97'S, 165°34.67'E, 531-660 m, 18.III.1993, 3 ♂♂ 16-18 mm (MNHN-Pa 1863). — Stn CP 709, 31°42.72'S, 166°35.75'E, 347-375 m, 9.III.1993, 2 ♂♂ 19 and 20 mm, 1 ♀ 19 mm (MNHN-Pa 1864). — Stn CP 710, 31°43.16'S, 166°36.35'E, 330-386 m, 19.III.1993, 1 ♂ 17 mm, 2 ♀♀ 18 mm (RMNH D 48732).

BATHUS 2, stn CP 742, 32°33.45'S, 166°25.86'E, 340-470 m, 14.V.1993, 1 ♂ 16 mm (MNHN-Pa 1875).

HALIPRO 1, stn CP 851, 21°43'S, 166°37'E, 314-364 m, 19.III.1994, 2 ♂♂ 18 and 19 mm, 1 ♀ 17 mm (RMNH D 48730). — Stn 856, 21°44'S, 166°37'E, 311-365 m, 20.III.1994, 1 ♂ 18 mm, 1 ♀ 17 mm (MNHN-Pa 1916).

BATHUS 4, stn CP 899, 20°16.68'S, 163°50.26'E, 500-600 m, 3.VIII.1994, 1 ♀ 19 mm (USNM 1000673). — Stn CP 946, 20°33.81'S, 164°58.35'E, 386-430 m, 10.VIII.1994, 3 ♀♀ 19-20 mm (MNHN-Pa 1903). — Stn CP 952, 20°34.70'S, 164°58.76'E, 316-270 m, 10.VIII.1994, 3 ♀♀ 16-19 mm (MNHN-Pa 1902).

Vanuatu (New Hebrides). MUSORSTOM 8, stn CP 1121, 15°06.97'S, 166°53.42'E, 315-360 m, 9.X.1994, B. Richer de Forges leg., 2 ♂♂ 17 and 19 mm, 2 ov. ♀♀ 19 and 20 mm (MNHN-Pa 1891). — Stn CP 1123, 15°07.19'S, 166°55.20'E, 262-352 m, 9.X.1994, B. Richer de Forges leg., 3 ♂♂ 16-18 mm (MNHN-Pa 1868). — Stn CP 1135, 15°40.50'S, 167°02.43'E, 282-375 m, 11.X.1994, B. Richer de Forges leg., 2 ♀♀ 15 and 20 mm, largest ov. (RMNH D 48733).

Fiji Islands. MUSORSTOM 10, Bligh Water, N of Viti Levu, stn CP 1318, 17°15.6'S, 178°03.4'E, 330-335 m, 6.VIII.1998, 1 ♀ 16 mm (photographed) (MNHN-Pa 1886). — Stn CP 1320, 17°16.8'S, 177°53.6'E, 290-300 m, 6.VIII.1998, 1 ♂ 16 mm (MNHN-Pa 1844). — Stn CP 1325, 17°16.4'S, 177°49.8'E, 282-322 m, 7.VIII.1998, 1 ♂ 17 mm, 3 ♀♀ 17-19 mm (MNHN-Pa 1867). — Stn CP 1326, 17°14.3'S, 177°49.7'E, 265-300 m, 7.VIII.1998, 2 ♂♂ 15 and 17 mm, 1 ♀ 17 mm (RMNH D 48735).

SE of Viti Levu, stn CP 1348, 17°30.3'S, 178°39.6'E, 353-390 m, 11.VIII.1998, 24 ♂♂ 16-18 mm, 26 ♀♀ 15-19 mm (MNHN-Pa 1865; RMNH D 48734; USNM 1000674). — Stn CP 1349, 17°31.1'S, 178°38.8'E, 244-252 m, 11.VIII.1998, 3 ♂♂ 16-17 mm (MNHN-Pa 1872). — Stn 1351, 17°31.1'S, 178°40.0'E, 292-311 m, 11.VIII.1998, 2 ♂♂ 15 and 16 mm, 2 ♀♀ 16 and 18 mm (MNHN-Pa 1870). — Stn CP 1355, 17°49.5'S, 178°49.4'E, 302-310 m, 12.VIII.1998, 2 ♂♂ 15 and 18 mm (USNM 1000672).

S of Viti Levu, stn CP 1390, 18°18.6'S, 178°05.1'E, 234-361 m, 19.VIII.1998, 1 ♂ 17 mm (MNHN-Pa 1904).

BORDAU 1. N of Vanua Levu, stn CP 1402, 16°38'S, 179°36'E, 260-279 m, 25.II.1999, 1 ♂ 16 mm (photographed, MNHN-Pa 1846), 2 ♀ 15 and 16 mm (MNHN-Pa 1847).

DISTRIBUTION. — This characteristic species has a wide distribution in the Indo-West Pacific region extending from the east coast of Africa (Gulf of Aden to Mozambique and Madagascar) to Taiwan, the South China Sea, the Philippines and Indonesia, N Australia, New Caledonia and Vanuatu. The western form has been separated from the typical form as a subspecies *arabicus* by Holthuis (1960). The type locality of the species is RV *Challenger*, stn 209, between Bohol and Cebu, Philippines, at 10°14'N, 123°54'E, depth 174 m, bottom blue mud. The two syntypes of *Arctus orientalis* Bate, 1888, for which *Scyllarus batei* Holthuis, 1946 is a new name, are preserved in the Natural History Museum, London.

HABITAT. — The species is known from depths of 152-531 (531-660) m; most records are from 152 to 400 m, with a peak between 152 and 200 m. A soft bottom is evidently preferred, it has been described as: fine mud; green mud (four times); dark green mud; grey mud; globigerina ooze; clayey mud; mud, shells and coral sand; sand and mud (twice); fine sand or fine sand with mud and shells; black sand.

DESCRIPTION

The carapace is rather flat and not strongly uneven; it is covered by a short pubescence. The rostrum is truncate, and somewhat constricted behind the top. It bears a small, low, and blunt tubercle, but no tooth. The postrostral carina shows a pregastric, a gastric and a cardiac tooth, all of which are rather low. The pregastric tooth lies somewhat closer to the gastric tooth than to the rostrum, it is rather broad and almost as strong as the gastric tooth, sometimes it has a double top. There are a few small tubercles behind and in front of it. The gastric tooth is somewhat stronger than the pregastric, it ends in a single or double top and is followed by a double row of eight to 12 indistinct squamiform tubercles. The cardiac tooth has the apex blunt or bilobed and is followed by a double row of nine to 16 low squamiform tubercles. Immediately before the cardiac tooth, below its top, there is a pair of small, but distinct tubercles, placed side by side in the cervical groove. The anterior and



FIG. 9. — *Scammarctus batei* (Holthuis, 1946) n. comb., Philippines, RV *Albatross*, stn D 5374, ♀ in dorsal view. Mrs P. Hogue del.

posterior submedian carinae each bear a group of tubercles, which are most conspicuous anteriorly, where the carina sometimes is somewhat elevated.

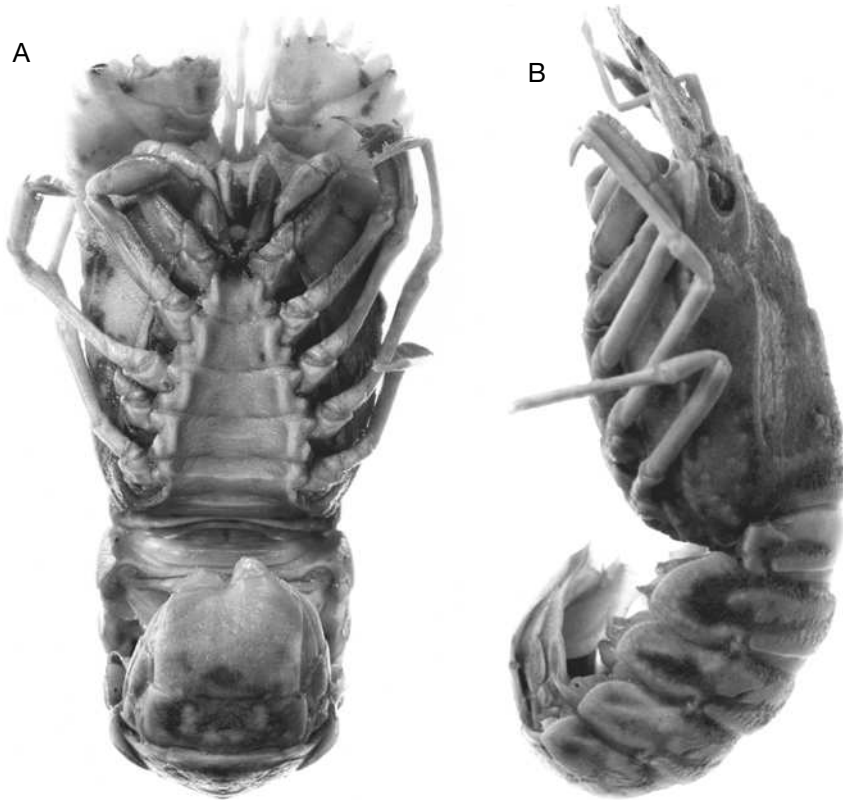


FIG. 10. — *Scammarctus batei* (Holthuis, 1946) n. comb., Philippines, RV *Albatross*, stn D 5374, ♀; **A**, ventral view; **B**, lateral view.

The branchial carina of the carapace is widely interrupted by the cervical groove. In the gap, just before the anterior end of the posterior carina, there is a sometimes small but always distinct tubercle. The anterior branchial carina ends in two low and blunt teeth, which are placed, one behind the other, on the inner margin of the orbit. The rest of the anterior branchial carina is entire. The posterior branchial carina ends anteriorly in a distinct tooth and bears behind that a single row of about 20 indistinct to very indistinct squamiform tubercles. The intermediate row consists of about six or seven blunt tubercles; furthermore there are a few tubercles at either side of the posterior branchial carina. The lateral margin of the carapace shows a narrow cervical incision and a wider postcervical. Apart from those mentioned, the region between the post-

rostral and branchial carinae shows no tubercles. There are about five to seven anterolateral teeth, four or five mediolateral and 12 to 16 posterolateral teeth; all these teeth, apart from the first of each group, show as vague serrations. Between the posterior branchial and posterolateral carinae there are a few small tubercles which are placed close to these carinae leaving the intermediate region smooth. In this same region there is a short blunt oblique carina right behind the cervical groove; it shows some blunt squamiform markings. There are one or two postorbital tubercles, which are small and partly hidden by the pubescence. The marginal groove is wide and rather shallow. Before it there are two, behind it one to three transverse rows of rather indistinct tubercles. The posterior margin of the carapace is emarginate in the middle.

In the first abdominal somite the transverse groove is widely interrupted in the middle. The median area of the somite is smooth, like the surface before and behind the groove; however, the posterior half may show indistinct traces of longitudinal grooves. In the next four somites the anterior half of the dorsal surface is entirely smooth. The posterior half is higher and bears a distinct, slightly elevated median carina; in the anterior of the four somites these carinae are slightly higher than in the posterior. The carinae of somites II to IV usually show an indistinct longitudinal groove. The carinae are lobulated at their base. The upper surface of each somite bears a wide transverse groove, which is interrupted by the median carina; this groove extends on to the pleuron. In its distal part, above the base of the pleuron the groove shows two anterior side grooves, which extend into the anterior part of the somite. There is, however, no distinct arborescent pattern of grooves as found in *Scyllarus arctus* and related species. In the pleuron of the second somite the transverse groove curves forward and slightly up. In the following pleura the groove is straight and ends in the distal part of the pleuron, however, a second groove is placed in the anterior half of the pleura of somites III to V. The upper surface of the somites shows indistinct squamiform tubercles, which may give the anterior margin of the transverse groove a lobulated appearance. The posterior margin of the first to third abdominal somites is slightly emarginate in the middle, sometimes, however, this emargination is hardly noticeable. The pleura are rather broad. That of the first somite is bilobed, the anterior lobe being widest. The pleura of somites II to V have the tip bluntly pointed and directed backward, while the margins are indistinctly serrate or practically smooth. The sixth abdominal somite shows some wide grooves and very few but large tubercles. On the end of the hard part of the telson there are two pairs of teeth, the teeth of the outer pair are placed on the margin of the telson and are broad and bluntly angular. The inner pair is narrower and more acute, it is placed in the median part of the telson at a more anterior level than the outer pair.

The anterior margin of the antennular somite bears a low and blunt but distinct tooth in the middle of each half.

The anterior margin of the distal (sixth) segment of the antenna is convex and bears five or six teeth, while a very small tooth is found on the inner margin. The teeth are rather elongate triangular, tapering regularly toward the narrowly rounded top; hereby the incisions between the teeth are wide. The fifth segment of the antenna shows a distinct blunt tooth on the inner margin; this tooth bears a dorsal carina. The anterior margin of the fourth segment bears three to seven teeth (not including the apical tooth), the inner of which is the largest. The outer margin of this segment bears two or three large teeth (again the apical one not included); behind these large teeth sometimes an extremely small additional tooth may be seen, while at the base of the apical tooth there sometimes are one or two small denticles. The apical tooth is strong and often reaches beyond the outer part of the distal margin of the sixth segment. The upper surface of the fourth segment shows a single strong oblique carina, which ends in the apical tooth; there are no additional carinae or tubercles on the outer half of the segment.

The anterior margin of the epistome is slightly sinuous or somewhat V-shaped, with an incision in the middle.

The third maxilliped *in situ* is only partly visible, being mostly hidden behind the first pereopods. The pereopods of this species, especially the fourth and fifth, are unusually long and slender, much more so than in most other Scyllarid species. P.1 is only slightly more heavy than P.2. In P.1 and P.2 the dactylus is naked, or has a few short hairs in the extreme proximal part of the upper margin; in the last three pereopods it bears two longitudinal rows of long hairs on the upper surface. The dactylus of P.4 is longer than that of any other leg; that of P.5 is almost as long as that of P.4, while the dactylus of P.2 is slightly longer than that of either P.1 or P.3. In the first three pairs of legs the propodus is rather broad and compressed, with a fringe of hairs both on the upper and lower margin. The propodi of the fourth and fifth legs are slender, cylindrical and

without any hairy fringes. None of the legs has a hairy groove on the outer surface of the propodus. The lower surface of the merus is hairy, the hairs are especially long in the first two legs, more velvety in the following, sometimes hardly visible there, or even absent. The outer surface of the merus bears an often very indistinct hairy longitudinal groove in the upper half. The propodus, carpus and merus of P.4 and P.5 are remarkably slender, especially when compared with these segments of the first two legs. The fixed finger of the chela of P.5 of the adult female is conspicuous, but does not reach the middle of the dactylus, in juvenile females it can be very short.

The anteromedian part of the thoracic sternum is gutter-like sunken and somewhat produced beyond the two anterolateral teeth, the anterior margin is convex, often with a small median tubercle, not incised in the middle. No median tubercles are present on any of the segments of the sternum, although the fourth and fifth show sometimes a slight median elevation. The posterior margin of the sternum is entire.

In the male the pleopods of the second abdominal somite are well-developed, all the other pleopods are rudimentary. In the female the blades of the pleopods of abdominal somites III to V are far narrower than those of somite II. In a male nisto stage collected by the *Albatross* in the Philippines (stn D 5408), the pleopods of abdominal somites II to V all are well-developed and all are provided with a stylamblys.

Size

The examined males have a carapace length of 14 to 31 mm. The females have cl. between 13 and 33 mm. The carapace length of ovigerous females varies between 19 and 33 mm, most are 24 mm or over. In the Fiji material (37 males and 35 females) the specimens all have cl. less than 20 mm and none of the females is ovigerous. This could be a sign that the younger specimens stay together. The youngest specimens (cl. 15 mm or less) are usually in the nisto stage.

Colour

Among the examined specimens there are several that still show traces of the original coloration. These are pale brown or greyish brown with the tubercles red or pale purple. The entire smooth anterior half of the first abdominal somite is brownish red or blood red. Small red spots are sometimes visible on the anterior smooth part of somites II and following. In some specimens also the median dorsal part of abdominal somites I to IV is red. An excellent colour figure of the species is provided by Chan & Yu (1993: 205). This also shows a yellowish brown animal with the anterior half of the first abdominal somite strikingly blood red; red dots are sprinkled also over the rest of the body as the tubercles are red and the ridges have small red spots. The tailfan is paler and without red dots, the soft part being transparent. The legs are pale brown without any visible transverse bands. The red colour of the anterior half of the first abdominal somite seems to be most characteristic for the species. It is possible that the western form of the species (*Scammarctus batei arabicus*) lacks the red colour on the first abdominal somite, as specimens from Kenya showing traces of the original colour pattern, were noted to have a rather red spot on each posterolateral angle of the carapace opposite the anterolateral angle of the pleura of the first abdominal somite; in the colour description of these specimens the red colour of the anterior half of the first somite was not mentioned; of course it is possible that this colour has disappeared upon preservation. A colour photograph taken of one of the specimens from N of Vanua Levu, Fiji (BORDAU 1 stn CP 1402) shows the typical coloration described above: pale greyish brown with the tubercles bright red, except in the tailfan and on abdominal somites V and VI where the tubercles are not red but greyish brown as the rest of the distal part of the abdomen. The anterior half of abdominal somite I is very dark red. The legs show pale reddish, rather wide and poorly delimited bands on propodus, carpus and merus; these bands are quite different from the very dark sharply delimited bands that one observes on many of the other species of this subfamily.

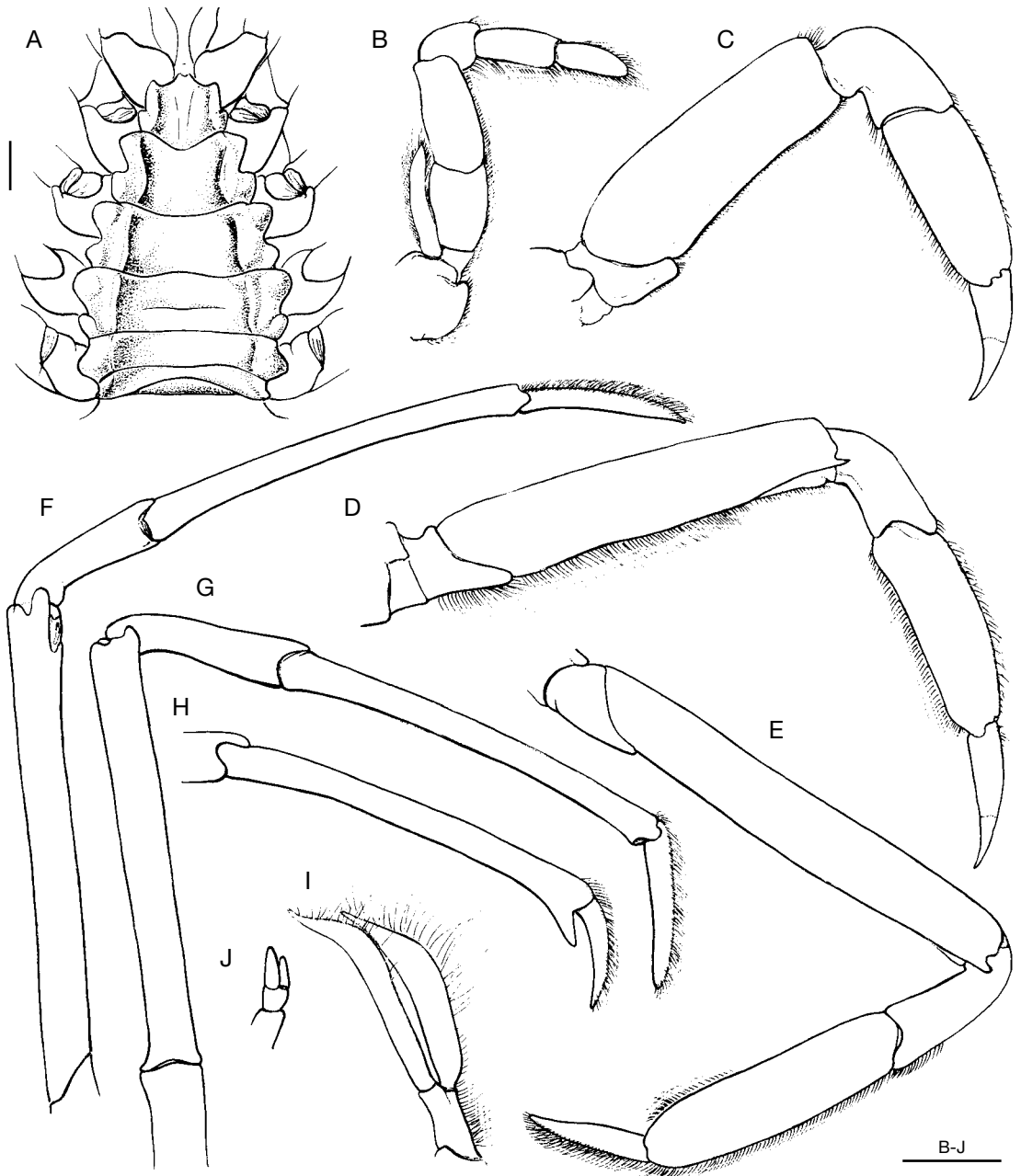


FIG. 11. — *Scammarctus batei* (Holthuis, 1946) n. comb., New Caledonia, BATHUS 1, strn 709; **A-G, I-K**, ♂; **H**, ♀; **A**, thoracic sternum; **B**, third maxilliped; **C-G**, pereiopods 1 to 5; **H**, propodus and dactylus of pereopod 5; **I, J** pleopods 1 and 2. Scale bars: 2 mm.

Genus *Antarctus* n. gen.

TYPE AND ONLY SPECIES. — *Scyllarus mawsoni* Bage, 1938 by present designation.

ETYMOLOGY. — From the Greek *antarktikos* (southern), latinized to *antarcticus*, shortened to provide the ending *-arctus*, based on the generic name *Arctus* De Haan, 1849. The name is given to indicate that this is the most southern of the scyllarid genera, its range extending closest to the Antarctic.

DIAGNOSIS. — Carapace with rostral, pregastric, gastric and cardiac teeth. Abdomen without arborescent markings; somites II to IV each with a transverse groove and a median longitudinal carina. The tips of pleura II to IV are acute and directed somewhat back. Fourth segment of antenna with two strong oblique carinae; the inner of these traversing the segment from the base to the apex. The anterior margin of this segment with five to eight teeth, the inner two largest; the outer margin has two (or one) large teeth. The pereopods 2 to 5 are slender, without fringes of long hairs. On the anterior margin of the thoracic sternum the two anterolateral teeth form a deep sharply V-shaped median incision.

DISTRIBUTION. — S and E coast of Australia from Eucla, Western Australia to Port Stephens, New South Wales.

REMARKS

A more extensive discussion of the type species will be given in a work in preparation by Dr John C. Yaldwyn.

Genus *Petrarctus* n. gen.

TYPE SPECIES. — *Scyllarus rugosus* H. Milne Edwards, 1837 by present designation.

OTHER SPECIES. — *Petrarctus brevicornis* (Holthuis, 1946) n. comb.; *P. demani* (Holthuis, 1946) n. comb.; *P. veliger* n. sp.

ETYMOLOGY. — From the Greek word *petra*, rock and the generic name *Arctus* De Haan, 1849 in reference to the very solid, knobby, stone-like body of the species of this genus.

DIAGNOSIS. — Body very solid. Carapace with gastric and cardiac teeth. Rostrum without tooth but with a small dorsal tubercle; pregastric tooth absent or replaced by a weak transverse carina or a transverse row of tubercles. Abdomen with longitudinal median carina on somites II to V. Dorsal surface of somites II to V with a wide transverse median groove before and behind which there are tubercles or ridges, but there is no arborescent pattern of very narrow grooves. Fourth antennal segment with a single oblique dorsal carina, sometimes with an additional row of tubercles. Thoracic sternum anteriorly U-shaped with a narrow median incision, the latter sometimes very indistinct. No teeth or spines on the posterior margin of the sternum.

KEY TO THE SPECIES OF *PETRACTUS* N. GEN.

Species dealt with in this paper are in bold.

1. Outer margin of fourth antennal segment with two to five distinct large teeth 2
 - Outer margin of the fourth antennal segment with five or more serrations, without large teeth *P. demani* n. comb.
2. Abdominal somite II at either side of the median transverse groove with a smooth transverse carina, that bears no tubercles. Carpus of P.3 without a long spur on the anterior margin. Posterior branchial carina of carapace about straight *P. rugosus* n. comb.
 - Abdominal somite II with transverse rows of tubercles before and behind the transverse groove. Posterior branchial carina of the carapace curved with the convex side directed laterally 3
3. Carpus of P.3 with a long spur on the anterior margin. Cardiac and gastric teeth not excessively high and not pointed. Outer margin of fourth segment of antenna with two to five large teeth *P. brevicornis* n. comb.

- Carpus of P.3 without a long spur on the anterior margin. Cardiac and gastric teeth very high and triangular; cervical groove visible between them as a very narrow slit. Outer half of upper surface of antennal segment 4 without a row of tubercles; outer margin of that segment with only two or three large teeth *P. veliger* n. sp.

Petrarctus rugosus

(H. Milne Edwards, 1837) n. comb.

(Figs 12; 13)

Scyllarus rugosus H. Milne Edwards, 1837: 283; 1838: 168. — White 1847: 67. — Morice 1875: 110. — Pfeffer 1881: 47. — Holthuis 1946: 89, pl. 7 fig. c, pl. 8 fig. a, pl. 9 fig. c; 1968: 288; 1991: 225, figs 425, 426. — Harada 1962: 128; 1965: 36. — Naiyanetr 1963: 68; 1980: 22; 1998: 12, 44, fig. — Prasad & Tampi 1969: 84. — Stephenson *et al.* 1970: 492. — Berry 1974: 13, 14. — Burukovsky 1974: 106; 1983: 149. — Tampi & George 1975: 34, figs 34-36. — Phillips *et al.* 1980: 70. — Prasad *et al.* 1980: 83, fig. 10. — Miyake 1982: 84. — Prasad 1983: 144, fig. 3a. — Chan & Yu 1986: 150, pl. 1, pl. 8 fig. A, pl. 10 fig. C. — Sekiguchi 1986a: 1289-1291; 1986b: 15, 17; 1987a: 331; 1987b: 415, 417, 418, fig. 48; 1988: 3; 1989b: 457. — Barnett 1989: 123, 126, fig. 3. — Mutchacheep 1992: 26. — Chan & Yu 1993: 201, coloured fig. — Huang 1994: 564. — McWilliam *et al.* 1995: 564. — Nguyễn Văn Chung & Phạm Thị Du 1995: 105. — Hu & Tao 1996: 144, pl. 3 figs 3, 4. — Chan 1998: 1043, 3 figs n.n.

Arctus tuberculatus Bate, 1888: 70, pl. 10 figs 1, 2. — Doflein 1900: 132. — Lanchester 1902: 557.

Scyllarus tuberculatus – Nobili 1903: 12. — Pearson 1905: 90. — De Man 1916: 68, 89. — Barnard 1926: 123, pl. 10; 1950: 560. — Dawydoff 1952: 136. — Prasad & Tampi 1968: 116, fig. 1. — Zarenkov 1971: 167. — Kensley 1981: 30. — Huang 1994: 564 [non *Scyllarus tuberculatus* – De Man 1924: 53, fig. 18 (= *Scyllarus demani* Holthuis, 1946)].

Scyllarus ragosus – Vine 1986: 107.

Scyllarus spec. A? – Berry 1974: 13, figs 36, 38, 45-47.

Scyllarus cultrifer – Hwang & Yu 1983: 264, fig. 5 [non *Arctus cultrifer* Ortmann, 1897].

Non *Arctus rugosus* Yokoya, 1933: 46, fig. 24 (= *Scyllarus brevicornis* Holthuis, 1946).

TYPE MATERIAL. — The type (or types) were deposited at the MNHN, but at present they cannot be located.

TYPE LOCALITY. — India, coast of Pondichery.

MATERIAL EXAMINED. — Red Sea. Sudan, Port Sudan, II.1979, J. C. Miquel, 1 ♂ 16 mm, 1 ♀ 16 mm

(RMNH D 39327). — Off Tokar Delta, 18°40'N, 38°00'E, otter trawl, 10-20 m, 1979, J. Branford, 1 ov. ♀ 22 mm (BM).

Ethiopia, near Massawa, 21.III.1958, A. Ben Tuvia & O. H. Oren, 3 ♂ 14-16 mm (RMNH D 18353). — Dahlak Archipelago, E of Museri Id, FV *Negus Salomon*, stn 12, 15°35'N, 40°44'E, 37 m, bottom flat with sponges, 23.X.1965, 1 ♀ 11 mm (RMNH D 23654).

Kenya. N of Ras Ngameni, southern Formosa Bay, RV *Shakwe*, 9-37 m, 26.VI.1969, A. J. Bruce, 1 ♀ 16 mm (RMNH D 27473). — Off Ras Ngameni, southern Formosa Bay, EAMFRO (East African Marine Fisheries Organisation), cruise 320, trawl stn 10, 24 m, trawled, 21.II.1971, A. J. Bruce, 5 ♂ 16-18 mm (RMNH D 30588).

Tanzania. S of Dar es Salaam, RV *Manihine*, cruise 309, trawl stn 12, 7°48.0'S, 39°34'E, 16-20 m, 14.VI.1970, A. J. Bruce, 1 ♂ 11 mm (RMNH D 28599).

Mozambique. NE of Beira, RV *Prof. Mesyatsev*, Haul No. 50, 19°37.0'S, 35°43.7'E, 27-33 m, 20.I.1976, B. G. Ivanov, 1 ov. ♀ 21 mm (VNIRO).

Madagascar. NW coast. RV *Vauban*, 12°55.2'S, 48°28.2'E, trawl, 42 m, 2.VIII.1973, A. Crosnier, 1 ov. ♀ 18 mm (MNHN-Pa 580). — RV *Vauban*, 13°04'S, 48°37'E, trawl, 23 m, 9.V.1973, A. Crosnier, 2 ov. ♀ ♀ (MNHN-Pa 585 and RMNH D 39326). — Baie d'Ambaro, 13°20'S, 48°40'E, trawl, shrimp grounds, 10-20 m, A. Crosnier, 2 ♀ ♀ 10 and 17 mm (MNHN-Pa 589). — Nosy Bé, 13°20'S, 48°20'E, 1960, A. Crosnier, 1 ov. ♀ 20 mm (MNHN-Pa 591). — Tany Kely, near Nosy Bé, 20 m, V.1966, A. Crosnier, 2 ♂ 17 and 18 mm, 1 ov. ♀ 16 mm (MNHN-Pa 583 and RMNH D 39328). — 13°27'S, 48°12'E, trawl, 27-30 m, 24.VIII.1967, R. Plante, 1 ♂ 18 mm (MNHN-Pa 584). — Near Majunga, RV *Vauban*, stn CH 52, 15°21.0'S, 46°12.5'E, trawl, 150 m, 8.XI.1972, 4 ♂ 10-12 mm, 5 ♀ ♀ 8-11 mm (3 ov. 10-11 mm) (MNHN-Pa 569; RMNH D 39325).

Burma. IIOE, RV *Anton Bruun*, cruise 1, stn 38, 14°07'N, 97°05'E, trawl, 69-73 m, 30.III.1963, 1 ♀ 11 mm (USNM). — Stn 39A, 14°52'N, 96°39'E, trawl, 48-64 m, 31.III.1963, 1 ♂ 13 mm (USNM).

Thailand. Between Naklua and Si Racha, Chonburi Province, about 35 m, from fishermen, 18 and 25.XI.1986, A. C. J. Burgers & L. B. Holthuis, 5 ♂ 18-20 mm, 1 non-ov. ♀ 19 mm, 4 ov. ♀ 17-22 mm (RMNH D 30637). — Laem Chabang near Si Racha, Chonburi Province, 10 m, trawled, from fishermen,

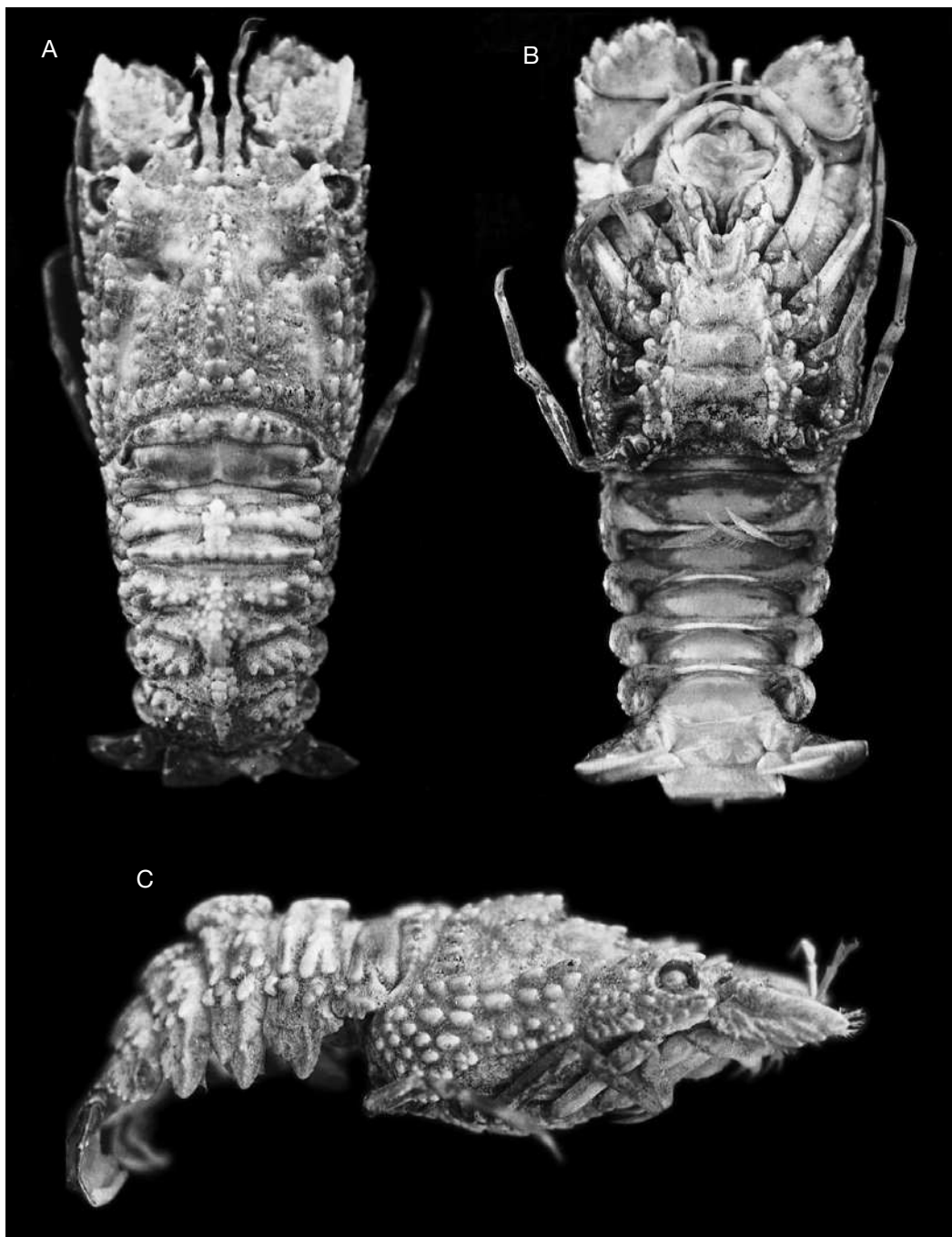


FIG. 12. — *Petrarctus rugosus* (H. Milne Edwards, 1837) n. comb., Gulf of Thailand, ♂ carapace length 20 mm (RMNH D 49589); A, dorsal view; B, ventral view; C, lateral view. Photos P. Naiyanetr.

11.I.1991, A. C. J. Burgers & L. B. Holthuis, 1 ♂ 13 mm (RMNH D 38686). — Near Koh Smet, Rayong Province, otter trawl, 15.X.1963, P. Naiyanetr, 2 ♂♂, 2 ♀♀ (RMNH D 37611). — Koh Chong, Rayong Province, 35 m, 19-20.X.1962, P. Naiyanetr, 1 ♀ 17 mm (RMNH D 18352). — Gulf of Thailand, off Pattani Bay, from fishermen, 14.XI.1985, C. Swennen No. 338, 1 ♂ 20 mm, 1 ♀ 13 mm (RMNH D 49589).

South China Sea. Hong Kong, 1867, capt. J. Schnehagen, 1 ♂ 14 mm (ZMH). — E of Hainan, RV *Cape St. Mary*, stn 108, 19°40'N, 111°31'E-19°35'N, 111°40'E, otter trawl, 101 m, 18.XII.1958, A. J. Bruce (RMNH D). — Near Macclesfield Bank, RV *Cape St. Mary*, cruise 3/64, stn 26, trawl, stn 156, 16°04.2'N, 114°41.8'E-16°04.0'N, 114°39.0'E, 80 m, white muddy sand and coral, 14.VI.1964, A. J. Bruce, 1 ♀ 9 mm (RMNH D 30936). — Vietnam, RV *Cape St. Mary*, cruise 7/64, stn 110, trawl, stn 156, 8°01.6'N, 107°41.2'E-8°04.1'N, 107°42.9'E, 59 m, sand, 19.XI.1964, A. J. Bruce, 1 ♂ 23 mm (RMNH D 45639). — Vietnam, RV *Lalessan*, entr. No. 7, 1930, A. Krempf, 1 ♀ 21 mm (MNHN-Pa 290). **Taiwan.** Takao (= Kaohsiung), 10.XII.1907, H. Sauter, 2 ♂♂, 1 ♀ (ZMB); 3-4.XII.1914, F. Baker, 3 ♂♂ 15-17 mm, 7 ♀♀ 15-21 mm (of which 5 ov. 15-21 mm) (USNM; RMNH D 14590). — Ping Tong, Tong-Kang County, c. 100 m deep, sand and mud, baby-shrimp trawlers, 2.XII.1984, T. Y. Chan, 1 ♂ 17 mm, 1 ov. ♀ 15 mm (RMNH D 49588).

Philippines. Mindoro Strait, MUSORSTOM 3, stn CP 121, 12°08'N, 121°18'E, 73-84 m, 3.VI.1985, 1 ♂ 14 mm, 1 non-ov. ♀ 9 mm, 2 ov. ♀♀ 14 and 15 mm (MNHN-Pa 1090). — Observatory Id (N), S 55°W 10.7 miles, Linapacan Strait, RV *Albatross*, stn D 5335, 11°37'15"N, 119°48'45"E, 84 m, sand and mud, 18.XII.1908, 1 ♀ 11 mm (USNM). — Balukbaluk Id (N), S 59°W 6.25 miles, RV *Albatross*, stn D 5134, 6°44'45"N, 121°48'E, 46 m, fine sand, 7.II.1908, 1 juv. ♀ 8 mm (USNM). — Off Jolo Id, Th. Mortensen Pacific Expedition, c. 22 m, dredge, sand and coral, 17.III.1914, 1 ♀ 13 mm (UZM).

Indonesia. Macassar Strait. CORINDON, stn 206, 85-79 m, 30.XI.1980, 1 ♂ 8 mm, 1 ov. ♀ 10 mm (MNHN-Pa 1054). — Java Sea, 1907-1911, RV *Gier*, 1 ♂ 20 mm (ZMA). — Java Sea, Th. Mortensen Kai Ids Expedition, stn 106, 5°50'S, 106°16'E, 32 m, sand, 5.VIII.1922, 1 ♂ 18 mm (UZM). — SW of Pulau Tarupa Kecil, NE Take Bone Rate (Tiger Ids), S of Sulawesi (= Celebes), Indonesian-Dutch Snellius II Expedition, 6°31.3'S, 121°6.5'E, 48 m, sandy bottom with spatangoid echinoderms, 1.2 m Agassiz trawl, 16.X.1984, 1 specimen (RMNH D 45638). — Ambon, Moluccas, 1861-1864, E. W. A. Ludeking, 1 ov. ♀ 21 mm (RMNH D 1516). — Arafura Sea, RV *Challenger*, stn 190, 8°56'S, 136°5'E, trawl, 90 m, green mud, 12.IX.1874, 1 ♂ 15 mm, 1 non-ov. ♀ 17 mm, 1 ov. ♀ 14 mm; all syntypes of *Arctus tuberculatus* Bate, 1888 (BM).

Off west coast of Wasir Id, Wokam, Aru Ids, Mariel King Memorial Expedition, 5°30'S, 134°12'E, 50-59 m, mud and sand, 15.VI.1970, 1 ♂ 10 mm (WAM). — West of Uojir Id, Wokam, Aru Ids, 5°37'S, 134°18'E, 55-66 m, mud and fine shelly grit, 1 ♂ 16 mm (WAM). — North of Doe Rowa, N of Nuhu Roa, Kai Ids, 5°32'S, 133°41'E, 27-37 m, sand and rubble, 11.VI.1970, 1 ov. ♀ 14 mm (WAM).

Australia. N Queensland, off Cairns, trawl, 20 m, mud, I.1983, Clive Jones, 2 ♂♂ 19 and 21 mm (RMNH D). — Low Isles, NE of Cairns, 20 m, sandy mud, 25.VIII.1984, Clive Jones, 2 ♀♀ (largest ov.) 18 and 21 mm (RMNH D 49590).

New Caledonia. LAGON, stn 376, Grand Récif Sud, 22°34'S, 167°06'E, 75-76 m, 21.I.1985, B. Richer de Forges, 1 ♂ 12 mm (MNHN-Pa 1203).

Vanuatu. MUSORSTOM 8, stn CP 1086, 15°36.58'S, 167°16.32'E, 182-215 m, 5.X.1994, B. Richer de Forges, 1 ♂ 10 mm, 2 ♀♀ 7 mm (RMNH D 48741). — Stn CP 1103, 15°3.87'S, 167°7.76'E, 163-165 m, 7.X.1994, B. Richer de Forges, 1 ♀ 13 mm (MNHN-Pa 1901).

Fiji Islands. MUSORSTOM 10, stn CP 1358, SE of Viti Levu, 17°48.5'S, 178°46.7'E, 80-120 m, 13.VIII.1998, 1 ♂ 10 mm, 1 ♀ 11 mm (MNHN-Pa 1900).

DISTRIBUTION. — The type locality of *Scyllarus rugosus* is Pondichery, India. That of *Arctus tuberculatus* is the Arafura Sea (8°56'S, 136°5'E). The range of the species extends from the Red Sea and East Africa to Japan or Taiwan, the Philippines, Indonesia, Australia, New Caledonia, Vanuatu and the Fiji Islands. A chart of its distribution was published by Chan (1998). The original records in the literature are (references to previously published records are omitted): Southern Red Sea near Massawa and near Museri Island, 15°35'N, 40°44'E (Holthuis 1968); Red Sea South of 15°N and Strait of Bab al Mandab (Zarenkov 1971); off Mozambique, 26°17'S, 33°10'E (Barnard 1926); Indian Ocean (White 1847), Pondicherry, India (H. Milne Edwards 1837); Pearl Banks, Aripu Reef and Galle, Gulf of Manaar, Sri Lanka (Pearson 1905); Andaman Sea off Thailand (Naiyanetr 1971); Japan (Doflein 1900); Taiwan (Hu & Tao 1996), Hsing-Ta and Tong-Kang, Taiwan (Chan & Yu 1986); Keelung, Taiwan (Hwang & Yu 1983); China (based on previous Taiwan records) (Huang 1994); Hong Kong (Pfeffer 1881); Viet Nam (Morice 1875; Nguyễn Văn Chung & Phạm Thị Dhu 1995); Hon Tcha reef, Pulo Condore, Viet Nam (Dawydoff 1952); Gulf of Thailand (Naiyanetr 1963, 1980, 1998; Mutchacheep 1992); Chonburi, Rayong, Pattani, Gulf of Thailand (Naiyanetr 1998); Kelantan, Malaya (Lanchester 1902); Singapore (Nobili 1903); Ambon, Indonesia (Holthuis 1946); Arafura Sea, 8°56'S, 136°5'E (Bate 1888); Gulf of Carpentaria, N Australia (McWilliam *et al.* 1995); Torres Strait, Australia (McWilliam *et al.* 1995); North Queensland

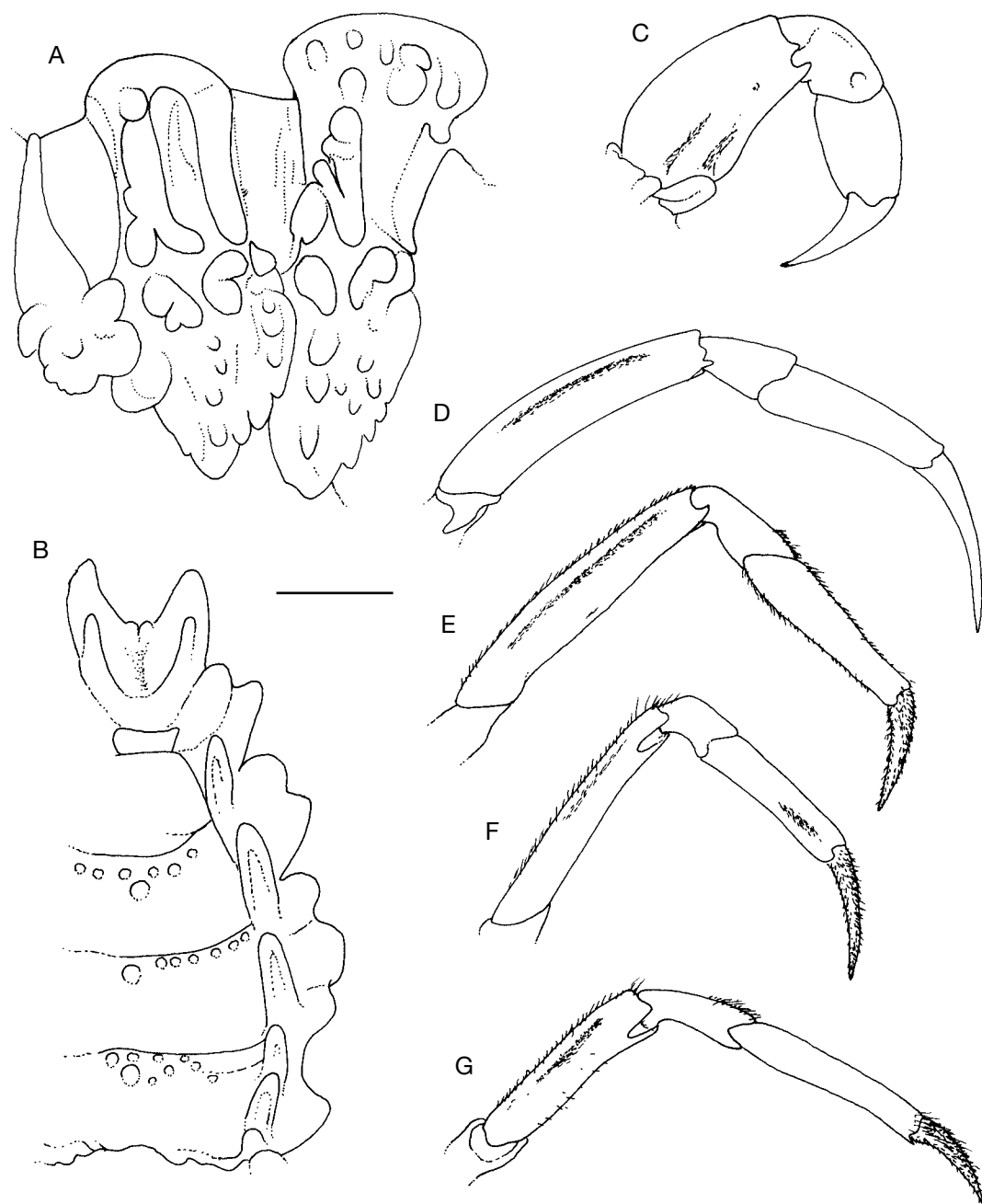


FIG. 13. — *Petrarctus rugosus* (H. Milne Edwards, 1837) n. comb., Burma, RV *Anton Bruun*, stn 39A, ♂ (USNM); **A**, abdominal somites I to III, lateral view; **B**, thoracic sternum, ventral view; **C-G**, pereiopods 1 to 5. Scale bar: 2 mm.

(Barnett 1989; McWilliam *et al.* 1995); Moreton Bay, Queensland, Australia (Stephenson *et al.* 1970). The record of the species from Japan is doubtful: the only original record is by Doflein (1900), all later authors only refer to Doflein. Doflein stated: "Mein Exemplar stammt aus Japan ohne genauere Angabe leg. Salmin". C. L. Salmin was not a collector but a dealer in natural history objects in Hamburg. It is well-known that the material offered by dealers often had unreliable labels. This, combined with the fact that notwithstanding the extremely intense study of the Japanese marine fauna in the last decades, *P. rugosus* n. comb. has not been found again in Japan, makes the correctness of the old label rather doubtful. The species, however, is quite common in Taiwan. The specimens reported upon by Pfeffer (1881) and Bate (1888) have been re-examined.

HABITAT. — The examined material came from depths between 10 and 182(-215) m, 90% was taken at less than 100 m depth, and 60% between 20 and 60 m. Chan & Yu (1993) also gave the depth as "20-60 m (rarely 200 m)". A Red Sea specimen was taken at 37 m (Holthuis 1968). Barnard's (1926) specimen was said to be taken at 415 m. Pearson (1905) reported the species from depths of 8-10, 8-13, and 16.5-26 m. The species inhabits flat and even bottoms and therefore is often taken by trawl. The nature of the bottom on which the examined material was found is described as sand, sometimes in combination with mud, coral, rubble, or with spatangoid echinoderms; sometimes the bottom is said to be fine sand, or white muddy sand and coral, or shelly grit, or sandy mud, or green mud. Pearson's (1905) material was taken from bottoms of coarse sand, sometimes with small corals, or with "fine green weeds and small pearl oysters".

DESCRIPTION

The rostrum is blunt and bears a low and blunt dorsal tubercle, behind which there are three diverging rows of small tubercles, which sometimes are fused to a low ridge. The pregastric tooth is absent and replaced by a short somewhat curved transverse row of two to four tubercles, the outer of which are the larger; this row continues laterally into the anterior submedian ridge. The gastric tooth is broad and blunt, it is followed by two rows of four or five blunt tubercles that converge posteriorly. The cardiac tooth is quite distinct and has a blunt apex which sometimes is slightly two-topped; the tooth is followed by a double row of four large blunt tubercles. The anterior and posterior submedian ridges bear about two to four blunt tubercles each. Both the postrostral and the branchial carinae are deeply

interrupted by the cervical groove. In the gap of the branchial groove no tubercle is visible. The branchial carina ends anteriorly in two teeth that are placed, one behind the other on the inner orbital margin; the posterior of these two teeth is low and not very distinct, behind it the carina shows two small teeth or tubercles. The posterior branchial carina is straight and ends in a blunt anterior tooth. It bears a double row of five to eight blunt tubercles. Between the posterior branchial carina and the posterior postrostral carina there is a longitudinal row of about five or six low and rounded intermediate tubercles, placed closer to the former than to the latter carina; a larger blunt tubercle is found between the intermediate row and the submedian carina. The lateral margin of the carapace shows three anterolateral, two or three mediolateral and a double row of nine or 10 posterolateral tubercles. Two, seldom three, tubercles may be seen behind the orbit. The intercervical area bears one or two rows of two to four tubercles. The space between the posterolateral and posterior branchial carina is entirely filled by tubercles. The marginal groove along the posterior margin of the carapace is wide. Before it the carapace bears a transverse row of smallish tubercles, the two submedian of which are larger than the rest. Behind the marginal groove there is a transverse row of small rather indistinct tubercles, the submedian two may be larger than the rest. The middle of the posterior margin of the carapace is shallowly and bluntly V-shapedly incised.

In the first abdominal somite the median transverse groove shows only in the extreme lateral parts; the rest of the dorsal surface of the somite is smooth, without grooves or tubercles. In the next four somites the anterior half (that disappears under the previous somite when the abdomen is stretched) is entirely smooth. The posterior half of these somites is raised and bears an elevated longitudinal median carina, which is by far highest on the third somite and may overhang the posterior margin of the somite and the median transverse groove. On either side of the median carina there are some tubercles, which are partly fused with the carina and give the median

structure a somewhat lobulated margin. On either side of the median carina the upper surface of somites II to V there are two parallel transverse carinae, separated by a deep groove. The posterior of each pair of carinae is simple with a smooth upper surface, having the posterior margin crenulate in somites IV and V, but there are no tubercles. The anterior carina of each pair is smooth in the second and usually also in the third somite, ending laterally in a forked or bilobate tip; in somites IV and V, sometimes also in somite III, it is more lobulated. The posterior margin of the first somite is bluntly V-shapedly incised. No such incision is visible in the following somites, although the second may have a slight median emargination. The median carina of somite IV even may end in a small posterior point. The pleura of somite I is very short and rounded with an irregularly lobulated margin. The pleura of the following somites are rather broad, the apex is blunt and directed downward. They bear a median carina and have the posterior margin crenulate or serrate (in the second pleura also the anterior margin). The dorsal surface of somite VI is tuberculate, the posterior margin is crenulate. Of the four bosses in the hard part of the telson, the anterior pair is larger than the posterior. The outer of the two pairs of teeth at the end of the calcified part of the telson are broad and triangular with a blunt top, the teeth of the inner pair are smaller and narrower, but the top is also blunt.

The anterior margin of the antennular somite is about straight, showing only a very inconspicuous low and blunt tooth in the middle of each half.

The anterior margin of the last (sixth) segment of the antenna is slightly convex and bears five to seven (usually six) long teeth, while a much smaller tooth is placed on the inner margin. The large teeth taper regularly towards the top. The spaces between the teeth are rather wide. The fifth segment shows no carina on the dorsal surface. The anterior margin of the fourth segment bears five to seven distinct teeth, the innermost of which is largest. The outer margin of the segment bears four or five teeth (not including the apical tooth),

each of which bears a (sometimes tuberculated) dorsal ridge. The median carina of the segment is very high and sharp.

The epistome is not much sunken and shows a hardly visible minute median incision in the anterior margin.

The first pereopods are very heavy. The following legs are slender. The dactylus of the second leg is longer than either that of the first or third leg, it is less than twice as long as that of the fourth. The dactyli of legs three to five are velvety pubescent in the basal part, sometimes with an inconspicuous fringe of short hairs. The third leg has the propodus as wide as the merus and not conspicuously wider than that of the second and fourth legs, it bears a distinct row of hairs along both the dorsal and ventral margins, but the outer surface shows no grooves. The propodi of the other legs do not have hairy fringes, but the propodus of the fourth leg may have very short hairs in the proximal part of the lower margin. The carpus of the pereopods is short and has no tooth on the anterior margin. The merus of P.3 to P.5 has a dorsal fringe of hairs, and a short velvety pubescence on the lower surface; there is a longitudinal hairy groove in the upper part of the outer surface. In the females the distal process of the propodus of the fifth leg is longer than half the dactylus.

The thoracic sternum is deeply U-shapedly incised anteriorly; it ends in two strong bluntly topped anterolateral teeth. Immediately behind these teeth there is a tubercle formed by two anteriorly converging short carinae. A median tubercle is present in the anterior half of the second to fifth sternites. The lateral part of the sternum is raised. The posterior margin of the last sternite is tuberculated.

The pleopod of abdominal somite II of the male is well-developed, the endopod being slightly longer than the exopod, both are slender. The pleopods of somites III to V have the exopods very narrow, that of the third somite is about half as long as that of the second, those of the fourth and fifth somites are still smaller. The pleopod endopods of somites III to V are elongate, being about half as long as their respective exopods.

Size

The type specimen of *Scyllarus rugosus* was said to have a tl. of 54 mm, which corresponds to a carapace length of roughly 17 mm. The type specimens of *Arctus tuberculatus* are about as long or slightly smaller (one male cl. 15 mm, one non-ovigerous female cl. 17 mm, one ovigerous female cl. 14 mm). In the examined material the carapace length of the males varies between 8 and 23 mm (70% between 14 and 20 mm), of the non-ovigerous females cl. varied between 8 and 21 mm, and of the ovigerous females between 10 and 22 mm (89% between 14 and 22 mm).

Colour

The first colour description published of the species is the one by Barnard (1926: 123): "General colour red, paler towards end of abdomen, mottled with paler red and white, most of the tubercles have white tips, outer margin of 2nd joint of antennae and the smooth dorsum of 1st abdominal segment violet". Coloured photographs of live or fresh specimens were published by Chan & Yu (1986: pl. 1 fig. E, pl. 8 fig. A, pl. 10 fig. C; these show the animal in ventral, dorsal and lateral view; their pl. 1 figs A-D shows a preserved specimen in colour). They described the colour as follows (Chan & Yu 1986: 151): "Dorsal surface brown and dark brown. Teeth at antennal segment VI, abdominal pleura III and IV, abdominal segment V and VI, tailfan and ventral surface whitish. Eyes light brown. Dorsal surface of pereopods brown and white. Dorsal surface of abdominal tergite I blue, color more concentrated at articulate surface. Lateral surfaces of abdominal somites I and II somewhat orange. Eggs orange-yellow". A new colour photograph of the species in dorsal view was later published by the same authors (Chan & Yu 1993: 201).

Larvae

Prasad & Tampi (1968) described and figured what they thought to be the nisto stage of this species from the Laccadive Archipelago, Western Indian Ocean. Phyllosomata, supposedly of this species, were described and figured by Berry (1974) from Natal as *Scyllarus* sp. A. Various

stages of phyllosomata from the Red Sea, South Africa, eastern and western Indian Ocean, supposedly belonging to this species, were dealt with by Tampi & George (1975), Prasad *et al.* (1980) and by Prasad (1983). Barnett (1989) described and figured a late phyllosoma from the Great Barrier Reef, 18°35'–19°10'S, 146°30'–147°00'E.

Petrarctus brevicornis (Holthuis, 1946) n. comb. (Figs 14; 67A, B)

Scyllarus brevicornis Holthuis, 1946: 92. — Harada 1962: 128; 1965: 36. — Burukovsky 1974: 106. — Phillips *et al.* 1980: 69. — Miyake 1982: 84. — Baba *et al.* 1986: 163, 286, fig. 113. — Chan & Yu 1986: 156, pl. 5, pl. 9 figs C, D; 1993: 207, col. fig. — Sekiguchi 1986a: 1289; 1986b: 15, 17; 1987a: 331; 1988: 3. — Sekiguchi & Tagawa 1987: 11, text-fig. 1, pl. 2. — Holthuis 1991: 222, figs 419, 420. — Wang 1991: 218, fig. 178. — Huang 1994: 564. — Wang *et al.* 1998: 447, 448.

Arctus rugosus Yokoya, 1933: 46, fig. 24 [non *Petrarctus rugosus* (H. Milne Edwards, 1837) n. comb.].

TYPE MATERIAL. — Holotype: male dried out and in very poor condition (Fishery Institute, Tokyo University).

ETYMOLOGY. — The specific epithet *brevicornis* (short horns) refers to Yokoya's (1933: 48) remark that the antennular peduncle is short. Chan & Yu (1993) proposed the vernacular name "Blue-back locust lobster".

TYPE LOCALITY. — Japan, Southern Bungo Strait.

MATERIAL EXAMINED. — **Western Indian Ocean. Zanzibar.** RV *Manihine*, cruise 334, stn D8, 5°30.5'S, 39°06.0'E, dredge, 155 m, 3.I.1972, 1 ov. ♀ 18 mm (RMNH D 49570).

Madagascar. NW coast, RV *Vauban*, stn CH 130, trawl, 170–175 m, 15°20'S, 46°11.5'E, 19.I.1975, 2 ♂♂ (MNHN-Pa 570). — Stn CH 52, 15°21.0'S, 46°12.5'E, 150 m, 8.XI.1972, 1 ov. ♀ 16 mm (MNHN-Pa 574).

East China Sea. 29°28.6'N, 126°56.3'E, 104 m, 19.VII.1985, K. I. Hayashi don., 1 ov. ♀ 16 mm (RMNH D 38506).

Taiwan. Ta-Chi, I-Lan County, c. 100 m, sand and mud, baby-shrimp trawl, 18.V.1985, T. Y. Chan leg. et don., 1 ov. ♀ 18 mm (RMNH D 39374).

South China Sea. RV *Cape St. Mary*, S of Hong Kong, cruise 4/65, stn 13, trawl 354, 21°20.0'N, 114°25.6'E, 84 m, mud, 24.IV.1965, A. J. Bruce, 1 ♀ 18 mm (RMNH D 49571). — SW of Hong Kong,

cruise 7/63, stn 46, trawl 108, 21°12.0'N, 113°30.5' E, 53-60 m, muddy sand, 17.XII.1963, A. J. Bruce, 1 ♂ 7 mm (RMNH D 49572). — NE of Hainan, 19°35'N, 111°40'E, No. 812.3.11-12, otter trawl, 101 m, 18.XII.1958, A. J. Bruce, 2 ♀♀ 11 and 16 mm (RMNH D 49587).

Philippines. MUSORSTOM 1, North of Lubang Id, stn 56, 13°53.3'N, 120°10.7'E, 129-134 m, 26.III.1976, 1 juv. 5 mm (MNHN-Pa 1803). — Stn 62, 14°00.6'N, 120°13.7'E, trawl, 179-194 m, 27.III.1976, 1 ♂ 10 mm (RMNH D 48759).

MUSORSTOM 2, stn 6, North of Lubang Id, 13°56.4'N, 120°22.3'E, trawl, 136-152 m, 20.XI.1980, 1 ov. ♀ 14 mm (MNHN-Pa 592).

Chesterfield Islands. CHALCAL 1, stn CP 9, 19°44.12'S, 158°28.52'E, trawl, 280 m, 21.VII.1984, 1 ♀ (MNHN-Pa 794).

CORAIL 2, stn CP 131, 19°25.49'S, 158°37.96'E, 215-217 m, 29.VIII.1988, B. Richer de Forges, 1 ♂ 8 mm, 1 ♀ 7 mm, 1 juv. 6 mm (MNHN-Pa 1304).

New Caledonia. BIOCAL, stn CP 42, 23°46'S, 167°13'E, 380 m, 30.VIII.1985, 1 juv. ♂ 10 mm (MNHN-Pa 1158).

MUSORSTOM 4, stn 173, 19°02.5'S, 163°18.8'E, 250-290 m, 17.IX.1985, 1 ♀ 13 mm (MNHN-Pa 1153).

LAGON, stn 396, Grand Récif Sud, 22°40'S, 167°09'E, 284 m, 23.I.1985, 1 ♀ 14 mm (MNHN-Pa 1198). — Stn 835, Lagon Est, 20°46.8'S, 165°17.3'E, 135-150 m, 11.I.1987, 1 ♂ 17 mm (photographed; MNHN-Pa 1279).

BATHUS 1, stn CP 667, 20°57.23'S, 165°34.59'E, 205-212 m, 14.III.1993, 1 ♂ 8 mm, 1 ♀ 7 mm (RMNH D 48761). — Stn CP 712, 21°44.3'S, 166°35.3'E, 210 m, 19.III.1993, 1 ♂ 6 mm (MNHN-Pa 1816). — Stn CP 713, 21°45.3'S, 166°36.8'E, 250 m, 19.III.1993, 1 ♂ 11 mm (USNM 1000669).

BATHUS 2, stn DW 715, 22°39.42'S, 167°10'E, 202-227 m, 10.V.1993, 1 ♂ 6 mm (MNHN-Pa 1814). — Stn CP 728, 22°47.11'S, 167°28.11'E, 241-245 m, 12.V.1993, 1 ♀ 16 mm (MNHN-Pa 1815).

BATHUS 4, stn CP 952, off East coast, 20°34.70'S, 164°58.76'E, 270-316 m, 10.VIII.1994, 1 ♀ 15 mm (MNHN-Pa 1873).

Loyalty Islands. MUSORSTOM 6, stn DW 399, 20°41.8'S, 167°00.20'E, 282 m, 14.II.1989, 1 juv. 5 mm (photographed) (MNHN-Pa 1817).

Vanuatu. MUSORSTOM 8, stn CP 1071, 15°36.63'S, 167°16.34'E, 180-191 m, 4.X.1994, 1 ♀ 8 mm (RMNH D 48760). — Stn CP 1077, 16°04.00'S, 167°06.09'E, 180-210 m, 5.X.1994, 3 ♂ 8-11 mm (MNHN-Pa 1818). — Stn CP 1086, 15°36.58'S, 167°16.32'E, 182-215 m, 5.X.1994, 1 ♂ 8 mm, 3 ♀♀ 7, 11 and 12 mm (largest ov.), 1 juv. 5 mm (MNHN-Pa 1819). — Stn CP 1099, 15°05.39'S, 167°10.51'E, 275-284 m, 7.X.1994, 1 damaged ♀ c. 9 mm (MNHN-Pa 1820). — Stn CP 1102, 15°03.82'S, 167°08.68'E, 208-210 m, 7.X.1994, 1 ♀ 7 mm (MNHN-Pa 1821).

Fiji Islands. Off Viti Levu. BORDAU 1, stn CP 1437, N of Viti Levu, 17°11'S, 178°46'W, 160-177 m, 2.III.1999, 1 ♀ 8 mm (MNHN-Pa 1874).

MUSORSTOM 10, stn CP 1323, 17°16.1'S, 177°45.7'E, 143-173 m, 7.VIII.1998, 1 ♂ 8 mm (MNHN-Pa 1810). — Stn CP 1349, 17°31.1'S, 178°38.8'E, 244-252 m, 11.VIII.1998, 2 juv. 9 mm (MNHN-Pa 1808). — Stn CP 1351, 17°31.1'S, 178°40.0'E, 292-311 m, 11.VIII.1998, 1 juv. 7 mm (MNHN-Pa 1811). — Stn CP 1355, 17°49.5'S, 178°49.4'E, 302-310 m, 12.VIII.1998, 1 ♂ 12 mm, 1 ♀ 13 mm (MNHN-Pa 1812). — Stn 1363, 18°12.4'S, 178°33.0'E, 144-150 m, 15.VIII.1998, 1 ♂ 10 mm, 2 ♀♀ 8 and 11 mm (MNHN-Pa 1804). — Stn CP 1366, 18°12.4'S, 178°33.1'E, 149-168 m, 15.VIII.1998, 1 ♀ 9 mm (MNHN-Pa 1809). — Stn CP 1370, 18°12.3'S, 178°33.1'E, 113-123 m, 16.VIII.1998, 2 ♂♂ 8 and 9 mm (MNHN-Pa 1805). — Stn CP 1371, 18°12.4'S, 178°32.8'E, 135-151 m, 16.VIII.1998, 1 ♀ 11 mm (MNHN-Pa 1806). — Stn DW 1383, 18°18.4'S, 178°02.6'E, 230-251 m, 18.VIII.1998, 1 ♀ 8 mm (MNHN-Pa 1813). — Stn CP 1385, 18°18.5'S, 178°05.2'E, 227-284 m, 18.VIII.1998, 2 ♂♂ 8 and 11 mm, 5 ♀♀ 8-14 mm (RMNH D 48729). — Stn CP 1386, 18°18.5'S, 178°05.1'E, 230-344 m, 19.VIII.1998, 2 ♂♂ 8 and 9 mm (MNHN-Pa 1807). — Stn CP 1387, 18°18.5'S, 178°04.7'E, 229-370 m, 19.VIII.1998, 2 ♂♂ 11 and 12 mm, 6 ♀♀ 9-12 mm (MNHN-Pa 1871). — Stn CP 1389, 241-417 m, 19.VIII.1998, 7 ♂♂ 8-12 mm, 10 ♀♀ 10-16 mm (MNHN-Pa 1869; USNM 1000668). — Stn CP 1390, 18°18.6'S, 178°05.1'E, 234-361 m, 19.VIII.1998, 2 ♂♂ 8 and 9 mm, 4 ♀♀ 10-13 mm (MNHN-Pa 1869).

DISTRIBUTION. — The type locality of the species is the southern Bungo Strait between Shikoku and Kyushu, Japan (Yokoya 1933). Baba *et al.* (1986) also reported material from Bungo Strait. The same authors furthermore mentioned the species from Tosa Bay, Shikoku, as well as from the East China Sea, West of the Tokara Islands (Baba *et al.* 1986). Other localities of the species in the East China Sea are 30°03.0'N, 123°35.0'E; 29°26.5'N, 126°32.6'E; 29°19.0'N, 126°44.7'E; 29°02.3'N, 125°47.7'E and 27°14.4'N, 122°23.7'E (Sekiguchi & Tagawa 1987). Wang (1991) reported the species from Zhejiang (= Chekiang) Province, China, at 29°45'N, 127°E. Huang (1994) and Wang *et al.* (1998) listed it from Chinese waters. Chan & Yu (1986, 1993) mentioned the species from Taiwan: Ta-Chi, I-Lan County; off NE Taiwan; and the Taiwan Strait. The present material shows that the species is very widely distributed, from the Indian Ocean and Japan to New Caledonia.

HABITAT. — The examined material of this species was found in depths between 53-60 m and 282 m; more than 60% of the lots originated from between 150 and 250 m. The depth records in the literature are

110 m (Yokoya 1933), 60 m, 100–115 m, 104 m (Baba *et al.* 1986), about 150 m (Chan & Yu 1986), 70 m, 98 m, 102 m, 110 m, 113 m (Sekiguchi & Tagawa 1987), 106 m (Wang 1991). Of only two of the examined lots the type of bottom has been indicated, namely mud and muddy sand. Chan & Yu (1993) reported the species from sand and mud.

DESCRIPTION

The body is very heavy and robust, roughened by high tubercles and deep grooves. The carapace is very uneven. The rostrum is small with a broadly rounded tip and is somewhat constricted near the base; dorsally it bears three very small tubercles arranged in a triangle; there is a rostral tooth, which sometimes is very indistinct. The pre-gastric tooth is absent, in its place the carapace shows a low transverse ridge, slightly curved with the convex side forwards. The gastric tooth is not large and placed rather far forward, sometimes, especially in the older specimens, it is hardly distinguishable from the surrounding tubercles; it is followed by a short median carina and two submedian rows of three tubercles. The whole area between the pregastric ridge and the cervical groove is pitted and eroded. The area before the pregastric ridge is rather even with hardly any tubercles. The cervical groove is wide and deep but is interrupted in the middle by the postrostral carina, which between gastric and cardiac tooth is high and continuous; before the cardiac tooth, namely, there is a curved transverse ridge with four tubercles that joins the median ridge behind the gastric tooth and so effectively closes the cervical groove. In older specimens the cardiac tooth is only slightly higher than the other tubercles, in juveniles it is quite distinct. It is followed by several smaller tubercles that are arranged in longitudinal rows of two to five. The anterior submedian ridge disappears into the eroded area, and is reduced to a single distinct tubercle placed at the level of the gastric tooth. The branchial ridge is widely interrupted by the cervical groove; in the posterior part of the gap a distinct tubercle is visible. The anterior branchial carina is very short because the cervical groove curves far forward; the carina ends in two teeth that are placed on the inner margin of the orbit, behind these, one or two

lower teeth or tubercles are visible on the ridge. There are three post-orbital tubercles, the outer is largest, the two inner are small and placed close to the branchial carina. Between the posterior post-rostral and the posterior branchial carina there is a longitudinal row of about four rounded intermediate tubercles of which the anterior are largest. The posterior branchial carina bears two longitudinal rows of seven to nine tubercles; these rows are distinctly curved with the convex side facing outward. The tubercles of the inner row are narrower (sometimes even ridge-like) than those of the outer row. The curvature of these rows of tubercles distinguishes the present species from many others, especially the closely related *P. rugosus* n. comb. The lateral margin of the carapace has four anterolateral, four mediolateral and about 10 posterolateral teeth, the latter are placed rather irregularly and are of various sizes. The intercervical ridge bears an almost circular conglomerate of about a dozen small tubercles. There are some tubercles between the posterior branchial carina and the posterior lateral margin of the carapace. The ventral surface of the carapace shows many tubercles in the posterior part and is pitted and eroded anteriorly. The marginal groove along the posterior margin of the carapace is rather deep and filled with short hairs. Before the groove is a transverse, rather irregular row of about 20 tubercles, of which two submedian are larger than the rest. Behind the groove there is a more regular row of about 12 tubercles. A short pubescence is present on the carapace between the tubercles. The posterior margin of the carapace shows a blunt rather wide median V-shaped incision.

On the dorsal surface of the first abdominal somite no transverse median groove is present except in the extreme lateral region. However, on the posterior half of the somite there are nine or 10 short longitudinal grooves that, in preserved specimens, show as whitish lines, resembling those of *Eduarctus martensii* n. comb. The pleura of the first somite end in three blunt teeth, the middle of which is narrow with a rounded top. The posterior margins of somites I and II show a distinct V-shaped median incision, slightly narrower

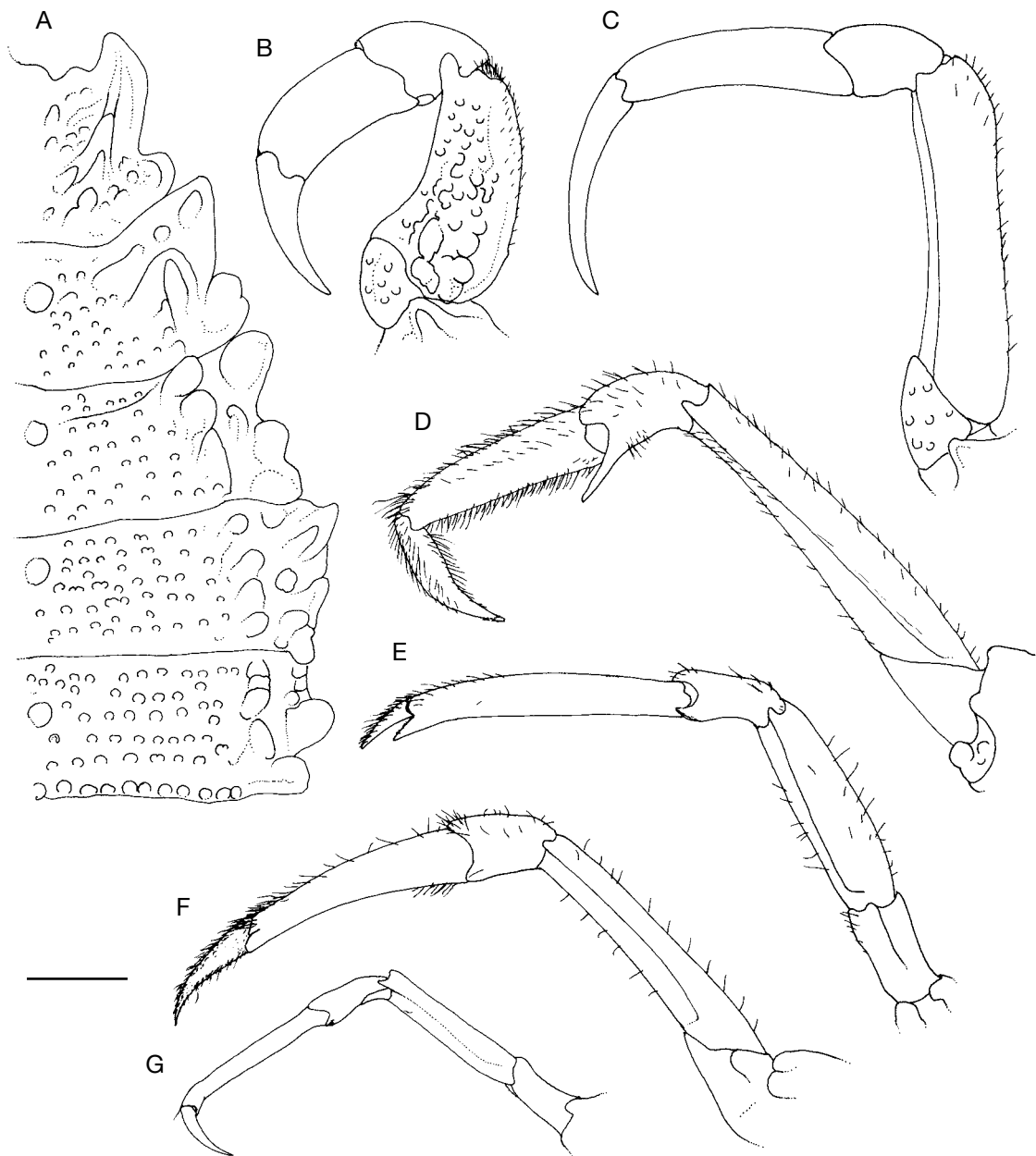


FIG. 14. — *Petrarctus brevicornis* (Holthuis, 1946) n. comb., New Caledonia; **A-F**, BATHUS 4, stn CP 952, ♀ (MNHN-Pa 1873); **A**, thoracic sternum; **B-D**, pereiopods 1 to 3; **E**, pereiopod 5; **F**, pereiopod 4; **G**, LAGON, stn 835, ♂ (MNHN-Pa 1279) pereiopod 5. Scale bar: 2 mm.

than that of the carapace. In somite III the incision is very small. Somites II to V all have a distinct, but not very high, median dorsal carina, which has the lateral margins lobulate; the cari-

nae of somites II and III have a median longitudinal groove. In somite II this groove widens posteriorly so that the two halves of the median carina are diverging. The median carinae of

somites IV and V are single and end in a point. The anterior halves of somites II to VI, which disappear under the previous somite when the body is stretched, show no grooves but are somewhat pitted. The posterior half of the tergite of somites II to V do not show the arborescent pattern of very narrow grooves in a smooth surface as found in the genus *Scyllarus*, but is dominated by a broad and deep, very hairy transverse groove behind which there is a single carina with tubercles and before which there are several groups of tubercles some of which are fused. In the following somites, the posterior transverse carina of the tergite moves farther to the back and becomes less conspicuous, leaving finally only a few scattered tubercles between it and the posterior margin. In these somites the tubercles on the anterior half of the tergite become less distinct than in somite II. The pleura of somites II to IV each show two tuberculate carinae over their full length. The anterior of these ends in the apex of the pleuron, the posterior ends in a blunt tooth on the posterior margin. The anterior margin of pleuron II shows three blunt lobes, each being the end of a short row of one to three small tubercles; the anterior margin of pleuron III shows one or two blunt teeth, that of the pleuron IV has an indistinct tooth or no teeth at all. The posterior margin of pleura II to IV shows the just mentioned blunt tooth, but for the rest the margin is smooth or minutely crenulate. The top of the pleuron is blunt and directed down. In somite V the pleuron has a single tuberculate carina ending in the apex of the pleuron; the anterior margin is convex without teeth, at most with minute crenulations; the posterior margin of the pleuron has two large lobiform teeth. The tergite of the sixth somite has three groups of flattened tubercles in the anterior part; the posterior margin of the tergite carries an irregular row of small tubercles. The telson shows in the central basal part a transverse row of four rather large, but low and blunt tubercles. The four teeth at the end of the firm part of the telson are small and triangular; they are of about equal size and are placed in a transverse line.

The antennular somite shows dorsally a longitudinal median groove; its anterior margin has two broad and bluntly triangular teeth.

The sixth (last) segment of the antenna is relatively short and wide. Its distal margin bears seven slender sharp teeth, of which several usually are broken; in the basal part of the inner margin an indistinct small tooth may be present. The fifth segment has two teeth on the anterior margin, the inner of these is the most slender and is followed by a distinct ridge; the outer tooth is shorter and if a ridge is present it is lower. The anterior margin of the fourth segment has a large tooth at the inner angle, followed outward by three smaller teeth. The upper surface of the segment has a distinct tuberculated oblique carina, which is curved or angled in the middle and ends in the apex of the segment; the basal part of this carina is distinctly higher than the distal part; the change from high to low is rather abrupt and takes place in an angle or curve. Sometimes the carina shows a short side branch. A tubercle may be present to the outside of the base of the main carina, it stands at the articulation with the third antennal segment. The outer margin of the fourth segment has three to five distinct teeth (the apex of the segment excluded); the distal of these are more slender than the proximal. The dorsal surface is rather uneven with a few depressions. The inner margin of the segment has a blunt tooth, and the margin near the articulation with the fifth segment is somewhat elevated.

The upper surface of the epistome is slightly convex. The anterior margin shows a blunt median incision and has at either side a triangular tooth placed near the inner margin of the base of the antenna.

The third maxilliped is implanted some distance dorsad of the anterior margin of the thoracic sternum and thereby somewhat sunken in ventral view.

P.1 is heavier and shorter than the following. The second leg is the longest and the fourth the shortest of the following legs. The dactylus of P.1 is about as long as the propodus, but much narrower and regularly tapering; the carpus is slightly shorter than the propodus and more cup-shaped,

both have the surface smooth and slightly swollen. There are no hairy fringes on either dactylus, propodus, or carpus. The merus is about as long as carpus and propodus together and has the exposed surface deeply and coarsely pitted and eroded; there is a row of very short hairs on its outer margin; the inner margin is somewhat carinated and is flanked by a wide groove; a tooth with a rounded top is present on the inner angle of the anterior margin. P.2 has the dactylus about 1.5 times as long as that of the first leg, and as long as the propodus. The carpus is slightly longer than half the propodus. Dactylus, propodus and carpus are smooth and have no hairy fringes. The merus is longer than carpus and propodus together; its outer margin shows an irregular row of rather short hairs. The third leg has the dactylus rather short and wide (about as long as that of the first leg), with rather dense hairy fringes on outer and inner margin and one on the upper surface. The propodus is about 1.5 times as long as the dactylus. It has likewise a fringe of rather long hairs on outer and inner margin and a less distinct one on the upper surface. The carpus is about as long as the dactylus with indistinct fringes of scattered hairs on outer and inner margins and on the exposed surface. It ends in a strong spur-like tooth at the inner anterolateral angle, differing in this respect strongly from the carpi of the first and second leg and from those of other species. The merus is distinctly longer than carpus and propodus together. It bears scattered short hairs. A ridge extends from the inner anterolateral angle posteriorly; the angle is bluntly tooth-shaped. The fourth leg has the dactylus about half as long as the propodus, it bears a dorsal fringe of hairs and a few scattered hairs on the lower edge. The propodus has a fringe of hairs in the distal part of the upper edge and a distal tuft; some scattered hairs are on the rest of the surface. The carpus is slightly less than half as long as the propodus and bears a few scattered hairs; the lower part of its anterior margin bears no spur, but has at the most a short triangular tooth there. The merus is somewhat longer than the propodus; like in the previous leg the lower outer margin shows a ridge that ends in a short rounded tooth. The fifth leg in the female

ends in a distinct chela, the dactylus being clearly longer than the fixed finger, it is less than a third of the length of the palm. A fringe of hairs is present on the dorsal margin of the dactylus and is continued on the distal part of the upper margin of the propodus, but is less distinct there. The carpus is slightly more than a third of the length of the propodus; it shows no spur, at most a short triangular tooth like in P.4. The merus is also similar to that of P.4, it is, however, shorter than the propodus.

The thoracic sternum has the anterolateral teeth reaching distinctly beyond the anterior margin proper. This anterior margin shows in the middle a small, rounded U-shaped incision, which is flanked with a small tubercle at each side. The anterolateral teeth carry a longitudinal carina, which in the middle of its length shows a blunt tooth. On each of the sternites a median tubercle is present. The surface of the sternum is closely pitted and eroded. The posterior margin carries a transverse row of tubercles. The lateral parts of the sternum are elevated with blunt ridges and large tubercles.

In the male the pleopods on the second abdominal somite are slender and narrowly elongate; they are widest in the middle and gradually taper to a long, slender tip; the exopod is slightly shorter than the endopod. The next pair of pleopods has the exopod rather short and oval, the endopod is very narrow and somewhat shorter than the exopod. In the following pleopods the exopod is elongate, the endopod is just a short bud.

Size

The examined males had a cl. of 8 to 17 mm, the non-ovigerous females of 7 to 18 mm, the only two ovigerous females examined had cl. 12 and 18 mm; two juveniles measured 5 and 6 mm cl. Baba *in* Baba *et al.* (1986: 286) mentioned two ovigerous females with cl. 15.5 and 18.2 mm. Chan & Yu (1986) gave the cl. of an ovigerous female as 15 mm, and that of a non-ovigerous female as 13.5 mm. Chan & Yu (1993: 208) gave the tl. of their specimens as 40 to 70 (mostly 40-55) mm, which would correspond with cl. about 13 to 23 (mostly 13-18) mm.

Colour

A colour photograph of the male specimen from Lagon Est, east coast of New Caledonia (stn 835) shows a specimen irregularly marbled and spotted with various shades of brown, the tailfan and part of abdominal somite V are much lighter than the rest. But the most conspicuous feature is a dark blue spot over the middle of the first abdominal somite. The margin of the blue spot is not very sharply defined. The specimen from Vanuatu stn CP 1071 is of a darker brown with a few scattered white dots and a white V-shaped line in front of the cardiac tooth. The dark blue spot on the first somite of the abdomen is also quite distinct. The specimen from near Zanzibar was provided with the annotation "Abdomen with bright blue patch". The coloured photographs of this species provided by Chan & Yu (1986: pl. 9 figs C, D; 1993: 207) also show a dark brown animal marbled with pale brown. The area around the cervical groove is whitish as are also two whitish spots on the posterolateral part of the carapace, and one on the distal part of each of the fourth antennal segments. The first abdominal somite bears the characteristic blue colour on its anterior half. The tailfan is whitish. The eggs are orange. The coloured photograph provided by Baba *et al.* (1986: 162) shows a dark brown animal slightly marbled. Of the whitish spots only the V-shaped whitish line in front of the cervical groove and the whitish tailfan are distinct, as well as the blue colour on the first abdominal somite.

REMARKS

The species is closely related to *P. rugosus* n. comb., but can immediately be recognized by curved postero-branchial ridges, the presence of tubercles on the anterior transverse carina of the second abdominal somite, and the presence of a large spur on the carpus of the P.3. It is also close to *P. veliger* n. sp. (see below).

Petrarctus veliger n. sp. (Figs 15-17)

TYPE MATERIAL. — Holotype: ♀ 19 mm, RV *Anton Bruun*, cruise 1, stn 38 (USNM); paratypes: 1 ♂ 18 mm, 1 ov. ♀ 17 mm (ZRC 2001.0326).

TYPE LOCALITY. — Andaman Sea, off South Burma, 14°07'N, 97°05'E, 69-73 m.

ETYMOLOGY. — The specific name *veliger* is Latin, meaning sail-bearer, in reference to the very high cardiac and gastric teeth towering above the body.

MATERIAL EXAMINED. — **Andaman Sea.** Off South Burma, IIOE, RV *Anton Bruun*, cruise 1, stn 38, 14°07'N, 97°05'E, trawl, 69-73 m, 30.III.1963, 1 ♀ holotype, 19 mm (USNM).

Philippines. Bohol, Balicasag Id, off Panglao Id, c. 200-300 m, tangle nets, XII.2000, from local fishermen, 1 ♂ 18 mm, 1 ov. ♀ 17 mm (ZRC 2001.0326).

DISTRIBUTION AND HABITAT. — There are only two depth records for this species: 69-73 m (Andaman Sea) and c. 200-300 m (Philippines). So far the species is only known from the types.

DESCRIPTION

The body is very robust, heavy and rough. The tubercles are quite high and the grooves and depressions deep.

The rostrum is bluntly rounded and bears a short and blunt tubercle, which is about as large as the tubercle found on the extreme inner part of the ophthalmic somite. There is no pregastric tooth, but the gastric tooth is very high and triangular ending in a single sharp point. The posterior surface of the gastric tooth is flattened and delimited by two curved rows of three or four tubercles, between which one or two smaller tubercles may be found. The posterior part of the gastric tooth is high and separated from the anterior part of the cardiac tooth by the cervical groove, which here forms a very narrow slit and curves up over the postrostral ridge. The cardiac tooth is even much higher and larger than the gastric, but of about the same shape. On its posterior margin it bears two rows of four or five distinct tubercles; the lateral surface of the cardiac tooth bears a few tubercles. On either side of the posterostral carina the cervical groove, which is very narrow on the ridge, strongly widens laterally forming a large smooth area between the postrostral and branchial ridges. The anterior submedian ridge lies close to the anterior postrostral ridge and ends in a distinct tubercle, which reaches about as far forward as the gastric tooth; it is followed by some smaller tubercles, some of which are interconnected.

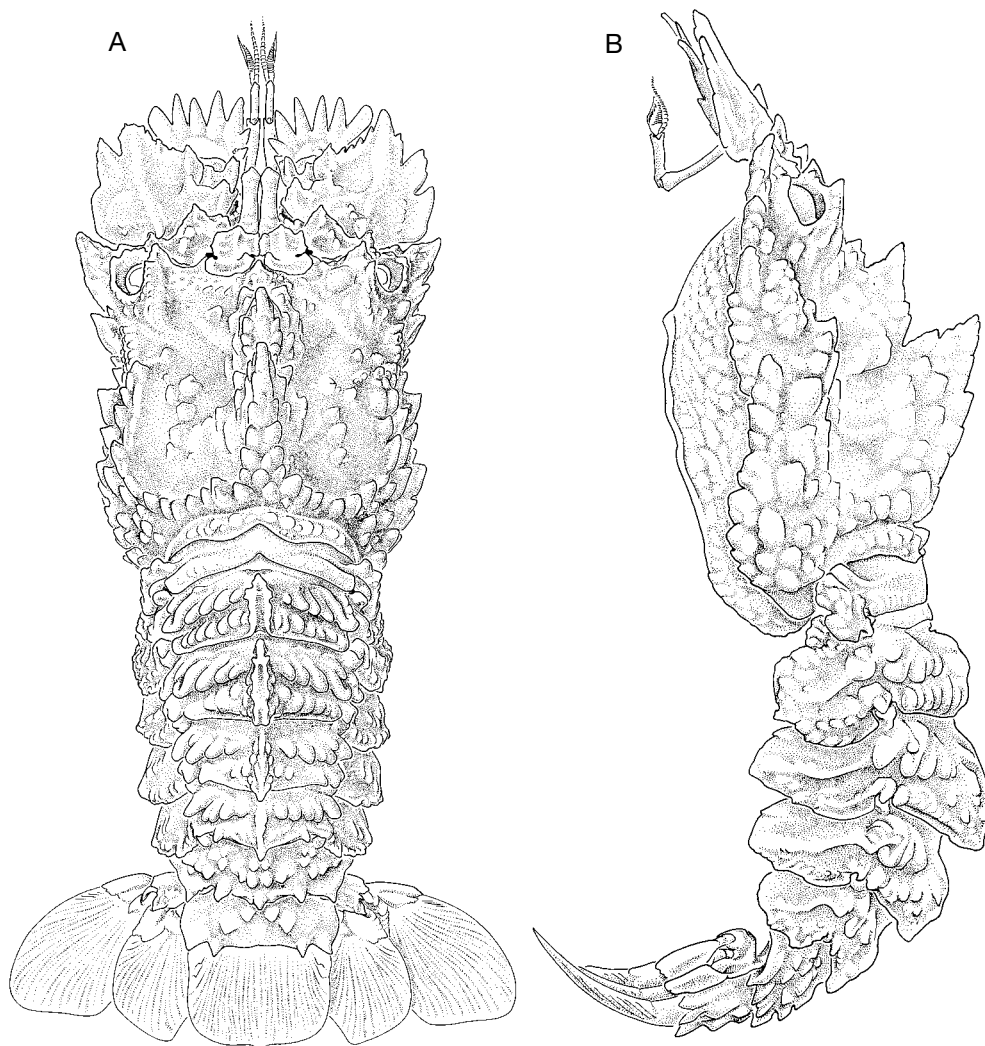


FIG. 15. — *Petrarctus veliger* n. gen., n. sp., Andaman Sea off Burma, ♀ holotype carapace length 19 mm (USNM); **A**, dorsal view; **B**, lateral view. J.-F. Dejouannet del.

The intermediate row consists of four tubercles, the anterior of which jots out into the cervical groove; one or two tubercles are present between the anterior part of the intermediate row and the posterior branchial carina. The space between the anterior postrostral and the anterior branchial ridges shows very few tubercles apart from a transverse row of very small tubercles behind the anterior margin.

The branchial carina is widely interrupted by the cervical groove, the gap showing a distinct

tubercle. The anterior branchial carina ends in the usual two teeth on the inner orbital margin; both teeth are sharply angled. Behind the posterior tooth the carina shows some three low tubercles. The orbital margin is finely tuberculate and between it and the branchial carina another tuberculated ridge is present. There are two post-orbital tubercles. The intercervical ridge is covered by about 10 small, rather high tubercles. The posterior branchial carina ends anteriorly in a strong blunt tooth, behind which the carina bears

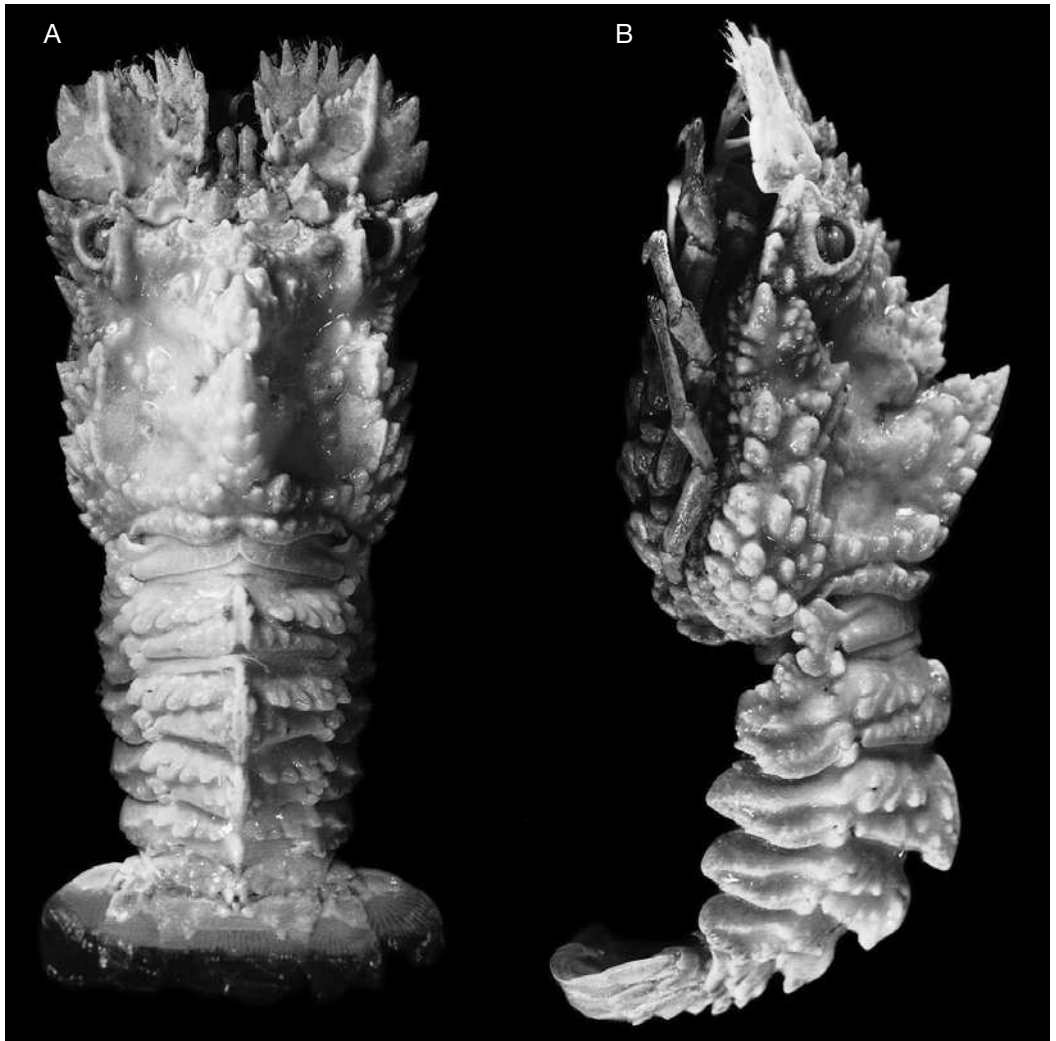


FIG. 16. — *Petrarctus veliger* n. gen., n. sp., Andaman Sea off Burma, ♀ holotype carapace length 19 mm (USNM); **A**, dorsal view; **B**, lateral view.

two slightly diverging rows of tubercles; the inner row has three tubercles, the last of which being elongate and ridge-like; the outer row consists of five or six distinct tubercles. The anterior tooth of the lateral margin of the carapace is strong and followed by one or two more or less distinct anterolateral teeth. The anterior of the mediolateral teeth is triangular, the two or three following are rounded. The posterolateral margin bears five or six strong teeth which show some grooves; it ends in a group of tubercles. The marginal groove

along the posterior margin of the carapace is quite distinct; before and behind it is a single row of tubercles. The posterior margin of the carapace has a blunt triangular median incision.

The first abdominal somite is entirely smooth and has no transverse groove, except for an indication of one near the base of the pleura. Also the longitudinal grooves are absent or only very vaguely indicated. The posterior margin of the somite shows a distinct blunt triangular median incision. Abdominal somites II to V have a distinct median

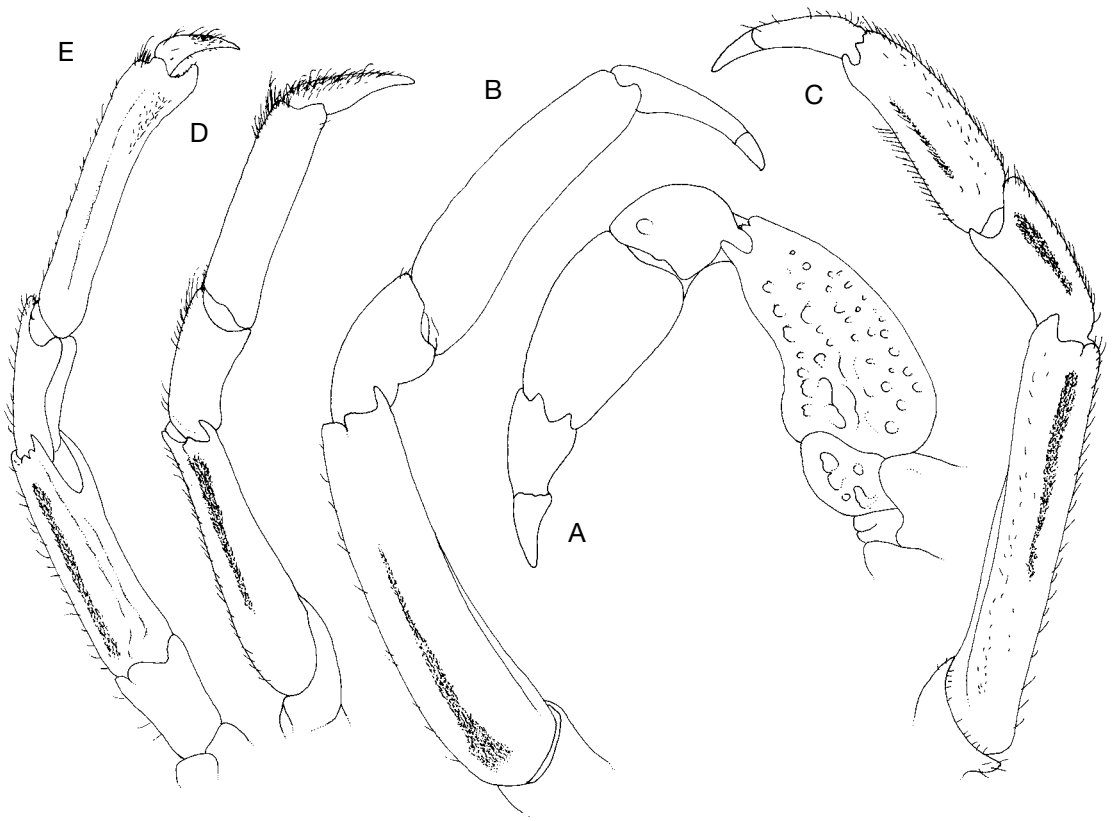


FIG. 17. — *Petrarctus veliger* n. gen., n. sp., Andaman Sea off Burma, ♀ holotype carapace length 19 mm (USNM); A-E, pereopods 1 to 5.

longitudinal carina. The carina of somite II is lowest and shows a central groove in all but the anteriormost part; its lateral margin is lobulated. The median carina of somite III is highest, it is bluntly triangular and somewhat produced posteriorly, it slightly overhangs the posterior margin; it has an indistinct and interrupted median groove dorsally, and tubercles and short grooves on its lateral surface. The carinae of somites IV and V are lower, they are also slightly produced posteriorly. The tergites of somites II to V show a rather wide transverse median groove with a row of large tubercles before it, and behind it a broad transverse ridge, which in somites II and III has faint tubercles and is smooth in somites IV and V. The pleura of somite I have tubercles on the outer surface and three incisions in the lateral margin.

The pleura of the other abdominal somites end in a blunt top. Those of somite II show two wide transverse grooves, separated by rows of flat tubercles. In somites III to V there is only one transverse groove and two ridges; before the anterior ridge the surface of the pleuron is smooth. The sixth somite has a continuous transverse groove with a row of tubercles before it and three tubercles on the posterior margin.

The hard part of the telson shows four low and rounded tubercles: two anterior in the median area, and two more behind and more lateral. The teeth at the end of the hard part are placed in one line, the outer being widest.

The ophthalmic somite shows four distinct blunt tubercles, one on either side of the rostrum and one laterally.

The anterior margin of the antennular somite shows a strong triangular tooth in each half.

The sixth (last) segment of the antenna ends in six teeth. The outer is wide and blunt. The following four are narrow and taper gradually towards the top. The inner tooth is short and triangular and has a small incision at its base. The fifth segment is short and ends in two small teeth, the upper of which carries a carina. The fourth segment has a distinct oblique dorsal carina, which is somewhat curved at its base and carries a tubercle there. The carina traverses the segment in its middle and the outer and inner halves of the dorsal surface are of about equal width, they are deeply concave; there is no additional carina or row of tubercles in the outer half, sometimes there are a few scattered small tubercles. The outer margin of the fourth antennal segment bears two or three distinct teeth (the apical tooth of the segment excepted), sometimes an additional minute tooth is present distally. The anterior margin of the fourth segment bears a strong tooth mediad of the articulation with the fifth segment. The margin between this articulation and the apex of the segment bears one large tooth near the articulation and four smaller acute teeth on the rest of the margin.

The anterior margin of the epistome is triangularly incised in the middle, the two halves are convex.

The first pereopod is robust. The dactylus is almost as long as the propodus. The surface of propodus and carpus is smooth with at most a few minor depressions. The outer surface of the merus has a wide ventral groove proximally and some depressions in the rest of the surface which thereby becomes rather rough. The second leg has the dactylus somewhat longer than in the other legs; dactylus, propodus and carpus are naked; the merus has a short dorsal hairy fringe and is rather roughly pitted. In P.3 the dactylus has a short dorsal hairy fringe, while the propodus has distinct dorsal and ventral fringes. The carpus has a dorsal area of hairs and does not carry a spur. P.4 and P.5 have hairs on the dorsal surface of the dactylus and

the distal part of the propodus. The merus of P.2 to P.5 has dorsal hairs which are placed more densely in the posterior than in the anterior legs. A groove in the dorsal part of the outer surface of the merus, if present, is very inconspicuous.

The anterior end of the sternum is U-shapedly concave with a median incision flanked on each side by an inconspicuous tubercle. The anterior margin is slightly swollen. On either of the anterolateral teeth there is a V-shaped carina, which narrows anteriorly and ends abruptly some distance behind the top of the anterolateral tooth. The central part of the sternum is deeply concave and somewhat pitted; at the borders of the sternites it is somewhat sunken. In the male specimen a small median tubercle is present on somites II to V; in the female only the one on the fifth somite is discernable. The elevated sides of the sternum along the bases of the legs show an intricate pattern of rounded knobs and grooves. The posterior margin of the sternum is straight.

Size

The carapace length of the examined specimens lies between 17 and 19 mm. The ovigerous female has cl. 17 mm.

Colour

In the preserved specimens almost all traces of the coloration have disappeared, except for the specimens from the Philippines, which show a very indistinct darkish rounded median spot on the smooth anterior part of the first abdominal somite.

REMARKS

The species is only known from the three specimens cited above. No details are known about colour, habitat, variation, etc.

P. veliger n. sp. is most closely related to *P. brevicornis* n. comb., but can be distinguished by the very high cardiac and gastric teeth, the presence of four tubercles on the ophthalmic somite, the small number of lateral teeth on the fourth antennal segment, etc.

Petrarctus demani (Holthuis, 1946) n. comb.
(Figs 18; 19)

Scyllarus demani Holthuis, 1946: 91, pl. 7 fig. d, pl. 8 fig. b, pl. 9 fig. a. — Burukovsky 1974: 106; 1983: 149. — Ritz 1977: 229, 231, figs 1-6. — Phillips *et al.* 1980: 69; 1981: 418, 422. — Barnett *et al.* 1986: 599, fig. 2. — Sekiguchi 1986a: 1290; 1987a: 331; 1987b: 415, 417; 1989b: 457; 1990a: 113; 1992: 212. — Barnett 1989: 124, fig. 1. — Phillips & McWilliam 1989: 357, 358. — Ito & Lucas 1990: 144, figs 1-10. — Jones 1990: 181. — Sheehy, 1990: 618. — McWilliam *et al.* 1995: 564. — Burton 1996: 499, 503, figs 14-16.

Scyllarus tuberculatus — Nobili 1903: 12. — De Man 1924: 53, fig. 18 [non *Arctus tuberculatus* Bate, 1888 = *Petrarctus rugosus* (H. Milne Edwards, 1837) n. comb.].

TYPE MATERIAL. — Holotype: ♀, H. Van der Horst leg., 1912 (ZMA).

TYPE LOCALITY. — Indonesia. Banka Id, East of Sumatra.

MATERIAL EXAMINED. — **Singapore.** Received 31.VII.1902, E. Deschamps leg., 1 ♂ 13 mm, 1 ♀ 14 mm, 4 juv. 7-8 mm (USNM).

Sarawak. Borneo, W of Tandjong Sirik, RV *Lanessan*, 2°40'N, 110°39'E-2°38'N, 110°29'E, A. Krempf No. 35, 5.IX.1926, 1 ♀ 24 mm (MNHN-Pa 795).

Indonesia. Banka Id, East of Sumatra, 1912, H. Van der Horst leg., 1 ♀ holotype (ZMA). — Jedan, Aru Ids, dredged, 10.II.1907, P. N. Van Kampen leg., 1 ♂ 19 mm (ZMA). — Off west coast of Wasir Id, Wokam, Aru Ids, Mariel King Memorial Expedition, stn AWI/HS, 5°30'S, 139°12'E, 55-59 m, mud, 15.VI.1970, 1 juv. ♂ 6 mm (WAM 251-70).

Australia. Western Australia, Shark Bay, 1964, E. Barker leg., 2 ♂♂ 19 and 22 mm, 1 non-ov. ♀ 21 mm, 4 ov. ♀♀ 22-27 mm (WAM 93-66); 15.X.1964, 1 ov. ♀ 26 mm (WAM 95-66); 20.X.1964, 1 ov. ♀ 24 mm (WAM 96-66). — RV *Lancelin*, in prawn trawl, 17.IX.1957, 2 ♂♂ 21 and 24 mm, 1 ♀ 24 mm (WAM 65-58). — FV *Bluefin*, VII.1963, W. Poole, 1 ♂ 25 mm, 2 ♀♀ 19 and 23 mm (WAM 94-66). — FV *Bluefin*, trawled, IX.1963, W. & W. Poole, 1 ♂ 25 mm (WAM 325-64). — IV.1957, G. K. Bowen leg., 1 ♂ 20 mm, 1 ♀ 18 mm (WAM 327-64). — In prawn trawl, 7.XI.1970, D. A. Ritz, 1 ♂ 24 mm, 2 ov. ♀♀ 25 and 26 mm (WAM 1-71). — FRV *Péron*, haul 1, 1.III.1962, 2 ov. ♀♀ 25 and 27 mm (WAM 319-64). — FRV *Péron*, haul 5, 2.III.1962, 1 ♂ 20 mm (WAM 321-66). — FRV *Péron*, haul 105, 14.VI.1962, 1 ♂ 24 mm (WAM 326-64); VI-VII.1961, Poole brothers, 2 ♂♂ 19 and 23 mm (WAM 330-64). — RV *Lancelin*, trawled, R. McKay, 1 ♀ 19 mm (WAM 320-64). — CSIRO, Danish seine, 1 ♀ 25 mm, 1 juv.

13 mm (AM-P12482). — Hopeless Reach, FRV *Péron*, 25°40'S, 113°45'E, 1.X.1965, 3 ov. ♀♀ 21-25 mm (WAM 239-700). — Denham Sound, Shark Bay, c. 25°35'S, 113°15'E, trawl, 2-11 m, VII.1955, 1 ♂ 20 mm, 1 non-ov. ♀ 26 mm, 2 ov. ♀♀ 24 and 27 mm (WAM 333-64 and 166/7-57). — Near Homestead, Shark Bay, FV *Davena*, Honolulu dredge, 11 m, VI.1960, 1 ♂ 22 mm (WAM 332-64). — Carnarvon, 16.V.1979, J. C. Miquel leg., 4 ♂♂ 18-22 mm, 1 ♀ 23 mm (RMNH D 32258). — 40 miles SW of Carnarvon, trawled, VI.1960, A. Snell, 1 ♀ 22 mm (WAM 328-64). — Exmouth Gulf or Shark Bay, FRV *Péron*, 1960, R. McKay, 1 ♂ 17 mm (WAM 329-64). — Between Shark Bay and Onslow, trawled, 1966, W. & W. Poole, 1 juv. 5 mm (WAM 236-70). East end of Mary Ann Passage, off Onslow, FV *Davena*, dredged, 13 m, 15.V.1960, B. R. Wilson, 1 ♂ 20 mm (WAM 324-64). — SE of Rosemary Id, Dampier Archipelago, dredged, 5-9 m, sand and shells, 26.VIII.1961, G. W. Kendrick & B. R. Wilson, 1 ♂ 16 mm (WAM 331-64). — NE of Mallus Id, FV *Davena*, Honolulu dredge, 18 m, 31.V.1960, R. D. Royce, 1 ♀ 12 mm (WAM 394-64). — Off Gantheaume Point near Broome, dredged, 7 m, VIII.1929, 1 ov. ♀ 21 mm (AM). — Near entrance of Roebuck Bay, dredged, 9-15 m, *Lithothamnion* reef bottom, 26.IX.1929, 1 ♂ 23 mm (AM). NW Coast. FV *Dorothea*, c. 21.5 miles ENE of Troughton Id, 13°45'S, 126°09'E, 59 m, mud, 23.X.1962, R. W. George, 1 ♀ 17 mm (WAM 323-64).

Northern Territory. Darwin, 20 miles 320°, 4.IX.1965, E. Barker, 1 ♂ 24 mm (WAM 101-66). — Darwin, trawled, IX.1975, E. Barker, 1 ov. ♀ 25 mm (WAM 231-70). — Chambers Bay, Darwin, FV *Paxia*, 13 m, 7.XI.1959, V. Wells, 1 ov. ♀ 25 mm (WAM 335-64).

Queensland. SE corner of Gulf of Carpentaria, FV *Rama*, stn 1527, up to 22 m, XI.1964, R. W. George, 1 ♀ 21 mm (WAM 98-66); stn 1540, up to 22 m, 3 ov. ♀♀ 23-26 mm (WAM 97-66); stn 1541, up to 22 m, 1 ♂ 22 mm (WAM 99-66); stn 1542, 1 ov. ♀ 24 mm (WAM 100-66). — Trawled, 21 m, sandy mud bottom, 20.II.1983, C. Jones, 1 ♀ 24 mm (RMNH D 39342). — Trawled, 15 m, soft muddy bottom, 16.III.1983, C. Jones, 1 ♀ 26 mm (RMNH D 49591). — Wellesley Ids, 5 m, 13.II.1983, C. Jones, 1 ♀ 14 mm (RMNH D 39341). — Off Karumba, trawled, less than 26 m, XII.1963, J. C. Yaldwyn, 2 ♂♂ 19 and 20 mm, 1 non-ov. ♀ 23 mm, 1 ov. ♀ 21 mm (RMNH D 49594).

NE Gulf of Carpentaria. Trawled, 14 m, soft muddy bottom, 15.III.1983, C. Jones, 1 ov. ♀ 25 mm (RMNH D 49592).

East coast of Queensland. Off Cairns, about 16°55'S, 145°46'E, trawl, 24 m, soft muddy bottom, 16.V.1984, C. Jones, 1 ♂ 24 mm, 1 ♀ 22 mm (RMNH D 49593). — Off Cairns, trawled, 26 m, soft muddy bottom, 18.V.1984, C. Jones, 1 ♀ 25 mm

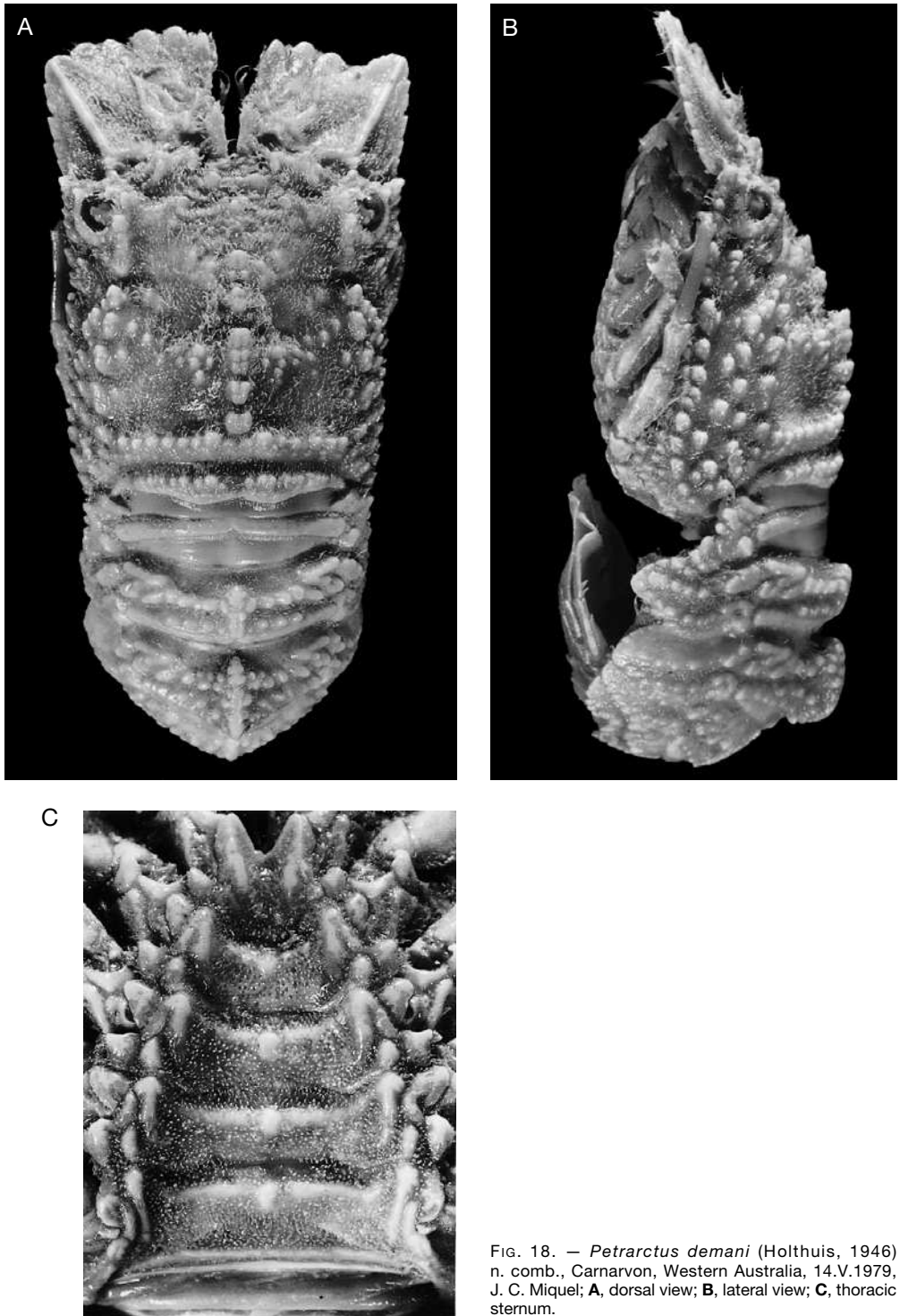


FIG. 18. — *Petrarctus demani* (Holthuis, 1946) n. comb., Carnarvon, Western Australia, 14.V.1979, J. C. Miquel; **A**, dorsal view; **B**, lateral view; **C**, thoracic sternum.

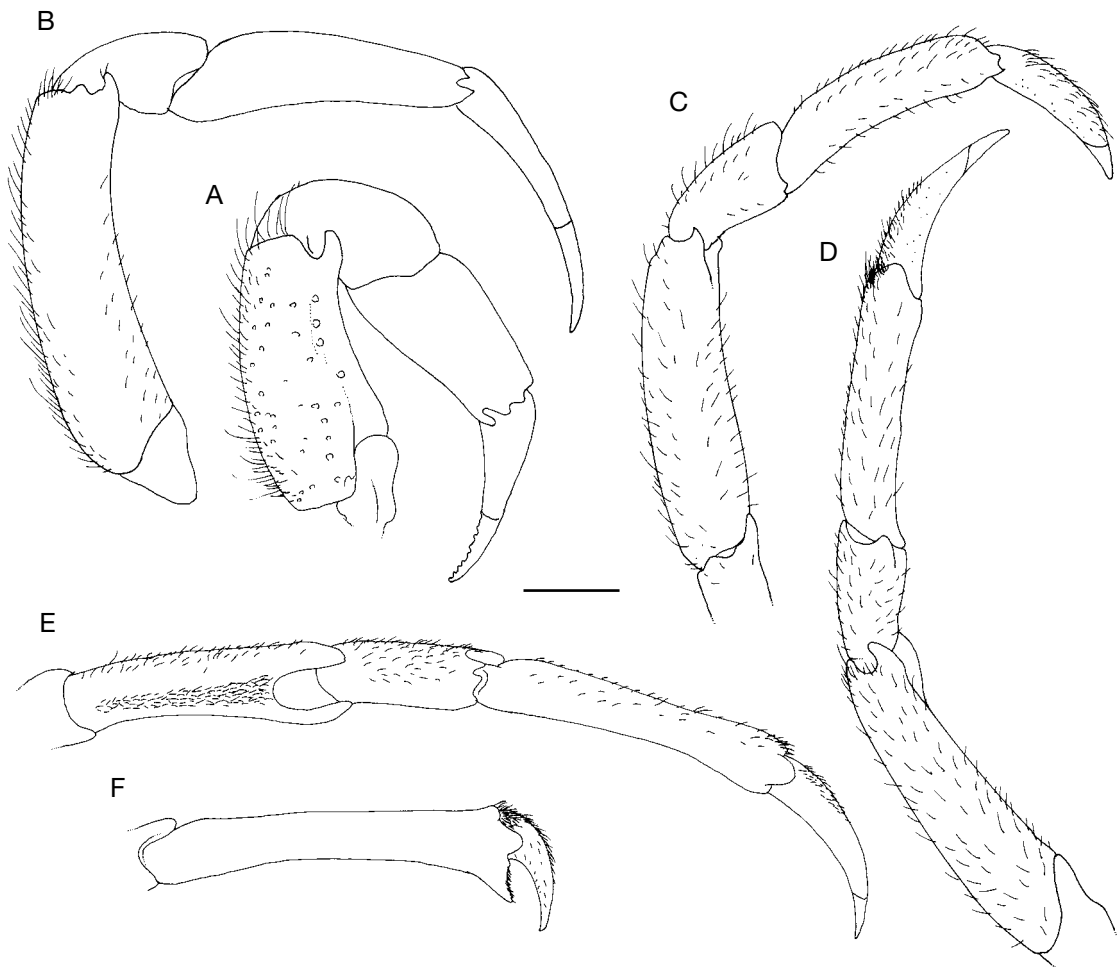


FIG. 19. — *Petrarctus demani* (Holthuis, 1946) n. comb., Carnarvon, Western Australia, 14.V.1979, J. C. Miquel; **A-E**, ♂, pereopods 1 to 5; **F**, ♀, propodus and dactylus of pereopod 5. Scale bar: 2 mm.

(RMNH D 49594). — Between Cape Gloucester (about 20°04'S, 148°27'E) and Cape Cleveland (19°11'S, 147°01'E), RV *Challenge*, CSIRO, trawled, 18-46 m, K. de Witte, 1 ♂ 24 mm (AM P.12992). — 7 miles NNE of Bowen, RV *Endeavour*, stn E 3098, 20°01'S, 148°14'E, 29 m, 2 ♂ 19 and 24 mm (AM P.3518). — Bowen Harbour, Port Denison, about 20°02'S, 148°15'E, F. H. Rainford, 1 juv. 11 mm (AM P.6017). — Between Hayman Id (20°03'S, 148°53'E) and Eshelby Id (20°02'S, 148°37'E), Cumberland Group, RV *Challenge*, trawl, 37-46 m, K. de Witte, 1 ov. ♀ 18 mm (AM P.12988). — SE of Mackay, 21°09'S, 149°12'E, dredged, 24.II.1964, W. Goode, 1 ov. ♀ 24 mm (WAM 334-64). — Great Sandy Id (= Fraser Id), Platypus Bay, RV *Endeavour*, stn E 3111, 25°15'S, 153°10'E, 9-16 m, 1 ♂ 23 mm,

1 ♀ 24 mm (AM). — Platypus Bay, RV *Endeavour*, 28.VII.1910, 2 ♂ 23 and 25 mm (AM P.3525). — Off Tin Can Bay, 25°49'S, 153°01'E, 46 m, P. T. Garrard, 1 ♂ 24 mm (AM). — Tin Can Bay, S end of Great Sandy Str., prawn trawl, P. T. Garrard, 1 ♀ 27 mm (AM P.12990). — Moreton Bay, II.1967, A. J. Bruce, 2 ♀ 22 and 23 mm, smallest ov. (RMNH D 23379).

DISTRIBUTION. — The species has been found in several localities in the Malay Archipelago (Sarawak, Singapore, Banka and the Aru Ids), and is taken in considerable numbers along the coasts of Western Australia (from Shark Bay north), Northern Territory, and Queensland (from Moreton Bay north). Nobili (1903: 12) reported it from Singapore, incorrectly

assigning it to *Scyllarus tuberculatus* (Bate, 1888). De Man (1924) brought a specimen from Banka to the same species; Holthuis (1946) based his new species on De Man's (1924) material, so that Banka, E of Sumatra, is the type locality. Ritz (1977) described phyllosoma stages 1 to 6 from Shark Bay, from the Gulf of Carpentaria and Moreton Bay; he had also described adult material from Shark Bay. Jones (1990) listed many specimens from Shark Bay (Homestead, Carnarvon and SW of it, Denham Sound, Hopeless Reach, between Shark Bay and Onslow, and material originating either from Shark Bay or Exmouth Gulf), all of this material has been examined for the present paper. Barnett (1989) mentioned the species from N Queensland, and Burton (1996) studied the sperm of material from the east coast of Queensland. McWilliam *et al.* (1995) gave the Australian range of the species as Western Australia to S Queensland, including Torres Strait, from where the species had so far not been reported. Barnett *et al.* (1986) and Ito & Lucas (1990) reported larvae from off Townsville, Queensland at about 19°S, 147°E. Phillips & McWilliam (1989) reported a final (gilled) phyllosoma stage of this species from 20 km off the SW coast of Oahu, Hawaiian Ids.

HABITAT. — The species has been reported from depths between 5 and 59 m; more than two thirds of the records are from 10 to 25 m. The species was found on bottoms described as: soft mud, sandy mud, mud, sand and shells, lithothamnion reef (in this order of frequency).

DESCRIPTION

The rostrum is not very narrow, the anterior margin is convex or bilobed, it is constricted behind the top. The dorsal surface bears a distinct rostral tooth. Apart from the rostral tooth there are two more teeth in the median line of the carapace. The cardiac tooth is very high, single or two-topped and overhangs the cervical groove; behind it there is a row of four to seven double tubercles. The gastric tooth ends in a single blunt point, it is likewise strong and forwards directed; behind it is a double row of three or four tubercles, the posterior pair being separated from the anterior by a distinct incision so that it seems as if two teeth are placed here, one right behind the other. A few tubercles are seen behind the rostral tooth. The branchial carina is deeply and rather narrowly interrupted by the cervical groove; there is no tubercle in the gap, but two tubercles are placed in the groove to the inner side of the gap.

Anteriorly the branchial carina ends in two blunt teeth that are placed, one behind the other, on the inner orbital margin. There are several very inconspicuous tubercles on the anterior branchial carina; one or two of these are placed behind the anterior of the two teeth and two to four behind the second. The posterior branchial carina ends anteriorly in a distinct tooth behind which there are posteriorly diverging rows of distinct and high tubercles; the inner row contains four to seven, the outer seven or eight tubercles. The posterior submedian carina is short and bears two to five tubercles; between it and the posterior postrostral carina there are one or two additional tubercles. The intermediate row consists of three tubercles, between it and the posterior submedian ridge there is a transverse row of two or three tubercles. The anterior submedian ridge bears one or two tubercles, behind it, just before the cervical groove, another tubercle is visible. A short ridge is placed laterally of and slightly more anterior of the anterior submedian ridge. A row of three tubercles extends along the inner side of the posterior branchial carina, this row sometimes ends anteriorly in a small group of small tubercles just before the cervical groove. The lateral margin of the carapace shows two to four distinct anterolateral teeth, two to four mediolateral and eight to 10 posterolateral. Between the posterolateral margin and the posterior branchial carina several large tubercles are present. The intercervical ridge is longitudinal and carries three to seven tubercles; a tubercle is present more medially. There are two or three postorbital tubercles. The marginal groove along the posterior margin of the carapace is deep and rather wide; before it is a double and behind it a single transverse row of tubercles. The posterior margin of the carapace is triangularly incised in the middle.

The first abdominal somite shows a transverse groove, which extends over the full width of the segment; before this groove the somite is smooth, behind it there are a few pits. The anterior half of the following four somites is smooth; the posterior half shows a distinct median carina, which is extremely high in the third somite, where it is

wide with tubercles on either side. The carina of the second somite is about half or less than half as high and almost as broad as that of the third, it shows a median dorsal groove and bears lateral tubercles. The median carinae of somites IV and V are sharply set off, narrow, less than half as low as that of somite II, and tuberculate dorsally. The carina of somite IV ends in one or two, that of somite V in a single median point. The posterior margin of somites I to III is incised in the middle, but otherwise entire; in somites IV and V the posterior margin bears 11 to 16 distinct small teeth. A broad transverse groove extends over the posterior half of somites II to V from the median carina to the tip of the pleura; on each side of this groove there is an elevated carina, which also extends to the tip of the pleura. On these carinae there are very distinct tubercles. In the lateral part of the tergite of somites II and III, the anterior carina bears elongate and forked tubercles. The pleuron of the first somite is divided into two lobes, the distal margin of the anterior lobe being again subdivided. The tips of the abdominal pleura are blunt and directed ventrally. The anterior margin of the second pleuron has a large lobulated tooth in the basal part, its distal part is serrate. The posterior margin of the pleura of somites II and III, sometimes also of IV, is entire in the proximal half, serrate in the distal, in somite V, and sometimes also in IV, it is entirely serrate. The anterior margin of the pleura of somites III to V is entire, or obscurely serrate. The upper surface of the sixth abdominal somite shows low tubercles, its posterior margin is denticulate.

The hard part of the telson shows two pairs of tubercles. The anterior pair is placed in the submedian region, the tubercles of the posterior pair are wider apart and about as large as the anterior. The posterior margin of this calcified part has the inner of the two pairs of teeth rather narrow and blunt, they reach farther back than the outer, which are broader and about rectangular.

The anterior margin of the antennular somite is produced forward in each half to a blunt low tooth; between this tooth and the median line of the somite there usually are some incisions in the margin.

The anterior margin of the distal (sixth) segment of the antenna is almost straight and rectangularly placed on the inner margin. It bears five or six broad teeth with broadly rounded tops. The inner margin bears a single triangular tooth. The antero-internal angle of the fifth segment ends in two teeth, the inner of which bears a dorsal carina. The fourth segment reaches beyond the sixth. Its anterior margin bears six to 10 small teeth, the inner of which, or the next, is largest. The outer margin of the fourth segment bears five to nine teeth of irregular size; these teeth are usually small and look more like serrations. The dorsal surface of the segment bears a strong median oblique carina, no additional carinae or rows of tubercles are found on the outer half of the segment.

The anterior margin of the epistome is concave without a median incision.

The first pereopod is distinctly more robust than the second; the propodus bears no dorsal hairy fringe. The dactyli of P.1 and P.2 are naked, that of P.2 is much longer than either that of P.1 or P.3, but it is less than twice as long as that of P.4. The dactyli of P.3 to P.5 have an extremely short pubescence in the basal part and some longer hairs in the proximal part of the upper surface. The propodus of P.3 is not flattened and not or hardly broader than that of P.2 or P.4, it bears a dorsal fringe of hairs, which lacks in the other legs. No ventral hairy fringe is visible in the propodus of any of the legs. A dorsal hairy fringe is furthermore present on the carpus of P.3 to P.5, and on the merus of all legs. The outer surfaces of all segments of P.3 to P.5 bear longitudinal rows of short stiff hairs. P.1 and P.2 have the distal three segments naked. There are no hairy grooves on the propodus of any of the legs; such a hairy groove is present on the merus, though it often is indistinct.

The anterior margin of the thoracic sternum is V- or U-shapedly emarginate with a narrow incision in the middle. The oblique carinae running back and slightly inwards from the anterolateral teeth do not meet. In large specimens a median tubercle is present on the anterior margins of somites II to V of the sternum; each forms the

central point of a transverse row of smaller tubercles. The posterior margin of the sternum is tuberculate in the males, smooth in the females. The first pleopods of the male (implanted on the second abdominal somite) are well-developed, the following pleopods are rudimentary, the branches being mere buds; in some cases either the endopod or the exopod are somewhat leaf-shaped.

Size

Of the examined specimens cl. varied from 5 to 27 mm. In the juveniles cl. was 5 to 11 mm, in the males 13 to 25 mm (with more than half between 20 and 25 mm), in the non-ovigerous females cl. was 14 to 27 mm, most between 20 and 27 mm. In the ovigerous females cl. was 18 to 27 mm in more than half between 24 and 26 mm. Sheehy (1990) reported on specimens with cl. 24.5 to 28 mm.

Colour

A specimen from Shark Bay, Western Australia (WAM 94-66), showed remnants of the original colour pattern. The most conspicuous is a dark circular spot in the middle of the upper surface of the first abdominal somite. An irregular longitudinal dark band extends either side of abdominal somites I to III just above the base of the pleura, these bands are narrow on somite I, widen posteriorly, and join in the middle of somite III. They also extend onto the pleuron of abdominal somite II and on the posterior part of pleuron III. On the antennae a dark spot was seen in the inner distal part of segment VI and in the outer basal part of segment IV. A dark ring is seen slightly behind the middle of the propodus of P.3 to P.5.

Larvae

The larval development of this species has been studied by several authors: Ritz (1977) described the first to sixth phyllosoma stages. Ito & Lucas (1990) described and figured the complete larval development after material from off Townsville, Queensland. Barnett (1989) provided a description and figures of the last phyllosoma stage, while the nisto stage, taken from the plankton at

a depth of 20-0 m off Townsville, was described and figured by Barnett *et al.* (1986). Larvae were also discussed by Phillips *et al.* (1981), Phillips & McWilliam (1989) and McWilliam *et al.* (1995). Burton (1996) studied spermiomorphism of the species.

Genus *Antipodarctus* n. gen.

TYPE AND ONLY SPECIES. — *Scyllarus aoteanus* Powell, 1949 by present designation.

ETYMOLOGY. — A combination of the word antipodes (*anti* [Greek] = opposite; *pous, podos* [Greek] = foot) = those that live on the opposite side of the globe, and the generic name *Arctus* De Haan, 1849, a junior synonym of *Scyllarus* Fabricius, 1775.

DIAGNOSIS. — Carapace with cardiac, gastric, pre-gastric and rostral teeth; gastric lower than pregastric and two-topped; cardiac tooth also two-topped. Abdomen with arborescent pattern of narrow grooves; pleura ending in blunt tops. No median carina on the abdominal somites, but the median lobulated figure of somites II and III slightly elevated. Fourth segment of antenna with two oblique carinae a strong median one ending in the top of the segment and a shorter outer one ending in the lower of the teeth of the lateral margin. Thoracic sternum U-shaped incised anteriorly with two distinct and sharp submedian tubercles. Sternum itself with a pattern of short carinae and tubercles along the sides.

DISTRIBUTION. — The genus so far is only known from New Zealand waters.

REMARKS

It will be dealt with more extensively in a work in preparation by Dr John C. Yaldwyn.

Genus *Remiarctus* n. gen.

TYPE AND ONLY SPECIES. — *Scyllarus bertholdii* Paulson, 1875 by present designation.

ETYMOLOGY. — From *remus* (Latin = oar) and *Arctus* De Haan, 1849, a junior synonym of *Scyllarus* Fabricius, 1775; in reference to the oar-like widened propodus of P.2 and P.3.

DIAGNOSIS. — Midline of carapace with rostral, gastric and cardiac teeth; pregastric tooth absent. Abdomen without sharp median carinae, with distinct arborescent markings and a median lobulated figure. Fourth antennal segment with a single oblique dorsal

carina. Anterior margin of thoracic sternum truncated, and thickened, minutely incised in the middle, the incision ending posteriorly in a groove. Second and third leg with the propodus widened and flattened, wider than its merus or than the propodus of the fourth leg.

Remiarcus bertholdii (Paulson, 1875) n. comb.
(Figs 20-22)

Scyllarus Bertholdii Paulson, 1875: 97; 1961: 103.

Scyllarus bertholdii – Holthuis 1946: 94; 1991: 221, figs 417, 418. — Holthuis & Sakai 1970: 92. — Phillips *et al.* 1980: 69. — Chan & Yu 1986: 152, pl. 2, pl. 8 fig. B; 1993: 203, col. fig. — Sekiguchi 1987a: 331. — Sekiguchi & Tagawa 1987: 11, pl. 1. — Yamaguchi 1993: 588. — Yamaguchi & Baba 1993: 254, fig. 60. — McWilliam *et al.* 1995: 564. — Nguyễn Văn Chung & Phạm Thị Du 1995: 103. — Chan 1998: 1043, 2 figs n.n. — Franssen *et al.* 1998: 66. — Naiyanetr 1998: 44. — Wang *et al.* 1998: 447, 448, fig. 5.

Scyllarus Arctus var. [third variety] – De Haan 1841: 154.

Scyllarus Haanii Berthold, 1845: 45; 1846: 23, pl. 2 figs 2, 3. — De Man 1916: 74, pl. 2 fig. 10 [non *Scyllarus haanii* De Haan, 1841].

Scyllarus sinensis (nom. nud.) White, 1847: 67.

?*Scyllarus arctus* p.p. Gibbes, 1850: 192.

Scyllarus arctus var. c – Herklots 1861: 142.

Scyllarus bertholdii – Liu 1963: 231. — Bruce 1966: 20. — Burukovsky 1974: 107; 1983: 151. — Phillips *et al.* 1981: 418. — Huang 1994: 564.

TYPE MATERIAL. — Lectotype: dry ♀ 19 mm (RMNH D 5518); ? paralectotype: dry ♀ 21 mm, Mare Indicum (MS) (see Material examined).

TYPE LOCALITY. — China.

MATERIAL EXAMINED. — **China.** De Haan's Specimen of *Scyllarus arctus* var. [third variety] and lectotype of *Scyllarus haanii* Berthold, 1845 and of *S. bertholdii* Paulson, 1875, 1 dry ♀ 19 mm (RMNH D 5518). — 8 dry specimens 16-19 mm (syntypes of *Scyllarus sinensis* White, 1847 nom. nud.) (BM). — As "*Scyllarus nov. spec.*" with note "nächstverwandt mit *arctus*, passt genau weder zu *vitiensis* Dana noch zu *sordidus* Stimps", 2 dry specimens (ZMB). — F. J. Pictet leg., 6 dry specimens (MG). — China (probably) from MCZ, 1 dry ♀ 16 mm (USNM). — Canton, 1 dry specimen 16 mm (probably syntype of *Scyllarus sinensis* White, 1847, nom. nud.) (BM). — Chile (probably error for China), A. Plagemann coll., 2 ♀ ♀ 18 mm (ZMH). — "Mare Indicum", 1 dry ♀ 21 mm, tl.

(including antennae) 68 mm (MS). The Senckenberg Museum received this specimen on permanent loan from Zoologisches Museum Göttingen. It is an old dry specimen and might even be Berthold's type of the present species in which the label "China" was changed to "Mare Indicum". In the old times museum authorities often considered the accuracy of locality labels not very important. In the Leiden Museum for instance the very accurate locality information given by F. C. Cantraine for the material that he collected in various places on the coasts of Italy and Dalmatia was ignored and practically all his material now carries only the label "Mer Méditerranée". It is interesting therefore that Berthold (1846: 17) mentioned that H. Milne Edwards included China in the "région carcinologique de l'Inde". The size of the specimen agrees rather well with the measurements given by Berthold for a female cl. 9" (= 18 mm), tl. 2"4" (= 58 mm); tl. here includes the antennae. However this may be, even though the type status of the specimen cannot be proved, it is most likely.

Taiwan. Su-Aou, I-Lan County, 16.III.1985, T. Y. Chan leg., 2 ov. ♀ ♀ (RMNH D 39322).

South China Sea. Off Hong Kong, RV *Albatross*, stn 5302, 21°42'N, 114°50'E, 69 m, soft grey mud, 9.VIII.1908, 1 ♂ 12 mm (USNM). — Stn 5304, 21°46'N, 114°47'E, 62 m, blue mud, 9.VIII.1908, 1 ♂ 14 mm, 3 ov. ♀ ♀ 14-15 mm (USNM). — Stn 5305, 21°54'N, 114°46'E, 68 m, soft grey mud, 24.X.1908, 1 ♂ 14 mm, 2 ♀ ♀ 13 and 15 mm (USNM).

Hong Kong, 1 ov. ♀ 14 mm (BM).

S of Hong Kong, RV *Cape St. Mary*, stn 806/3/8, 21°43'N, 114°00'E-21°47'N, 114°05'E, shrimp trawl, 42 m, 27.VI.1958, A. J. Bruce leg., 1 ov. ♀ 17 mm (RMNH D 24944). — Cruise 2/63, stn 3, 5, 17, trawl 5, 7, 9, 21°42.0'N, 114°35.0'E-21°42.0'N, 114°38'36"E-21°42.0'N, 114°35.0'E-21°42.0'N, 114°35'36"E and 21°05.0'N, 114°45'30"E-21°03'18"N, 114°45'36"E, Granton trawl, 66, 66 and 91 m, mud, 30-31.VIII.1963, 6 ♂ ♂ 10-14 mm, 4 ♀ ♀ 13-15 mm (RMNH D 24946). — Cruise 9/65, stn 18, trawl 371, 21°04.5'N, 114°30.0'E-21°05.0'N, 114°30.5'E, 84 m, mud and coarse sand, 25.VII.1965, 1 ♀ 6 mm (RMNH D 24934).

SW of Hong Kong, RV *Cape St. Mary*, 21°02.5'N, 113°32.0'E, 25.VI.1958, A. J. Bruce leg., 1 ♂ 13 mm, 1 ov. ♀ 17 mm (RMNH D 24931). — Cruise 7/63, stn 37, trawl 104, 20°48.0'N, 112°31.5'E-20°44.0'N, 112°31.0'E, 73-90 m, sandy mud, 8.XII.1963, 1 ♂ 17 mm (RMNH D 24932).

Off Hainan, RV *Cape St. Mary*, cruise 3/65, stn 6, trawl 288, 20°53.0'N, 112°31.0'E-20°49.0'N, 112°39.0'E, 59-62 m, coarse mud, 12.II.1965, A. J. Bruce leg., 1 ♀ 13 mm (RMNH D 24941). — Cruise 3/65, stn 9, trawl 289, 20°38.0'N, 112°31.0'E-20°33.3'N, 112°36.0'E, 62-66 m, sandy mud, 13.II.1965, 1 ♂ 13 mm (RMNH D 24935). — Cruise 3/65, stn 76, trawl 317, 19°57.2'N,

112°09.5'E-19°58.5'N, 112°04.8'E, 93-95 m, muddy sand, 19.II.1965, 2 juv. 5 and 7 mm (RMNH D 24936). — Cruise 5/63, stn 8, trawl 63, 17°30.0'N, 107°30.0'E-17°33.5'N, 107°28.2'E, 70 m, mud, 6.X.1963, 1 ♂ 7 mm (RMNH D 24938). — Cruise 4/63, stn 31, trawl 34, 17°18.8'N, 107°42.9'E-17°18.5'N, 107°46.8'E, 73 m, mud, 10.IX.1963, 1 ♂ 9 mm (RMNH D 24937). — Cruise 4/63, stn 25, trawl 30, 17°18.3'N, 107°42.2'E-17°17.0'N, 107°44.3'E, 73 m, mud, 6.IX.1963, 6 juv. 6-8 mm (RMNH D 49573). — Cruise 4/63, stn 26, trawl 31, 17°17.9'N, 107°46.2'E-17°14.5'N, 107°46.1'E, 73 m, mud, 6.IX.1963, 1 ♂ 9 mm, 5 ♀♀ 7-12 mm (largest ov.) (RMNH D 24940). — Cruise 4/63, stn 24, trawl 29, 17°14.2'N, 107°41.1'E-17°18.9'N, 107°41.7'E, 73 m, mud, 5.IX.1963, A. J. Bruce leg., 1 ov. ♀ 12 mm (RMNH D 21003). — Cruise 4/63, stn 32, trawl 35, 17°17.6'N, 107°47.1'E-17°13.8'N, 107°48.7'E, 18 m, mud, 10.IX.1963, A. J. Bruce leg., 2 ♀♀ 10 and 11 mm (largest ov.) (RMNH D 24943). — Cruise 4/63, stn 42, trawl 40, 17°16.7'N, 107°41.7'E-17°16.6'N, 107°45.8'E, 73 m, mud, 12.IX.1963, A. J. Bruce leg., 1 ♂ 10 mm, 2 ♀♀ 11 and 13 mm (RMNH D 24933). — Cruise 4/63, stn 33, trawl 36, 17°13.8'N, 107°48.7'E-17°13.8'N, 107°46.6'E, 73 m, mud, 10.IX.1963, 1 ♂ 11 mm, 1 ♀ 10 mm (RMNH D 24939). — Cruise 4/63, stn 57, trawl 51, 17°13.8'N, 107°41.5'E-17°16.3'N, 107°42.8'E, 73 m, mud, 14.IX.1963, 1 ♂ 8 mm, 2 ♀♀ 9 and 11 mm (RMNH D 24942).

Vietnam, *Naga* Expedition, off Cap Anhea, S 10, stn 61-0045, 15°41.0'N, 108°39.3'E, beam trawl, 31 m, mud and sand, 24.I.1961, 1 ♂ 10.5 mm (RMNH D 30997). — N of Nhatrang, S 4, stn 60-0211, 15°41.0'N, 108°41.0'E, beam trawl, 37 m, sand and mud, 27.II.1960, 4 ♂♂ 11-14 mm, 1 ov. ♀ 16 mm (RMNH D 30996).

Philippines. RV *Albatross*, no data, 1 ov. ♀ 14 mm (USNM). — Stn 5105, Sueste Point Light, S 58°W 1.90 miles, 14°43'55"N, 120°12'50"E, 46 m, 8.I.1908, 1 ♂ 10 mm (USNM). — Stn 5376, Tayabas Light (outer), N 53°W 18.7 miles, 13°42'50"N, 121°51'30"E, 165 m, grey mud and sand, 2.III.1909, 1 juv. ♂ 7 mm (USNM). — Stn 5442, San Fernando Point Light, N 39°E 8.4 miles, 16°30'36"N, 120°11'06"E, 82 m, coral sand, 10.V.1909, 3 ♂♂ 9-12 mm, 4 ♀♀ 9-14 mm (USNM). — Stn 5477, Tacub Point, Leyte, S 87°W 11 miles, 10°44'45"N, 125°12'30"E, 88 m, grey mud, 29.VII.1909, 2 ♀♀ 11 and 12 mm (USNM).

MUSORSTOM 1, stn 56, off Lubang Id, 13°53.3'N, 120°10.7'E, 129-134 m, 26.III.1976, 1 ♂ 15 mm, 1 juv. 6 mm (MNHN-Pa 1050). — Stn 57, off Lubang Id, 13°52.7'N, 120°13.5'E, 96-107 m, 26.III.1976, 3 ♀♀ 16-17 mm (MNHN-Pa 1068, RMNH D 39323). — Stn 73, off mouth of Manila Bay, 14°16.6'N, 120°31.8'E, 70-76 m, 28.III.1976, 1 dry ♀ 9 mm (MNHN-Pa 1060).

MUSORSTOM 2, stn 6, off Lubang Id, 13°56.4'N, 120°22.3'E, 136-152 m, 20.XI.1980, 2 ♂♂ (MNHN).

MUSORSTOM 3, stn CP 121, S of Mindoro, 12°08'N, 121°18'E, 73-84 m, 3.VI.1985, 1 ♂ 11 mm (MNHN-Pa 1090). — Stn CP 141, N of Panay, 11°45'N, 122°45'E, 40-44 m, 6.VI.1985, 6 ♂♂ 10-13 mm, 2 ov. ♀♀ 11 and 12 mm, 2 non-ov. ♀♀ 12 mm (MNHN-Pa 1074; RMNH D 48742).

Visayan Sea, Smithsonian Philippine Expedition, *Sting Ray V*, stn T3, 11°27'45"N, 123°23'45"E, otter trawl, 37 m, 4.VI.1978, 1 ♂ 17 mm (USNM). — Stn T4, 11°28'42"N, 123°45'45"E, otter trawl, 70 m, 5.VI.1978, 5 ♂♂ 11-15 mm, 8 non-ov. ♀♀ 12-19 mm, 7 ov. ♀♀ 16-21 mm (USNM). — Stn T8, 11°37'40"N, 123°55'45"E, otter trawl, 75 m, 5.VI.1978, 1 ♂ 18 mm, 1 ov. ♀ 20 mm (USNM). — Stn T15, 11°37'07"N, 123°54'45"E, otter trawl, 91 m, 6.VI.1978, 1 ov. ♀ 19 mm (USNM). — Stn T23, 11°22'15"N, 123°51.0'E, otter trawl, 80 m, 8.VI.1978, 2 ♂♂ 13 and 14 mm, 1 ♀ 13 mm.

Thailand. Phaaphun, Nakhon Si Thammarat province, 27.III.1982, P. Naiyanetr leg., 1 ov. ♀ 12 mm (PN). — Gulf of Thailand, *Galathea* Expedition, stn 381, 7°00'N, 103°18'E, 55 m, 8.VI.1951, 1 juv. 6 mm (ZMC).

Malaya. In front of Penang Id, the Fifth Thai-Danish Expedition, 26.I.1966, P. Naiyanetr leg., 1 ♂ 6 mm (PN).

Indonesia. S China Sea, NE of Riouw Archipelago, 1°45'N, 106°40'E, 64 m, 1869, capt. Andréa leg., 1 juv. 5 mm (UZM).

Macassar Strait, CORINDON, stn 205, 1°07.8'S, 117°18.7'E, 49 m, 30.X.1980, 1 ov. ♀ 12 mm (MNHN-Pa 1067). — Stn 208, 0°14.6'S, 117°52.0'E, 150 m, 31.X.1980, 1 ♂ 14 mm, 2 ♀♀ 15 and 17 mm (MNHN; RMNH D 39324).

Sunda Strait, RV *Brak*, stn 79, 6°28'S, 105°38'E, Sigsbee trawl, 47 m, sand, 29.VII.1922, Th. Mortensen leg., 1 ♂ 7 mm (UZM).

Java Sea, *Galathea* Expedition, stn 454, 5°23'S, 116°02'E, 60 m, coralline clay, 25.VIII.1951, 1 juv. 6 mm (UZM). — Stn 455, 5°32'S, 112°41'E, 66 m, coralline bottom, 26.VIII.1951, Th. Mortensen leg., 1 ♂ 10 mm (UZM).

Java Sea, RV *Dog*, stn 5, 8°23'S, 114°29'E, 70 m, sand, 5.IV.1929, Th. Mortensen leg., 1 juv. 6 mm (UZM). — Stn 19, 7°25'S, 114°30'E, trawled, c. 100 m, mud, 11.IV.1929, Th. Mortensen leg., 1 juv. 6 mm (UZM).

Teluk Dodinga, Halmahera, Moluccas, Mariel King Memorial Expedition, stn HDI/2-3, fine mud, 20.V.1970, 1 ♂ 9 mm (WAM).

Jamdena Strait, E of Wotap Id, Tanimbar Group, Mariel King Memorial Expedition, stn TJ III/1-2-3, 64-73 m, mud, 23.V.1970, 3 juv. 5-6 mm (WAM).

Sapeh Strait, Lesser Sunda Ids, *Siboga* Expedition, stn 49a, 8°23.5'S, 119°4.6'E, 70 m, bottom coral and shells, 14.IV.1899, 1 juv. (ZMA).



FIG. 20. — *Remiarctus bertholdii* (Paulson, 1875) n. comb., Philippines, RV *Albatross*, stn 5442, ♀ (USNM); **A**, dorsal view; **B**, ventral view.

Australia. Northern Territory. Gulf of Carpentaria, Grote Eylandt, 30 m, 3.XI.1983, Clive Jones leg., 1 ov. ♀ 16 mm (RMNH D 39320). — Arnhem Bay, 18 m, sand and mud, V. Wells leg., 1 ♂ 6 mm (AM P 16397).

Western Australia. W of Northwest Cape, CSIRO, stn 173, 21°50'S, 113°46'E, beam trawl, 128-141 m, 5.X.1963, 1 ♂ 9 mm (WAM 361-64). — SW of Point Cloates, CSIRO, stn 187, 23°39'S, 113°11'E, beam trawl, 133 m, bottom with crinoids and starfishes, 27.X.1960, 1 ♀ 17 mm (WAM).

New Caledonia. BATHUS 1, stn DW 691, 20°35.30'S, 164°58.77'E, 227-250 m, 17.III.1993, 1 ♀ 18 mm (MNHN-Pa 1848).

Fiji Islands. N of Vanua Levu. BORDAU 1, stn CP 1402, 16°38'S, 179°36'E, 260-279 m, 25.II.1999, 1 ♂ 14 mm, 1 ♀ 19 mm (MNHN).

Bligh Water, N of Viti Levu. MUSORSTOM 10, stn CP 1322, 17°17.1'S, 177°47.9'E, 210-282 m, 7.VIII.1998, 16 ♂♂ 11-15 mm, 12 ♀♀ 11-21 mm (MNHN-Pa 1915; RMNH D 48743; USNM

1000670). — Stn CP 1328, 17°16.8'S, 177°50.4'E, 248-277 m, 7.VIII.1998, 2 ♂♂ 14 and 15 mm (MNHN-Pa 1849).

Locality unknown. Sir Joseph Banks coll., 1 dry specimen 15 mm; and without any data, 5 dry specimens 18-20 mm (possibly syntypes of *Scyllarus sinensis* White, 1847 nom. nud.) (BM). — “no.221”: 3 dry specimens 16-17 mm (ANS).

Doubtful localities. Marseille, France, 2 ♀♀ (1 ov.) 14 mm [“ces deux exemplaires trouvés dans un bocal avec de nombreux ex. *Sc. arctus* pris à Marseille; ancienne collection” (MNHN)]. — India (“118 *Scyllarus arctus* Fabr. *fide* L.R. Gibbes”): 2 dry specimens 12 and 19 mm (ANS). Judging by the note on the label, these possibly are the specimens that Gibbes (1850: 192) listed as *Scyllarus arctus* from the “Philadelphia Cabinet” (see also previous paragraph Locality unknown).

DISTRIBUTION. — The species is known from the East China Sea southward to Indonesia, Australia, New

Caledonia and the Fiji Islands. Apart from a very dubious record from "India" the species has not been found in the western Bay of Bengal and farther west, while it proves to be quite common in the Philippines and the East China Sea and especially the South China Sea. The early records (De Haan 1841; Berthold 1845; White 1847) all are just from "China" without more details. Also recent records (Huang 1994; Wang *et al.* 1998) reported it from the Chinese coasts. The first more detailed localities are provided by De Man (1916), who mentioned the species from three places (NE of Ceram, and from Sape Strait and Madura Bay, the last two in the Lesser Sunda Islands) in Indonesia. Bruce (1966) mentioned the species from three stations in the South China Sea, without stating the actual positions; this material is included in the present paper. Chan & Yu (1986, 1993) mentioned the species from various localities off Taiwan. Sekiguchi & Tagawa (1987) provided the northernmost record: East China Sea, 28°16.8'N, 122°57.0'E, 77 m. Nguyễn Văn Chung & Phạm Thị Du (1995) listed it from Vietnam. Naiyanetr (1998: 44) listed the species from both coasts of Thailand: Nakhon Si Thammarat on the Gulf of Thailand and from Phuket Island in the Andaman Sea.

HABITAT. — The species has been found at depths between 18 and 260 (260–279) m, mostly between 35 and 100 m, with the peak at around 70 m. It clearly prefers a soft bottom: at the stations from which the species was reported, the bottom was mostly mud (soft mud, fine mud, soft grey mud, grey mud, blue mud, coarse mud, sandy mud) also mud and sand, grey mud and sand, mud and coarse sand, sand and mud, muddy sand, sand, fine grey sand, coral sand, coralline clay, coral and shells, coarse sand and shells, hard coarse sand, crinoids and starfish.

DESCRIPTION

The rostrum is rather broad, the anterior margin is slightly bilobed; it is constricted behind the top. On the dorsal surface of the rostrum there is a sharp rostral tooth, which sometimes is reduced to a distinct tubercle. Apart from this rostral tooth, there is only one other tooth in the median line of the carapace, namely the gastric tooth, which lies between the rostral tooth and the cervical groove, somewhat closer to the former. Instead of the cardiac tooth there are two flattened rounded submedian tubercles just behind the cervical groove. There are several flattened tubercles in the median area of the carapace, both before and behind the cervical groove, forming rather indistinct longitudinal rows. The branchial

carina is deeply, narrowly and obliquely interrupted by the cervical groove. No tubercle is present in the gap. Anteriorly the carina ends in two teeth, the anterior of which forms the blunt end of the inner orbital margin; the posterior tooth is sharp, distinct and more conspicuous than the anterior. Behind the posterior tooth the carina bears several very inconspicuous tubercles. The posterior branchial carina ends anteriorly in a sharp tooth; the carina itself is not very conspicuous, being obscured by the pubescence of the carapace; it bears a double row of about nine to 14 tubercles, posteriorly an additional row is added. The anterior and posterior submedian carinae are represented each by an irregular group of tubercles. The intermediate row consists of five to seven tubercles. The lateral margin of the carapace shows three sharp teeth, one on the antero-lateral angle, one immediately behind the cervical groove, and the third behind the postcervical groove. There are two anterolateral and two mediolateral tubercles, all rather inconspicuous; the posterolateral tubercles are eight to 10 in number and rather broad. Between the lateral and posterior branchial carinae a few tubercles are present. The intercervical ridge is replaced by a group of tubercles. There are several post-orbital tubercles. The posterior marginal groove is rather deep and narrow; before it there are two or three transverse rows of tubercles, behind it there are three or four such rows. The posterior margin of the carapace is shallowly incised in the middle.

The first abdominal somite has a complete transverse groove extending over its full width; before this groove there is a second, similar, groove; behind it the segment shows a complicated arborescent pattern of oblique, sometimes branched, grooves. The anterior half of each of the four following somites shows two complete transverse grooves, each with a row of very short hairs. The posterior halves of these somites show no median carina, but the usual arborescent pattern of grooves, of which the transverse groove is the most conspicuous; the median figure of the arborescent pattern is lobulate. The posterior margin of somites I to III is deeply incised in the middle, in the following somites there is no such incision



FIG. 21. — *Remiarctus bertholdii* (Paulson, 1875) n. comb., Philippines, *Sting Ray V*, stn T4, lateral view.

or at the most a trace of it. The pleura of the first abdominal somite are short and bilobed. In the following three somites the pleura end in a slender, sharp, somewhat posteriorly directed tooth. The top of the pleura of the fifth somite is bluntly truncate. The margins of the pleura are entire or indistinctly serrate. Apart from a median groove the pleura show squamose tubercles, in the pleura of somites III to V some of these tubercles are placed on a longitudinal ridge. Abdominal somite VI shows tubercles of various size; its posterior margin, like that of the fifth somite is entire. The hard part of the telson bears several squamiform tubercles and ends in four posteriorly directed teeth, all of which are acute and are of about the same size.

The anterior margin of the antennular somite bears no teeth; each half is slightly concave in the external, convex in the internal half.

The last (sixth) segment of the antenna is rather narrow, its distal margin is convex and bears five rather slender teeth, which gradually taper

to an acute tip; the inner margin of the segment bears one small triangular tooth, which in its basal part shows an additional denticle. The antero-internal angle of the fifth segment bears a sharp tooth. The anterior margin of the fourth segment shows a single very strong triangular tooth in the inner part, the rest of the margin is unarmed; the outer margin of the segment bears two teeth (not including the apical tooth); the dorsal surface of the segment shows a strong straight oblique carina, no additional ridges or tubercles are present in the outer half of the surface.

The anterior margin of the epistome is slightly and evenly concave without a median incision.

P.1 is more robust than P.2. The dactyli of the pereopods have a very short velvety pubescence in the basal part; in addition to this pubescence, the dactylus of the third leg bears a dorsal fringe of hairs. The dactylus of P.2 is slightly longer than either that of P.1 or P.3, but it is shorter than that of P.4, which is the longest of all; in the

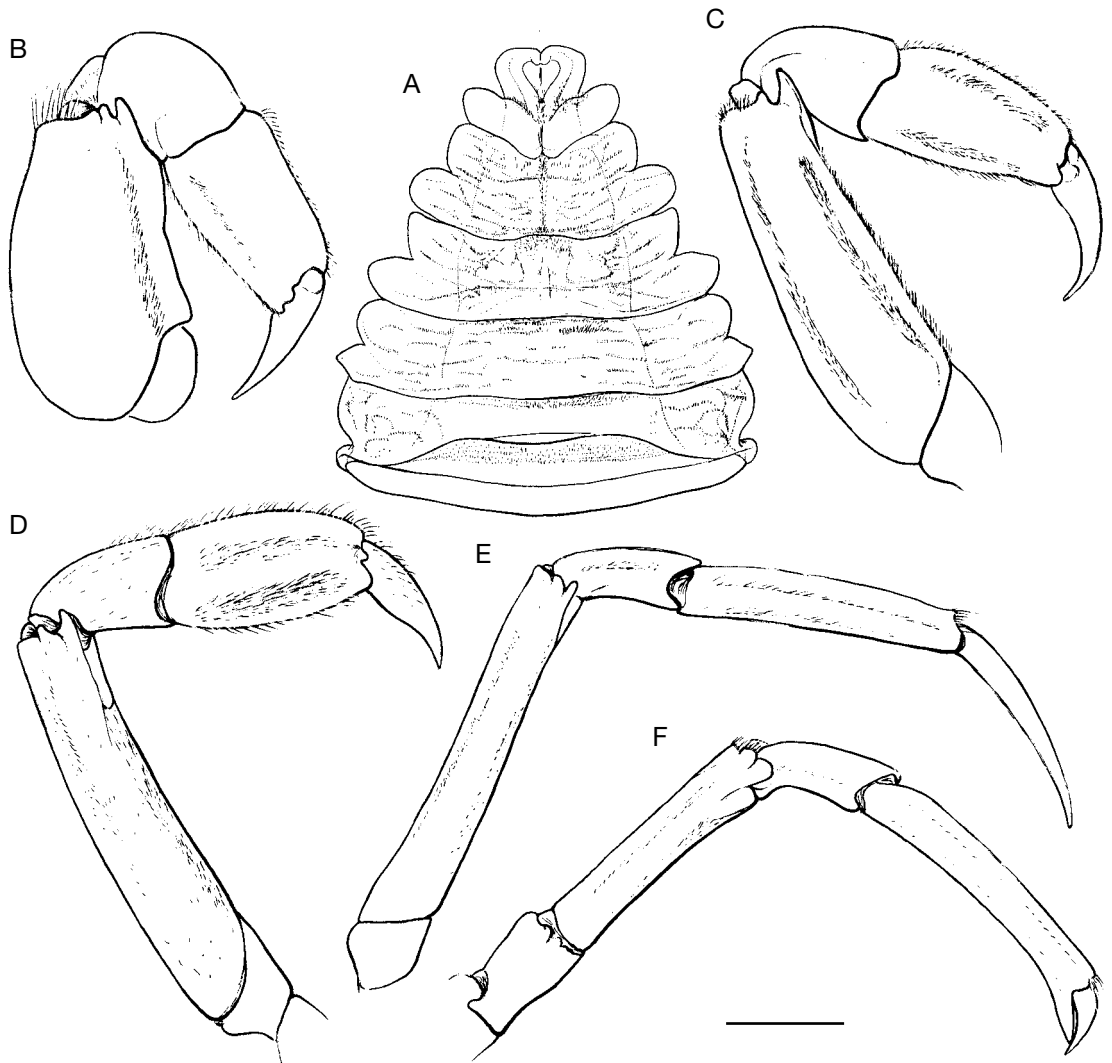


FIG. 22. — *Remiarctus bertholdii* (Paulson, 1875) n. comb.; **A**, New Caledonia, BATHUS 1, stn DW 691, ♀ (MNHN-Pa 1848), sternum; **B-F**, S of Hong Kong, ♀, pereopods 1 to 5. Scale bar: 2 mm.

males the dactylus of P.5 is almost as long as that of P.4. The lower margin of the propodus of P.1 to P.3 bears a fringe of short hairs; this fringe is absent in P.4 and P.5. The propodus of P.1 to P.3 is laterally compressed, broadened and carries a dorsal fringe of hairs, which is especially distinct in P.3; the propodi of P.4 and P.5 are cylindrical and slender. The outer surface of the propodus of P.1 has one, that of P.2 to P.5 has two longitudi-

nal hairy grooves. The lower surface of the merus of these legs is pubescent (most conspicuously so in P.2) and a short pubescent groove is visible in the upper part of the outer surface of the merus. The anterior margin of the thoracic sternum is truncate with a narrow incision in the middle, which posteriorly continues in a median groove. The anterior margin is ridge-like swollen and from either anterolateral angle a carina extends

posteriorly and medially, the two carinae forming together a V. The rest of the sternum is concave and shows no median tubercles. The posterior margin of the sternum is not tuberculate. The surface of the sternum shows rows of very short hairs. The first pleopods of the male (placed on abdominal somite II) are normal in shape. The following pleopods have the endopods rudimentary, while the exopods are laminate and fairly well-developed, but becoming smaller posteriorly.

Size

The examined material has the cl. between 5 and 21 mm. The largest males had cl. 17 mm, and most were between 9 and 14 mm. The largest female had cl. 21 mm and most were between 9 and 18 mm; the ovigerous females had cl. between 12 and 17 mm. Chan & Yu (1993) gave as maximum tl. 70 mm and the common tl. between 30 and 50 mm.

Colour

The most conspicuous colour feature of this species is the presence on the dorsal surface of the first abdominal somite of a large dark spot at the base of either pleuron, this spot extends some distance onto the second somite. These dark spots are often still visible in preserved material. Excellent coloured figures of fresh specimens have been published by Chan & Yu (1986: pl. 2, pl. 8 fig. B; 1993: 203). Their figures show the animal of a pale reddish brown colour with small dark reddish brown spots on the carapace and a larger spot of the same colour on the base of the anterolateral tooth. The fourth antennal segment has a darker spot in the posterolateral corner and a narrow dark line at the base of the apical tooth. The abdomen is rather even pale reddish brown becoming paler posteriorly with the fifth and sixth somite and the tailfan yellowish white. The two large spots, one on either side of the first abdominal somite, are dark reddish brown. The legs show the usual dark bands on merus, carpus and propodus, but they are quite light and inconspicuous.

De Man's (1916) description of the colour, evidently made after preserved material, calls it a

"[...] beautifully coloured species. The ground-colour of carapace and antennae is a yellowish olive-green, the tubercles and prominences are white, the hairs with which they are fringed, brown; the abdomen is of pale ground-colour, but the 1st tergum is marked [...] on each side, near the pleura, with a large round, wine-red fleck and with a few smaller ones on the posterior margin; the second and especially the third tergum are also wine-red coloured".

REMARKS

The specimen from China, that De Haan (1841) considered to be a variety of *Scyllarus arctus* (Linnaeus, 1758), was correctly identified by Berthold (1845: 45) as belonging to a new species of which Chinese material was available to him and which he named *Scyllarus haanii*. Berthold's and De Haan's specimens thus both are syntypes of Berthold's species. As pointed out above, Berthold's specimen almost certainly is the specimen labelled "Mare Indicum" in the Senckenberg Museum. De Haan's specimen is still in the Leiden Museum. The name *Scyllarus haanii* Berthold, 1845 is preoccupied by *Scyllarus haanii* De Haan, 1841, and therefore Paulson's (1875) replacement name *bertholdii* should be used.

Genus *Galearctus* n. gen.

TYPE SPECIES. — *Scyllarus timidus* Holthuis, 1960 by present designation.

OTHER SPECIES. — *Galearctus aurora* (Holthuis, 1982) n. comb.; *G. kitanoviriosus* (Harada, 1962) n. comb.; *G. rapanus* (Holthuis, 1993) n. comb.; *G. umbilicatus* (Holthuis, 1977) n. comb.

ETYMOLOGY. — From *galea* (Latin), helmet, and *Arctus* De Haan, 1849, a junior synonym of *Scyllarus* Fabricius, 1775; in reference to the helmet-like protrusion of the middle of the anterior margin of the thoracic sternum.

DIAGNOSIS. — Midline of carapace with rostral, gastric and cardiac teeth; pregastric tooth absent. Abdomen without sharp median carinae, with distinct arborescent markings and a median lobulated figure. Pleura of somites II to IV often ending in a sharp, posteriorly directed tooth. Fourth antennal segment with a single dorsal carina, without additional carinae. The

anterior margin of the thoracic sternum forwards produced beyond the anterolateral angles, the tip with a small median triangular incision, that ends in a groove.

P.3 with the propodus widened, broader than the merus or the propodus of P.2. Dactyli smooth without hairy fringes.

KEY TO THE SPECIES OF *GALEARCTUS* N. GEN.

Species dealt with in this paper are in bold.

1. Propodus of P.3 smooth, without hairy grooves on outer surface, rather narrow, being only slightly broader than that of P.2 2
- Propodus of P.3 distinctly wider than that of P.2, with two parallel, often hairy, grooves on the posterior surface 3
2. Anterior margin of the third antennal segment with two distinct teeth of about equal size *G. aurora* n. comb.
- Anterior margin of the third antennal segment with the outer of the two large teeth much larger than the inner *G. rapanus* n. comb.
3. Gastric tooth of carapace very high, its anterior height is distinctly more than half the distance between the anterior base of the gastric and the tip of the rostral teeth. Anterior half of dorsal surface of the abdominal somites with transverse grooves lined with hairs 4
- Gastric tooth not conspicuously higher than the other teeth on the midline of the carapace, its anterior height much less than half the distance between its anterior margin and the rostral tooth. Anterior half of the abdominal somites smooth or with an incomplete single hairy groove *G. kitanoviriosus* n. comb.
4. Anterior half of abdominal somites II to V smooth, at most with a single, rather indistinct, sometimes interrupted, transverse groove that bears a row of short hairs *G. timidus* n. comb.
- Anterior half of abdominal somites II to V with two distinct crenulated grooves that sometimes are connected with short longitudinal or oblique grooves *G. umbilicatus* n. comb.

Galearctus timidus (Holthuis, 1960) n. comb.
(Figs 23; 24; 67C-E)

Scyllarus timidus Holthuis, 1960: 150. — Burukovsky 1974: 107; 1983: 150. — Ritz 1977: 230, 237, fig. 8. — Phillips *et al.* 1980: 70. — Sekiguchi 1986a: 1290; 1987a: 331; 1987b: 415, 417. — McWilliam *et al.* 1995: 564. — Fransen *et al.* 1998: 68.

Scyllarus cultrifer – Holthuis 1946: 93, pl. 8 figs c-e [non *Arctus cultrifer* Ortmann, 1897].

?*Scyllarus martensii* – Debelius 1999a: 224, col. fig. n.n.; 1999b: 224, col. fig. n.n.; 2000: 224, col. fig. n.n.

Non *Scyllarus timidus* Tinker, 1965: 42, pl. 9. — M. W. Johnson 1971a: 83, figs 22, 23. — A. Michel 1971: 472. — Clarke 1972: 313-315 (= *Scyllarus aurora* Holthuis, 1982).

Non *Scyllarides tumidus* – Colin & Arneson 1995: 225, fig. 1071 (= *Biarctus vitiensis* (Dana, 1852) n. comb.).

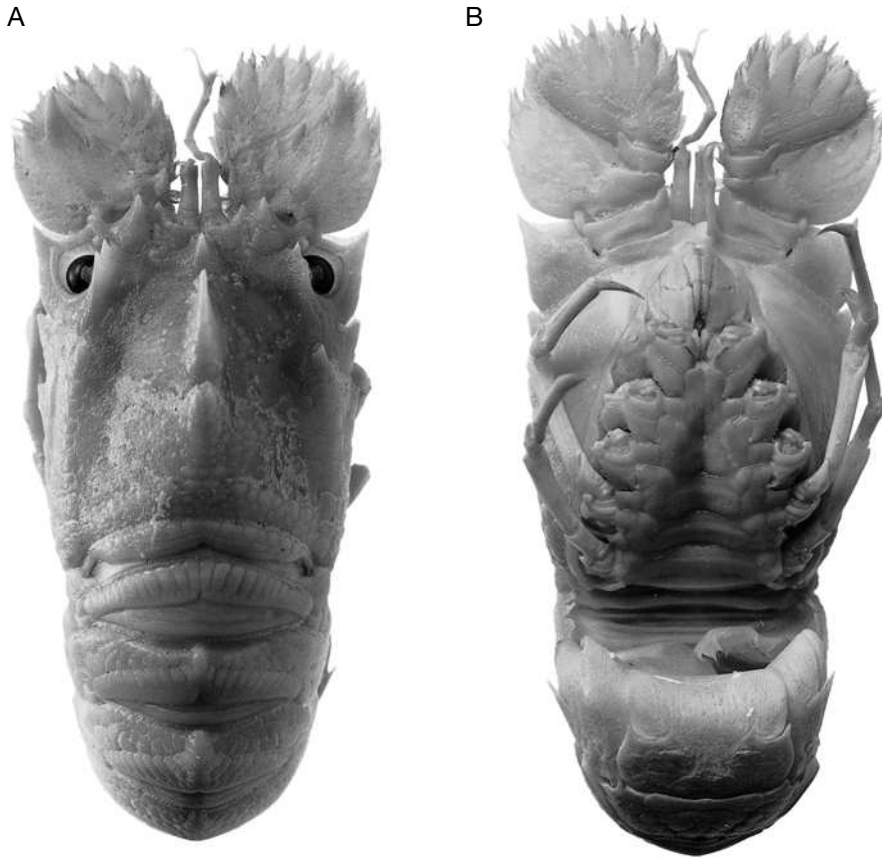


FIG. 23. — *Galearcus timidus* (Holthuis, 1960) n. comb., Japan (BM), ♂; **A**, dorsal view; **B**, ventral view.

TYPE MATERIAL. — Holotype: ♂ 18 mm, Snellius Expedition, stn 60 (RMNH D 6228, part); paratypes: 1 ♂ 12 mm, 3 ♀ 17–27 mm (RMNH D 6228, part).

TYPE LOCALITY. — Philippines. Sulu Archipelago. Basilan Strait, 6°58'N, 121°52.5'E, 72–80 m.

MATERIAL EXAMINED. — **South Africa.** Off Natal, IIOE, RV *Anton Bruun*, cruise 8, stn 394B, 29°27'S, 31°31'E, shrimp trawl, 68–70 m, 25.IX.1964, 2 ♂ 13 and 16 mm (USNM).

Madagascar. RV *Vauban*, stn CH 72, 25°11.2'S, 47°14.7'E, 85–90 m, 3.III.1973, 1 ♂ 23 mm (MNHN-Pa 587).

Japan. Tosa Bay, K. Sakai, 2 ♂ 19 and 20 mm (BM).

Taiwan. SW coast. Tong-Kong fishing port, Ping Tong County, about 300 m deep, from commercial trawler, 31.X.1995, T. Y. Chan leg., 1 ♂ 28 mm.

Philippines. MUSORSTOM 1, stn 56, 13°53.1'N, 120°08.9'E–13°53.3'N, 120°10.7'E, 129–134 m, 4 m beam trawl, 26.III.1976, 1 juv. 7 mm (MNHN-Pa 1854). — Stn 57, 13°53.1'N, 120°13.2'E–13°52.7'N, 120°13.5'E, 96–107 m, 4 m beam trawl, 26.III.1976, 2 juv. 7 and 8 mm (MNHN-Pa 1855). — Stn 60, W of Luzon, N of Lubang Id, 14°6.6'N, 120°18.2'E–14°5.2'N, 120°18.8'E, 124–129 m, 4 m beam trawl, 27.III.1976, 2 juv. 7 and 8 mm (MNHN-Pa 1853). MUSORSTOM 3, stn CP 134, N of Panay, 12°01'N, 121°57'E, 92–95 m, 5.VI.1985, 3 ♂ 17–23 mm, 1 ov. ♀ 23 mm, 1 juv. ♀ 13 mm (RMNH D 48745). Sulu Archipelago. Basilan Strait, Snellius Expedition, stn 60*, 6°58'N, 121°52.5'E, dredge, 72–80 m, 5.IX.1929, 2 ♂ 12 and 18 mm, 3 ♀ 17–27 mm (holotype [♂ 18 mm] and paratypes) (RMNH D 6228). — 9 miles 242° from Zal Id, southwest of Pearl Bank, FV *Pele*, c. 5°49'N, 119°42'E, 123–124 m, sponges, 22.II.1964, B. R. Wilson, 1 ♂ 15 mm, 2 ♀ 13 and 16 mm (WAM 358–64).

New Caledonia. BIOCAL, stn CP 84, 20°43'S, 167°01'E, 150-210 m, 6.IX.1985, 1 ♀ 15 mm (MNHN-Pa 1159).

MUSORSTOM 4, stn DW 151, Grand Passage, S of Surprise Atoll, 19°07.0'S, 163°22.0'E, 200 m, 14.IX.1985, 1 ♂, 14 mm (MNHN-Pa 1157). — Stn 226, SW Île des Pins, 22°47.2'S, 167°21.6'E, 390 m, 30.IX.1985, 1 ♂ 12 mm (MNHN-Pa 1152).

LAGON, stn 537, lagon Nord, 19°07'S, 163°22'E, 200 m, 6.III.1985, 1 ov. ♀ 20 mm (MNHN-Pa 1192).

Lagon, Passe Coco, RV *Dar-Mad*, 22.IV.1986, 1 ♂ 31 mm (MNHN-Pa 1276).

BATHUS 2, stn DW 715, 22°39.42'S, 167°10.99'E, 202-227 m, 10.V.1993, 2 ♀ ♀ 19 and 22 mm, 1 nisto 8 mm (USNM 1000667).

HALIPRO 1, stn 851, off east coast, 21°43'S, 166°37'E, 314-364 m, 19.III.1994, 2 ♂ ♂ 7 and 8 mm, 1 ♀ 13 mm, 1 juv. 6 mm (RMNH D 48744).

LITHIST, stn CP 17, Banc Jumeau Ouest, 23°40.8'S, 168°00.8'E, 247-281 m, 12.VIII.1999, 1 ♂ 8 mm (MNHN-Pa 1889).

Vanuatu. MUSORSTOM 8, stn CP 1018, 17°52.88'S, 168°25.08'E, 300-301 m, 27.IX.1994, 1 ♂ 11 mm (photographed, MNHN-Pa 1852). — Stn CP 1077, 16°04.00'S, 167°06.09'E, 180-210 m, 5.X.1994, 1 ♀ 17 mm (photographed, MNHN-Pa 1851). — Stn CP 1133, 15°38.83'S, 167°03.06'E, 174-210 m, 11.X.1994, 1 ♂ 15 mm (MNHN-Pa 1850).

DISTRIBUTION. — The type locality is Basilan Strait, Philippines, 6°58.0'N, 121°52.5'E. The range of the species includes South Africa, Madagascar, Japan, the Philippines, New Caledonia and Vanuatu. Larvae have been reported from S Queensland, Australia (Ritz 1977). Dr Chan (pers. comm.) informed me that the specimen from Salamaua Peninsula, Papua-New Guinea, figured as *Scyllarus martensii* by Debelius (1999a, b, 2000) is most likely the present species; Debelius' small photograph of the anterior part of a specimen from Sydney cannot be identified.

HABITAT. — The species was taken from depths of (70-)80 to 390 m.

DESCRIPTION

The rostrum is broad and constricted at its base, with a median anterior incision. Dorsally it bears a strong and sharp rostral tooth, which reaches beyond the anterior margin of the rostrum. There is no pregastric tooth, but the gastric tooth is very large and high, it is laterally compressed and sharply triangular in outline. Its anterior height is more than half the distance between its base and the anterior margin of the rostrum; in

the specimen from Taiwan it is much higher, being almost as high as the length of that distance. From its single tip the gastric tooth slopes gradually backwards towards the cervical groove; the dorsal margin is about straight, slightly convex, or even slightly concave. This margin bears seven to 10 broad squamae, which are most distinct posteriorly. The cardiac tooth, situated immediately behind the cervical groove, is distinct but small, being about as large as the rostral tooth. It ends into two sharp triangular teeth situated side by side. It is followed by about eight to 12 double submedian, and a few single median squamae.

The branchial carina is rather widely interrupted by the cervical groove; no tubercle is found in the gap. Anteriorly the branchial carina ends in two sharp and strong teeth of about equal size, which are placed on the distal inner part of the orbital margin. Behind the posterior of these teeth there are two diverging carinae, each with about eight indistinct squamiform tubercles. The posterior branchial carina ends anteriorly in a sharply pointed tooth, behind which there is a row of nine to 12 squamiform tubercles; this row is double anteriorly, treble posteriorly.

At each side of the posterior postrostral carina, in place of the posterior submedian carina there is an irregular group of about nine to 12 squamae, which merges with the squamae of the postrostral carina itself. The intermediate row consists of six tubercles, while two additional tubercles are placed near the mesial side of the posterior branchial carina. The anterior submedian carina consists of a group of three or four larger and four or five smaller squamiform tubercles.

The lateral margin of the carapace ends in a sharp and strong anterolateral tooth, followed by four or five inconspicuous squamiform tubercles. The cervical incision is deep and wide. There is one strong and sharp mediolateral tooth followed by about four inconspicuous squamiform tubercles. The posterolateral margin ends in a strong, sharp tooth, behind which there are nine blunt but distinct squamiform teeth. The intercervical ridge bears two broad and blunt squamiform teeth which sometimes are divided in two; a small tubercle is situated some distance mediad of the

ridge. A postorbital tubercle is present, it almost merges with the postorbital ridge. The outer orbital angle ends in a small sharp tooth. The marginal groove along the posterior margin of the carapace is deep and rather wide. Before it there are two or three transverse rows of flattened tubercles; behind it are two or three rows of smaller tubercles, some of which may be fused; the rows are separated by transverse grooves. The posterior margin of the carapace has a distinct, though blunt and rather shallow median incision. The first abdominal somite has a complete transverse groove extending over its full width. The anterior half of the somite before the groove is smooth or with two small submedian pits. Behind the groove there are 23 to 27 longitudinal grooves, some of which are forked posteriorly; the median groove sometimes shows side branches. The following abdominal somites bear no median longitudinal carina, but in the second and third somites the median area may be slightly elevated. The anterior half of somites II to V bears a transverse ciliated groove, which is either uninterrupted or only slightly interrupted in somites II to IV, distinctly interrupted in somite V. Before this groove traces of a second ciliated groove may be seen; this second groove is very incomplete in somites II and IV and lacks in somite V. The posterior half of somites II to VI have the usual arborescent sculpturation. The median figure of this pattern is slightly elevated and has deeply lobulated margins. The posterior margin of somites I to III are deeply and narrowly incised in the middle; in somite IV this incision is slightly wider. In the fifth somite the posterior margin is not or very inconspicuously incised, in somite VI there is no median incision and the posterior margin is slightly produced in the middle.

The pleura of somite I are small and bilobed, those of somites II to IV are large and end in a sharp posteriorly curved point; those of somite V end in a blunt downward directed angle. The anterior margins of the pleura are indistinctly serrate, the posterior margins are entire. The arborescent markings of the abdominal somites are also found on the pleura and in the basal part of

the telson. The four teeth at the end of the hard part of the telson are of about equal size, they are well-developed and sharply pointed, the outer may be slightly longer than the inner.

The anterior margin of the antennular somite shows two short, blunt, often indistinct teeth near the lateral ends; in the middle of the margin an incision is visible.

The distal margin of the last (sixth) segment of the antenna is slightly convex and bears five teeth; the inner four of these gradually narrow towards the top, to rather suddenly end in a slender tooth; the fifth (outer) tooth is truncate; the inner margin of the segment bears one tooth. The fifth antennal segment bears two sharp teeth in the upper part of the distal margin; the inner of these bears a dorsal carina. The anterior margin of the fourth segment bears two distinct teeth (or one distinct and a small tooth) in the inner half, while the outer margin bears two large teeth (the apical tooth not included); the inner margin of this segment bears a single sharply pointed carinated tooth; a distinct oblique carina extends over the full length of the segment, from the base to the apical tooth, no additional carinae are present. The third antennal segment is provided with two strong teeth, the outer of which is the stronger.

The anterior margin of the epistome is incised in the middle, laterally of this incision the margin is convex, ending in a bluntly pointed anterolateral tooth, and may become somewhat concave before reaching that tooth.

P.1 is far more robust than P.2. The dactylus of P.2 is slightly longer than either those of P.1 or P.3, while the dactylus of P.4 is again slightly shorter than that of P.3. None of the dactyli shows a hairy fringe. A dorsal fringe of short hairs is present on the propodus and the distal part of the carpus of P.3, but not in the other legs; no ventral fringes are present in any of the legs. The posterior surface of the propodus of P.3 shows two wide longitudinal grooves filled with short hairs; one similar but shorter and narrower groove may be present on the propodus of P.4; the propodi of P.1, P.2 and P.5 are smooth. The propodus of P.3 is much higher and more compressed

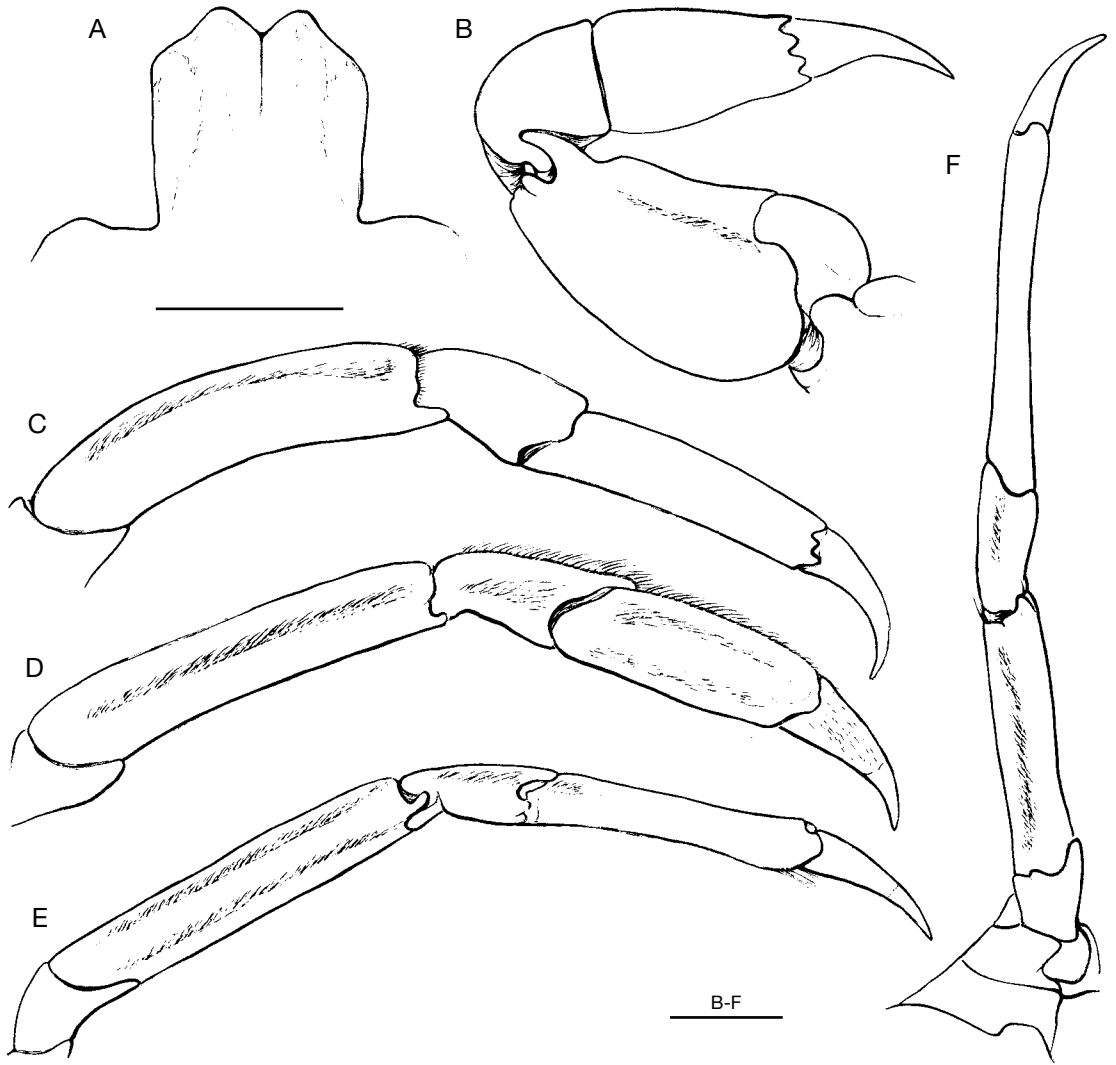


FIG. 24. — *Galearctus timidus* (Holthuis, 1960) n. comb.; **A**, Japan (BM), ♀, anterior part of thoracic sternum; **B-F**, New Caledonia, Passe Coco, ♂, pereopods 1 to 5. Scale bars: A, 2 mm; B-F, 4 mm.

than that of any of the other legs; its distoventral angle is rounded and shows no tooth. In the females and juveniles the propodus of P.3 is slightly less broadened than in the males. The posterior surface of the carpus of P.3 to P.5 (sometimes also of P.2) shows a longitudinal hair-filled groove. Such a groove is also present on the posterior and lower surface of the merus of P.2 to P.5.

The anterior part of the thoracic sternum is forward produced. The anterior margin shows a distinct triangular median incision, which continues posteriorly as a median groove. The median part of the surface of the second to fourth segment of the sternum is concave and shows no tubercles, the posterior margin of these sternites is smooth, not tuberculate; the last segment of the sternum in the females may show a very inconspicuous

median tubercle, which lacks in the males. In the males the sternum shows a distinct sharply pointed short tooth behind the basis of the fifth leg, with sometimes a short blunt external tooth next to it. These teeth are absent or indistinct in the female, they are more conspicuous in the small females than in the large, in the largest females they are hardly or not at all noticeable.

In the males the exopods of the pleopods of the second to fifth abdominal somites are well-developed, that of the second somite is narrow with a narrowly triangular top, those of the following somites are broadly oval in shape. The endopod of the pleopod of the second somite is about as long and as slender as the exopod; in the following somites the endopod is reduced to a short rod-like process.

One of the most characteristic features of *Galearctus timidus* n. comb. is the strong and high gastric tooth, which towers above all the other teeth of the carapace.

Size

The examined males range from cl. 8 to 31 mm, and the females from 13 to 27 mm. A nisto stage has cl. 8 mm, juveniles with cl. 7.5 to 12 mm have been examined.

Colour

Colour photographs of the specimens from MUSORSTOM 8, stn CP 1018 and CP 1077, show a white spotted dark brown animal. The teeth of the antennae are white with one or more narrow brown bands. The white spots on the carapace are of medium size and rather regularly distributed over the whole carapace. A rather indistinct broad dark band is visible behind the anterior margin of the carapace and a dark brown median area may be seen behind the cardiac tooth. The first abdominal somite shows a large median brown spot surrounded by two brown and two or three white rings, which continue for a short distance on the carapace. This pattern of parallel white and dark lines continues posteriorly as parallel lines on the median portion of the second abdominal somite, and become inconspicuous more posteriorly.

The rest of the abdomen is spotted like the carapace, with the exception of the sixth somite and the tailfan. The sixth somite is very light with a few scattered brown spots. The tailfan is whitish with a few brown spots in the basal part. The third to fifth legs have the usual dark band on the middle of the merus and in the basal half of carpus, propodus and dactylus; that of the dactylus being the least distinct.

Larvae

Ritz (1977) described and figured the first phyllosoma of the species from Queensland.

REMARKS

The type material of this species was first identified by Holthuis (1946) as *Scyllarus cultrifer*, notwithstanding several differences were noted. Later, when material of both species was available, Holthuis (1960) realized the distinctness of the present species. Material identified as *S. timidus* by Tinker (1965), M. W. Johnson (1971a) and Clarke (1972) proved to belong to *Galearctus aurora* (Holthuis, 1982) n. comb. (see there).

Colin & Arneson (1995: fig. 1071) published a colour photograph of a scyllarid from Hawaii, which they identified as "*Scyllarides tumidus*". This name may be a lapsus for "*Scyllarus timidus*" as it clearly shows a scyllarine species, and it certainly is not a *Scyllarides*. It was not possible for me, from the photograph alone, to identify the species, but Dr T. Y. Chan recognized it from its coloration as *Biarctus vitiensis* (Dana, 1852) n. comb. (see there).

Galearctus umbilicatus (Holthuis, 1977) n. comb.

Scyllarus umbilicatus Holthuis, 1977: 195, figs 1, 2. — Phillips *et al.* 1980: 70. — McWilliam *et al.* 1995: 564. — Fransen *et al.* 1998: 68.

TYPE MATERIAL. — Holotype: ♂ (AM P.8232); paratypes: 2 ♂, 3 ♀ (2 ov.), 2 juv., see Material examined under Stradbroke Id and New South Wales.

TYPE LOCALITY. — Australia. New South Wales. Two to three miles North of Green Cape, about 37°15'S, 150°03'E, 55-73 m.

MATERIAL EXAMINED. — **Australia.** Queensland. Off Queensland, 165 m, early 1964, W. Goode, 1 ♂ 11 mm (WAM, 357-64).

Off SE coast of Queensland. RV *Nimbus*, stn 10, 26°31'S, 153°40'E, 138 m, 26.VII.1968, A. J. Bruce, 1 ♂ 18 mm (RMNH D 30926). — Stn 19, 26°49'S, 153°37'E, 183-192 m, 27.VII.1968, 1 ♀ 13 mm (RMNH D 30930). — Stn 20, 26°50'S, 153°39'E, 225-234 m, 27.VII.1968, 1 ♂ 11 mm (RMNH D 30929). — Stn 24, 27°00'S, 153°33'E, 93-95 m, 28.VII.1968, 2 ♂ ♂ 16 and 22 mm, 4 juv. 10-12 mm (RMNH D 30927). — Stn 25, 27°00'S, 153°36'E, 137 m, 28.VII.1968, 1 ♀ 20 mm (RMNH D 30924). — Stn 26, 27°00'S, 153°39'E, 183 m, 28.VII.1968, 6 ♂ ♂ 10-14 mm (RMNH D 30925). — Stn 27, 27°00'S, 153°41'E, 228-232 m, 28.VII.1968, 1 juv. 7.5 mm (RMNH D 30928).

Due East of Jumpinpin bar, Stradbroke Id, about 27°40'S, 153°25'E, 86 m, among fan corals, 1.VII.1961, W. Stephenson, 2 juv. paratypes (AM P.14045).

New South Wales. Off mouth of Manning River, about 31°52'S, 152°38'E, 82-91 m, 1 ♂ paratype (AM P.11405). — Off Broughton Id, Port Stephen, FV *Challenge*, trawl, about 32°37'S, 152°21'E, 88-104 m, mud, VII.1959, A. A. Racek, 1 ♀ paratype (RMNH D 20143). — NE of Newcastle, about 32°55'S, 151°45'E, about 84 m, inside 50 fathom reef, 28.IX.1967, N. Ruello, 1 ov. ♀ paratype (AM). — Off Newcastle, about 32°55'S, 151°45'E, trawl, XII.1953, A. d'Ombrian, 1 ov. ♀ paratype 27 mm (AM P.12326). — South-east of Sydney, RV *Kapala*, 33°45'S, 151°30'E, 137-146 m, VI.1971, 1 ♂ paratype 20 mm (AM P.18012). — Two to three miles north of Green Cape, FV *Bar ea Nuel*, about 37°15'S, 150°03'E, trawl, 55-73 m, VII.1925, W. Boardman, 1 ♂ holotype (AM P.8232).

DISTRIBUTION. — So far the species has only been reported from the east coast of Australia between 26°30'S (S Queensland) and 37°S (S New South Wales).

HABITAT. — The species has been found at depths between (55-)73 and 228(-232) m. The only two mentions of the bottom configuration said "mud" and "among fan corals".

DESCRIPTION

This species is very close to *G. timidus* n. comb., but it is slightly narrower. The arborescent markings on the abdominal somites are finer and deeper.

In *G. timidus* n. comb. the anterior half of the abdominal somites is smooth with a single transverse groove carrying short posteriorly directed hairs; a trace of a second such groove may be visible. In *G. umbilicatus* n. comb. there are two

parallel grooves in the smooth anterior part that are somewhat crenulate and often are in contact with one another. The upper margin of the large gastric tooth in the present species is convex, it is almost straight in *G. timidus* n. comb. Other differences are mentioned by Holthuis (1977), where an extensive description and figures of the present species are given.

Size

The carapace length of the examined males varies between 10 and 22 mm. The non-ovigerous females have cl. 13 to 27 mm, the ovigerous females 22 to 24 mm.

Galearctus kitanoviriosus

(Harada, 1962) n. comb.

(Fig. 25)

Scyllarus kitanoviriosus Harada, 1962: 120, text-figs 6, 7, pl. 9, pl. 12 fig. 14, pl. 13 fig. 18; 1965: 36, fig. 1c-d; 1968: 82. — Nishimura & Suzuki 1971: 89, pl. 30 fig. 5. — Kim & Park 1972: 210, pl. 6 figs 5, 6. — Motoh 1972: 48, pl. 15 figs 1, 2. — Kim 1976: 147; 1977: 339, 400, text-figs 152, 153, pl. 36 fig. 75. — Matsuzawa 1977: pl. 75 fig. 1. — Suzuki 1979: 295, pl. 18 fig. 232. — Phillips *et al.* 1980: 70. — Miyake 1982: 84. — Higa & Saisho 1983: 86, figs. — Chan & Yu 1986: 158, pl. 6, pl. 10 fig. A; 1993: 209, col. fig. — Sekiguchi 1986a: 1289-1291; 1986b: 15, 17; 1986c: 293; 1987a: 331; 1987b: 417, 418; 1988: 3; 1990a: 113. — Sakaji & Tokai 1992: 97, figs 1-7. — Huang 1994: 564. — Fransen *et al.* 1998: 67. — Wang *et al.* 1998: 446, 448, fig. 2. — Debelius 1999a: 224, col. fig.; 1999b: 224, col. fig.; 2000: 224, col. fig. — Motoh 1999: 38, 2 col. figs. — Minemizu *et al.* 2000: 124, col. fig.

TYPE MATERIAL. — Holotype: ♂ (Misaki Park Aquarium); paratypes: 1 ♀ 36 mm (RMNH D 30923); 1 ♂ and 2 ♀ ♀ (Seto Marine Biological Laboratory), see paragraph Distribution.

TYPE LOCALITY. — Japan. Saikasaki, Kitan Channel, entrance of Osaka Bay.

MATERIAL EXAMINED. — **Japan.** Saikasaki, Kitan Channel, entrance of Osaka Bay from gill net, spring 1961, E. Harada don., 1 ♀ paratype 36 mm (RMNH D 30923).

Off Yoshimi, Shimonoseki, Yamaguchi prefecture, K. Kataoka leg., K. I. Hayashi don., 1 ♂ 28 mm (RMNH D 38508).

Off Ushibuka, Kumamoto Prefecture, Kyushu, 15.VI.1983, N. Koike leg., K. I. Hayashi don., 1 ♂ 30 mm (RMNH D 38510).

Taiwan. NE coast, Peace Id, Keelung, about 100 m deep, bottom gill net, V.1997, T. Y. Chan leg., 2 ♀ (RMNH D 49568).

Chesterfield Islands. Dredge, 250 m, 22.V.1979, 1 ♀, 28 mm (MNHN-Pa 1046).

New Caledonia. North New Caledonia. HALICAL 1, stn 2, 20°47.5'S, 164°52'E, 658-680 m, 23.XI.1994, 1 ♂ 13 mm (badly damaged, part of carapace missing) (MNHN-Pa 1860).

East New Caledonia. HALIPRO 1, stn CP 851, 21°43'S, 166°37'E, 314-364 m, 19.III.1994, 1 ♂ 11 mm (MNHN-Pa 1861).

BATHUS 1, stn CP 711, 21°43.16'S, 166°36.35'E, 315-327 m, 13.III.1993, 1 juv. 9 mm (MNHN-Pa 1859).

South-West New Caledonia. S îlot Ua, RV *Vauban*, stn 248, 22°30.75'S, 166°46.20'E, 25.XI.1978, A. Intès, 1 ov. ♀ 23 mm (MNHN-Pa 775).

Norfolk Ridge. SMIB 3, stn DW 14, 23°40'S, 168°00'E, 246 m, 22.V.1987, 1 ♀ 26 mm (MNHN-Pa 1274).

BERYX 11, stn CP 22, 24°44'S, 168°07'E, 490-510 m, 17.X.1992, 1 ov. ♀ 31 mm (MNHN-Pa 1862). — Stn CP 23, 24°43'S, 168°08'E, 270-290 m, 17.X.1992, 1 ov. ♀ 23 mm (USNM 1000666). — Stn CP 26, 24°42'S, 168°08'E, 230-260 m, 17.X.1992, 1 ov. ♀ 26 mm (MNHN).

LITHIST, stn CP 17, Banc Jumeau Ouest, 23°40.8'S, 168°00.8'E, 247-281 m, 12.VIII.1999, 1 ov. ♀ 25 mm (RMNH D 48746).

Matthew Id. VOLSMAR, stn DW 39, 22°20.5'S, 168°43.5'E, 305 m, 8.VI.1989, 1 ♀ 26 mm (MNHN-Pa 1384).

Fiji Islands. BORDAU 1, stn CP 1474, 19°39'S, 178°10'W, 316-340 m, 8.III.1999, 1 ♂ 11 mm, 1 ♀ 10 mm (MNHN-Pa 1913). — Stn CP 1501, 18°40'S, 178°30'W, 350-357 m, 12.III.1999, 1 juv. 7 mm (MNHN-Pa 1914).

DISTRIBUTION. — The type locality of the species is Saikasaki, Kitan Channel, entrance of Osaka Bay, Honshu, Japan. The other records in the literature all pertain to Korean, Japanese and Taiwanese material.

Korea: off Haeundae, Korea Strait, SE Korea (Kim 1976, 1977), Seogwipo, Jeju Id (= Cheju Id, = Quelpart Id), Korea Strait (Kim & Park 1972; Kim 1977).

Japan (Nishimura & Suzuki 1971; Phillips *et al.* 1980; Miyake 1982; Sekiguchi 1986a, b, c, 1987a, b, 1988, 1989a, 1990a; Motoh 1999; Minemizu *et al.* 2000).

Sea of Japan, west coast of Honshu: Yamagata Prefecture (Suzuki 1979), off Nozaki, east coast of Noto Id, Toyama Bay (Motoh 1972), Mihonoseki, Miho Bay (Harada 1962, 1968). South coast of Honshu: Izu Peninsula (Debelius 1999a, b, 2000), Kii District (Harada 1965), Saikasaki, Kitan Channel, Osaka Bay (Harada 1962), Minabe, Wakayama Prefecture (Harada 1962), Seto Inland Sea near Hikari, Yamaguchi Prefecture (Sakaji & Tokay 1992; larvae), Siraisi-sima, Seto Inland Sea (Harada 1962).

Shikoku: Muroto Peninsula, Kochi Prefecture (Matsuzawa 1977).

Taiwan: Northern Taiwan (Chan & Yu 1993; Huang 1994; Wang *et al.* 1998), Keelung City (Chan & Yu 1986).

The examined material extends the known range of the species to New Caledonia and the Fiji Islands.

HABITAT. — In New Caledonia the species has been found at depths between (230-)246 and 658(-680) m. Depth records of the Korean, Japanese and Taiwanese material are very scarce and vague. Kim & Park (1972) give the depth as probably 30 m, Chan & Yu (1993) give the depth at which the species occurs as "probably less than 50 m". Also the bottom on which the species lives is seldom mentioned "in rocky areas" (Motoh 1972); collected by "diving around coral reef" (Chan & Yu 1986).

DESCRIPTION

The rostrum is truncated with the anterior margin slightly emarginate and the base constricted. It bears a strong and sharply pointed rostral tooth, which reaches beyond the end of the anterior margin of the rostrum. There is no pregastric tooth, but the gastric tooth is well-developed; although it is large, it is lower and much less pronounced than in *G. timidus* n. comb. and its anterior height is distinctly less than half the distance between the anterior end of the gastric tooth and the tip of the rostral tooth. This is the easiest character to distinguish adults of the two species. Behind the rostral tooth there are about four transverse rows of low and flat squamae, behind the gastric tooth there are about eight such rows of one to five squamae. The upper margin of the gastric tooth is about straight and reaches the cervical groove. The cardiac tooth is rather low and placed immediately behind the cervical groove and is distinctly smaller than the rostral tooth, it ends in a double tip, the two points of which may be acute or more blunt, rarely there is a single tip. It is followed by about seven transverse rows of two to five squamae, which often are more or less fused.

The branchial carina is widely interrupted by the cervical groove, the gap shows no tubercle. The anterior branchial carina ends in two sharp teeth of equal size, that are placed on the inner orbital margin. Behind the posterior of these two teeth there are two diverging carinae which are not

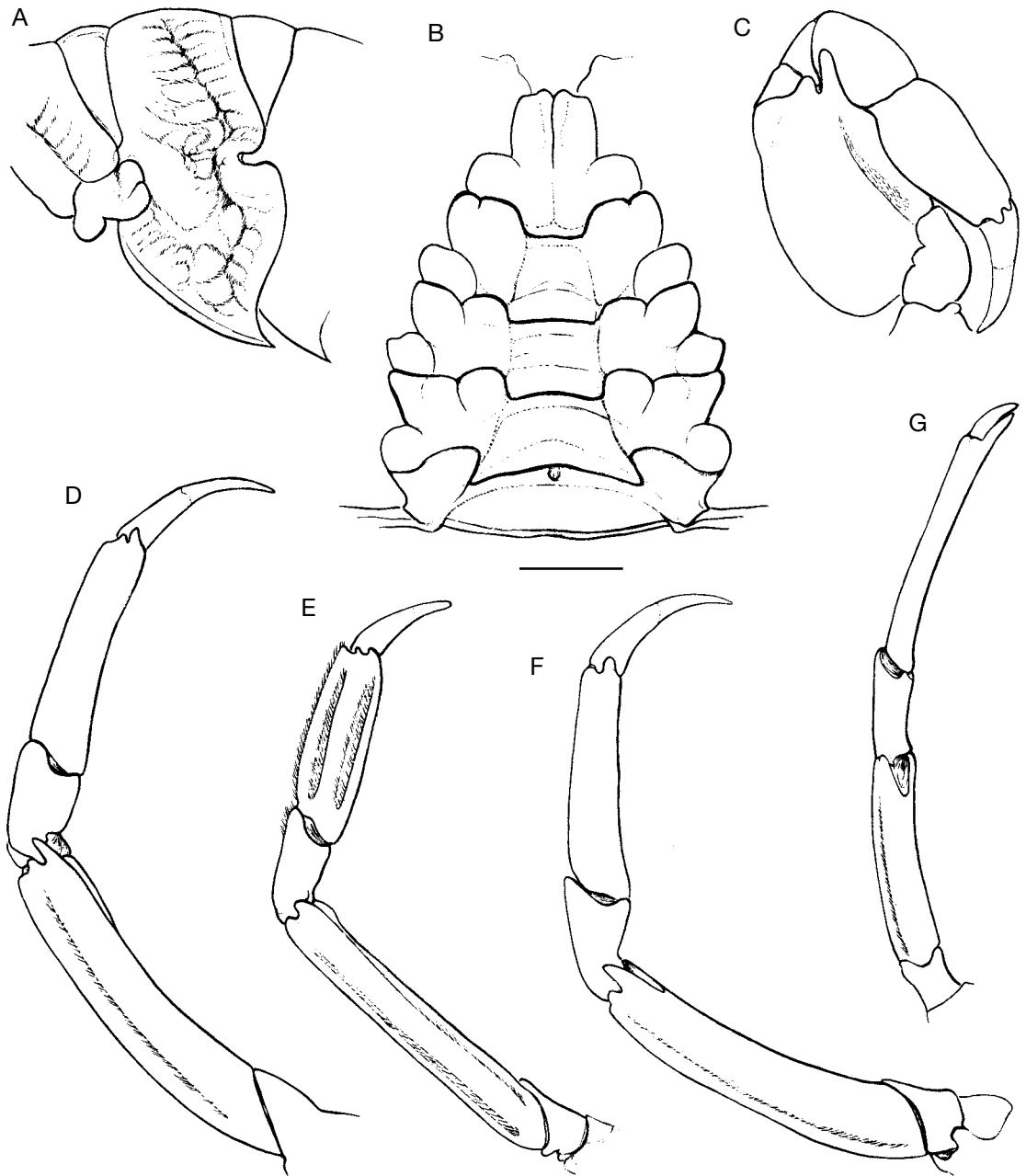


FIG. 25. — *Galearctus kitanoviriosus* (Harada, 1962) n. comb., New Caledonia, VOLSMAR, stn DW 39, ♀ (MNHN-Pa 1384); **A**, abdominal somites I and II in lateral view; **B**, thoracic sternum; **C-G**, pereopods 1 to 5. Scale bar: 4 mm.

very distinct and carry small squames. The posterior branchial carina ends anteriorly in a well-developed sharply pointed tooth, which

overhangs the cervical groove. Behind this tooth the carina shows a row of some eight squamiform tubercles. Outside this row, there are more simi-

lar tubercles. At the place of the anterior submedian carina there are some tubercles, two of which are much larger and flatter than the others. At each side of the posterior postrostral carina there is a group of several flattened tubercles that reach almost to the intermediate row. The intermediate row consists of about seven rather small rounded tubercles; between its anterior end and the cervical gap of the branchial carina two or three parallel more or less elongate tubercles are placed in a short oblique row. Two more flattened tubercles are found near the inner margin of the posterior branchial carina.

The orbital margin is formed by a smooth carina, which at its outer end bears a sharp small spine. Behind the orbit there is an indistinct postorbital tubercle.

The lateral margin of the carapace ends in a strong anterolateral tooth followed by a few flattened squamiform tubercles. The mediolateral area of the lateral margin also ends in a sharp tooth, followed by about four squamiform tubercles that merge with the tubercles of the intercervical area. The posterolateral margin ends in a sharp anterior tooth followed by about seven broad squamiform tubercles. Some broad tubercles are also present in the posterior part of the space between the posterior branchial and posterolateral carinae.

The marginal groove along the posterior margin of the carapace is distinct, but neither very deep nor very wide. Between it and the posterior margin of the carapace a parallel transverse groove is present; between the two grooves flattened tubercles are visible. Before the marginal groove there are two rows of rather indistinct tubercles. The median incision of the posterior margin of the carapace is small but distinct.

The first abdominal somite has a complete, uninterrupted and distinct transverse groove over the middle; about 20 short longitudinal grooves extend from the transverse groove posteriorly. The posterior margin of somites I to IV has a median incision, which is distinct in the anterior somites, less so in the fourth. In the fifth and sixth somites the posterior margin is somewhat convex in the middle and not incised. The smooth

anterior part of the somites has the surface perfectly smooth and naked, at most with some inconspicuous dimples or an interrupted groove. The abdominal somites show no median carina. There is the normal arborescent sculpturation of deep and narrow grooves in the posterior half of each somite. In the middle of the dorsal surface the grooves form a lobulated figure that is slightly longer than wide.

The pleura of somite I are small and bilobed, those of somites II to IV end in a sharp postero-ventrally directed tooth. The tip of the pleura of somite V is blunt and directed down. The margins of the pleura are smooth, at the most a faint crenulated pattern is formed on the anterior margin by the arborescent markings of pleura II to IV. The four teeth at the end of the hard part of the telson are of about the same length, the outer teeth may be slightly narrower than the inner; there is no denticulation between the teeth.

The anterior margin of the antennular somite is incised in the middle and bears two blunt teeth in the lateral part.

The distal margin of the last (sixth) segment of the antenna is slightly convex and bears five distal teeth, the outer of which is broader and shorter than the others, which narrow gradually distally into a sharply pointed top. A sixth tooth is placed on the inner margin of the segment, which sometimes shows an indistinct incision somewhat below this tooth. The fifth segment bears the usual pair of sharp teeth on the upper distal margin. The anterior margin of the fourth segment bears two large and sharply pointed teeth, placed close together near the articulation with the fifth segment, sometimes only one tooth is present here. Between these teeth and the apex of the fourth segment, the anterior margin is entire. The outer margin of the segment bears two well-developed sharply pointed teeth (the tip of the segment not included). The inner margin of the fourth segment, near the articulation with the fifth, bears a sharply pointed tooth. The upper surface of the fourth segment is smooth with a single sharp carina extending from the base to the tip of the segment. The third segment has two teeth on the mediad side of the anterior margin;

the outer of these is longer and slightly stronger than the inner.

The anterior margin of the epistome is slightly convex and incised in the middle. The anterolateral tooth is blunt and slightly less than rectangular. P.1 is distinctly more robust than the other legs. Its dactylus is about as long as that of P.2 and longer than those of P.3 to P.5. No hairy fringes are found on any of the dactyli. The propodus of P.1 is about 1.6 times longer than high, being highest basally and tapering distally; it is smooth and without hair. The carpus is short, cup-shaped and smooth. The merus is about as long as propodus and carpus combined; it is 1.5 times as long as high and shows a longitudinal hairy groove in the lower part of the outer surface. The propodus of P.2 is slender and almost cylindrical, being slightly higher at the base than distally, it is about twice as long as the dactylus and about four times as long as high; it shows no hairy grooves and no dorsal hairy fringe. The merus of P.2 is longer than propodus and carpus together, it is about cylindrical and shows a hairy groove in the upper part of the outer surface. The dactylus of P.3 is slightly shorter than that of P.2. The propodus of P.3 is flattened and distinctly higher than the merus, it is also much higher than the propodus of P.2 or P.4: it is about 2.5 times as long as high. It has a dorsal fringe of short hairs along the entire dorsal margin and two distinct and wide longitudinal hairy grooves on the outer surface. The lower margin of the propodus is straight with a rounded anterior angle; there is no tooth here. The carpus of P.3 is short and has a fringe of short hairs in the distal part of the dorsal margin and a hairy groove on the outer surface. The merus is longer than carpus and propodus combined, it is much narrower than the propodus, being more than six times as long as high. It has a longitudinal hairy groove in the upper part of the outer surface and one on the lower surface. P.4 is about as long as P.3, but P.5 is much shorter. None of the segments of P.4 and P.5 have a dorsal fringe of hairs; the propodus, carpus and merus show a longitudinal hairy furrow on the outer surface, but this is often indistinct or interrupted; the merus also has a ventral hairy groove.

The anterior margin of the thoracic sternum is produced forward; each half of the margin is either straight or somewhat concave. A small but distinct median triangular incision separates the two halves, it continues posteriorly as a groove; a triangular area around the groove is sunken. The thoracic sternites show a rounded transverse ridge extending over the full width of the anterior part. No median tubercles are present, at most there is an indistinct median elevation on the last ridge. In the males the posterolateral angle of the sternum shows a short rather sharp tooth at the base of P.5; the smallest female shows there a small but rather sharp tooth, followed by a lower rounded lobe; the situation being similar to that of males and small females of *G. timidus* n. comb. In all other females at most two very low and weak lobes are visible there.

In the males the pleopods of abdominal somite II are small, have the endo- and exopod similar, both are short and narrow, with the exopod only slightly wider and shorter than the endopod. The pleopods of somites III to V have the exopod rather wide and leaf-shaped, being more than twice as wide as the exopod of the pleopod of somite II; the endopods of the pleopods of somites III to V are similar to those of somite II, but become smaller in the posterior somites.

Size

In the examined males cl. is 11 to 30 mm; the non-ovigerous females have cl. 10 to 36 mm, the cl. of ovigerous females is 23 to 31 mm.

Colour

The only trace of colour in the preserved specimens is the presence of a reddish ring in or somewhat below the middle of propodus, carpus and merus of P.1 to P.5. The coloured figure published by Chan & Yu (1993: 209) shows a dark brown animal, with a lighter transverse band over the antennae, and one over the anterior half of the carapace. Light median spots are present on abdominal somites II to V, the one on somite II being by far the broadest. The sixth somite and the tailfan are bright yellowish white. The first abdominal somite shows a large circular dark spot in the

middle surrounded by a light ring. A very small bright blue spot is present at the base of the antennulae. The legs have the usual yellowish colour with a dark ring in the basal half of dactylus, propodus and merus. A similar colour pattern, but less distinct, is shown by the colour photograph of this species published by Kim (1977: pl. 36 fig. 75). Motoh (1999), Debelius (1999a, b, 2000), and Minemizu *et al.* (2000) also published a coloured figure of the species. According to T. Y. Chan (pers. comm.) the presence of the two small bright blue spots at the base of the antennulae is quite characteristic for the species.

Larval development

The late stage phyllosoma of this species was described from Japan by Higa & Saisho (1993) who also provided figures.

REMARKS

The species is close to *Galearctus aurora* n. comb., but differs in having: 1) the propodus of P.3 much more strongly widened and with hairy grooves; 2) two strong teeth on the anterior margin of the fourth antennal segment; and 3) no sharply pointed posteriorly directed teeth on the fifth thoracic sternites of the female. It can immediately be distinguished from *G. timidus* n. comb. by the low gastric tooth.

Galearctus aurora (Holthuis, 1982) n. comb. (Fig. 68A, B)

Scyllarus aurora Holthuis, 1982: 847, figs 1, 2; 1993: 184, fig. 3. — Manac'h & Carsin 1985: 473. — Sekiguchi 1986a: 1289-1291; 1986b: 15; 1987a: 331; 1987b: 417, 418; 1988: 3; 1992: 212. — Phillips & McWilliam 1989: 353, 354, 357. — Sekiguchi *et al.* 1989: 81, text-fig. 1, pl. 1. — Poupin 1996a: 16, pl. 7 col. fig. a.; 1996b: 11, 96. — Fransen *et al.* 1998: 65.

Scyllarus timidus – Tinker 1965: 42, pl. 9. — M. W. Johnson 1971a: 83, figs 22-33. — A. Michel 1971: 472. — Clarke 1972: 313-315 [non *Scyllarus timidus* Holthuis, 1960].

?*Scyllarus* sp. III – A. Michel 1971: 467, 472, fig. 6F.

TYPE MATERIAL. — Holotype: ov. ♀ (RMNH); paratypes: 5 ♂♂, 3 ♀♀ (RMNH); 1 ♂ (MNHN-Pa 566). Complete informations about paratypes in Holthuis (1982).

TYPE LOCALITY. — Hawaii, Oahu, Barber's Point, 21°18'N, 158°07'W, 117-128 m.

MATERIAL EXAMINED. — **Taiwan.** North coast. Peace Id, Keelung, about 100 m deep, bottom gill-net, 1.VI.2000, T. Y. Chan leg., 1 ♂, 4 ov. ♀♀ (RMNH D 49569).

Philippines. North of Lubang Id, MUSORSTOM 1, stn 57, 13°53.1'N, 120°13.2'E-13°52.7'N, 120°13.5'E, 96-107 m, 26.III.1976, 1 ♂ 15 mm, 1 juv. 6 mm (MNHN-Pa 1263).

New Caledonia. Yandé Id, North New Caledonia, about 20°3'S, 163°50'E; outside the reef, 200 m, 1.IX.1978, 1 badly damaged ♀ (MNHN-Pa 1240). Île des Pins, LAGON, stn 586, 22°48'S, 167°35'E, 57 m, 18.VII.1985, 1 ♂ 11 mm, 1 ov. ♀ 14 mm (MNHN-Pa 1256).

Fiji Islands. SE of Viti Levu, MUSORSTOM 10, stn CP 1349, 17°31.1'S, 178°38.8'E, 244-252 m, 11.VIII.1998, 1 ♀ 24 mm (photographed; MNHN-Pa 1890).

DISTRIBUTION. — The species has a rather wide range in the Pacific. In the original description it was reported from Hawaii, Japan, Society Islands and New Caledonia (more precise localities are given there). Since then it was reported from the following additional localities. Off Kii-Nagashima, Kii Peninsula, Japan (Sekiguchi *et al.* 1989), and from the South Pacific: Tubuai (= Austral) Archipelago (Maria, Rurutu and Tubuai islands), Society Archipelago (Maupiti, Moorea, Raiatea and Tupai islands), Tuamotu Archipelago (Akiaki, Fangataufa, Hao, Makemo, Marutea South, Maria, Mururoa, Tuanake, Tureia and Vanavana islands), Marquesas Archipelago (Fatuhiwa and Tahuata islands), Gambier Archipelago; all these South Pacific islands were listed by Poupin (1996b) while in his previous publication (Poupin 1996a) only the names of the archipelagoes were mentioned. Manac'h & Carson (1985) reported the capture of the species at Mururoa and/or Fangataufa islands, Tuamotu Archipelago.

HABITAT. — The species has been reported from depths between 90 and 300 m (Poupin 1996a, b). Holthuis (1982: 852) listed the depth records known at that time (117-200 m) and one report from "a depth below 100 feet (= 30 m)". The present specimens are from depths that do not change the picture (96-107 to 244-252 m), except for the material from Île des Pins, which was taken at 57 m.

DESCRIPTION

The material agrees well with the published description (Holthuis 1982). In the ovigerous female there is no sharp posterolateral spine on the sternum; the spine is very distinct and sharp in the male. *G. aurora* n. comb. and *G. rapanus*

n. comb. are the species in which the propodus of the third leg is atypical for the genus *Galearctus* n. gen. This propodus, namely, is rather slender, only slightly wider and flatter than the propodus of P.2 and without hairy grooves. The anterior margin of the thoracic sternum which is produced in the middle, shows that the species belongs to the present genus.

Size

In the literature the cl. is given as 15–39 mm. The males (cl. to 31 mm) seem to be somewhat smaller than the females (cl. to 38 mm). The present specimens from Île des Pins are remarkably small, the cl. of the ovigerous female being only 14 mm.

Colour

The Fiji specimen was photographed in colour when just caught. It shows the body variegated with brown and whitish spots and areas. The tips of many spines are white. A mostly whitish transverse band extends behind the anterior margin of the carapace and a similar band is seen some distance before the posterior margin. A broad whitish spot extends in each half of the carapace from the middle of the cervical groove posteriorly; a short transverse brownish band covers the cardiac tooth. The abdominal somites are mottled with brown and whitish, except the tailfan which is entirely whitish. The most conspicuous part of the colour pattern is formed by a large reddish brown median spot on the first abdominal somite which is flanked at either side by about six alternating brown and white lines, which extend backward over the larger part of the second somite. Poupin (1996a: pl. 7 fig. a) published a coloured figure of the species.

Larvae

The stage V, VII and IX phyllosoma's from the Hawaiian Islands that M. W. Johnson (1971a) brought to *Scyllarus timidus* more likely belong to the present species. Likewise the phyllosomas from New Caledonia and the New Hebrides, that Michel named *Scyllarus* sp. III, and that he identified with Johnson's just mentioned phyllosomas, probably belong here as well. Poupin (1996b: 11)

identified Michel's (1971) *Scyllarus* sp. IV and V with the present species, but Michel (1971: 472) clearly indicated only sp. III as identical with M. W. Johnson's *S. timidus* larvae, while he assigned his *Scyllarus* sp. V to *S. modestus* (= *Eduarctus modestus* n. comb.) and gave no opinion on sp. IV. Phillips & McWilliam (1989) described and figured a scyllarid nisto stage, which they thought to most likely belong to the present species.

Galearctus rapanus (Holthuis, 1993) n. comb.

Scyllarus rapanus Holthuis, 1993: 179, figs 1, 2. — Poupin 1996a: 16, pl. 7 fig. b; 1996b: 95, 96.

TYPE MATERIAL. — Holotype: ♂ 27 mm. SMCB, stn 101 (MNHN-Pa 1394).

TYPE LOCALITY. — Polynesia. Tubuai Archipelago. Rapa Id, 27°36'S, 144°16'W, 250–300 m.

REMARKS

The species was very recently described, and is only known from the type locality. I may refer to the original description. Poupin (1996a) published a coloured photograph of one of the types.

Genus *Chelarctus* n. gen.

TYPE SPECIES. — *Arctus cultrifer* Ortmann, 1897 by present designation.

OTHER SPECIES. — *Chelarctus aureus* (Holthuis, 1963) n. comb.; *C. crosnieri* n. sp.

ETYMOLOGY. — From *chela* (Latin), scissors, and *Arctus* De Haan, 1849, a junior synonym of *Scyllarus* Fabricius, 1775; in reference to the remarkable subchela-like shape of the P.3.

DIAGNOSIS. — Midline of carapace with distinct rostral and gastric teeth, the cardiac tooth replaced by two low tubercles; pregastric tooth absent. Abdomen without median carinae, with distinct arborescent markings and a median lobulated figure. Fourth antennal segment with a single oblique carina, no additional carinae or tubercles on the upper surface. The middle of the anterior margin of the sternum anteriorly produced, reaching beyond the anterolateral teeth. Propodus of the P.3 strongly compressed, anteroventral angle produced as a tooth, that makes a kind of subchela with the dactylus. Dactyli smooth without hairy fringes.

KEY TO THE SPECIES OF *CHELARCTUS* N. GEN.

Species dealt with in this paper are in bold.

1. Propodus of P.2 not flattened, without an antero-ventral tooth and without pubescent grooves. Anterior margin of fourth antennal segment with two teeth or with one large and a few serrations 2
- Propodus of P.2 flattened, with a distinct anteroventral tooth and with two pubescent grooves on the outer surface. The short hairs on the body with a golden sheen *C. aureus* n. comb.
2. Pleura of abdominal somites II to IV ending in a sharp posteriorly directed point. Palm of P.3 more than twice as long as high. Abdominal somites II to V of the living animal of a rather uniform reddish brown colour; without conspicuous transverse rows of round spots *C. cultrifer* n. comb.
- Pleura of abdominal somites II to IV bluntly topped, not ending in a sharp point. Palm of P.3 less than twice as long as high. Dorsal surface of the abdominal somites II to V each with two transverse rows of two or four rounded dark red spots *C. crosnieri* n. sp.

Chelarctus cultrifer (Ortmann, 1897) n. comb.
(Figs 26; 27)

Arctus cultrifer Ortmann, 1897: 272. — Yokoya 1933: 46.

Scyllarus cultrifer Balss, 1914: 80. — De Man 1916: 68. — Parisi 1917: 9. — Barnard 1947: 382; 1950: 557, fig. 104a. — Utinomi 1956: 62, pl. 31 fig. 5; 1965: 62, pl. 31 fig. 5; 1978: 62, pl. 31 fig. 5. — Kubo 1960: 98, pl. 49 fig. 5; 1965: 627, fig. 1023. — Miyake 1961: 9; 1972: 67, fig. 220; 1975: 106, fig.; 1982: 84, 85, pl. 29 fig. 1. — Harada 1962: 114, text-figs 3-5, pl. 8, pl. 12 fig. 13, pl. 13 fig. 17; 1965: 36, fig. 1a, b. — Miyake *et al.* 1962: 124. — Ikematsu 1963: 10. — Prasad & Tampi 1969: 82. — Nishimura & Suzuki 1971: 89, pl. 30 fig. 4. — Friese 1973: 81, fig. — Berry 1974: 13, 16. — Burukovsky 1974: 106; 1983: 149. — Tampi & George 1975: 32, figs 29-33. — Matsuzawa 1977: pl. 76 fig. 1. — Prasad *et al.* 1980: 80, fig. 9. — Shirai 1980: 411, fig. — Kensley 1981: 30. — Sekiguchi 1982: 25; 1986a: 1289-1291; 1986b: 15, 17; 1986c: 293; 1987a: 331; 1987b: 417, 418; 1988: 3. — Takeda 1982: 43, fig. 129. — Prasad 1983: 144, fig. 2d. — Sakai & Nakano 1983: 76. — Baba *et al.* 1986: 163, 286, fig. 114. — Masuda *et al.* 1986: 104, fig.; 1996: 104, fig. — Konishi & Sekiguchi 1990: 77, figs 1-3. — Chan & Yu 1993: 217, col. fig. — Huang 1994: 564. — Hayashi 1995: 345, pl. 92 fig. 4. — Chan 1997: 413. — Wang *et al.*

1998: 446, 448. — Debelius 1999a: 225, fig.; 1999b: 225, fig.; 2000: 225, fig. — Minemizu *et al.* 2000: 123, fig. — Kato & Okuno 2001: 63, fig.

Arctus sordidus — Bate 1888: 66, pl. 9 fig. 3. — Barnard 1926: 122, pl. 10. [non *Arctus sordidus* Stimpson, 1860].

Arctus haani p.p. Ortmann, 1891: 42.

Scyllarus cultrifer meridionalis Holthuis, 1960: 150. — Phillips *et al.* 1980: 69.

?*Scyllarus* spec. D — Berry 1974: 15, figs 48, 49.

Scyllarus cultrifer cultrifer — Phillips *et al.* 1980: 69.

Scyllarus ? *cultrifer* — Titgen 1988: 142.

Non *Scyllarus cultrifer* — Holthuis 1946: 93, pl. 8 figs c, e (= *G. timidus* n. comb.). — Hwang & Yu 1983: 264, fig. 5 (= *Petrarctus rugosus* n. comb.).

TYPE MATERIAL. — Lectotype: ♀ 23 mm, *Challenger* Expedition, stn 192 (BM); paralectotypes: 2 ♂ 18 and 19 mm (BM).

TYPE LOCALITY. — Indonesia. Arafura Sea, Kai Ids, 5°49'15"S, 132°14'15"E, 256 m.

MATERIAL EXAMINED. — **Somalia**. IIOE, RV *Anton Bruun*, cruise 9, stn 447, 10°00'N, 51°15'E, shrimp trawl, 59-61 m, 16.XII.1964, 1 ♂ 12 mm (USNM). — Stn 463, 11°24'N, 51°35'E, trawl, 75-175 m (150 m), 17.XII.1964, 1 ♂ 14 mm, 1 ♀ 15 mm (USNM).

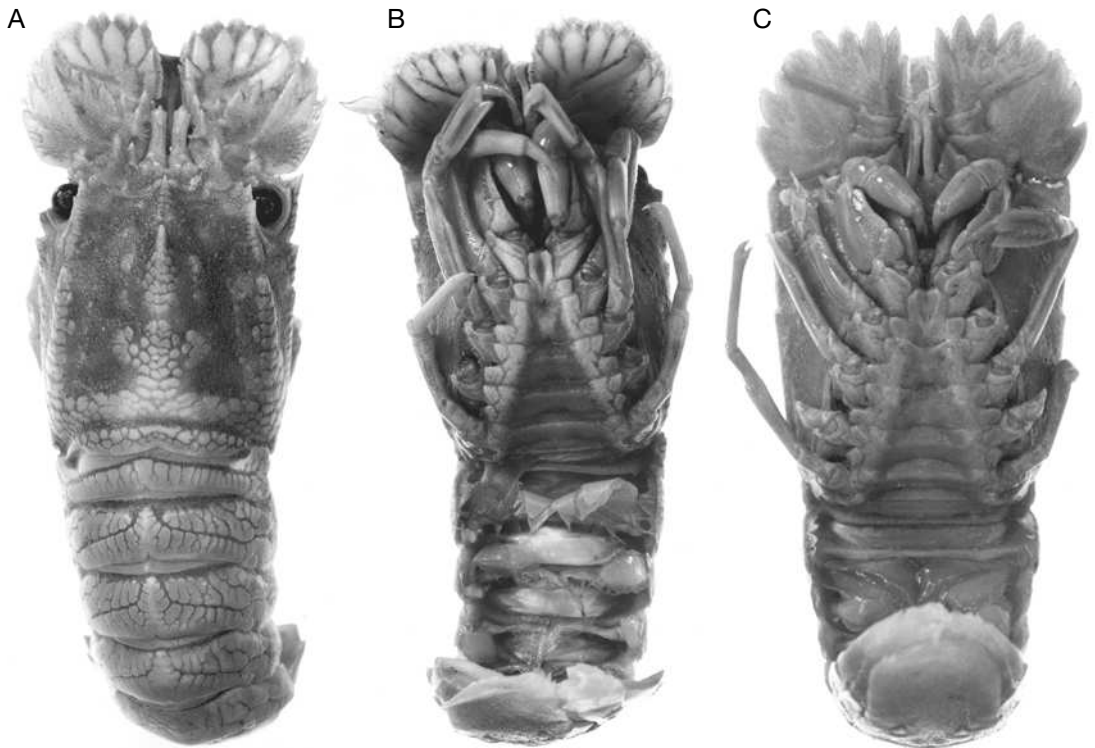


FIG. 26. — *Chelarctus cultrifer* (Ortmann, 1897) n. comb.; **A, B**, Misaki, Japan, *Albatross* Expedition, ♀ carapace length 21 mm (USNM); **C**, Philippines, RV *Albatross*, stn D 5398, ♀ carapace length 22 mm (USNM), holotype of *Scyllarus cultrifer meridionalis* Holthuis, 1960; **A**, dorsal view; **B, C**, ventral view.

Kenya. IIOE, RV *Anton Bruun*, cruise 8, stn 420A, 2°42'S, 40°53'E, 140 m, shrimp trawl, 6.XI.1964, 1 ♂ 14 mm, 1 ♀ 19 mm (USNM).

RV *Manihine*, cruise 334, SE of Malindi, trawl 6 No. 6, 3°15.2'S, 40°13.7'E-3°17.0'S, 40°11.0'E, 137-165 m, muddy sand, 7.I.1972, A. J. Bruce (photographed), 1 ♀ 14 mm (RMNH D 30587). — Cruise 329, S Kenya, 4°44'S, 39°24.5'E, 110-146 m, dredge, 6.VIII.1971, P. S. Sandhu & A. J. Bruce, 1 ♂ 13 mm (RMNH D 49559).

Saya de Malha Bank. RV *Prof. Mesyatsev*, stn 136, 11°25.0'S, 61°39'E, 156-159 m, 9.IV.1976, 4 ♂♂ 18-26 mm, 3 ov. ♀♀ 22-27 mm (VNIRO, RMNH D 33139).

Seychelles. *Tyro* Seychelles Expedition 1992-1993, stn 783, Île Desnoeufs, northern slope of platform, 6°12'S, 53°02'E, reef slope, scuba diving, 2.I.1993, 1 ♀ 10 mm (RMNH D 49560). — Stn 785, South of Alphonse Atoll, canal de Mort, 7°03'S, 52°43'E, rectangular dredge, 160-200 m, coral rubble, 3-5.I.1993, 2 juv. ♂♂ 9 and 11 mm, and a fragment of a much larger specimen (RMNH D 49561).

Îles Glorieuses (North of Madagascar). BENTHEDI, stn 8 DR, 11°29.2'S, 47°18.2'E, coarse coral sand, 250 m, 19.III.1977, 1 ov. ♀ 28 mm (MNHN-Pa 601).

Madagascar. NW coast, Majunga, 1902, M. Boucard leg., No. 582, H. Balss det., 1 ♂ 20 mm, 1 ov. ♀ 21 mm (MNHN).

Japan. Japan, 1 ♀ 22 mm (BM). — Off Sunosaki, Chiba-ken, Honshu, 37-146 m, hard bottom, 12.VI.1914, Th. Mortensen, 1 juv. ♂ 8 mm (UZM). — Misaki, Kanagawa-ken, Sagami Bay, *Albatross* Expedition, 1906, 1 ♀ 21 mm (USNM). — Off Nabeta, Shimoda, Kanagawa-ken, dredge, 12.VI.1936, Y. Okada, 1 ♂ 9 mm (RMNH D 38513). — Atami district, Kanagawa-ken, V.1894, 1 ♀ 10 mm (USNM). — Tanabe Bay, Wakayama-ken, 18.IV.1961, T. Yamamoto, 1 ♂ 16 mm (USNM). — Off Taiji, Wakayama-ken, Honshu, 1982, F. Yanagisawa, 1 ♂ 19 mm, 1 ov. ♀ 31 mm (SUF). — Tosa Bay, Kochi-ken, Shikoku, 1961, K. Sakai, 1 juv. 8 mm (RMNH D). — Kanada (or Hanada) Bay, ? Fukuoka-ken, 18 m, mud, 1 ♀ 14 mm (USNM). — Bonotu, Kagoshima-ken, 29.V.1951, K. Isobe, 1 ov. ♀ 22 mm (ZLK).

Philippines. RV *Albatross*, stn D 5398, Gigantangan Id, between Masbate and Leyte, 11°35'12"N, 124°13'48"E, 209 m, green mud, 15.III.1909, 1 ♀ 22 mm (USNM; holotype of *Scyllarus cultrifer meridionalis* Holthuis, 1960).

MUSORSTOM 1. N of Lubang Id, stn 27, 14°00.5'N, 120°15.7'E, 188-192 m, trawl, 22.III.1976, 1 ♂ 16 mm, 1 ov. ♀ 26 mm (MNHN-Pa 1057; RMNH D 39370). — Stn 35, 14°08.0'N, 120°16.5'E, 186-187 m, trawl, 23.III.1976, 1 ♂ 22 mm, 1 ♀ 24 mm (MNHN-Pa 1053; RMNH D 39371). — Stn 61, 13°59.7'N, 120°16.8'E, 184-202 m, trawl, 27.III.1976, 1 ♀ 22 mm (MNHN-Pa 1055). — Off entrance of Bay of Manila, stn 72, 14°13.1'N, 120°28.8'E, 122-127 m, trawl, 28.III.1976, 1 juv. 9 mm (MNHN-Pa 1048).
 MUSORSTOM 2, stn 51, N of Lubang Id, 14°00.4'N, 120°17.6'E, 170-187 m, trawl, 27.III.1976, 1 ov. ♀ 26 mm (MNHN-Pa 1052).
 MUSORSTOM 3, stn DR 130, W of Panay, 11°37'N, 121°43'E, 178-195 m, 5.VI.1985, 1 ♀ 8 mm (MNHN-Pa 1087).

Indonesia. Arafura Sea, Kai Ids. *Challenger* Expedition, stn 192, 5°49'15"S, 132°14'15"E, 256 m, blue mud, 26.IX.1874, 2 ♂ ♂ paralectotypes 18 and 19 mm, 1 ♀ lectotype 23 mm (BM; types of *Arctus cultrifer* Ortmann, 1897).

Danish Expedition to the Kai Ids, 5°47'20"S, 132°13'E, 300 m, clay and mud, 2.V.1922, Th. Mortensen, 2 ♂ ♂ 16 and 18 mm (UZM). — Stn 49, 5°37'10"S, 132°23'E, 245 m, sand, trawled, 3.V.1922, Th. Mortensen, 2 ♀ ♀ 20 and 23 mm, the larger dried out (UZM).

KARUBAR, stn DW 24, 5°32'S, 132°51'E, 230-243 m, 26.X.1991, 1 juv. ♀ 9 mm (MNHN-Pa 1912). — Stn CP 36, 6°05'S, 132°44'E, 210-268 m, 27.X.1991, 9 ♂ ♂ 11-20 mm, 15 ♀ ♀ 11-20 mm (none ov.) (MNHN-Pa 1880; RMNH D 48747; USNM 1000652).

Hawaiian Islands. Brooks Banks, NW Hawaiian Ids, 124 m, 24.V.1980, regurgitated by *Epinephelus quernus* Seale, 1901, 1 ov. ♀ 21 mm (in poor condition) (BPBM).

DISTRIBUTION. — As shown by the above material and by the records in the literature, the species has a wide distribution in the Indo-West Pacific region, but the records give a rather disjunct picture. In the first place the species is known from the western Indian Ocean: 1) East coast of Africa from Kenya (present records) to Mozambique (Barnard 1926), Madagascar area (present records) and 11°25'S, 61°39'E (present record); 2) Japan: numerous records from the Pacific coast south of Inubo-zaki at 35°42'N (Baba *et al.* 1986) to the Ryukyu Islands (Shirai 1980); 3) NE Taiwan (Chan & Yu 1993); 4) Chinese coast (Huang 1994; Wang *et al.* 1998); 5) Philippines: off entrance to Manila Bay (present records) and between Masbate and Leyte (present record); 6) Indonesia: Kai Islands; it is interesting that all the records from Indonesia (by three expeditions, from 1874, 1922 and 1991 respectively) are only from the Kai Islands; and 7) Hawaiian Islands: Brooks Bank, NW Hawaiian Islands (Titgen 1988); record not certain as animal from fish stomach and partly digested.

HABITAT. — The examined material has been taken from depths between 124 and 300 m. A record of 18 m depth is doubtful. The bottom is given in a few instances, being described as: hard bottom, coarse coral sand, muddy sand, and mud.

DESCRIPTION

The rostrum is rather broad, constricted behind the top; the anterior margin is often somewhat bilobed. Dorsally the rostrum bears a large and sharp rostral tooth. There is no pregastric but only a well-developed gastric tooth between the rostral tooth and the cervical groove. Behind the cervical groove there are two distinct flattened submedian tubercles, which replace the cardiac tooth. Several flattened tubercles are placed on the postrostral carina both before and behind the cervical groove; these tubercles are arranged in indistinct longitudinal rows. The branchial carina is rather widely interrupted by the cervical groove; no tubercle is found in the gap. The anterior branchial carina ends in two sharp teeth of about equal size, that are situated on the inner orbital margin. Behind the posterior of these teeth there are a few indistinct tubercles. The posterior branchial carina ends anteriorly in a tooth and bears a double (in the posterior part treble) row of about eight to 12 tubercles. The anterior submedian carina shows two or three large and a few small tubercles. At each side of the posterior postrostral carina, in place of the posterior submedian carina there is a group of irregular tubercles. The intermediate row consists of four tubercles. The lateral margin of the carapace bears about five or six mostly inconspicuous anterolateral teeth, about four to six inconspicuous mediolateral teeth of which the anterior is sharp, and 10 to 12 posterolateral teeth, the first of which is large, the rest smaller. A postorbital tubercle is present. The intercervical ridge consists of an irregular group of two to five tubercles, while a further tubercle is placed more to the interior. The marginal groove is rather narrow and deep, before it there are three and behind it two transverse rows of tubercles. The posterior margin is triangularly incised in the middle.

The first abdominal somite has a complete transverse groove extending over its full width; before this groove there are traces of a second similar

groove in the shape of two extremely short transverse grooves in the submedian region. The posterior half of the first somite shows numerous (more than 20) longitudinal grooves, most of which are forked distally and provide this part of the somite with an arborescent pattern. The following somites, like the first, bear no longitudinal median carina. The anterior part of these somites is smooth but for a single transverse groove which is widely interrupted in the middle; sometimes there are two or three rather indistinct transverse grooves that may form a kind of irregular squamiform pattern. The posterior half of the somites shows the usual arborescent pattern of narrow grooves; the median figure of this pattern is lobulated. Somites I to III show a deep triangular median incision in the posterior margin, in somite IV this incision may be obscure, in somites V and VI it is absent. The pleura of somite I are bilobed, those of somites II to IV are large and end in a sharp point which is directed posteriorly; the pleura of somite V end in a blunt angle. The margins of the pleura are entire or indistinctly serrate. The arborescent pattern of the somites continues onto the pleura and are also found on the sixth somite and on the hard part of the telson. The four teeth at the posterior margin of the hard part of the telson are of about equal size.

The anterior margin of the antennular somite is sinuous: the inner part of each half is convex, the outer half concave.

The distal margin of the last (sixth) segment of the antenna is convex and bears five teeth which (apart from the broad outer tooth) gradually taper towards an acute narrow tip. The inner margin of the segment bears a single tooth. The antero-internal angle of the fifth segment has a sharp tooth, which carries a dorsal carina. The anterior margin of the fourth segment shows two large teeth (in juveniles sometimes only one), while also two large teeth are present on the outer margin of this segment (the apical tooth excluded). This fourth segment has a distinct, but not very high median carina; no additional carinae or tubercles are present on the outer half of the segment.

The anterior margin of the epistome shows a distinct median incision.

P.1 is more robust than P.2. The dactylus of P.2 is slightly longer than either that of P.1 or P.3. That of P.4 is slightly shorter than that of P.3, being practically of the same length. None of the dactyli shows a dorsal hairy fringe, neither is the lower margin of the propodus pubescent in any of the legs; the upper margin and the outer surface of the propodus of P.1, P.2 and P.5 are naked, but that of P.3 has a distinct dorsal fringe of hair, and in P.4 such a fringe, although indistinct, is present also. The outer surfaces of the propodus of both P.3 and P.4 show two longitudinal hairy grooves which are absent in the other legs. The propodus of P.3 is flattened, much wider than that of P.2, and also broader than the merus; it ends in a distinct flattened anteroventral tooth, which can act as a subchela with the dactylus; a similar, but much smaller and less distinct tooth is present in the propodus of P.4. The propodus of P.4, although somewhat flattened, is not widened, while that of P.2 is not flattened at all. The carpus of P.3, and less distinctly so that of P.4, are similar to the propodus in having a dorsal fringe of hair and two outer hairy grooves. The carpus of the other legs do not have the dorsal fringe of hairs, while the outer surface of the carpus of P.1 and P.2 are smooth, that of P.5 has a single hairy groove. The merus of P.1 has one or two hairy grooves on the outer surface, those of P.2 to P.5 have two such grooves, the lower of these becoming gradually transposed to the lower surface of the segment. The juvenile female with cl. 9 mm does not yet show a chela on P.5.

The anterior part of the thoracic sternum is produced; its anterior margin is truncate with a median fissure, which continues as a deep longitudinal groove, so that this part of the sternum in transverse section is V-shaped. The rest of the sternum is shallowly excavate and shows no median tubercles. The posterior margin of the sternum is not tuberculate. The posterolateral angles of the sternum near the base of P.5 of the male show a rectangular tooth which is absent in the female.

In the male the pleopods of abdominal somites II to V have the exopod well-developed, those of somite II ending in a long narrow tip. The endopod of somite II is about as large and of the same

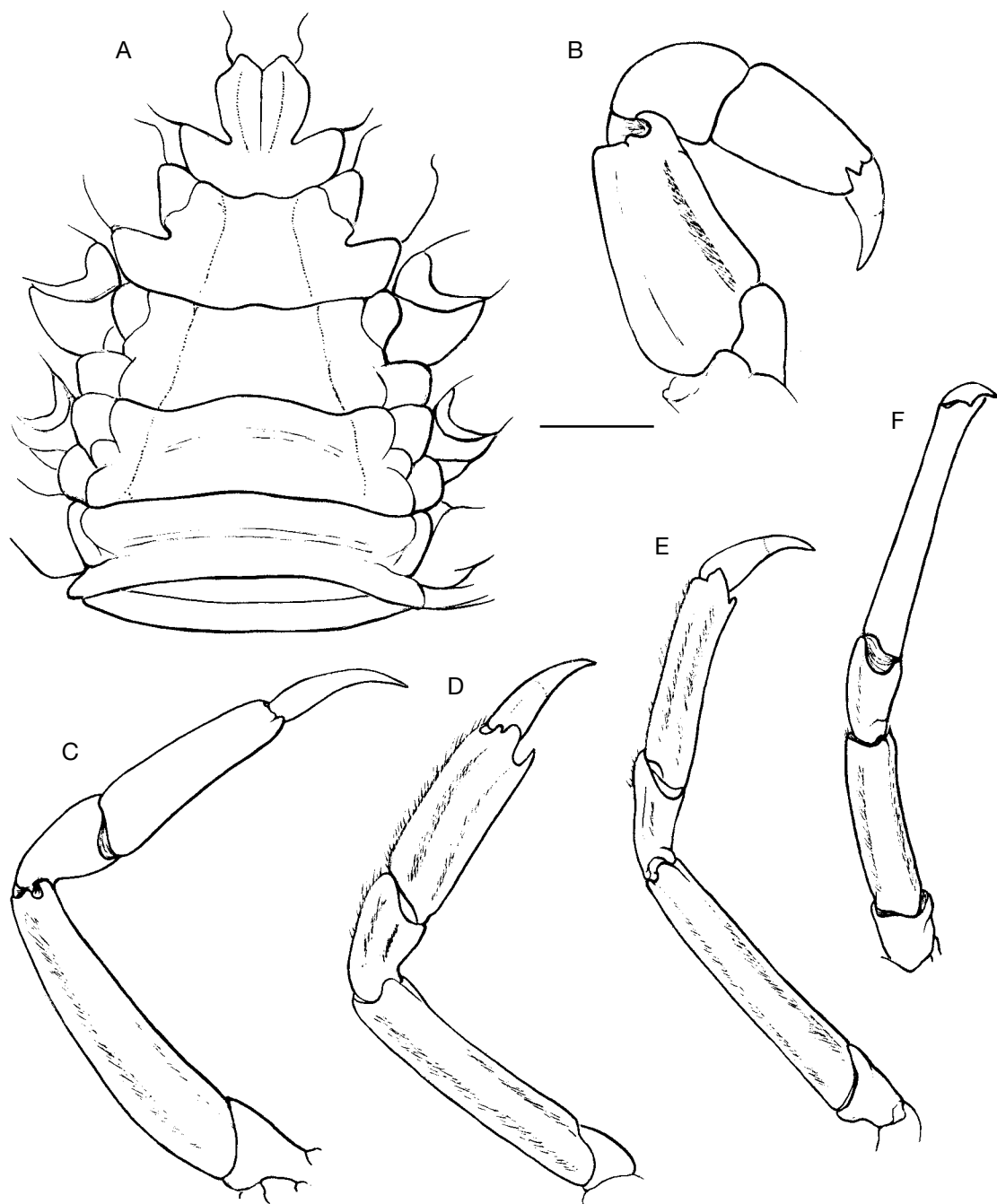


FIG. 27. — *Chelarctus cultrifer* (Ortmann, 1897) n. comb., Philippines, MUSORSTOM 1, stn 35, ♀; **A**, thoracic sternum; **B-F**, pereopods 1 to 5. Scale bar: 4 mm.

shape as the exopod, in the other pleopods it is reduced to a mere short vermiform process.

Size

The examined males had a cl. of 8 to 26 mm, the females from 8 to 31 mm. The ovigerous females ranged between cl. 21 and 31 mm; the largest non-ovigerous female had cl. 24 mm.

Colour

Many colour figures of the present species have been published, especially in the popular Japanese guide books for the marine fauna. In many of these, "*Scyllarus cultrifer*" is shown as the only representative of its genus, and one wonders if the identifications are always trustworthy; also some of the photographs may have been taken from preserved animals, and it seems good therefore not to accept all the figures as providing an accurate impression of the colour of this species. One of the most reliable photographs is the one by Chan & Yu (1993), which gives not only the colour of a fresh animal, but also provides the morphological details that identify the species. In their photograph the carapace is given as dark greyish brown with a broad lighter transverse band in the posterior part and a narrower one just before the middle. The abdomen is brownish red becoming paler posteriorly, the tailfan being transparent. On the first abdominal somite a broad red spot occupies the median area; it is flanked by two narrow yellow longitudinal bands, and the rest of the somite is reddish brown like the next somite. The antennae are greyish mottled with some brown and with white tips on the marginal teeth. The legs are yellowish with a dark blue band over the middle of merus, carpus and propodus. In other figures the carapace is almost uniformly very dark brown (with only the teeth lighter), strongly contrasting with the rather pale reddish abdomen; the antennae being paler greyish brown (Kubo 1960; Miyake 1975; Shirai 1980; Takeda 1982). The orbits often are reddish. The colour pattern of the first abdominal somite shown by Chan & Yu (1993) is not, or not distinctly visible in most other coloured figures, which as a rule

are smaller and less detailed. Dr Chan (pers. comm.) informed me that the coloured photographs of this species published by Debelius (1999a), Minemizu *et al.* (2000) and Kato & Okuno (2001) give a good picture of the living animal.

Larvae

There are numerous records of larvae from the eastern and western Indian Ocean, especially from off Java and Sumatra (Tampi & George 1975; Prasad *et al.* 1980), but in view of the difficulty of identification of Scyllarid larvae and especially of those of the subfamily Scyllarinae, which is so rich in species, the identifications have to be treated with some reserve.

Type

When Ortmann in 1897 proposed the name *Arctus cultrifer* he intended it as a replacement name for *Scyllarus arctus* var. of De Haan (1841), *Arctus sordidus* sensu Bate 1888 (*non* Stimpson 1860) and *Arctus haani* Ortmann, 1891 (*non* Berthold, 1845). As pointed out by Holthuis (1946: 94-96) the material that De Haan (1841) indicated as *Scyllarus arctus* var. consists of three species, viz., *Crenarctus bicuspidatus* (De Man, 1905) n. comb., *Eduarctus martensii* (Pfeffer, 1881) n. comb. and *Remiarctus bertholdii* (Paulson, 1875) n. comb. These three species were indicated by Herklots (1861) with the names *Scyllarus arctus* vars a, b and c, respectively. It is obvious that Ortmann (1897) assigned var. a (thus *C. bicuspidatus* n. comb.) to his *Arctus cultrifer*. Bate's *Arctus sordidus*, as well as Ortmann's own material belong to the true *Chelarctus cultrifer* n. comb. As Ortmann's *Arctus cultrifer* is a composite species, it seems reasonable to select a lectotype for it. Therefore I now select as lectotype specimen for *Arctus cultrifer* Ortmann, 1897, the female specimen collected by the *Challenger* Expedition at its stn 192, which was described and figured by Bate (1888: 66, pl. 9 figs 3, 3", 3q, 3r) under the name *Arctus sordidus*, and at present preserved in The Natural History Museum (BM). The restricted type locality hereby becomes "off the Ki [= Kai] Islands, Arafura Sea, 5°49'15"S, 132°14'15"E, 256 m, blue mud", Indonesia.

REMARKS

As already pointed out by Chan (1997), the differences between *Chelarctus c. cultrifer* and *C. c. meridionalis* (Holthuis, 1960), when a large material is studied, prove to fall within the range of variation of the characters of the species. Therefore the subspecies is abandoned here.

Chelarctus aureus (Holthuis, 1963) n. comb.
(Figs 28; 29)

Scyllarus aureus Holthuis, 1963: 59. — Burukovsky 1974: 106; 1983: 149. — Phillips *et al.* 1980: 69.

TYPE MATERIAL. — Holotype: ov. ♀ 15 mm, RV *Albatross*, stn D 5371 (USNM).

TYPE LOCALITY. — Philippines. Tayabas Light (outer), N 43°W 6 miles, 13°49'40"N, 121°40'15"E, 152 m.

MATERIAL EXAMINED. — **South China Sea.** *C.* 60 miles off Sarawak, 4°44'N, 113°23'E, *Te Vega* Expedition, stn 60, 6 foot beam trawl, 100 m, 6.X.1963, I. Bennett leg., 1 juv. ♂ 9 mm (AM P.15818), 2 ♀♀ 14 and 15 mm (USNM).

Philippines. Tayabas Light (outer), N 43°W 6 miles, RV *Albatross*, stn D 5371, 13°49'40"N, 121°40'15"E, 152 m, green mud, 24.II.909, 1 ov. ♀ holotype 15 mm (USNM). — Off Lubang Id, MUSORSTOM 1, stn 56, 13°53.1'N, 120°08.9'E-13°53.3'N, 120°10.7'E, 129-134 m, 26.III.1976, 14 ♂♂ 7-12 mm, 4 ♀♀ 7-11 mm (MNHN-Pa 1049 and RMNH D 39372).

Indonesia. Strait Macassar, CORINDON, stn 273, 1°56.0'S, 119°16.0'E, 180-220 m, 7.XI.1980, 3 ♂♂ 8-12 mm, 2 ♀♀ 7 and 13 mm (MNHN-Pa 1056; RMNH D 39373).

Fiji Islands. South of Viti Levu. MUSORSTOM 10, stn CP 1363, 18°12.4'S, 178°33.0'E, 144-150 m, 15.VIII.1998, 6 ♂♂ 8-10 mm, 7 ♀♀ 7-11 mm, 3 of these ov. 10-11 mm (MNHN-Pa 1894; RMNH D 48748; USNM 1000649). — Stn CP 1366, 18°12.4'S, 178°33.1'E, 149-168 m, 15.VIII.1998, 5 ♂♂ 7-10 mm, 1 ♀ 10 mm (MNHN-Pa 1892). — Stn CP 1370, 18°12.3'S, 178°33.1'E, 113-123 m, 16.VIII.1998, 1 ov. ♀ 11 mm (MNHN-Pa 1911).

DISTRIBUTION. — So far, the species is known only from the material dealt with here, which was taken at one station off Borneo, two stations in the Philippines, one in Indonesia, and three in the Fiji Archipelago.

HABITAT. — The depths at which the species so far has been found are 100 m, 113-123 m, 120-200 m, 129-134 m, 144-150 m, 149-168 m, and 152 m, the range thus being 100-152(-200) m. The type was found on green mud, the kind of bottom of the other stations where the species was taken is not known.

DESCRIPTION

The rostrum is rather broad and is constricted behind the top; it bears dorsally a small and low, but rather sharp rostral tooth. Behind the rostral tooth is a low median carina on which there are some small squamiform tubercles. There is no pregastric tooth, but the gastric tooth is well-developed, it is sharply pointed and is placed closer to the rostral tooth than to the cervical groove. A rather narrow field of squamiform tubercles (about five rows of four to 11 tubercles) is present behind the gastric tooth. The cardiac tooth is indicated by two low blunt squamiform submedian tubercles, which are placed side by side behind the cervical groove. Behind these two tubercles there is a rather irregular double row of about eight squamiform and flattened tubercles.

The branchial carina is rather widely interrupted by the cervical groove; there is no tubercle in the gap. The anterior branchial carina ends in two teeth, that are placed on the inner orbital margin; the posterior is smaller than the anterior. Behind the posterior tooth the carina bears numerous small squamiform tubercles; a ridge with about eight small tubercles splits off from the anterior branchial carina and curves down about parallel to the posterior orbital margin. The posterior branchial carina ends anteriorly in a sharp tooth and bears a dorsal row of about 10 squamiform tubercles. The posterior submedian carina bears a row of three small tubercles, while two or three tubercles are placed next to the posterior postrostral carina. There are three tubercles in the intermediate row. The anterior submedian carina bears one or two tubercles which are rather vague. The lateral margin bears about 10 very small anterolateral denticles; at first sight this part of the margin seems smooth. The anterior mediolateral tooth is remarkably sharp and pointed, the following teeth, seven in number, are low, short, broad and squamiform. The gap between the medio- and posterolateral teeth is very wide. There are about 14 posterolateral teeth, which are broad, blunt and squamiform. Between the posterolateral row and the posterior branchial row there are about eight small round-ed tubercles which are placed close to or even

against the posterior branchial carina. The intercervical carina bears seven tubercles which are so short and wide that they resemble seven short parallel ridges. There is no postorbital tubercle. The marginal groove is rather wide and deep; before its median part there is a single or double transverse row of tubercles, which are absent laterally. Behind the groove a double row of tubercles is visible. The posterior margin of the carapace is shallowly triangularly incised in the middle. The greater part of the carapace between the tubercles and the ridges is covered with a dense pubescence which shows a golden shine. This golden shine was absent in the material of all other species of the genus that I have examined.

The abdomen shows no median ridge. The first abdominal somite has a complete transverse groove extending over its full width. The smooth anterior half of the segment before this groove shows a practically complete second transverse groove, which is shortly interrupted in its lateral parts. The posterior half of the first somite bears 33 to 36 short longitudinal grooves, which are not branched. The pleura of the first somite end in two broadly rounded lobes. The following somites bear the usual arborescent pattern of grooves on their posterior half, the central figure of this structure is slightly elevated with deeply lobed margins. The pleura of somites II to IV end in a triangular point which is directed posteriorly, most distinctly so in somite II and hardly so in somite IV, in somite V the pleura end in a broad and blunt apex. The anterior half of somites II to V show two complete transverse ciliated grooves. The posterior margin of somites I to III is distinctly, but not deeply incised in the middle. In somite IV the incision is indistinct; it is absent in somites V and VI. The arborescent or squami-form sculpturation continues on somite VI and the hard part of the telson. Of the four teeth on the posterior margin of the hard part of the telson, the inner are triangular, the outer rectangular, but pointed.

The anterior margin of the antennular somite is concave in each half, it bears no teeth or tubercles.

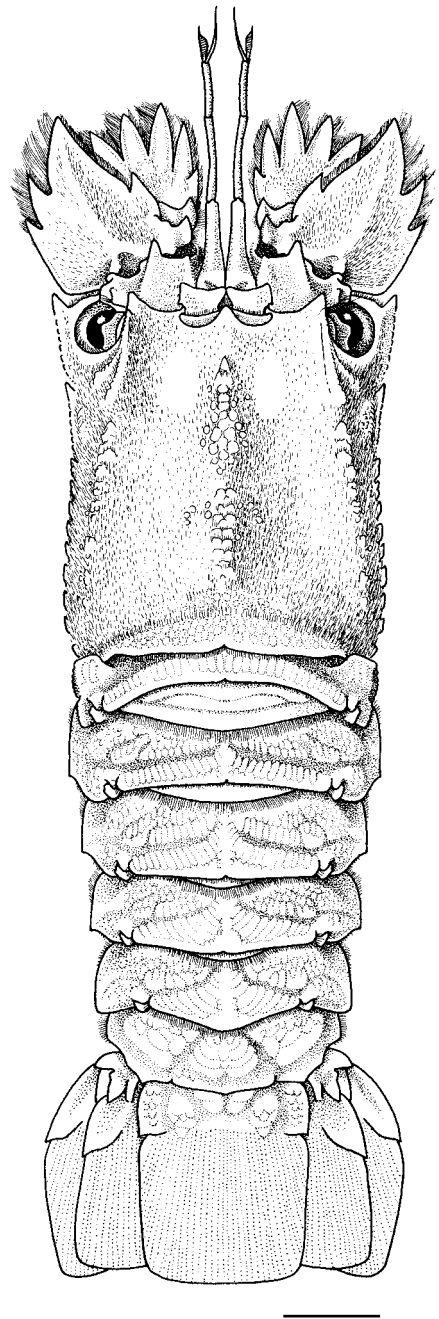


FIG. 28. — *Chelarctus aureus* (Holthuis, 1963) n. comb., Philippines, RV *Albatross*, stn D 5371, ♀ holotype carapace length 15 mm (USNM), dorsal view. Scale bar: 4 mm.

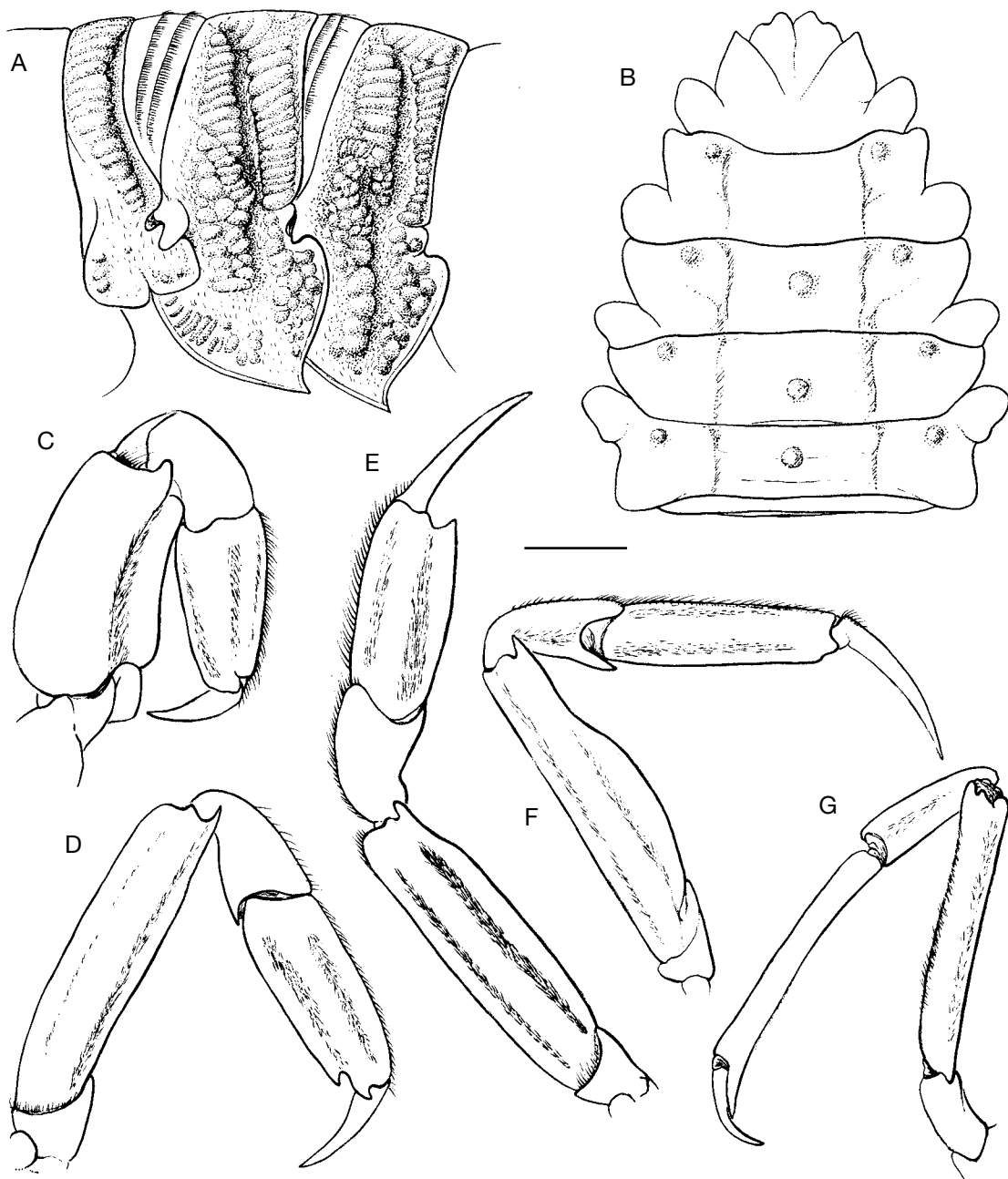


FIG. 29. — *Chelarctus aureus* (Holthuis, 1963) n. comb., Philippines, RV *Albatross*, stn D 5371, ♀ holotype carapace length 15 mm (USNM); A, abdominal somites I to III, lateral view; B, thoracic sternum; C-G, pereiopods 1 to 5. Scale bar: 2 mm. F. Theureau del.

The distal margin of the sixth (last) segment of the antenna is rounded and bears four or five slender teeth, which gradually taper towards the

top, and which are separated by wide triangular interspaces. The inner margin bears one sharp tooth. The antero-internal angle of the fifth seg-

ment ends in a blunt tooth and bears a dorsal carina. The anterior margin of the fourth segment bears a single large tooth in the proximal half, the rest of the margin is entire; the outer margin bears two large teeth. The dorsal surface of the segment shows a strong oblique carina, no other carinae or tubercles are present. The dorsal surface of the antenna is covered with golden hairs like those on the carapace.

The anterior margin of the epistome is straight with a distinct triangular median incision.

P.1 is shorter and more robust than P.2. The dactylus of P.4 is longer than that of any other leg, being slightly longer than or practically as long as that of P.3, which in its turn is again longer than the dactylus of P.2; that of P.1 is still shorter, being only slightly more than half as long as that of P.4; the dactylus of P.5 is the shortest. The chela of the fifth leg in the female has the dactylus very long and slender, it curves hook-like over the end of the fixed finger. A few short hairs are present in the proximal upper part of the dactyli of P.1 to P.3, but no real dorsal fringe is visible in any of the dactyli. The propodus of P.1 to P.4 shows a distinct dorsal fringe of hairs; the segment itself is distinctly flattened and is produced ventrally into a sharp edge, which anteriorly ends in a tooth. This tooth is present in all four legs, but is most distinct in P.3, least in P.4. The outer surface of the propodus of these legs shows two broad longitudinal hairy grooves; in P.1 there is even an additional third groove in the dorsal half. The propodus of P.5 is more or less cylindrical. The carpus bears a dorsal fringe in P.3; in P.2 and P.4 there is a short fringe distally on the upper margin and some short scattered hairs proximally. In P.1 the dorsal margin of the carpus is sharply carinate, the inner surface shows a shallow groove in the upper part and bears some scattered short hairs. In P.2 to P.4, the lower margin of the carpus ends in a distinct tooth. The outer surface of the carpus of P.4 and P.5 shows a longitudinal hairy groove. Like the propodus, the merus of P.1 to P.4 bears a high alate carina on the ventral margin, which ends in a distinct distal tooth. The carina becomes lower distally; in P.4 the change from the high proximal carina to the low distal one is quite

abrupt in the distal third; in P.2 and P.3 this change is less abrupt and situated closer to the end of the merus. The outer surface of the merus of P.1 shows a longitudinal carina in the lower half, which is separated from the ventral alate carina by a rather deep depression; the upper of these two carinae is interrupted at several places and resembles a row of wide, bluntly truncated teeth. Similar, but less distinctly interrupted carinae are present on the merus of P.2 to P.4, which furthermore have a longitudinal hairy groove in the upper half of the segment. The merus of the fifth leg is about cylindrical with a longitudinal hairy groove on the ventral surface and one in the dorsal half of the outer surface.

The anterior part of the thoracic sternum is produced forward. The median part is broadly rounded with a deep triangular incision in the middle and a shallower and smaller incision in about the middle of each half. The entire median part of the sternum is concave. Median tubercles are present on sternites III to V, that of sternite IV being strongest. The lateral parts of sternites II to V show a distinct tubercle slightly behind the anterior margin. The posterior margin of the sternum is not tuberculate. In sternite V of the males the lobe behind the base of the fifth leg forms a rather high and convex oblique ridge, on the inner side of which is a short but quite distinct ridge which runs parallel to the posterior ridge of the fifth sternite and overlaps its extreme lateral end. In the females the lobe is inconspicuous and the oblique ridge runs parallel with and close to the base of the fifth leg.

C. aureus n. comb. is most closely related to *C. cultrifer* n. comb., but differs in the lower gastric tooth of the carapace, the golden sheen on the hairs of carapace and antennae, the presence of two parallel transverse grooves in the anterior part of the abdominal somites, by having only one tooth on the anterior margin of the fourth antennal segment, by the shape of the legs and that of the sternum.

Size

The males have cl. 7-12 mm, in the non-ovigerous females it is 7-15 mm, while the ovigerous females have cl. 10-15 mm.

Colour

In the Philippine specimens collected during MUSORSTOM 1 colour markings are still visible in the form of dark stripes. These stripes are present: 1) in the central part of the midrib of the fourth antennal segment; 2) in the central part of the posterior branchial carina; 3) in the lateral part of the transverse carinae before and behind the marginal groove; and 4) along the two grooves in the smooth anterior half of the abdominal somites. Furthermore there may be scattered black chromatophores in the posterior half of the abdominal somites accentuating the ridges of the arborescent structures. The hairs on the outer margin of the sixth (last) antennal segment are dark brown as sometimes are also some of the hairs on the inner and outer margin of the fourth antennal segment. The dark colour on the midrib of the fourth antennal segment and that of the hairs of the sixth segment is present and conspicuous in all specimens of the lot; the other dark markings are often inconspicuous or not visible at all. The Fiji specimens show apart from the just mentioned dark markings, a vague spot at either end of the marginal carina at the posterior margin of the carapace.

Chelarctus crosnieri n. sp. (Figs 30; 31; 68C)

TYPE MATERIAL. — Holotype: ♂ 72 mm, BORDAU 2, stn CP 1541 (MNHN-Pa 1887).

TYPE LOCALITY. — Tonga Islands. SW of Tongatapu, 21°15'S, 175°14'W, 319-333 m.

ETYMOLOGY. — This new species is named for Alain Crosnier, as a token of gratitude for the extensive help that he has given with the completion of this paper, and also for his patience with my slow pace.

MATERIAL EXAMINED. — **Tonga Islands.** SW of Tongatapu, BORDAU 2, stn CP 1541, 21°15'S, 175°14'W, 319-333 m, 5.VI.2000, 1 ♂ holotype 72 mm (MNHN-Pa 1887).

DESCRIPTION

The rostrum is rounded anteriorly and constricted at the base, it bears a very distinct and sharp rostral tooth. There is no pregastric tooth, but

the gastric tooth is strong, about as large as the rostral tooth; it is placed somewhat closer to the rostral tooth than to the cervical groove. Between the gastric tooth and the cervical groove there are about seven transverse rows of very low, flattened and rounded squamiform tubercles. The cardiac tooth is very low, consisting of two small rounded squamiform tubercles. Between the cardiac tooth and the posterior marginal groove there are about eight transverse rows of very low and anteriorly rounded squamiform tubercles which together form very low anteriorly crenulated ridges. The submedian ridges are hardly indicated. The branchial carina is low and widely interrupted by the cervical groove; there is no tubercle in the gap. The anterior branchial carina ends in two sharp distinct teeth of about the same size that are placed on the inner margin of the orbit. From the posterior of these teeth three short but distinct ridges extend backward; one of these forms the posterior orbital margin, one the dorsal margin of the branchial ridge and the third lies in-between; none of these three bears any tubercles or teeth. The posterior branchial carina ends in a sharp tooth and it has no tubercles except for a few very flattened rounded squamae that are very inconspicuous and form some eight transverse rows. No intermediate row of tubercles was seen. The lateral margin of the carapace bears a distinct anterolateral tooth; behind this tooth the anterolateral margin bears two hardly visible incisions. The mediolateral ridge ends in a sharp tooth behind which there are a few vague flattened squamiform tubercles. A distinct, broadly rounded tubercle is placed just behind the cervical groove practically next to the anterior mediolateral tooth; together with some faint tubercles it may be considered a remnant of the intercervical ridge. No postorbital tubercle is seen. The anterior tooth of the posterolateral margin is flattened and rounded squamiform; it is hardly larger than the tubercles on the mediolateral and posterolateral margins, the latter being about eight or nine in number. Apart from the low squamiform tubercles on the carinae, no true tubercles are seen on the dorsal surface of the carapace, which is covered by very

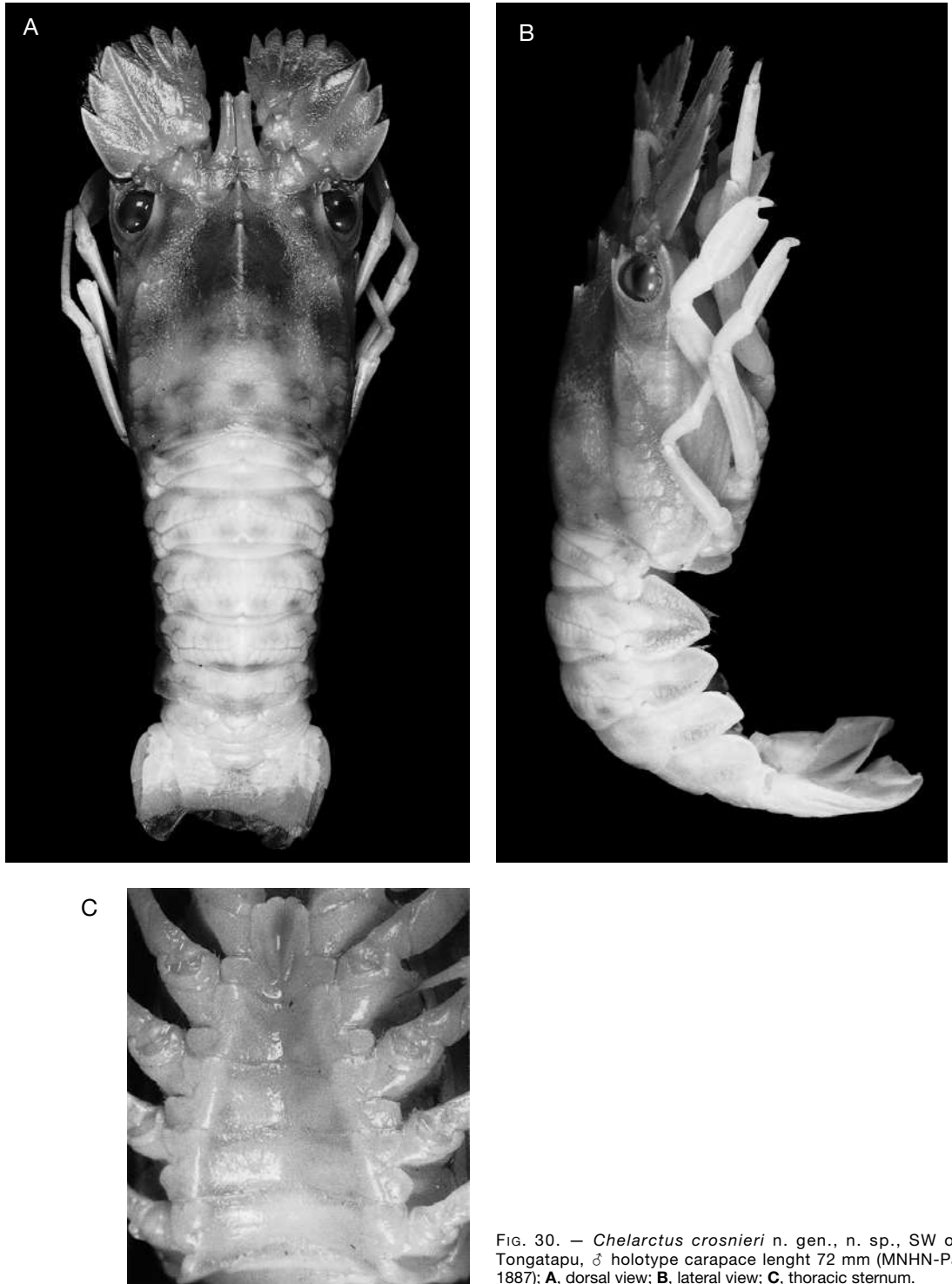


FIG. 30. — *Chelarctus crosnieri* n. gen., n. sp., SW of Tongatapu, ♂ holotype carapace length 72 mm (MNHN-Pa 1887); **A**, dorsal view; **B**, lateral view; **C**, thoracic sternum.

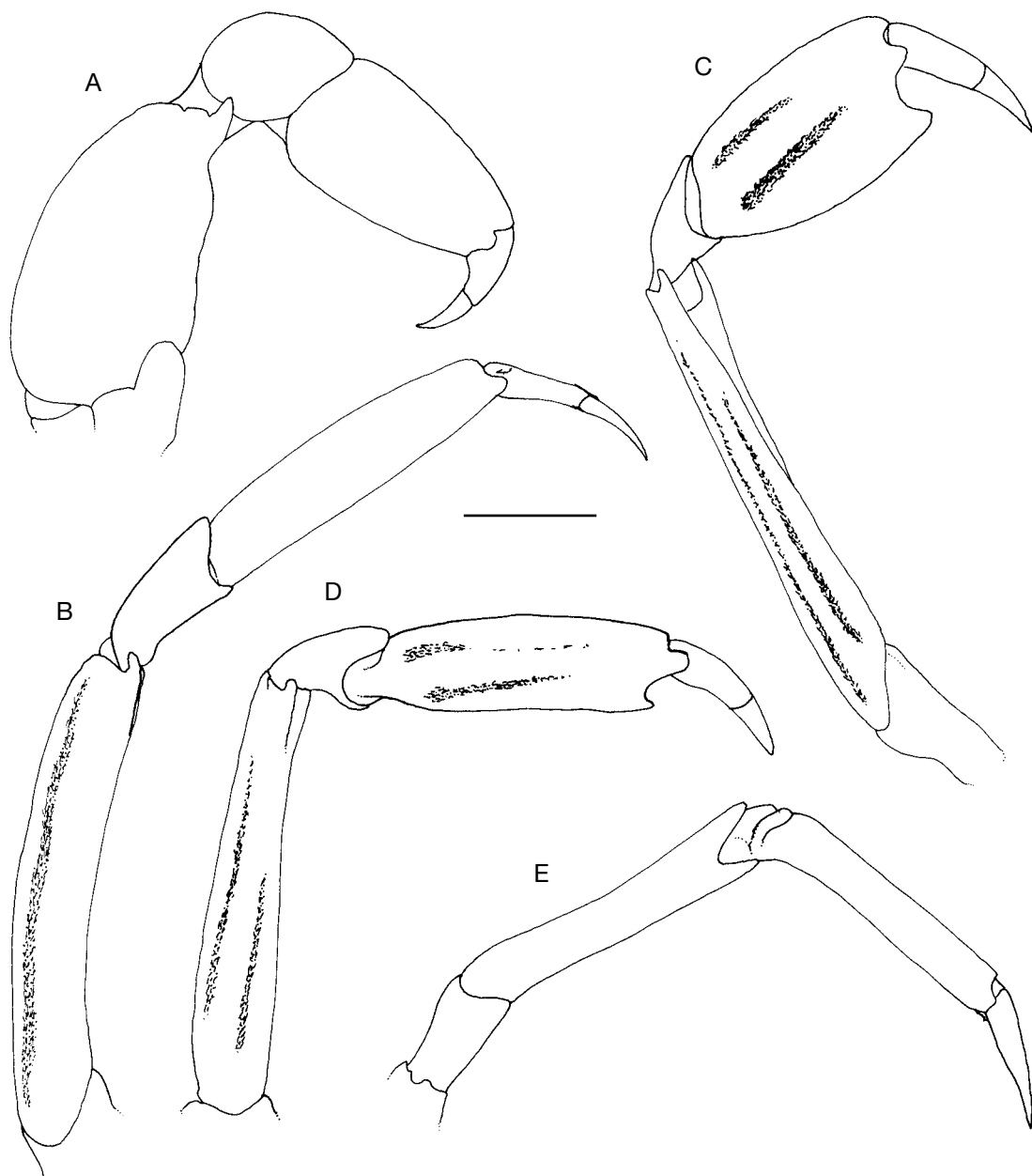


FIG. 31. — *Chelarctus crosnieri* n. gen., n. sp., SW of Tongatapu, ♂ holotype (MNHN-Pa 1887); **A-E**, pereopods 1 to 5. Scale bar: 2 mm.

short hairs, except for a circular area on either side of the gastric tooth. The posterior marginal groove is narrow and deep, filled with hairs; before it there are two smaller transverse rows of

flattened rather indistinct squamiform tubercles; between the groove and the posterior margin of the carapace there are also two transverse rows of small flattened squamiform tubercles. The posterior

margin of the carapace shows a shallow emargination in the middle.

The first abdominal somite has an uninterrupted narrow transverse groove over the middle; behind this groove there are about 20 to 24 short longitudinal grooves, which are not very distinct. The anterior half of the somite is smooth. Abdominal somites II to V have the usual distinct arborescent pattern of narrow grooves in the posterior half, the central part of this pattern forms an oval lobulated figure that is hardly at all elevated and no median carina is present on any of the somites. The anterior half of somite II shows two short interrupted transverse grooves, which are slightly crenulate and bear a posteriorly directed row of very short hairs. In somites III to V, the anterior half is smooth and shows at the most a few small pits. The posterior margin of somites I to III shows a distinct, though small, median incision; this incision is not visible in somites IV and V. The posterior margin of somite VI is slightly convex in the middle. The firm anterior part of the telson shows larger and smaller flattened, rounded tubercles; the posterior margin of this firm part carries four sharply pointed triangular teeth of about the same size. The pleura of abdominal somite I end laterally in two distinct rounded lobes. The margins of pleura II to V are without any teeth, their tops are bluntly rounded. The arborescent markings of the somites continue on to these pleura.

The anterior margin of the antennular somite is concave in each half. There is a median incision flanked by a bluntly rounded tooth at either side. The anterolateral angles of the somite show each two low and inconspicuous blunt teeth.

The distal margin of the last (sixth) segment of the antenna bears six teeth, the outer of which is very broad distally and has the distal margin slightly concave in the middle; the next three teeth have the distal margin rounded with a small sharp tooth at the top. Near the inner margin of the segment are two narrower teeth that end in a triangular point. Behind these two teeth the inner margin of the segment shows a small incision. The inner anterolateral angle of the fifth antennal segment bears a rather wide, sharply tipped

tooth. The fourth antennal segment bears an oblique carina over the full length of the dorsal surface; apart from this carina the upper surface shows no tubercles or ridges. The anterior margin of the fourth segment bears a single large tooth; between this tooth and the top of the segment the anterior margin is minutely serrate. The outer margin of the segment bears two distinct teeth which are about as large as, but distinctly more acute than, the top of the segment.

The anterior margin of the epistome is rather deeply divided in the middle and the two halves are convex.

P.1 is shorter and far more robust than P.2. The dactylus, propodus and carpus are smooth; the outer surface of the merus has a shallow ventral groove filled with very short hairs. The dactylus of P.2 is longer than any other of the dactyli; it is more than half as long as the propodus of P.2. This propodus is slender without any teeth. There are no hairs on either propodus or carpus. The merus is as long as propodus and carpus combined; it has a shallow pubescent groove in the upper half of the outer surface, no other hairs are seen. P.3 has the dactylus slender and slightly shorter than that of P.2. The propodus is strongly compressed and very high, much higher than any of the segments in the other legs, it is as high as long. The anteroventral angle of the propodus is blunt and produced forward, forming a kind of subchela with the dactylus. A blunt ridge extends over the full length of the propodus, above it there are two parallel longitudinal shallow grooves, below it the propodus is strongly keel-like compressed. On the upper margin of the propodus there is a longitudinal row of short hairs. The carpus has some short hairs on the anterodorsal margin. The merus is elongate and has two longitudinal pubescent grooves on the outer surface, but otherwise does not show any hairs. P.4 has the dactylus somewhat shorter than that of P.3. The propodus is compressed, about as long as the propodus of P.3 but slightly more than half its height. The outer surface shows two shallow longitudinal pubescent grooves. The lower margin of the propodus is produced anteriorly in a distinct blunt tooth, which almost

reaches the base of the dactylus. The carpus and merus of P.4 are similar to, but slenderer than those of P.3. No hairy fringes are observed on the dorsal margin of any of the segments. The dactylus of P.5 is shorter than that of P.4; the outer surface of the merus has a shallow longitudinal hairy groove in the upper half. The lower surface of this segment shows a very short pubescence.

The anterior margin of the thoracic sternum is incised in the middle; the two halves are distinctly convex and reach beyond the anterolateral angles of the sternum. The sternum is smooth, with rows of short pubescence at the lines between the segments. Behind the base of the fifth leg the thoracic sternum shows a rounded carina, but no teeth.

The pleopods of the second abdominal somite have the exo- and endopod narrow and slender, reaching the middle of the somite. The pleopods of somites III to V have the exopod small and broadly oval and the endopod reduced to a bud.

Colour

A coloured photograph of the holotype specimen taken when the animal was fresh shows a yellowish grey animal with a remarkable pattern of dark red circular dots and lines. The fourth antennal segment is plain yellowish grey with the oblique dorsal carina red, while there is also some red along the anterior margin. A dark red circle is seen around the eyes and a red line along the anterior margin of the antennular and antennal somites. The tip of the gastric tooth is whitish and at the base of the tooth is a roundish red dot. A transverse row of three of such circular dots is placed in the median area of the carapace behind the cervical groove. A red dot is also visible on the carapace behind the anterior tooth of each posterior branchial carina. A transverse row of red dots extends before the posterior marginal groove; the distance between the inner two is larger than that between each outer pair. There are four smaller dots on the posterior margin of the carapace. Abdominal somite I has a large dark red spot in

the middle; apart from that, there are two dots on each half of the anterior part of the somite and one on each side of the central spot in the posterior half of the somite. Somites II and III each have two transverse rows of four dark red dots (one row in the anterior half of the somite and one in the posterior half). Somites IV and V each have two similar rows of dots, except for the fact that the posterior rows each have only two dots. The tailfan is whitish. P.2 to P.5 have a wide purple band over the merus.

REMARKS

So far the species is only known from the holotype.

Genus *Eduarctus* n. gen.

TYPE SPECIES. — *Scyllarus martensii* Pfeffer, 1881 by present designation.

OTHER SPECIES. — *Eduarctus aesopius* (Holthuis, 1960) n. comb., *E. lewinsohni* (Holthuis, 1967) n. comb., *E. marginatus* n. sp., *E. modestus* (Holthuis, 1960) n. comb., *E. perspicillatus* n. sp., *E. pyrrhonotus* n. sp. and *E. reticulatus* n. sp.

ETYMOLOGY. — A combination of part of the name Eduard, the first name of Eduard von Martens, for whom the type species was named, and the generic name *Arctus* De Haan, 1849. Gender masculine.

DIAGNOSIS. — The rostrum is short and rounded, constricted at the base. Carapace with pregastric, gastric and cardiac teeth; rostral tooth present or absent. Dorsal surface of carapace with numerous squamiform tubercles.

Second, third and fourth abdominal somites with a median longitudinal carina, sometimes low, but often very high. First abdominal somite with a distinct transverse median groove, behind which short longitudinal grooves. Abdominal somites II to IV with an arborescent pattern of very narrow grooves which practically reach both the anterior and posterior margins of the somites. Pleura of the abdominal somites II to V bluntly rounded. Fourth antennal segment with an additional carina in the outer half outside of the oblique main carina; the additional carina composed of distinct tubercles. Anterior margin of thoracic sternum shallowly emarginate between the anterolateral teeth, with a short median incision, that is flanked by a pair of very small tubercles. Legs smooth, no hairs on the lower surface of the propodus of any of them.

KEY TO THE SPECIES OF *EDUARCTUS* N. GEN.

Species dealt with in this paper are in bold.

1. Posterolateral and mediolateral margins of the carapace in one line. Median carina of third abdominal somite usually high, higher than the carinae of the other somites, some of which, however, are also distinctly elevated 2
 - Posterior end of the mediolateral carina of the carapace ending below the anterior end of the posterolateral carina. Median carinae of the abdominal somites usually similar in height, none conspicuously elevated 6
2. The median ridge of the third somite very high, higher than those of the other somites 3
 - The median ridges of abdominal somites II and III only slightly higher than those of the other somites 5
3. The posterior margin of the smooth anterior half of abdominal somites II to IV is straight, non-crenulate 4
 - The posterior margin of the smooth anterior half of abdominal somites II to IV crenulate *E. aesopius* n. comb.
4. The longitudinal grooves on the posterior half of the first abdominal somite straight, unbranched and of a whitish colour *E. martensii* n. comb.
 - The longitudinal grooves on the posterior half of the first abdominal somite are branched. They do not show a whitish colour *E. lewinsohni* n. comb.
5. The posterior margin of the smooth anterior half of abdominal somites II to IV crenulate. The margins of the pleura of abdominal somites II and III show incisions and blunt teeth *E. pyrrhonotus* n. sp.
 - The posterior margin of the smooth anterior half of abdominal somites II to IV straight. The margins of abdominal pleura II to V are entire, without incisions or teeth, but with a whitish rim *E. marginatus* n. sp.
6. Smaller species, carapace length up to 14 mm. The posterior margin of the smooth anterior half of abdominal somites II to IV straight 7
 - Larger species, carapace length up to 20 mm. The posterior margin of the smooth anterior half of abdominal somites II to IV crenulate *E. reticulatus* n. sp.
7. Inner orbital margin with two distinct teeth *E. modestus* n. comb.
 - Inner orbital margin without teeth *E. perspicillatus* n. sp.

***Eduarctus martensii* (Pfeffer, 1881) n. comb.**
(Figs 32; 33; 68D-F)

Scyllarus Martensii Pfeffer, 1881: 48. — Nobili 1905a: 3. — De Man 1916: 84, pl. 3 fig. 13.

Arctus martensii — Ortmann 1891: 44.

Scyllarus martensii — Balss 1914: 79. — Estampador 1937: 496; 1959: 40. — Holthuis 1946: 96; 1991: 223, figs 421, 422. — Barnard 1947: 382; 1950: 558. — Harada 1962: 128; 1965: 36. — Liu 1963: 231. — Liu & Hsu 1963: 309. — Naiyanetr 1963: 68; 1980: 22; 1998: 44. — Bruce 1965: 290. — McNeill 1968: 25. — Prasad & Tampi 1969: 82. — Holthuis & Sakai 1970: 92, 290. — M. W. Johnson 1971b: 265, figs 62-64. — Berry 1974: 13-15. — Tampi & George 1975: 35, figs 37-41. — Phillips *et al.* 1980: 70; 1981: 418. — Prasad *et al.* 1980: 86, fig. 11. — Kensley 1981: 30. — Miyake 1982: 84. — Prasad 1983: 144, fig. 3b. — Barnett *et al.* 1986: 601, fig. 5. — Chan & Yu 1986: 153, pl. 3, pl. 8 figs C, D; 1993: 199, col. fig. — Phillips & McWilliam 1986: 133, figs 1-11. — Sekiguchi 1986a: 1289-1291; 1986b: 15, 17; 1986c: 293; 1987a: 331; 1987b: 415, 417, 418; 1988: 3; 1989b: 457; 1992: 212. — Barnett 1989: 123. — Wang 1991: 217, fig. 177. — Yamaguchi 1993: 588. — Yamaguchi & Baba 1993: 252, fig. 59. — Huang 1994: 564. — McWilliam *et al.* 1995: 564. — Nguyễn Văn Chuang & Phạm Thị Du 1995: 104. — Coutures 1996: 132. — Richer de Forges & Laboute 1996: 65. — Fransen *et al.* 1998: 159. — Wang *et al.* 1998: 446, 448.

Non *Scyllarus martensii* — Edmondson 1933: 223; 1946: 258. — Matthews 1954: 205, figs 1, 2B, 3B, 5B (= *Arctides regalis*). — Hwang & Yu 1983: 264, fig. 6 (= *Galearctus kitanoviriosus* n. comb.). — Debelius 1999a: 224, fig.; 1999b: 224, fig.; 2000: 224, fig. (= *Galearctus timidus* n. comb.).

Scyllarus Arctus var. — De Haan 1841: 154; 1844: pl. 38 fig. 2 (second variety).

Scyllarus Arctus var. b — Herklots 1861: 142.

Scyllarus Martensi — Nobili 1903: 12. — Serène 1937: 71.

Scyllarus martensi — Borradaile 1904: 754, pl. 58 fig. 4. — Dawydoff 1952: 136. — Burukovsky 1974: 107; 1983: 150.

Non *Scyllarus martensi* — Rathbun 1906: 896, pl. 18 fig. 2 (= *S. modestus*). — Hiatt 1954: 30 (= *S. modestus*).

Thenus orientalis — Stebbing 1920: 267 [non *T. orientalis* (Lund, 1793)].

?*Scyllarus* spec. B — Berry 1974: 14, fig. 41.

TYPE MATERIAL. — Syntypes: 2 ♀♀ both 9 mm, 1 ov. (ZMH).

TYPE LOCALITY. — Amur. See Material examined.

MATERIAL EXAMINED. — **Arabia.** Masqat (= Muscat), 1925, Major S. G. Knox, 1 ov. ♀ 8 mm (BM).

Somalia. IIOE, RV *Anton Bruun*, cruise 9, stn 453, 11°11'N, 51°14'E, 47-49 m, 17.XII.1964, 1 ♂ 9 mm, with bopyrid in right branchial chamber (USNM).

Kenya. RV *Manihine*, cruise 352, stn D6, 2°42'S, 40°39.5'E, 73 m, dredge, coral rock, B. Benbow & A. J. Bruce, 1 ♂ 7 mm (RMNH D 49564). — Cruise 336, trawl 30, 4°46'S, 54°23'E, Agassiz trawl, 55 m, sand, 17.II.1972, A. J. Bruce, 1 ♂ 7 mm, 1 ♀ 7 mm (RMNH D 30589). — Cruise 357, stn 4 (AT-1), 23.IV.1973, A. J. Bruce, 2 ov. ♀♀ 7 mm each (RMNH D 49563). — Stn 130, Wasin Id off Shimoni, 4°40.5'S, 39°20.0'E, dredge, 13 m, mud, 22.IX.1971, A. J. Bruce & N. Bruce & P. S. Sandhu, 1 ♂ 10 mm (RMNH D 49565).

Zanzibar. Received 1971, A. J. Bruce, 1 ♂ 8 mm (RMNH D 28601).

Mozambique. 20-25 m, 1887, Mr Heurtel leg., 1 ov. ♀ 11 mm (MNHN-Pa 269).

Seychelles. REVES 2, stn 3, 5°13.3'S, 56°40'E, dredge, 50 m, 2.IX.1980, 1 ♂ 7 mm (MNHN-Pa 1065). — Stn 5, 5°05.4'S, 56°24.5'E, dredge, 33 m, 4.IX.1980, 1 ♀ 6 mm (MNHN-Pa 1063). — Stn 37, 4°25.2'S, 55°12.2'E, dredge, 65 m, 10.IX.1980, 1 ♂ 7 mm (MNHN-Pa 1064).

Tyro Seychelles Expedition 1992-1993, stn 712, NE of Aride Id, 4°10'S, 55°42'E, 4-foot Agassiz trawl, 55 m, 18.XII.1992, 1 ♂ 9 mm (RMNH D 49566).

Madagascar. NW coast. Nosy Bé, 1 ♀ 7 mm (ZSM). — Baie d'Ampasindava, stn 11, 13°28.5'S, 48°05'E, 45 m, R. Plante, 1 ♂ 7 mm (MNHN-Pa 581). — RV *Vauban*, stn CH 129, off Majunga, 15°25'S, 46°03.5'E, trawled, 57 m, 19.I.1975, 1 ♀ 7 mm (MNHN-Pa 571).

Ceylon (Sri Lanka). Gulf of Mannar, Pearl Banks, 12.XI.1909, R. Biedermann-Imhoof, 1 ♂ 8 mm, 1 ov. ♀ 9 mm (ZMH).

Burma. Gulf of Martaban, 1888, E. W. Oates, 2 ♀♀ 10 mm (BM).

West of Malay Peninsula. S. Thai-Danmark Expedition, stn 1168, 9°43'N, 98°20'E, 23 m, sandy mud, 6.III.1966, 2 ♀♀ 10 (ov.) and 11 mm (UZM).

Far East. "Amur", 2 syntype ♀♀, 1 ov. both 9 mm (ZMH). As already pointed out by Holthuis (1991: 223), the type locality "Amur" of the present species is highly doubtful. Pfeffer (1881) in the original description did not mention any locality for the species; he might have some doubts on its correctness, or the locality indication was added later to the material. The mouth of the Amur River lies far north of the range of any *Scyllarus* species. It seems best therefore to ignore this locality record, even though it is given to the type material.

Japan. Japan, 2 ♂♂ 7 and 8 mm, 1 ♀ 11 mm (AM). — Sagami Bay near Manazuru, Honshu, 1968, T. Sakai, 1 ♂ 10 mm (RMNH D 49567). — Tosa Bay,

Shikoku, 13.IX.1961, K. Sakai, 5 specimens 8-10 mm (BM). — Tosa Bay, 60 m, 29.IX.1985, M. Toriyama & K. Baba, 1 ♀ (RMNH D 39293). — Nagasaki, Kyushu, James Jordan, H. F. E. Jungersen don., 1 ♀ 11 mm (UZM). — Probably Nagasaki region, Kyushu, 1823-1834, P. F. von Siebold & H. Bürger, 3 dry specimens 9-10 mm (RMNH D 5509). — Mogi, Nagasaki Prefecture, XII.1965, K. I. Hayashi, 2 ov. ♀♀ 11 and 12 mm (Shimonoseki University Fisheries) (RMNH D 38511). — Kagoshima, Kyushu, 1880, L. H. P. Döderlein, 2 ov. ♀♀ 9 and 10 mm (Mus. Strasbourg).

Taiwan. Ta-Chi, I-Lan County, from baby-shrimp trawlers, c. 50-100 m, sand and mud, 9.XI.1980, Tin-Yam Chan leg., 1 ♂ 9 mm (RMNH D 39295); 5.VIII.1984, Tin-Yam Chan leg., 2 ov. ♀♀ 8 and 9 mm (RMNH D).

South China Sea. Near Hong Kong, RV *Albatross*, stn D 5303, 21°44'N, 114°48'E, 62 m, blue mud, 9.VIII.1908, 1 ♀ 7 mm (USNM). — W of Borneo, RV *Cape St. Mary*, cruise 7/64, stn 86, 2°51.5'N, 110°16.8'E-2°51.0'N, 110°17.0'E, trawl, 48-49 m, sandy mud, 16.XI.1964, A. J. Bruce, 1 ov. ♀ 10 mm (RMNH D 30921).

Vietnam. Nhattrang Bay, W of Honlon, dredge, 12 m, shells, sand and Foraminifera, 8.X.1959, J. Knudsen, 1 juv. (UZM).

Gulf of Thailand. RV *Naga*, stn 60-1077, 11.2 miles off Ko Samet, 12°21.6'N, 101°31.9'E, 16' otter trawl, 32 m, 12.XII.1960, 2 ♂♂ 5 and 6 mm, 2 ♀♀ 5 and 8 mm (larger ov.) (RMNH D 31002). — Stn 60-1085, 17.8 miles off Ko Chuang, 12°19.2'N, 100°43.7'E, 16' otter trawl, 33 m, muddy sand, 13.XII.1960, 5 ♂♂ 5-7 mm, 3 ♀♀ 6-8 mm (largest ov.) (RMNH D 31001). — Stn 60-1091, 17.2 miles off Sattakut, 12°17.5'N, 100°18.7'E, 16' otter trawl, 34 m, sand, 13.XII.1960, 1 ♀ 7 mm (RMNH D 31004). — Stn 60-1097, 18.5 miles off Khae Takiap, 12°39.4'N, 100°15.7'E, 16' otter trawl, 33 m, sand, 13.XII.1960, 1 ♂ 6 mm (RMNH D 31005). — Stn 60-1103, 20.5 miles off Laem Phat Bia, 13°05.8'N, 100°26.2'E, 16' otter trawl, 23 m, sand, 13.XII.1960, 1 ♂ 5 mm (RMNH D 31003).

6 miles E of Cape Liant, 16 m, shells, 1.II.1900, Th. Mortensen coll., 1 ov. ♀ 9 mm (UZM). — 4-6 miles S of Koh Samit, 26-33 m, 3.II.1900, 1 ♀ 9 mm (UZM). — W of Ko Chang, trawl, 37 m, mud, 29.I.1900, 1 ♀ 7 mm (UZM). — Between Ko Chang and Ko Chuen, 27 m, mud and shells, 3.III.1900, 1 ♂ (UZM). — W of northern end of Ko Kut, 20 m, 29.I.1900, 1 ov. ♀ 8 mm (UZM). — W of Ko Kut, c. 27 m, 4.III.1900, 1 ov. ♀ 7 mm (UZM). — Between Ko Kut and Ko Kahdat, c. 18 m, shells, 10.I.1900, 1 ♀ 7 mm (UZM).

Ko Sichung, Chonburi province, 9.I.1981, P. Naiyanetr, 4 specimens (RMNH D 39290). — Between Naklua and Si Racha, Chonburi province, trawled, c. 35 m, 14.III.1985, A. C. J. Burgers & L. B. Holthuis, 3 specimens (RMNH D 39292). — Off

Patani Bay, South Thailand, 14.XI.1985, C. Swennen, 1 ov. ♀ 11 mm (RMNH D 39291).

Singapore. Singapore, 4-5 m, 4.XII.1899, Th. Mortensen, 1 ♀ 14 mm (UZM). — Singapore, 31.VII.1902, E. Deschamps, 6 ♂♂ 8-9 mm, 29 ♀♀ 10-12 mm (of which 12 ov. 10-12 mm) (USNM).

Singapore Regional Fisheries Research Station, Bedok, Singapore coast, 5.XII.1956, 1 specimen 7 mm (BM). — Angler Buoy, 9 m, 24.VIII.1956, 2 specimens 8 mm (BM). — Pulau Senang, 18 m, 10 and 31.VII.1956, 2 specimens 8 and 9 mm (BM).

Philippines. RV *Albatross*, stn D 5104, off S Luzon, Sueste Pt. Light S 58°W 1.30 miles, 14°45'48"N, 120°12'20"E, 60 m, 8.I.1908, 1 ♀ 7 mm (USNM). — Stn D 5157, Tawitawi Group, Sulu Archipelago, Tinakta Id. (N) S 80°W 3.30 miles, 5°12'30"N, 119°55'50"E, 33 m, fine sand, 21.II.1908, 1 specimen 9 mm (USNM). — Stn D 5159, Tawitawi Group, Tinakta Id. (N) N 82°W 1.40 miles, 5°11'50"N, 119°55'10"E, 18-22 m, coarse sand and shells or coral sand, 21.II.1908, 1 juv. ♂ 5 mm (USNM). — Stn D 5181, off eastern Panay, Antonia Id. (S) S 63°W 6.60 miles, 11°36'40"N, 123°26'35"E, 48 m, mud and fine sand, 27.III.1908, 1 ♀ 9 mm (USNM).

MUSORSTOM 1, stn 56, N of Lubang Id, 13°53.3'N, 120°10.7'E, trawl, 129-134 m, 26.III.1976, 1 ♂ 56 mm (MNHN).

MUSORSTOM 3, stn CP 142, N of Panay, 11°47'N, 123°02'E, 26-27 m, 6.VI.1985, 3 ♂♂ 9-10 mm, 4 ov. ♀♀ 10-11 mm, 5 non-ov. ♀♀ 8-11 mm (MNHN-Pa 1084; RMNH D 48762).

SIPHILEX 78, RV *Sting Ray V*, stn T.29, Visayan Sea, 11°22'0"N, 123°19'48"E, otter trawl, 37 m, 9.VI.1978, 1 ♂ 11 mm (USNM). — Bohol, 27 m, 1862, C. G. Sempér leg., 5 specimens (ZMB).

Tawitawi Bay, about 9 miles from Bongao Light, Sulu Archipelago, RV *Pele*, 24 m, sand and dead shells, 24.II.1964, B. R. Wilson, 1 ♀ 10 mm (WAM). — South Lagoon, Sibutu, Sulu Archipelago, 4°31'N, 114°22'E, 22 m, sand, 25-26.II.1964, B. R. Wilson, 1 ov. ♀ 10 mm (WAM).

Off Jolo Id, 46 m, sand and coral, 19.III.1914, Th. Mortensen, 1 ♂ 6 mm (UZM).

Indonesia. Sulawesi (= Celebes). North Celebes, III.1840-IV.1842, E. A. Forsten, 1 ♀ 9 mm (RMNH D 5511). — Limbe [recte: Lembeh] Strait near Lembeh Id, N Sulawesi, RV *Albatross*, between stn D 5600 and D 5601, c. 1°10'N, 125°10'E, with electric light, 10.XI.1909, 1 ♀ 9 mm (USNM). — Macassar Strait, W of Sulawesi, CORINDON 2, stn 205, 1°07.8'S, 117°18.7'E, trawl, 49 m, 30.X.1980, 1 ov. ♀ 8 mm (MNHN-Pa 1066). — Samalona Id near Ujung Pandang (= Macassar), Danish Expedition to the Kai Ids, c. 25 m, sand, 29.VI.1922, 1 ov. ♀ 9 mm (UZM).

Java. Java Sea. Danish Expedition to Kai Ids, stn 72, 5°41'N, 105°57'E, Sigsbee trawl, 35 m, stones, 28.VII.1922, 1 ov. ♀ 10 mm (UZM). — 5°48'S, 106°12'E, sand, 27.VII.1922, 1 ov. ♀ 11 mm

(UZM). — Stn 106, 5°50'S, 106°16'E, 32 m, sand, 5.VIII.1922, 1 ♀ 8 mm (UZM). — Stn 64, 5°51'S, 106°22'E, trawl, 35 m, sandy mud and shells, 26.VII.1922, 2 ♂♂ 5 and 6 mm (UZM). — Stn 118, 5°54'S, 106°40'E, Sigsbee trawl, 27 m, sand and shells, 7.VIII.1922, 1 ♀ 6 mm (UZM). — Stn 116, 5°57'S, 106°34'E, Sigsbee trawl, 22 m, sand and shells, 7.VIII.1922, 1 ♀ 7 mm (UZM).

Strait Sunda. Danish Expedition to Kai Ids, stn 82, 6°38'S, 105°21'E, Sigsbee trawl, 35 m, sandy mud, 30.VII.1922, 2 ♂♂ 6 and 7 mm (UZM). — Stn 84, 5°55'S, 105°31'E, 38 m, sandy mud, pumice, 31.VII.1922, 1 ♀ 8 mm (UZM).

East Java, between Surabaya and the north coast of Madura Id, RV *Gier*, Expedition 4, stn 19, 14.XII.1907, 1 ov. ♀ 8 mm (ZMA). — Strait Bali, 8°23'S, 114°29'E, trawl, 70 m, sand, 5.IV.1929, Th. Mortensen, 1 juv. 4 mm (UZM).

Moluccas. Teluk Kau, Halmahera, RV *Te Vega*, stn 54, 1°08.6'N, 128°01'E, just inside narrow entrance, 6' beam trawl, 46-55 m, 25.IX.1963, 1 ov. ♀ 7 mm (AM).

Kai Islands. Danish Expedition to Kai Ids, stn 11, off Tual, Kai Dula, 20 m, sand, 9.IV.1922, 1 ♂ 5 mm, 1 ♀ 6 mm (UZM). — Stn 19, same locality, trawl, 20 m, sand, 12 or 14.V.1922, 1 ♂ 5 mm, 1 ♀ 6 mm, 1 juv. 3 mm (UZM). — Stn 61, between Doe Rowa and Kai Doelah, trawl, 50 m, bryozoans, 14.V.1922, 1 ov. ♀ 9 mm (UZM).

Mariel King Memorial Expedition, stn K.R.VI/H1, N of Doe Rowa, N of Nuhu Rowa Id, 5°32'S, 132°41'E, 33-37 m, sand, 10.VI.1970, 1 ♂ 8 mm, 1 ov. ♀ 8 mm, 1 juv. 4 mm (WAM). — Stn K.R.VI/H3-10, same locality, 5°32'S, 133°41'E, 27-37 m, sand and rubble, 11.VI.1970, 1 ov. ♀ 11 mm (WAM). — Stn K.N.II/H3-4, off Elat Bay, west coast of Nuhu Tjut, 5°40'S, 132°59'E, 49-68 m, rubble, fan coral and sand, 13.VI.1970, 1 ♂ 7 mm (WAM). — Stn K.N.II/H5, same locality, 5°40'S, 132°59'E, 82-139 m, coarse sand and rubble, 13.VI.1970, 1 juv. 5 mm (WAM). — Stn K.N.II/H6, same locality, 5°70'S, 132°59'E, 49-55 m, rubble, algae and sand, 13.VI.1970, 1 ♂ 13 mm (WAM).

Aru Islands. Mariel King Memorial Expedition, stn AWI/H1-2, off west coast of Wasir Id near Wokam Id, 5°30'S, 134°12'E, 24-46 m, mud, 15.VI.1970, 6' beam trawl, 1 ♂ 7 mm (WAM). — Stn AM II/H3, SW of Tandjong Ratu, Maikoor Id, 55-64 m, sand and rubble, 18.VI.1970, 1 ♂ 6 mm, 1 ♀ 7 mm (WAM). Arafura Sea. RV *Helix*, stn M-14, 11°33.5'S, 135°52.5'E, dredge, 22 m, 2.VI.1979, 3 juv. 4-6 mm (USNM).

Australia. Western Australia. Holothuria Bank, off NW Australia, 44 m, 1 ♂ 8 mm (BM). — NW of Bluff Point, Geraldton, CSIRO, stn 131, 27°40'S, 113°03'E, 128 m, sponges and Bryozoa, IV.1963, 1 juv. 5 mm (WAM).

Dampier Archipelago. FV *Davena*, 20 miles N of Delambre Id, about 20°26'S, 117°05'E, 7.VI.1960,

B. R. Wilson, 1 ♂ 11 mm (WAM). — NE of Malus Id, about 20°30'S, 116°41'E, Honolulu dredge, 18 m, 31.V.1960, Mr Royce, 1 ♂ 6 mm (WAM). — 14 miles W of Eagle Hawk Id, about 20°40'S, 116°28'E, 14.VI.1960, B. R. Wilson, 1 ov. ♀ 11 mm (WAM). Northern Territory. Arafura Sea, off Arnhem Land, RV *Helix*-79, stn M.14, 11°33.5'S, 135°52.5'E, 22 m, dredge, 2.VI.1979, 3 juv. 4-5 mm (USNM).

Queensland. FV *Dorothea*, 1962-1963, 1 ov. ♀ 11 mm (WAM). — Thursday Id, Torres Strait, 10°37'S, 142°10'E, 14.VI.1943, 1 ♂ 7 mm (AM). — North end of Albany Passage, about 10°44'S, 142°36'E, VIII-IX.1928, 1 ♂ 6 mm (AM). — 0.5 mile SE of Lizard Id, off Lookout Point, Great Barrier Reef Expedition, stn XIV, about 14°50'S, 145°14'E, dredge, 35 m, 7.III.1929, 1 ♂ 6 mm (BM). — Low Isles, NE of Cairns, about 16°23'S, 145°34'E, 20 m, 25.VIII.1984, C. Jones, 2 ♀♀ 12 and 13 mm, smallest ov. (RMNH D 39338). — Lindeman Id, Whitsunday Passage, 20°27'S, 149°02'E dredged, 16 m, I.1929, 1 ♂ 7 mm (AM). — Humpy Id, Keppel Group, 23°13'S, 150°58'E, under stones, 1964, T. Garrard, 1 ♂ 10 mm (AM P.14929). — Keppel Bay, FV *Ramadoo*, 23°21'S, 150°55'E, 35 m, weedy sand, 12.XI.1976, T. Nielsen, A. J. Bruce don., 1 ♀ 12 mm (RMNH D 39294). — Off southern Queensland, RV *Nimbus*, stn 8, 26°30'S, 153°15'E, 46-48 m, 26.VII.1968, A. J. Bruce, 2 specimens (RMNH D 30922).

Chesterfield Islands. CHALCAL 1, stn CP 7, 19°17.90'S, 158°35.50'E, 65-80 m, 18.VII.1984, 1 ♂ 9 mm (MNHN-Pa 770). — Stn CP 12, 20°35.30'S, 158°47.40'E, 67 m, 23.VII.1984, 1 ♂ 8 mm, 1 ov. ♀ 11 mm (MNHN-Pa 768). — Stn D 44, 20°46.03'S, 158°33.73'E, 79 m, sand with segments of *Halimeda*, 23.VII.1984, 1 ♂ 10 mm (MNHN-Pa 772). — Stn D 50, 21°04.40'S, 158°40.70'E, 70 m, 24.VII.1984, 2 ♂♂ 7 and 10 mm, 1 ♀ 11 mm (MNHN-Pa 767). — Stn D 52, 21°13.40'S, 152°50.20'E, 69 m, 24.VII.1984, 1 ♂ 4 mm (MNHN). — Stn CP 14, 21°13.50'S, 158°50.20'E, 66 m, 24.VII.1984, 4 ♀♀ 8-12 mm, largest ov. (MNHN-Pa 766; RMNH D 39289). — Stn D 55, 21°23.9'S, 158°59.6'E, 55 m, *Halimeda* and Foraminifera, 25.VII.1984, 2 ♀♀ 7 and 11 mm (MNHN-Pa 1787). — Stn CP 15, 21°24.90'S, 159°09.30'E, 60 m, 25.VII.1984, 1 ♀ 10 mm (MNHN-Pa 1191).

CORAIL 1, Bellona Ids, VIII.1988, 2 ♂♂ 7 and 10 mm (MNHN-Pa 1337).

CORAIL 2, stn DW 20, 20°38.97'S, 161°01.01'E, 88 m, 22.VII.1988, 3 ♂♂ 6-8 mm (MNHN-Pa 1289 and 1297). — Stn DW 21, 20°36.14'S, 161°1.75'E, 86 m, 22.VII.1988, 1 ♂ 7 mm, 1 juv. 4 mm (MNHN-Pa 1299). — Stn DW 28, 20°28.07'S, 160°56.34'E, 78 m, 22.VII.1988, 1 ♂ 11 mm (RMNH D 48765). — Stn DW 35, 19°21.65'S, 158°52.69'E, 52 m, 23.VII.1988, 1 ♂ 5 mm (USNM 1000662). — Stn DW 43, 19°21.49'S, 158°25.98'E, 52 m, 23.VII.1988, 1 ♂ 5 mm (MNHN-Pa 1339). —

Stn DW 51, 19°18.58'S, 158°36.55'E, 69 m, 24.VIII.1988, 1 ♀ 7 mm (MNHN-Pa 1290). — Stn DW 57, 19°18.53'S, 158°49.98'E, 65 m, 24.VIII.1988, 1 ♂ 8 mm (MNHN-Pa 1303). — Stn DW 64, 19°15.00'S, 158°43.85'E, 67 m, 24.VIII.1988, 1 ♂ 7 mm (MNHN-Pa 1342). — Stn DW 72, 19°15.3'S, 158°20.89'E, 32 m, 25.VIII.1988, 1 ♂ 4 mm (MNHN-Pa 1292). — Stn DW 73, 19°12.11'S, 158°22.57'E, 41 m, 25.VIII.1988, 2 ♂ ♂ 7 and 8 mm, 1 ♀ 6 mm (MNHN-Pa 1294). — Stn DW 93, 19°05.92'S, 158°53.0'E, 58–60 m, 27.VIII.1988, 1 ♀ 7 mm (MNHN-Pa 1291). — Stn DW 100, 19°05.99'S, 158°26.09'E, 48 m, 27.VIII.1988, 1 ov. ♀ 12 mm (MNHN-Pa 1296). — Stn DW 109, 19°08.97'S, 158°52.50'E, 47–64 m, 28.VIII.1988, 1 ♂ 8 mm (RMNH D 48763). — Stn DW 121, 19°25.08'S, 158°18.00'E, 34 m, 29.VIII.1988, 1 ov. ♀ 11 mm (RMNH D 48764). — Stn DW 152, 19°52.0'S, 158°20.0'E, 51 m, 1.IX.1988, 1 ♂ 9 mm (MNHN-Pa 1302). — Stn DW 154, 19°52.04'S, 158°26.50'E, 35 m, 1.IX.1988, 1 ♀ 7 mm (USNM 1000663).

Lansdowne Bank. CHALCAL 1, stn D 7, 20°50.86'S, 161°36.99'E, 62 m, 14.VII.1984, 1 juv. (MNHN-Pa 773). — Stn CP 3, 20°30.83'S, 161°05.21'E, 15.VII.1984, 1 ♀ 11 mm (MNHN-Pa 765). — Stn D 11, 20°31.52'S, 161°06.60'E, 15.VII.1984, 1 ♂ 6 mm (MNHN-Pa 764).

New Caledonia. N New Caledonia. Huon Atoll. LAGON, stn 439, 18°07'S, 162°55'E, 39 m, 25.II.1985, 1 ♂ 6 mm (MNHN-Pa 1206).

N New Caledonia. Surprise Atoll. LAGON, stn 447, 18°20'S, 163°06'E, 36 m, 28.II.1985, 3 ♂ ♂ 4–5 mm, 2 ♀ ♀ 6 and 7 mm (MNHN-Pa 1218). — Stn 454, 18°30'S, 163°10'E, 36 m, 28.II.1985, 1 ♂ 6 mm, 1 ♀ 5 mm, 1 juv. 3 mm (MNHN-Pa 1237). — Stn 467, 18°25'S, 163°08'E, 41 m, 1.III.1985, 3 ♂ ♂ 4–5 mm, 2 ♀ ♀ 6 mm (ov.) and 7 mm (USNM 1000660). — Stn 468, 18°27'S, 163°10'E, 40 m, 1.III.1985, 1 ♂ 5 mm (MNHN-Pa 1233). — Stn 469, 18°29'S, 163°10'E, 39 m, 1.III.1985, 4 ♂ ♂ 4–7 mm, 2 ♀ ♀ 5 and 6 mm (MNHN-Pa 1229). — Stn 470, 18°28'S, 163°09'E, 41 m, 1.III.1985, 1 ♂ 5 mm (MNHN-Pa 1222). — Stn 475, 18°36'S, 163°11'E, 415–450 m, 2.III.1985, 1 ♂ 6 mm, 3 ♀ ♀ 5, 6 and 7 mm (two largest ov.), 1 juv. 4 mm (MNHN-Pa 1272). — Stn CP 1378, 18°26.3'S, 163°08.2'E, 39 m, 9.V.1999, 1 ov. ♀ 6 mm (MNHN-Pa 1788). — Stn DW 1390, 18°27.5'S, 163°08.7'E, 38 m, 11.V.1999, 6 ♂ ♂ 6–8 mm, 3 ♀ ♀ 5–6 mm (RMNH D 48771). — Stn DW 1396, 18°20.7'S, 163°04.7'E, 39 m, 13.V.1999, 1 ♂ 7 mm (MNHN-Pa 1789).

N New Caledonia. Grand Passage. SMIB 6, stn DW 112, 19°05.6'S, 163°30.2'E, 220–225 m, 2.III.1990, 1 ♂ 10 mm (MNHN-Pa 1369).

N New Caledonia. Cook Reef. CHALUTAGES, stn 13, 19°40.2'S, 163°47.2'E, 42 m, 15.VI.1985, 1 ov. ♀ 12 mm (MNHN-Pa 1253).

N New Caledonia. Belep Islands. CHALUTAGES, stn 37, 19°19.75'S, 163°20.2'E, 61–64 m, 21.VI.1985, 1 ♂ 9 mm, 3 ♀ ♀ 10–12 mm (largest ov.) (MNHN-Pa 1251). — Stn 42, 19°34.0'S, 163°37.7'E, 43–49 m, 22.VI.1986, 1 ♀ 12 mm (MNHN-Pa 1248).

N New Caledonia. Alliance Reef. CHALUTAGES, stn 8, 19°51.8'S, 163°45.1'E, 33–36 m, 14.VI.1985, 1 ♂ 13 mm (MNHN-Pa 1255). — Stn 9, 19°54.1'S, 163°42.9'E, 33 m, 1 ♂ 13 mm (MNHN-Pa 1252).

New Caledonian lagon. Lagon Nord. LAGON, stn DW 1068, 19°57.3'S, 163°52.8'E, dredge, 26 m, 23.X.1989, 1 ♂ 11 mm, 1 ♀ 11 mm (RMNH D 48776). — Stn DW 1069, 19°59.1'S, 163°52.5'E, dredge, 30 m, 23.X.1989, 3 ♀ ♀ 9, 14 and 16 mm, the smaller 2 ov. (RMNH D 48769). — Stn DW 1073, 19°59.8'S, 164°03.0'E, dredge, 28 m, 23.X.1989, 2 ov. ♀ ♀ 9 and 10 mm (RMNH D). — Stn DW 1075, 19°52.0'S, 163°58.4'E, dredge, 28 m, 23.X.1989, 1 ov. ♀ 10 mm (MNHN-Pa 1380). — Stn DW 1110, 19°43.6'S, 163°41.6'E, dredge, 31 m, 25.X.1989, 1 ♂ 11 mm (RMNH D 48773). — Stn DW 1112, 19°40.5'S, 163°44.5'E, dredge, 12 m, 25.X.1989, 1 ov. ♀ 13 mm (RMNH D 48775). — Stn 1116, 19°37.3'S, 163°52.6'E, dredge, 38 m, 25.X.1989, 1 ov. ♀ 11 mm (MNHN-Pa 1372). — Stn DW 1155, 19°09.3'S, 163°15.9'E, dredge, 48 m, 30.X.1989, 1 ♂ 8 mm (MNHN-Pa 1364). — Stn DW 1156, 19°9.5'S, 163°12.6'E, dredge, 55 m, 30.X.1989, 1 damaged ♀ c. 10 mm (MNHN-Pa 1375). — Stn DW 1162, 19°12.2'S, 163°17.5'E, dredge, 62 m, 30.X.1989, 2 ♂ ♂ 10 and 12 mm (MNHN-Pa 1368 and 1383). — Stn DW 1166, 19°15.5'S, 163°15.1'E, dredge, 63 m, 30.X.1989, 1 ♀ 10 mm (USNM 1000658). — Stn DW 1192, 19°35.3'S, 163°24.6'E, dredge, 48 m, 1.XI.1989, 1 ov. ♀ 9 mm (MNHN-Pa 1374). — Stn DW 1194, 19°29.5'S, 163°22.9'E, dredge, 57 m, 1.XI.1989, 1 ♀ 8 mm (MNHN-Pa 1367). — Stn DW 1205, 19°41.6'S, 163°25.6'E, dredge, 38 m, 2.XI.1989, 1 ov. ♀ 11 mm (MNHN-Pa 1366). — Stn DW 1206, 19°44.3'S, 163°27.1'E, dredge, 36 m, 2.XI.1989, 1 ♀ 11 mm (MNHN-Pa 1373). — Stn DW 1214, 19°49.9'S, 163°36.6'E, dredge, 29 m, 3.XI.1989, 1 ♂ 7 mm, 1 ♀ 12 mm (MNHN-Pa 1376). — Stn DW 1215, 19°48.0'S, 163°40.0'E, dredge, 26 m, 3.XI.1989, 1 ♂ 10 mm (MNHN-Pa 1379).

New Caledonian lagon. Lagon Nord-Ouest. LAGON, stn DW 918, 20°54.4'S, 164°27.0'E, dredge, 15 m, 26.IV.1988, 1 ♀ 7 mm (MNHN-Pa 1315, photographed). — Stn DW 919, 20°52.2'S, 164°25.2'E, dredge, 17 m, 26.IV.1988, 1 ♂ with branchial bopyrid parasite 8 mm (MNHN-Pa 1306, photographed). — Stn DW 933, 20°44.9'S, 164°14.9'E, dredge, 90–100 m, 27.IV.1988, 1 ♀ 7 mm (MNHN-Pa 1320, photographed). — Stn DW 934, 20°43.0'S, 164°16.8'E, dredge, 10 m, 27.IV.1988, 1 ♂ 8 mm (MNHN-Pa 1308). — Stn DW 937, 20°39.5'S,

164°15.4'E, dredge, 50-55 m, 27.IV.1988, 1 ♀ 9 mm (MNHN-Pa 1307, photographed). — Stn DW 945, 20°34.6'S, 164°09.8'E, dredge, 15-16 m, 28.IV.1988, 1 ov. ♀ 9 mm (MNHN-Pa 1332). — Stn 948, 20°32.2'S, 164°08.8'E, dredge, 16 m, 28.IV.1988, 1 ♂ with branchial bopyrid parasite 8 mm (MNHN-Pa 1344). — Stn DW 1010, 20°08.9'S, 163° 57.2'E, 16 m, 3.IV.1988, 1 ♀ 7 mm (MNHN-Pa 1316). — Stn DW 1017, 20°07.5'S, 163°51.0'E, dredge, 21 m, 3.IV.1988, 2 ♀ ♀ both 7 mm, 1 (Pa 1317) with branchial bopyrid parasite (MNHN-Pa 1317 and 1324, photographed). — Stn DW 1018, 20°06.6'S, 163°53.1'E, dredge, 21 m, 3.IV.1988, 2 ♀ ♀ 6 and 7 mm (MNHN-Pa 1325 and 1341). — Stn DW 1024, 20°05.5'S, 163°50.3'E, dredge, 26 m, 3.IV.1988, 1 ♂ 10 mm (MNHN-Pa 1321, photographed). — Stn DW 1025, 20°06.7'S, 163°48.6'E, dredge, 25-28 m, 3.IV.1988, 1 ♀ 7 mm (MNHN-Pa 1338). — Stn CP 1029, 20°01.6'S, 163°52.7'E, trawl, 26-27 m, 3.IV.1988, 1 ♀ 13 mm (MNHN-Pa 1328). New Caledonian lagon. Lagon Est. LAGON, stn 603, 22°15.8'S, 167°04.8'E, 78-80 m, 5.VIII.1986, 1 ♂ 5 mm (MNHN-Pa 1182). — Stn 633, 21°55.6'S, 166°48.2'E, 50 m, 6.VIII.1986, 1 ♂ 6 mm, 1 ♀ 7 mm (MNHN-Pa 1188). — Stn 656, 21°49.1'S, 166°32.5'E, 30-40 m, 8.VIII.1986, 1 ♀ 7 mm (MNHN-Pa 1178). — Stn 658, 21°46.5'S, 166°35.2'E, 49-51 m, 8.VIII.1986, 1 ♂ 5 mm (RMNH D 48768). — Stn 709, 21°22.2'S, 166°03.5'E, 39-40 m, 10.VIII.1986, 1 fragmented ♀ c. 9 mm (MNHN-Pa 1175). — Stn 713, 21°22.6'S, 166°00.7'E, 34-35 m, 11.VIII.1986, 1 ♂ 7 mm, 1 ♀ 7 mm (MNHN-Pa 1189). — Stn 716, 21°22.1'S, 165°58.9'E, 30 m, 11.VIII.1986, 1 ♂ 5 mm (MNHN-Pa 1181). — Stn 836, 20°46.4'S, 165°15.75'E, 57 m, 11.I.1987, 1 ♂ 7 mm (MNHN-Pa 1794). — Stn 895, 20°15.5'S, 164°26.8'E, 16 m, 14.I.1987, 1 ♀ 9 mm (MNHN-Pa 1283, photographed). — Stn DW 1049, 20°08.1'S, 164°08.4'E, dredge, 8-12 m, 4.V.1988, 1 ♀ 10 mm (MNHN-Pa 1326, photographed). — Stn DW 1052, 20°11.6'S, 164°11.5'E, dredge, 16 m, 4.V.1988, 1 ♀ 6 mm (MNHN-Pa 1343). — Stn DW 1053, 20°11.5'S, 164°13.4'E, dredge, 13 m, 4.V.1988, 1 ♀ 7 mm (MNHN-Pa 1331). — Stn CP 1060, 20°14.3'S, 164°15.4'E, trawl, 12-14 m, 5.V.1988, 1 ♂ 8 mm (USNM 1000659). — Stn CP 1061, 20°12.4'S, 164°12.4'E, trawl, 13-17 m, 5.V.1988, 1 ♂ 8 mm (MNHN-Pa 1310).

New Caledonian lagon. Lagon Sud-Ouest. LAGON, stn 1, 22°18.0'S, 166°24.6'E, dredge, 19 m, 21.V.1984, 1 ♂ 8 mm (MNHN-Pa 786), 2 ♀ ♀ 7 and 9 mm (MNHN-Pa 783), 1 ♀ 7 mm (MNHN-Pa 1216). — Stn 5, 22°25'S, 166°21'E, 10 m, 21.V.1984, 1 ♀ 10 mm (MNHN-Pa 1242). — Stn 9, 22°20'S, 166°20'E, 10 m, 21.V.1984, 1 damaged ♂ 8 mm, 1 ♀ 10 mm (MNHN-Pa 1238 and 1260). — Stn 10, 22°19.9'S, 166°20.4'E, dredge, 14-15 m, 21.V.1984, 1 ♂ 8 mm, 2 ♀ ♀ 9 (ov.) and 9.5 mm

(MNHN-Pa 782; RMNH D 39287). — Stn 13, 22°20'S, 166°29'E, 20 m, 22.V.1984, 3 ♂ ♂ 8-9 mm, 1 ♀ 10 mm (RMNH D 48772). — Stn 16, 22°20.7'S, 166°37.9'E, dredge, 28-30 m, 28.V.1984, 1 ♀ 11 mm (MNHN-Pa 785). — Stn 19, 22°22.0'S, 166°33.4'E, dredge, 28-36 m, 28.V.1984, 1 ♀ 9 mm (MNHN-Pa 789). — Stn 25, 22°21'S, 166°27'E, 28 m, 23.V.1984, 1 ♂ 11 mm, 2 ♀ ♀ 8 and 11 mm (MNHN-Pa 1194). — Stn 38, 22°20.3'S, 166°17.4'E, dredge, 20 m, 24.V.1984, 1 ♂ 9 mm, 1 ov. ♀ 9.5 mm (MNHN-Pa 781). — Stn 48, 22°16.6'S, 166°15.2'E, dredge, 27-28 m, 25.V.1984, 1 ♂ 8 mm, 4 ♀ ♀ 8-10 mm (MNHN-Pa 788; RMNH D 39288). — Stn 50, 22°16.6'S, 166°12.2'E, dredge, 12 m, 25.V.1984, 1 ♀ 7 mm (MNHN-Pa 787). — Stn 53, 22°13.1'S, 166°12.5'E, dredge, 12 m, 25.V.1984, 1 ♂ 7.5 mm, 1 ♀ 10 mm (MNHN-Pa 790). — Stn 55, 22°11.4'S, 166°16.6'E, dredge, 22-23 m, 25.V.1984, 1 ♂ 6 mm, 1 ♀ 11 mm (MNHN-Pa 791). — Stn 57, 22°12'S, 166°14'E, 10 m, 25.V.1984, 1 ♀ 10 mm (MNHN-Pa 1009). — Stn 59, 22°10.7'S, 166°11.8'E, dredge, 21 m, 25.IV.1984, 1 ♀ 9 mm (MNHN-Pa 784). — Stn 62, 22°26'S, 166°26'E, 25 m, 20.VIII.1984, 1 ♀ 9 mm (MNHN-Pa 1000). — Stn 63, 22°26'S, 166°26'E, 20 m, 20.VIII.1984, 2 ♀ ♀ 6 and 8 mm, largest with bopyrid parasite in left branchial chamber (MNHN-Pa 1001). — Stn 66, 22°26'S, 166°29'E, 15 m, 20.VIII.1984, 1 ♀ 7 mm (MNHN-Pa 998). — Stn 67, 22°26'S, 166°29'E, 21 m, 20.VIII.1984, 1 ♂ 7 mm (MNHN-Pa 999). — Stn 71, 22°20'S, 166°34'E, 22 m, 20.VIII.1984, 1 ♂ 8 mm (MNHN-Pa 997). — Stn 72, 22°18'S, 166°35'E, 15 m, 20.VIII.1984, 2 ♀ ♀ 8 and 11 mm (largest ov.) (MNHN-Pa 1002). — Stn 83, 22°31'S, 166°30'E, 22 m, 21.VIII.1984, 1 ♂ 6 mm (MNHN-Pa 1006). — Stn 84, 22°30'S, 166°31'E, 17 m, 21.VIII.1984, 2 ♀ ♀ 6 and 7 mm (MNHN-Pa 1007). — Stn 85, 22°29'S, 166°32'E, 21 m, 21.VIII.1984, 1 ♂ 10 mm (MNHN-Pa 1008). — Stn 100, 22°33'S, 166°35'E, 15 m, 21.VIII.1984, 1 ♂ 9 mm with bopyrid parasite in left branchial chamber (MNHN-Pa 1017). — Stn 101, 22°31'S, 166°36'E, 18 m, 21.VIII.1984, 1 ♂ 8 mm (MNHN-Pa 1018). — Stn 101bis, 22°29'S, 166°37'E, 18 m, 22.VIII.1984, 1 ♀ 7 mm (USNM 657). — Stn 104, 22°26'S, 166°40'E, 24 m, 22.VIII.1984, 1 ♂ 8 mm, 1 ov. ♀ 11 mm (MNHN-Pa 1020). — Stn 111, 22°24'S, 166°48'E, 25 m, 22.VIII.1984, 1 ♂ 7 mm, 1 ♀ 9 mm (MNHN-Pa 1012). — Stn 113, 22°23'S, 166°48'E, 32 m, 22.VIII.1984, 6 ♂ ♂ 7-8 mm, 4 ♀ ♀ 8-9 mm (2 ov. 8 and 9 mm), 1 juv. 4 mm (MNHN-Pa 1023; RMNH D 39284). — Stn 116, 22°26'S, 166°42'E, 43 m, 22.VIII.1984, 1 ♂ 8 mm, 1 ♀ 8 mm (MNHN-Pa 1025). — Stn 119, 22°28'S, 166°46'E, 20 m, 23.VIII.1984, 1 ♂ 9 mm, 1 ♀ 11 mm (USNM 1000655). — Stn 120, 22°28'S, 166°43'E, 46 m, 23.VIII.1984, 4 ♂ ♂ 4-7 mm (MNHN-Pa 1026). — Stn 123, 22°30'S, 166°40'E, 21 m, 23.VIII.1984, 1 ♂ 8 mm, 2 ♀ ♀ 7 and 9 mm (largest ov.) (MNHN-Pa

- 1027). — Stn 133, 22°24'S, 166°52'E, 59-62 m, 23.VIII.1984, 1 ♂ 6 mm (MNHN-Pa 1029). — Stn 146, 22°24'S, 166°55'E, 40-52 m, 24.VIII.1984, 2 ♂ ♂ 7 and 8 mm, 1 ♀ 7 mm (MNHN-Pa 1030). — Stn 151, 22°32'S, 166°48'E, 31-33 m, 24.VIII.1984, 5 ♂ ♂ 7-9 mm, 6 ♀ ♀ (including ov.) 8-9 mm (MNHN-Pa 1031; RMNH D 39285). — Stn 152, 22°33'S, 166°43'E, 23 m, 24.VIII.1984, 3 ♂ ♂ 6-8 mm, 3 ♀ ♀ 5-11 mm (largest ov.) (MNHN-Pa 1032). — Stn 153, 22°33'S, 166°43'E, 22 m, 24.VIII.1984, 1 ♀ 9 mm (MNHN-Pa 1033). — Stn 154, 22°33'S, 166°40'E, 29 m, 24.VIII.1984, 1 ♂ 7 mm (MNHN-Pa 1034). — Stn 155, 22°31'S, 166°38'E, 23 m, 24.VIII.1984, 1 ov. ♀ 9 mm (MNHN-Pa 1035). — Stn 158, 22°36'S, 166°34'E, 22 m, 24.VIII.1984, 1 ♂ 7 mm (MNHN-Pa 1036). — Stn 165, 22°09'S, 166°10'E, 21 m, 18.IX.1984, 1 ov. ♀ 11 mm (MNHN-Pa 1199). — Stn 169, 22°08'S, 166°08'E, 22 m, 18.IX.1984, 1 ♂ 6 mm, 4 ♀ ♀ (3 ov.) 8-9 mm (MNHN-Pa 1037; RMNH D 39283). — Stn 170, 22°11'S, 166°06'E, 22 m, 18.IX.1984, 1 ♂ 5 mm (MNHN-Pa 1201). — Stn 171, 22°11'S, 166°06'E, 32 m, 18.IX.1984, 1 ♂ 6 mm, 1 ♀ 6 mm, 1 juv. 3 mm (MNHN-Pa 1226). — Stn 175, 22°06'S, 166°06'E, 17 m, 18.IX.1984, 1 ♂ 7 mm, 1 ♀ 9 mm with branchial bopyrid, 1 ov. ♀ 9 mm (MNHN-Pa 1038; RMNH D). — Stn 176, 22°06'S, 166°04'E, 15 m, 18.IX.1984, 1 ♂ 7 mm, 1 ♀ 9 mm (MNHN-Pa 1039). — Stn 177, 22°04'S, 166°03'E, 12 m, 18.IX.1984, 1 ♂ 8 mm (MNHN-Pa 1040). — Stn 187, 22°03'S, 166°02'E, 13 m, 19.IX.1984, 2 ♂ ♂ 7 and 8 mm (MNHN-Pa 1041). — Stn 188, 22°02'S, 166°01'E, 8 m, 19.IX.1984, 3 ♂ ♂ 8-9 mm (MNHN-Pa 1042; RMNH D 39282). — Stn 226, 22°39'S, 166°37'E, 28 m, 22.X.1984, 1 ♂ 12 mm, 2 ♀ ♀ 9 and 11 mm (largest ov.) (RMNH D 48767). — Stn 230, 22°36'S, 166°42'E, 35 m, 22.X.1984, 1 ov. ♀ 9 mm (MNHN-Pa 1205). — Stn 234, 22°32'S, 166°51'E, 56 m, 23.X.1984, 1 ♀ 8 mm (MNHN-Pa 1011). — Stn 234b, 22°32'S, 166°51'E, 60 m, 23.X.1984, 1 ♂ 7 mm (MNHN-Pa 1012). — Stn 240, 22°23'S, 166°59'E, 42 m, 23.X.1984, 1 ov. ♀ 9 mm (MNHN-Pa 1013). — Stn 247, 22°24'S, 166°51'E, 43 m, 24.X.1984, 1 ov. ♀ 8 mm (MNHN-Pa 1313). — Stn 251, 22°19'S, 166°25'E, 20 m, 7.XI.1984, 1 ♀ 10 mm (USNM 1000661). — Stn 252, 22°22'S, 166°23'E, 22 m, 7.XI.1984, 5 ♂ ♂ 7-10 mm (RMNH D 48766). — Stn 260, 22°17'S, 166°24'E, 23 m, 7.XI.1984, 1 ♀ 12 mm (MNHN-Pa 1261). — Stn 266, 22°22'S, 166°17'E, 19 m, 8.XI.1984, 1 ♀ 7 mm (MNHN-Pa 1269). — Stn 269, 22°18'S, 166°18'E, 20 m, 8.XI.1984, 2 ♀ ♀ 8 and 9 mm (MNHN-Pa 1015). — Stn 277, 22°17'S, 166°16'E, 30 m, 8.XI.1984, 1 ov. ♀ 9 mm (MNHN-Pa 1208). — Stn 279, 22°20'S, 166°27'E, 29 m, 9.XI.1984, 1 ♂ 10 mm (MNHN-Pa 1793). — Stn 280, 22°24'S, 166°24'E, 24 m, 9.XI.1984, 1 ov. ♀ 14 mm (MNHN-Pa 1232). — Stn 295, 22°42'S, 166°43'E, 41 m, 26.XI.1984, 1 ♀ 7 mm (MNHN-Pa 1211). — Stn 298, 22°36'S, 166°48'E, 37 m, 26.XI.1984, 1 ♂ 8 mm (RMNH D 48777). — Stn 299, 22°36'S, 166°48'E, 35 m, 26.XI.1984, 1 ♂ 9 mm, 1 ♀ 11 mm (MNHN-Pa 1219). — Stn 301, 22°36'S, 166°52'E, 46 m, 26.XI.1984, 1 ♀ 10 mm (MNHN-Pa 1209). — Stn 302, 22°38'S, 166°49'E, 17 m, 27.XI.1984, 1 ♀ 10 mm (MNHN-Pa 1195). — Stn 303, 22°38'S, 166°49'E, 35 m, 27.XI.1984, 1 ♀ 7 mm (MNHN-Pa 1235). — Stn 310, 22°44'S, 166°47'E, 46 m, 27.XI.1984, 1 ♂ 9 mm (MNHN-Pa 1215). — Stn 324, 22°24'S, 167°03'E, 39 m, 28.XI.1984, 1 juv. 4 mm (MNHN-Pa 1236). — Stn 335, 22°40'S, 166°53'E, 47 m, 28.XI.1984, 1 ov. ♀ 14 mm (MNHN-Pa 1212). — Stn 337, 22°45'S, 166°49'E, 33 m, 28.XI.1984, 1 juv. 5 mm (MNHN-Pa 1234). — Stn 346, 22°45'S, 166°52'E, 40 m, 29.XI.1984, 2 ♂ ♂ both 8 mm (MNHN-Pa 1202). — Stn 348, 22°42'S, 166°54'E, 45 m, 29.XI.1984, 1 ♂ 4 mm, 1 non-ov. ♀ 7 mm, 3 ov. ♀ ♀ 7-10 mm (MNHN-Pa 1213). — Stn 371, 22°39'S, 167°04'E, 165 m, 30.XI.1984, 1 ♀ 5 mm (MNHN-Pa 1221). — Stn 402, 22°33'S, 167°17'E, 40 m, 23.I.1985, 1 ♂ 8 mm (MNHN-Pa 1230). — Stn 403, 22°35'S, 167°18'E, 45 m, 23.I.1985, 3 ♂ ♂ 6-10 mm (MNHN-Pa 1243). — Stn 407, 22°40'S, 167°23'E, 24 m, 23.I.1985, 1 ♀ 7 mm (MNHN-Pa 1204). — Stn 408, 22°40'S, 167°25'E, 18 m, 23.I.1985, 1 ♀ 7 mm (MNHN-Pa 1224). — Stn 415, 22°36'S, 167°14'E, 20-60 m, 24.I.1985, 1 ♀ 7 mm (MNHN-Pa 1268). — Stn 558, 22°46'S, 166°54'E, 43 m, 16.VII.1985, 1 ♂ 8 mm, 2 ♀ ♀ 8 and 9 mm (MNHN-Pa 1250). — Stn 569, 22°49'S, 166°59'E, 62 m, 17.VII.1985, 1 ♀ 7 mm (USNM 1000656). — Stn 570, 22°50'S, 167°01'E, 53 m, 17.VII.1985, 1 ♀ 11 mm (RMNH D 48774). — Stn 572, 22°52'S, 167°00'E, 65 m, 17.VII.1985, 2 ♀ ♀ 8 and 9 mm (MNHN-Pa 1246).
- Île Ouen (W side), diving, 6 m, J.-L. Menou leg., 1 ♀ 13 mm (MNHN-Pa 1329). — Chenal de l'îlot Maître, Mission Pecten, stn 17, 22°19'S, 166°39.0'E, 24 m, red mud, oyster shells and coral, 28.V.1984, 1 damaged ♂, 2 ♀ ♀ 11 and 14 mm (largest ov.) (MNHN-Pa 1042; RMNH D 39286). — Baie Sainte Marie, 14 m, diving, P. Bouchet leg., 4.I.1993, 1 juv. 4 mm (MNHN-Pa 1796). — DRAGAGES T. P., stn A1, 22°18.3'S, 166°25.0'E, dredge, 15 m, coarse sand, 11.II.1985, 2 ♀ ♀ 6 and 11 mm (MNHN-Pa 1278). — Lagoon between Récif des Croissants (22°20'S, 166°23'E) and Récif Larégnère (22°21'S, 166°19'E), 20 m, diving, P. Bouchet leg., 24.IV.1993, 1 ♂ 7 mm, 3 ♀ ♀ 6-8 mm (♀ of 7 mm with bopyrid parasite in left branchial chamber) (MNHN-Pa 1790). — Quatre Bancs de l'Ouest, c. 22°27'S, 166°28'E, 1 ♀ 7 mm (MNHN-Pa 1792). — 22°29.6'S, 166°40.8'E, 20-22 m, C. Lévi leg., 28.IX.1979, 1 ov. ♀ 10 mm (MNHN).
- BATHUS 1, stn DW 1236, 21°18.13'S, 165°53.68'E, 13.III.1993, 1 ♂ 5 mm, 1 ♀ 5 mm (MNHN-Pa 1797).

SMIB 3, stn DW 3, S of Île des Pins, 24°55'S, 168°22'E, 513 m, 20.V.1987, 1 ♀ 9 mm (MNHN-Pa 1795).

New Caledonia, 1883, Réveillère leg., 3 ♂♂ 5-9 mm, 3 ♀♀ 9-10 mm (MNHN-Pa 1791).

Fiji Islands. Bligh Water. MUSORSTOM 10, stn CP 1309, 17°32.0'S, 178°53.2'E, 843-877 m, 5.VIII.1998, 1 ♂ 10 mm (damaged, antennal and thoracic appendages missing; photographed; MNHN-Pa 1802). Label possibly incorrect.

Viti Levu, Lagon Ouest. SUVA 2, stn CP 45, 17°51.6'S, 177°13.3'E, 35 m, 19.X.1998, 1 ov. ♀ 12 mm (MNHN-Pa 1799). — Stn DW 62, 17°47.9'S, 177°12.9'E, 32 m, 20.X.1998, 1 ov. ♀ 10 mm (USNM 1000654). — Stn DW 64, 17°48.3'S, 177°10.3'E, 21.X.1998, 1 ♂ 6 mm (USNM 1000653). — Stn CP 65, 17°47.9'S, 177°12.8'E, 32 m, 21.X.1998, 1 ov. ♀ 7 mm (MNHN-Pa 1800). — Stn CP 66, 17°45.1'S, 177°13.7'E, 327 m, 21.X.1998, 1 ♂ 8 mm, 2 ov. ♀♀ 9 and 11 mm (RMNH D 48778). — Stn CP 67, 17°44.1'S, 177°18.3'E, 28 m, 21.X.1998, 1 ♂ 8 mm (MNHN-Pa 1801).

Viti Levu, Beqa Lagoon. SUVA 4, stn CP 20, 18°26.4'S, 178°02.4'E, 50-51 m, 25.IX.1999, 1 ov. ♀ 8 mm (MNHN-Pa 1798).

DISTRIBUTION. — The species inhabits the greater part of the Indo-West Pacific region from East Africa to Japan, New Caledonia and Fiji. The records in the literature are: South Africa (Stebbing 1920; Barnard 1947, 1950; Berry 1974; Kensley 1981), Zanzibar, Tanzania (Nobili 1903, 1905a), western Indian Ocean (Borradaile 1904), India (Prasad & Tampi 1969; Prasad *et al.* 1980; Prasad 1983), Japan (De Haan 1841, 1844; Herklots 1861; Ortmann 1891; Balss 1914; Holthuis 1946; Harada 1962, 1965; Holthuis & Sakai 1970; Miyake 1982; Sekiguchi 1986a, b, c, 1987a, 1988, 1989a, 1992; Yamaguchi 1993; Yamaguchi & Baba 1993), China (Liu 1963; Liu & Hsu 1963; Huang 1994; Wang *et al.* 1998), 29°45'N, 24°30'E, Zhejiang (= Chekiang) Province, China (Wang 1991), Taiwan (Chan & Yu 1986, 1993), Vietnam (Serène 1937; Dawydoff 1952; Nguyễn Văn Chuang & Phạm Thị Du 1995), Thailand (Naiyanetr 1963, 1980, 1998), Chonburi, Rayong, Pattani, Gulf of Thailand (Naiyanetr 1998), Singapore (Nobili 1903), South China Sea (Bruce 1965; Johnson 1971a), Philippines (De Man 1916; Estampador 1937, 1959), Indonesia (De Man 1916; Holthuis 1946), Western Australia (Phillips *et al.* 1981), Gulf of Carpentaria, Australia (Phillips & McWilliam 1986), Queensland, Australia (McNeill 1968; Barnett 1989; McWilliam *et al.* 1995), New South Wales, Australia (Phillips & McWilliam 1986), New Caledonia (Coutures 1996; Richer de Forges & Laboute 1996). According to Chan (pers. comm.) the specimen described and figured by Hwang & Yu (1983) as belonging to the present species actually is *Galearctus*

kitanoviriosus n. comb., while the specimen figured by Debelius (1999a, b, 2000) as *Scyllarus martensii* is more likely *Galearctus timidus* n. comb.

HABITAT. — *Eduarctus martensii* n. comb. is a species from rather shallow water. From the more than 250 known depth records, 96% are from 4 to 70 m, and 88% between 10 and 60 m. There are only four records from more than 100 m: Grand Récif Sud, stn 371 from 165 m; Sud Nouvelle Calédonie, SMIB 3, stn DW 3 from 513 m; Lagon Nord, stn 475 from 415-460 m; and stn CP 1309, Bligh Water, Fiji, 843-887 m. In the lot from stn 475 the depth may be erroneous, as in the previous station, stn 474, the depth was 52 m, and the specimens reported upon here may have remained in the net from that previous haul. The same may be true for the specimen from Bligh Water, 843-887 m, this specimen is in a very poor condition and also may have remained in the net from a previous haul. No such explanation can be given for the other two lots; it seems quite likely that, at least with the material from stn DW 3 and CP 1309, some error may have been made.

The nature of the bottom, if stated, is usually given as sand, sometimes mixed with Foraminifera, coral, shells, rubble, weeds, or mud; characterized as coarse, fine or muddy. Far less frequently the bottom is said to be mud (blue, red, or sandy), mixed with fine sand, shells, or pumice; still less often the bottom is characterized as coral rock, or with pebbles, stones, sponges or bryozoans.

DESCRIPTION

The rostrum is short and blunt, it bears a flat dorsal tubercle, but no true rostral tooth. There are three rather large and broad teeth in the median line of the carapace. The pregastric tooth is very low, it lies slightly closer to the rostrum than to the gastric tooth; between it and the rostrum there are a few tubercles. The gastric tooth is distinctly larger than the pregastric and somewhat smaller than the cardiac; it is followed by two or three rows of about three tubercles. The cardiac tooth is the largest and highest, it has a rectangular tip and is followed by a double row of about five flattened somewhat squamiform tubercles. The branchial carina is narrowly interrupted by the cervical groove; a small tubercle is placed just inside the gap. The anterior branchial carina ends in two low blunt rectangular teeth, which are placed one behind the other on the inner orbital margin; behind the posterior of these teeth are about five to seven squamiform

tubercles. The posterior branchial carina bears eight to 10 squamiform tubercles. The area between the branchial and postrostral carinae shows many tubercles, these are most numerous in the posterior half, and least in number near the cervical groove. The lateral margin of the carapace is serrate. The cervical incision is very narrow, the postcervical often is wider. The anterior and posterior parts of the lateral margin form a single continuous line. There are three or four anterolateral teeth, four mediolateral, and 10 to 12 posterolateral. The space between the lateral and branchial carinae is entirely filled with large squamiform tubercles. The marginal groove at the posterior margin of the carapace is rather broad; a double (at some places treble) transverse row of large tubercles is placed just before it and a single or double row behind it. The posterior margin is distinctly incised in the middle.

The first abdominal somite bears a distinct and complete transverse groove. Behind this groove the posterior half of the somite is traversed by 18 to 25 straight longitudinal unbranched grooves. These grooves are often paler than the rest of the dorsal surface of the somite and give a most characteristic impression. The anterior half of the somite shows a very short median transverse groove. The posterior margin of somites I and II shows a deep median incision, in somites III and IV the posterior margin has only a faint notch there, which often is hardly noticeable. The anterior part of abdominal somites II to V is smooth except for a narrow transverse groove bearing a single row of posteriorly directed hairs, this groove may be interrupted in the middle. The groove between the anterior and posterior halves of the somites is rather narrow and has the anterior rim straight. A distinct median carina is present on somites II to V. That of somite II consists of two parallel or slightly V-shaped ridges, those of somites III to V are single, although in the posterior part of the carina of somite III it may be double. Laterally the median carinae show a faint lobulation. The median carina of somite III is by far the highest, being conspicuously higher than both the previous and the following median ridge. The posterior halves of somites II to IV

show the normal arborescent narrow grooves. The pleura of the first somite is three-lobed, the incisions between the lobes are distinct. The pleura of somites II to V are broad, the tips are blunt and directed downward; apart from a blunt tooth on the anterior margin of the second pleura there are no teeth on the pleural margins, at most some feeble crenulations or serrations. The dorsal surface of the sixth abdominal somite and that of the calcified parts of the telson bear numerous large squamiform tubercles. The posterior margin of the sixth somite is practically straight with traces of a few lobules. Of the two pairs of teeth at the end of the calcified part of the telson, the inner are narrow and rounded, the outer very wide and almost rectangular.

The anterior margin of the antennular somite is practically straight and shows only a faint indication of a tooth in the middle of each half.

The anterior margin of the last (sixth) segment of the antenna is convex and bears five broad teeth, which taper rather gradually distally to end in a rounded top. A small tooth is present on the inner margin of the segment. The upper surface of this segment bears a few scattered small squamiform tubercles. The fifth segment shows a blunt inner tooth with a blunt dorsal ridge. The anterior margin of the fourth segment shows about five to nine rather small teeth, the inner of which is larger than any of the others. The outer margin of the segment bears three to five teeth (the apical tooth not included) with a low dorsal ridge each; one of these usually is very small. The strong median carina of the dorsal surface of the segment has the upper surface smooth, but laterally it shows short transverse grooves, giving the impression that it is formed by a row of squamiform tubercles, the tops of which have worn off. There are a few small squamiform tubercles on the inner half of the upper surface of the segment; in the extreme proximal part of the outer half there is a short carina or a row of about four broad squamiform tubercles.

The epistome shows no median incision in the anterior margin, this part is even somewhat produced forward; the lateral ridges of the oral field

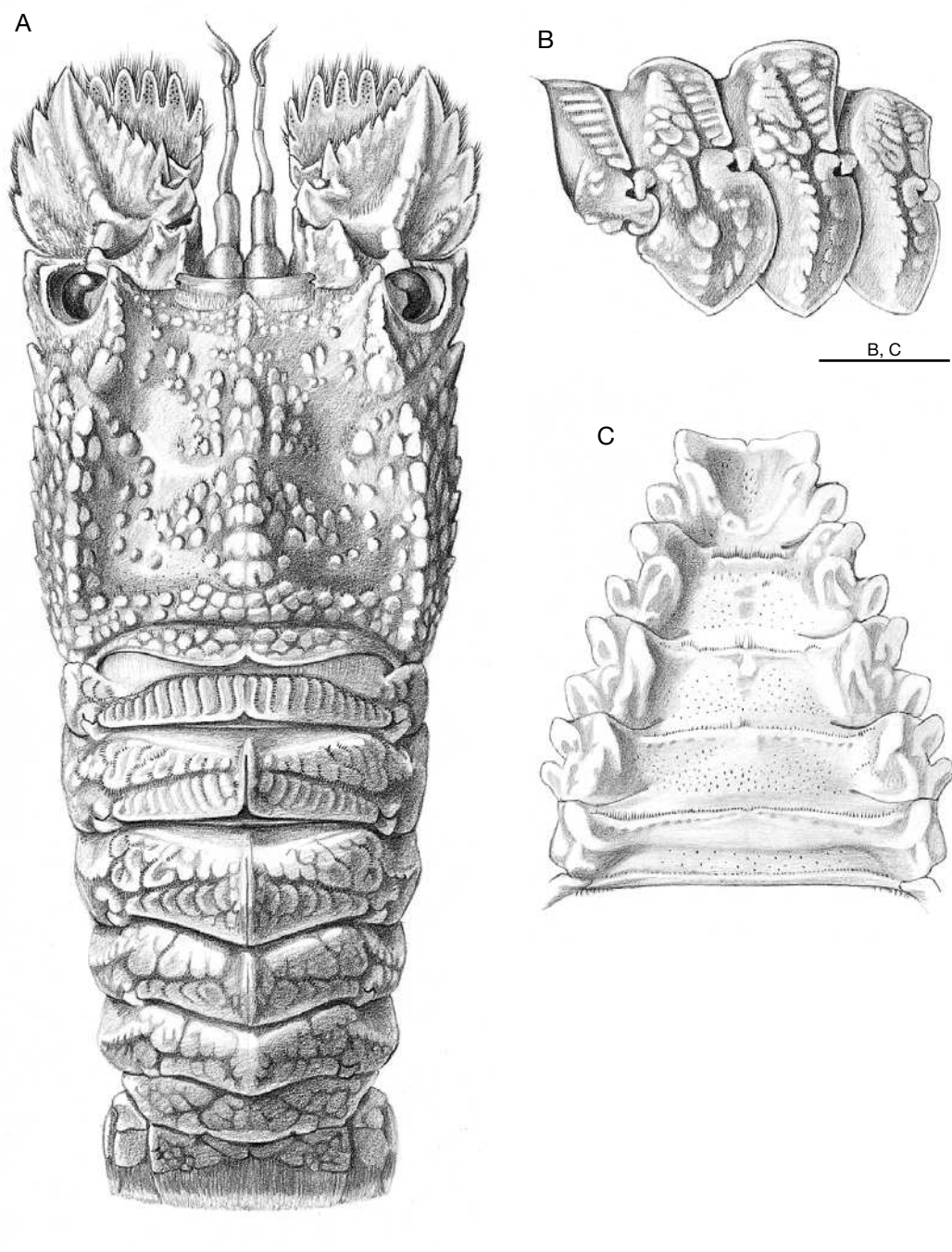


FIG. 32. — *Eduarctus martensii* (Pfeffer, 1881) n. comb., Singapore, E. Deschamps (RMNH D 14591); **A**, dorsal view; **B**, abdominal somites I to IV, lateral view; **C**, thoracic sternum. Scale bars: A, 4 mm; B, 3 mm; C, 2 mm.

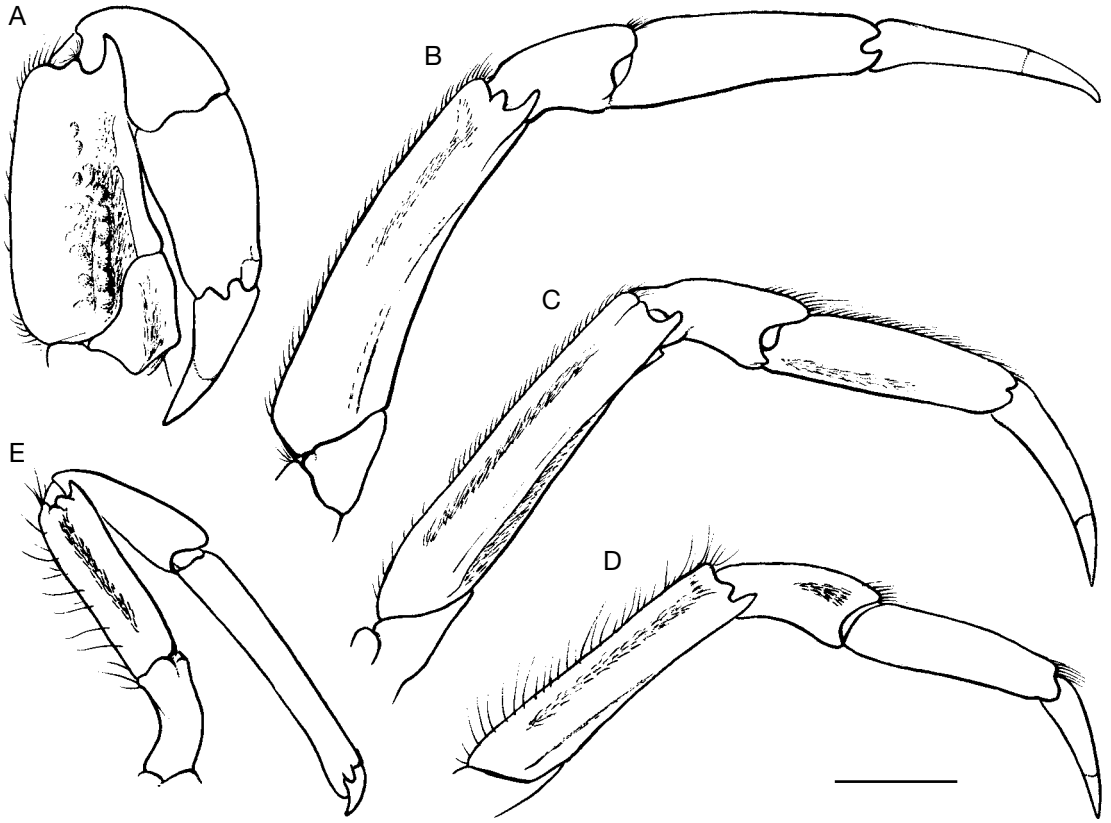


FIG. 33. — *Eduarctus martensii* (Pfeffer, 1881) n. comb., New Caledonia, LAGON, strn DW 1069, ovigerous ♀ (RMNH D 48769); A-E, pereopods 1 to 5. Scale bar: 2 mm.

extend very close to the anterior margin of the epistome.

The first pereopods are much heavier than the following. The dactyli of legs 1 and 2 are practically naked, those of the following legs are slightly pubescent in the basal portion; none has a dorsal hairy fringe. The dactylus of the second leg is longer than any of the other dactyli. It has less than twice the length of the dactylus of P.4. The dactylus of P.3 is longer than that of P.4. The dactylus of the fifth leg is the shortest of all. No ventral fringe of hairs is found in the propodus of any of the legs, a dorsal fringe is present on the propodus and the carpus of the third leg; sometimes a trace of such a dorsal fringe can be seen on the propodus or carpus of the fourth leg. The

dorsal margin of the merus of all legs has a hairy fringe. In the third leg the propodus is about as broad as or narrower than the merus, it is narrower than the propodus of the second leg and broader than that of the fourth; it shows an indistinct hairy groove in the lower part of the outer surface. The carpus of P.4 shows a small hairy depression on the outer surface. The merus of the last four legs bears a dorsal fringe of hairs and an inconspicuous hairy groove in the upper part of the outer surface. The merus of P.1 has a wide hairy groove in the ventral part of the outer margin and in P.3 the lower surface is somewhat hairy.

The anterior margin of the thoracic sternum is very shallowly emarginate in the middle; at each

side of the median incision it shows a small hardly produced tubercle. The anterolateral teeth are blunt and from them a posterior directed carina curves toward the median line of the sternum where the two carinae meet. A median tubercle is present near the anterior margin of the third to fifth sternite, that of the fifth sometimes is indistinct.

Size

Eduarctus martensii n. comb. is one of the smaller species of the subfamily Scyllarinae. Specimens up to cl. 14 mm have been reported, but adult specimens usually have cl. between 6 and 11 mm. Oviparous females with cl. 6 to 14 mm are known. The tl. is up to about 36 mm. De Haan's (1841) specimen was 25 mm long ("pollicem aequante"). Pfeffer's type material consisted of two specimens, one of these, a female, was later selected by De Man (1916: 85) to be the lectotype, it measured "vom Schnabel zur Schwanzspitze" 27.6 mm, the carapace measured 8.8 mm. Ortmann's (1891) specimens had a tl. of 27 mm. Nobili (1905a) reported upon a specimen of 21 mm total length. De Man's (1916) specimens measured 14 to 36 mm in total length.

Colour

Pfeffer (1881: 49) stated "Die Farbe ist hellgrau, die Furchen, welche ihre Farbe von den Haaren haben, braun, wenn angetrocknet, staubgrau". De Man (1916: 89) remarked that "In most specimens [...] the ground-colour is more or less dark-gray, the squamiform prominences on the abdominal somites being whitish or sometimes of a pale bluish tinge; the carinae on the 2nd and 3rd somites are often blood-red coloured posteriorly. The lobes and teeth of the distal squame are of a dark slate colour and their margin is white. Sometimes there is a pale-red fleck on the cardiac region. The two males from Stat. 164 present a different colour. The ground colour is of a pale yellowish gray, but the carapace is traversed by a broad brown band that runs across the cardiac region to the lateral margins; in the larger specimen it extends farther backward than in the younger one and in both it reaches laterally

nearly to the orbits. The 4 posterior pairs of thoracic legs are marked, in all specimens, with four slate-coloured rings, four on each leg, precisely as in *Scyll. sordidus*".

In specimens from Singapore a dark band is visible in the outer half of the upper surface of the fourth antennal segment; furthermore there is a dark spot at the end of the median carina of the third, sometimes also the second, abdominal somite. Here as in many other specimens the longitudinal grooves of the first abdominal somite are flanked by a whitish line, which is quite characteristic for the species. In preserved specimens from Lagon Nord, New Caledonia (MNHN-Pa 1364), which have lost practically all colour, the teeth of the last antennal segment (especially the outer) show a dark colour, which is especially noticeable on the lower surface. Judging by the colour photographs made of living specimens collected in New Caledonia, the colour of the carapace is quite variable from almost pure white to dark brown, sometimes with a reddish tinge. Usually the colour is marbled, but as a rule a dark spot is visible either side of the gastric tooth. Another small black spot is usually present on the base of the gastric tooth, this spot usually is well-marked, sometimes quite small, rarely it is absent. A transverse row of nine to 13 quite small but very dark and very distinct spots are placed along the posterior margin of the carapace; these spots are seen in every specimen. The first abdominal somite is quite characteristic as the longitudinal grooves show as white or very pale lines on a dark, sometimes almost black background. Abdominal somites II to V are brownish or whitish with the grooves quite dark; the brownish colour varies from pale yellowish brown to very dark almost black, sometimes it is uniform, sometimes marbled and then it sometimes shows also red areas. The posterior margin of somites II to IV shows along the posterior margin a row of small well-defined dark spots similar to those found along the posterior margin of the carapace. The tailfan, including abdominal somite VI (sometimes also V and IV), are uncoloured, very pale, almost white. The antennae have the teeth of the sixth segment, especially the outer, practi-

cally black (more clearly so on the ventral than on the dorsal surface). Sometimes a dark spot is seen in the posterolateral angle of the fourth segment. A small black spot is always present in the distal third of the oblique carina on the dorsal surface of the fourth antennal segment.

Larvae

M. W. Johnson (1971a) described and figured the final phyllosoma stage of what he thought to be the present species from the South China Sea. Berry (1974) described a phyllosoma larva from the Natal coast, South Africa, which he named *Scyllarus* sp. B., and pointed out its close resemblance to Johnson's phyllosoma larvae assigned to this species. Tampi & George (1975) reported stages III to XI phyllosoma's from several localities in the Indian Ocean region (off Somalia, Arabian Sea, Bay of Bengal, Andaman Sea, S of Java); they assigned these definitely to *Scyllarus martensii*. Prasad *et al.* (1980) figured all the phyllosoma stages of what they thought to be the present species, and gave characters in a tabular form; their conclusions were based on a very extensive material collected from plankton all over the Indian Ocean. Barnett *et al.* (1986) described and figured a juvenile from off Townsville, Queensland, Australia, found in plankton at a depth of 0-20 m. Finally Phillips & McWilliam (1986) discussed all the phyllosoma stages (I-IX) and the nisto stage of *Scyllarus martensii* and gave a description and excellent figures of all; they were rather critical of some of the identifications of some previous authors.

Parasites

Several of the specimens (all marked as such in the above enumeration of the material) are parasitized by a bopyrid parasite in the branchial chamber. The presence of the parasite is quite noticeable by the swelling of the carapace over the branchial chamber. Bourdon (1967: 168, figs 1-3) described a new species of the epicarid *Dactylocepon*, *D. holthuisi*, from *Scyllarus lewinsohni* Holthuis, 1967 (= *Eduarctus lewinsohni* n. comb.) from the Red Sea, which scyllarid is closely related to *E. martensii* n. comb. But from



FIG. 34. — *Eduarctus lewinsohni* (Holthuis, 1967) n. comb., Elat, Israel, ♀ paratype with bopyrid, carapace length 10 mm (RMNH D 30932), dorsal view. W. C. G. Gertenaar del.

E. martensii n. comb. itself, so far as I know, no epicarideans have been reported before now.

Eduarctus lewinsohni (Holthuis, 1967) n. comb.
(Figs 34; 35)

Scyllarus lewinsohni Holthuis, 1967: 307; 1968: 289. — Bourdon 1967: 168. — Zarenkov 1971: 167. — Burukovsky 1974: 107; 1983: 150. —

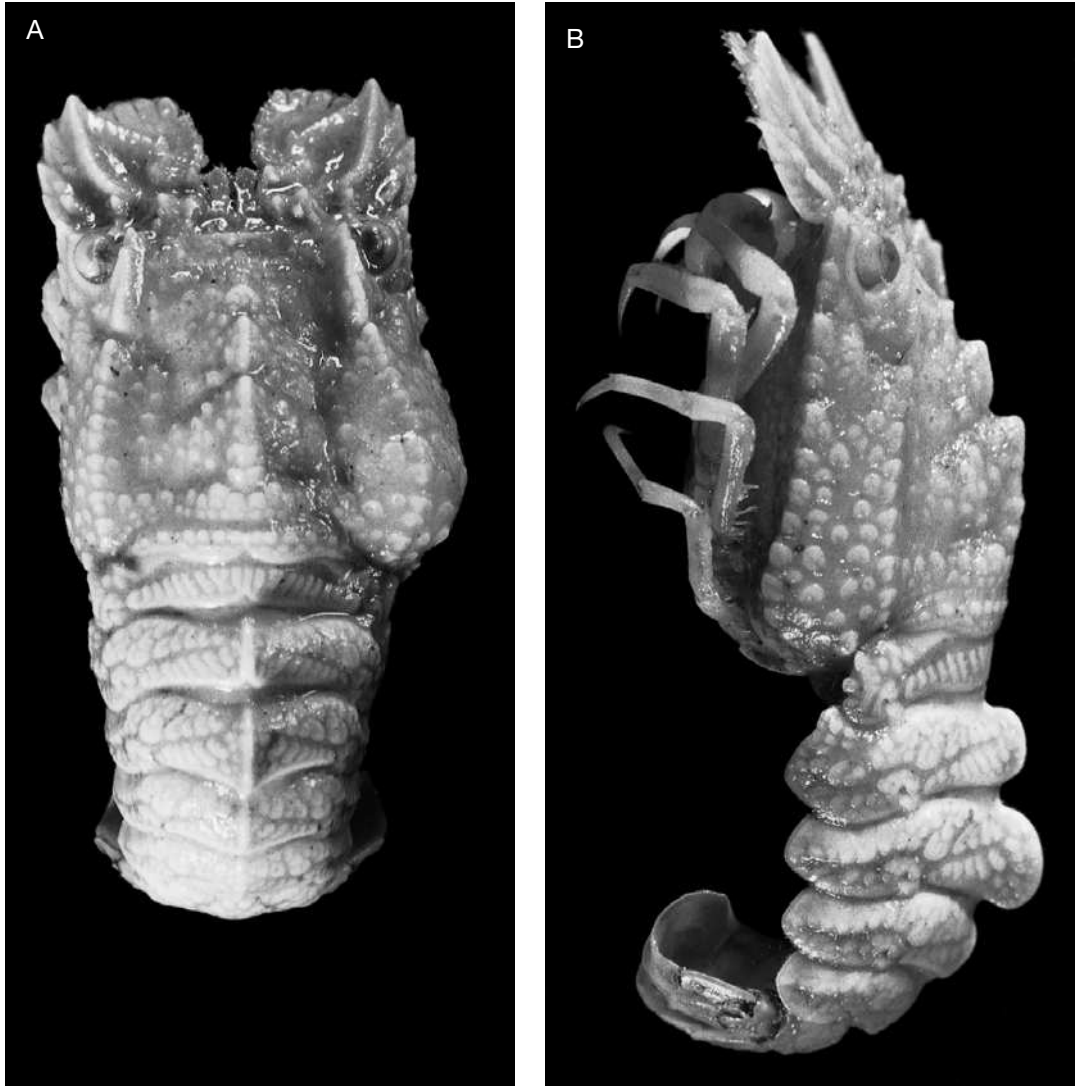


FIG. 35. — *Eduarctus lewinsohni* (Holthuis, 1967) n. comb., Elat, Israel, ♀ paratype with bopyrid, carapace length 10 mm (RMNH D 30932); **A**, dorsal view; **B**, lateral view.

Phillips *et al.* 1980: 70. — Lewinsohn 1983: 203. — Vine 1986: 107. — Fransen *et al.* 1998: 67.

TYPE MATERIAL. — Holotype: ♂ 8 mm, RV *La Merkhaw*, stn 4 (RMNH D 30931); paratype: 1 ♀ 10 mm (RMNH D 30932).

TYPE LOCALITY. — Red Sea. Gulf of Aqaba, N of Elat, 40–46 m.

MATERIAL EXAMINED. — **Red Sea.** Gulf of Aqaba. Offshore N of Elat, Israel, RV *La Merkhaw*, stn 4,

dredged, 40–46 m, 6.IX.1966, Ch. Lewinsohn No. NS 1165, 1 ♂ holotype 8 mm (RMNH D 30931), 1 ♀ paratype 10 mm with bopyrid (RMNH D 30932). — Elat, Israel, from plankton, 16.V.1959, Ch. Lewinsohn No. NS 1064, 1 postlarva 3 mm (RMNH D 30933). — Off Wadi Murach (= Wadi Murrah), Sinai coast of Gulf of Aqaba, stn 36, about 28°47'N, 34°30'E, 73–82 m, 9.X.1969, Ch. Lewinsohn, 1 ♀ 12 mm (RMNH D 49577).

DISTRIBUTION. — *E. lewinsohni* n. comb. is only known from the Red Sea and the Strait of Bab al

Mandab. The records in the literature are Gulf of Aqaba off Elat (Holthuis 1967, 1968; Bourdon 1967), southern Gulf of Suez, stn 412 (Zarenkov 1971), extreme southern Red Sea, north of the Strait of Bab al Mandab, stn 400, 401, 635, 666 (Zarenkov 1971), Strait of Bab al Mandab, stn 395 (Zarenkov 1971).

HABITAT. — The examined material was obtained at depths of 40–46 and 73–82 m. Zarenkov (1971) reported it from 20–60 m. The postlarva was taken from the plankton.

DESCRIPTION

The species is extensively described by Holthuis (1968), but is not illustrated there. Therefore two illustrations of the animal in dorsal and lateral views are provided here.

Size

In the present material the male specimen has cl. 8 mm, the two females cl. 10 and 12 mm, cl. of the postlarva is 3 mm. Zarenkov (1971) reported on four non-ovigerous females with cl. 6 to 9 mm, and three ovigerous females with cl. 8 to 10 mm.

Colour

The specimen from off Wadi Murach still showed some colour. A reddish brown area is visible on either side of the carapace just behind the cervical groove. It extends from the submedian area to the lateral margin of the carapace, leaving the post-rostral carina without this colour. The inner part of the anterior margin of this area touches the cervical groove, but the outer part lies somewhat behind the groove. A small reddish brown spot is seen in the inter-cervical area. Such a small spot is also found near the top of the elevated part of the median carina of abdominal somites II and III; a much larger, irregular spot is present on the lateral surface of the second abdominal somite above the base of the pleura. A small spot is seen at the articulations of abdominal somites II to V. P.3 to P.5 have a dark band in the proximal part of carpus and propodus.

Eduarctus aesopius (Holthuis, 1960) n. comb.
(Figs 36; 37)

Scyllarus aesopius Holthuis, 1960: 149. — Burukovsky 1974: 107; 1983: 150. — Phillips *et al.* 1980: 69.

TYPE MATERIAL. — Holotype: ♂ 11 mm, RV *Albatross*, stn D 5165 (USNM).

TYPE LOCALITY. — Philippines. Observation Id, N 70°W, 6.40 miles, Tawi Tawi Group, Sulu Archipelago, 4°58'20"N, 119°50'30"E, 16 or 33 m.

MATERIAL EXAMINED. — **Indian Ocean, off Somalia.** IIOE, RV *Anton Bruun*, cruise 9, stn 447, 10°00'N, 51°15'E, shrimp trawl, 59–61 m, 16.XII.1964, 1 ♂ 15 mm, 1 ov. ♀ 11 mm (USNM). — Stn 445, 9°41'N, 51°03'E, trawl, depth unknown, 16.XII.1964, 2 ♀♀ 14 and 15 mm (USNM).

Tanzania. Dar-es-Salaam, beach, 1965, H. Sassoon, 1 ♀ 15 mm (MT).

Philippines. Observation Id, N 70°W, 6.40 miles, Tawi Tawi Group, Sulu Archipelago, RV *Albatross*, stn D 5165, 4°58'20"N, 119°50'30"E, 16 or 33 m, bottom coral or green mud, 24.II.1908, 1 ♂ holotype 11 mm (USNM).

DESCRIPTION

This species is closely related to *Eduarctus martensii* n. comb. but differs in the following characters: 1) the rostrum usually bears a small but prominent dorsal tooth, so that the median line of the carapace bears four teeth (rostral, pregastric, gastric and cardiac). The pregastric tooth is more distinct and elevated than in *E. martensii* n. comb.; 2) the longitudinal grooves in the posterior half of the first abdominal somite are not all straight, but several are branched and anastomosed with other grooves; 3) the anterior half of abdominal somites II to V are not smooth but show flattened tubercles in two or more transverse rows; 4) the groove separating the anterior from the posterior half of abdominal somites II to V is very wide (especially in somites II and III) and with the anterior margin not straight but crenulate; 5) the median carina of somite II shows no distinct double ridge on the top and is more distinctly lobulated laterally. As in *E. martensii* n. comb. the ridges of abdominal somites II and III are conspicuously higher than that of somite IV; the ridge on somite III is higher than that of somite II; 6) the distal segment of the antenna is broader than in *E. martensii* n. comb. and has five to seven broad teeth on the anterior margin. The teeth have their anterior margin truncate and somewhat convex, resembling more those of *E. modestus* n. comb. than those of *E. martensii*

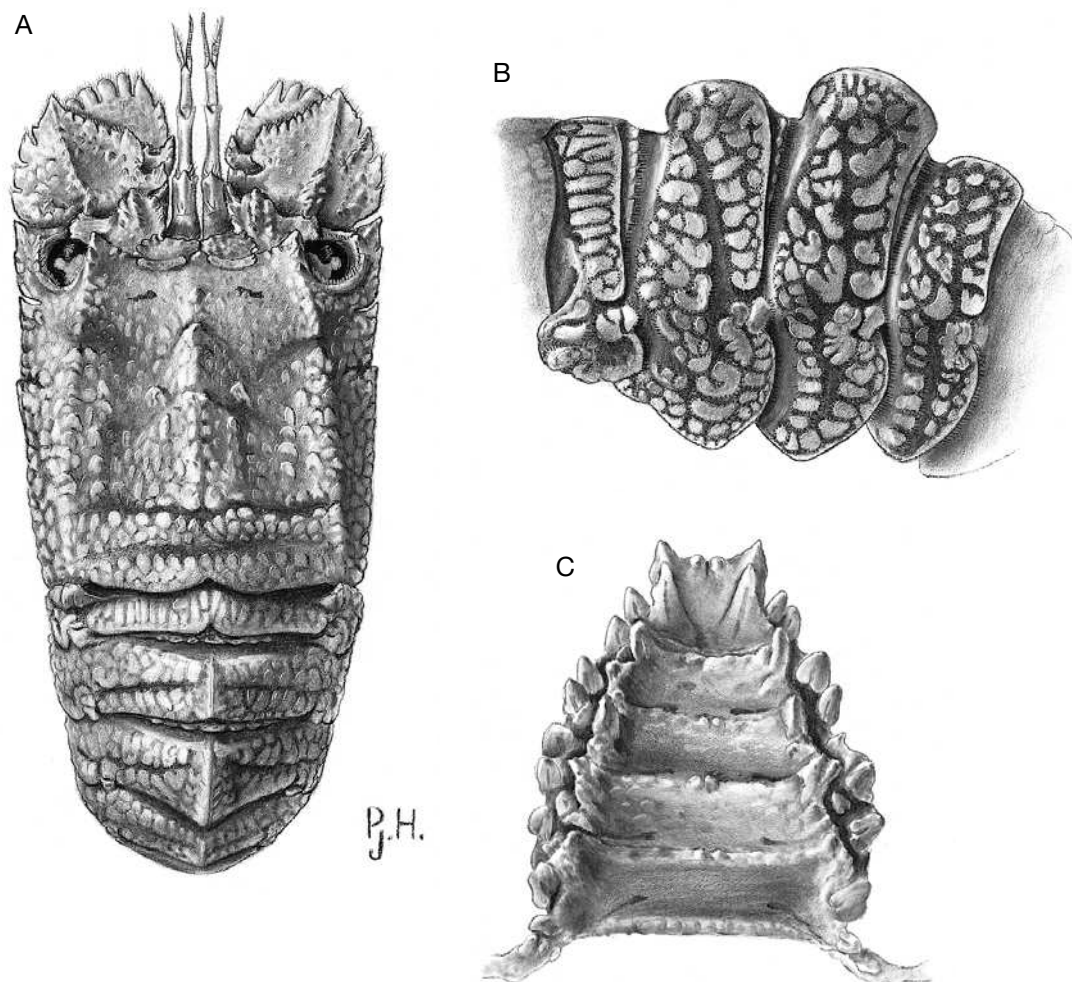


FIG. 36. — *Eduarctus aesopius* (Holthuis, 1960) n. comb., Philippines, RV *Albatross*, stn D 5165, ♂ holotype carapace length 11 mm (USNM); **A**, dorsal view; **B**, lateral view of abdominal somites I to IV; **C**, thoracic sternum. Mrs P. Hogue del.

n. comb.; 7) the anterior part of the sternum is similar to that of *E. modestus* n. comb.; 8) the fourth leg has the dactylus slightly more than half as long as that of the second leg; and 9) the pereopods and pleopods are similar to those of *E. modestus* n. comb.

REMARK

So far the species is only known from the above material.

Eduarctus pyrrhonotus n. sp. (Figs 38-40)

TYPE MATERIAL. — Holotype: ovigerous ♀ 23 mm, REVES 2, stn 16 (MNHN-Pa 1876); paratypes: 1 ♂ 15 mm (MNHN-Pa 1878), 1 ♀ 15 mm (MNHN-Pa 1879), 1 ov. ♀ 17 mm (MNHN-Pa 1877), 1 ♂ 12 mm and 1 ov. ♀ 19 mm (MNHN-Pa 586).

TYPE LOCALITY. — Seychelles. 5°35.9'S, 56°55.6'E, 46-55 m.

ETYMOLOGY. — The name *pyrrhonotus* is derived from *pyrrhos* (Greek) = red, and *notos* (Greek) = back; in

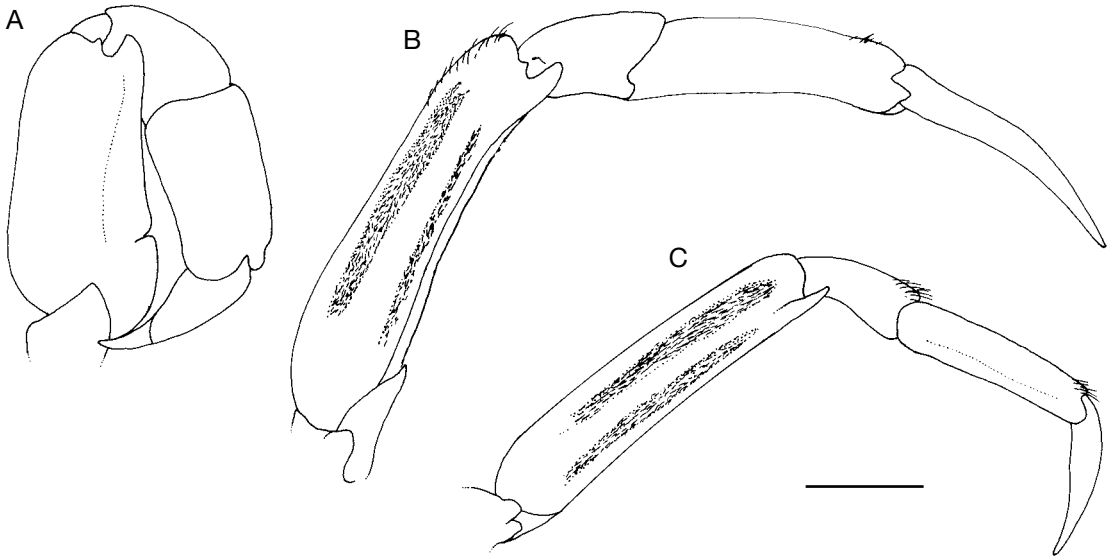


FIG. 37. — *Eduarctus aesopius* (Holthuis, 1960) n. comb., off Somalia, RV *Anton Bruun*, stn 445, ♀ (USNM); **A**, pereiopod 1; **B**, pereiopod 2; **C**, pereiopod 4. Scale bar: 2 mm.

reference to the red colour observed on the back of several of the animals.

MATERIAL EXAMINED. — **Kenya.** 4°41'S, 54°24.5'E, 37 m, RV *Manihine*, cruise 336, stn 32, 7.II.1972, A. J. Bruce, 1 ♀ paratype 15 mm (RMNH D 49576).

Seychelles. REVES 2, stn 11, 5°04.9'S, 55°53.2'E, dredge, 58 m, sand with shells (*sable coquillier*), 7.IX.1980, 1 ♀ paratype 15 mm (MNHN-Pa 1879). — Stn 16, 5°35.9'S, 56°55.6'E, trawl, 46–55 m, bottom maerl, 5.IX.1980, 1 ov. ♀ holotype 23 mm (MNHN-Pa 1876). — Stn 17, 5°42.7'S, 56°38.9'E, trawl, 55 m, bottom flat, maerl, 5.IX.1980, 1 ♂ paratype 15 mm (MNHN-Pa 1878). — Stn 19, 5°51.1'S, 56°20.5'E, trawl, bottom flat, of shelly sand with *Pinna*, 30–35 m, 5.IX.1980, 1 ov. ♀ paratype 17 mm (MNHN-Pa 1877).

Madagascar. RV *Vauban*, stn CH 72, 25°11.24'S, 47°14.7'E, trawl, 85–90 m, 3.III.1973, 1 ov. ♀ paratype 19 mm, 1 ♂ paratype 12 mm (MNHN-Pa 586).

South China Sea. Macclesfield Bank, 15°37.5'N, 114°12.2'E–15°36.8'N, 114°15.4'E, 73–84 m, bottom with coral, RV *Cape St. Mary*, cruise 3/64, stn 48, trawl 169, 17.V.1964, A. J. Bruce, 1 ♀ paratype 20 mm (RMNH D).

DISTRIBUTION AND HABITAT. — So far the species is only known from the area of the western Indian Ocean and the South China Sea. It was found at depths of (30–)35–85(–90) m, on flat bottoms of shelly sand and maerl, or with coral.

DESCRIPTION

The rostrum is short and bears three dorsal tubercles at the anterior margin, the outer being largest. There is no rostral tooth. The pregastric tooth is rather well-developed and distinct, but smaller than the gastric tooth. Both are triangular in lateral view. Behind the pregastric tooth are some four or five tubercles. Behind the gastric tooth, tubercles are arranged in about three or four longitudinal curved rows of two or three tubercles each. The cardiac tooth is rather large and obscurely two-topped, it reaches slightly over the cervical groove. Behind it the tubercles are arranged more or less in two longitudinal rows of about four tubercles each, the posterior being the largest. At either side of the cardiac tooth there is a distinct rounded tubercle, that reaches slightly farther forward than the cardiac tooth itself. The branchial carina is bisected by the cervical groove; two tubercles lie slightly medially of the gap so formed. The anterior branchial carina ends in two rather small teeth placed on the inner orbital margin; the anterior tooth is followed by a tubercle, so that sometimes the impression of

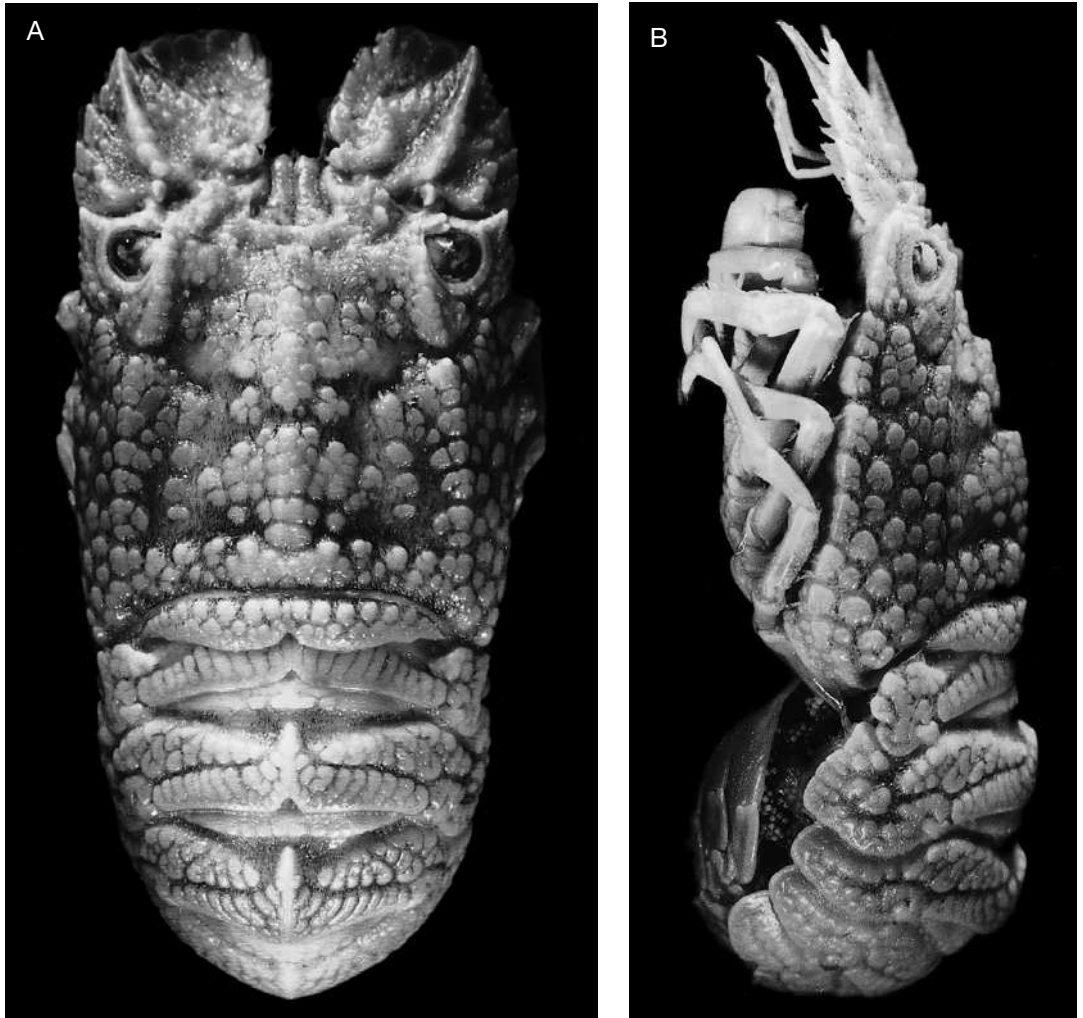


FIG. 38. — *Eduarctus pyrrhonotus* n. gen., n. sp., Seychelles, ovigerous ♀ holotype, carapace length 23 mm (MNHN-Pa 1876); **A**, dorsal view; **B**, lateral view.

three supraorbital teeth is given. Behind the posterior supraorbital tooth the anterior branchial carina shows a number of squamiform tubercles. The posterior branchial carina ends anteriorly in a strong blunt tooth, which is followed by five transverse rows of squamiform tubercles. There are many squamiform tubercles between the postrostral and branchial carinae. The intermediate row consists of four tubercles the anterior of which is largest and is situated right behind the cervical groove, it sometimes is subdivided. The

lateral margin of the carapace behind the anterolateral angle consists of three small anterolateral, two rather large mediolateral and about eight posterolateral teeth. These teeth are arranged in a single uninterrupted line. The intercervical ridge is covered by about six tubercles, which completely fill the intercervical space. There are about three or four postorbital tubercles. The space between the branchial carina and the lateral margin of the carapace is completely filled with distinct squamiform tubercles. The marginal groove

along the posterior margin of the carapace is distinct and filled with hairs. Behind it there is a transverse row of about 20 distinct flattened squamiform tubercles, and behind these one or two more irregular and less distinct rows of smaller tubercles. The posterior margin of the carapace is triangularly incised in the middle; the incision is rather wide with a blunt top. The squamiform tubercles of the carapace have a fringe of hair along the anterior and lateral margins.

The first abdominal somite has a complete transverse groove. The anterior half of the somite, before this groove is smooth; the posterior half shows about 20 longitudinal grooves which partly are branched and anastomosing; they do not reach the posterior margin of the somite. The abdominal somites I to IV have a median incision in the posterior margin, that of the fourth somite being rather indistinct. The anterior half of somites II to V have one or two rows of flattened tubercles along the posterior margin; thereby the median transverse groove of these somites has its anterior margin crenulated. The posterior half of somites II to V have the normal arborescent pattern of narrow grooves. The median area of these somites shows a smooth longitudinal carina, which, however, is not very highly elevated and never shows the high ridge seen in *E. martensii* n. comb. The carinae of somites II and III are slightly higher than the others and in the male they are slightly higher than in the females; the carina of somite II is the most pronounced and has a longitudinal groove in its posterior part. The carinae are lobulated laterally. The pleura of the first somite are short and have the lateral margin divided into three or four lobes, the posterior of which is largest. The tips of pleura II to IV are bluntly rounded and not curved posteriorly. The margins of pleura II and III are crenulated or incised. The solid part of the telson is covered with squamiform tubercles but shows no sharp teeth. Of the two pairs of posterior teeth of this solid part, the inner shows as a narrow rounded lobe, the outer is very wide and quadrangular with a long posterior margin, having at most a tiny triangular denticle at the posterolateral angle.

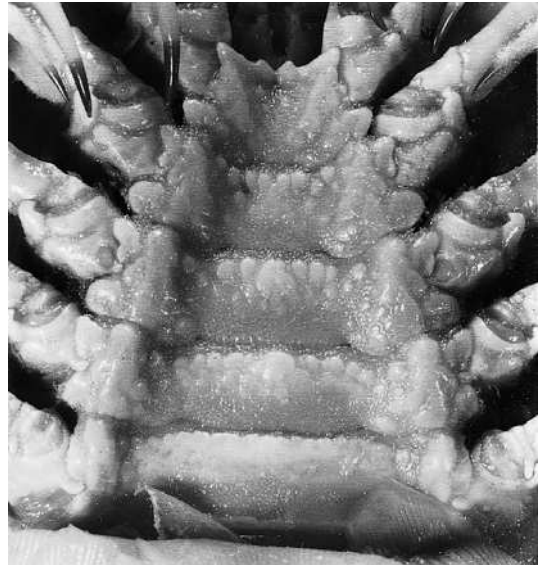


FIG. 39. — *Eduarctus pyrrhonotus* n. gen., n. sp., Seychelles, ovigerous ♀ holotype carapace length 23 mm (MNHN-Pa 1876), thoracic sternum.

The anterior margin of the antennular somite is almost straight or slightly curved with a median incision; a few squamiform tubercles are seen in the basal part of this somite.

The sixth (last) antennal segment ends in four or five broadly truncated distal teeth; there are two, more triangular, on the inner margin. The upper surface of the segment bears a few scattered tubercles. The fifth segment ends in a bluntly rounded top, and has a short dorsal carina that does not quite reach the top of the segment. The anterior margin of the fourth antennal segment bears a row of six or seven teeth, the inner of which usually is the largest, the outer the smallest. The outer margin of the segment has three or four large teeth (the apical tooth excluded). The oblique median carina is strong and ends in the apex; it bears flat tubercles, which are quite distinct in the basal part and become more indistinct distally. An erect blunt spinule is placed at the base of the carina. The outer half of the dorsal surface of the segment shows a curved row of rather large tubercles, the basal of which is largest. The inner half of this dorsal surface has scattered tubercles.

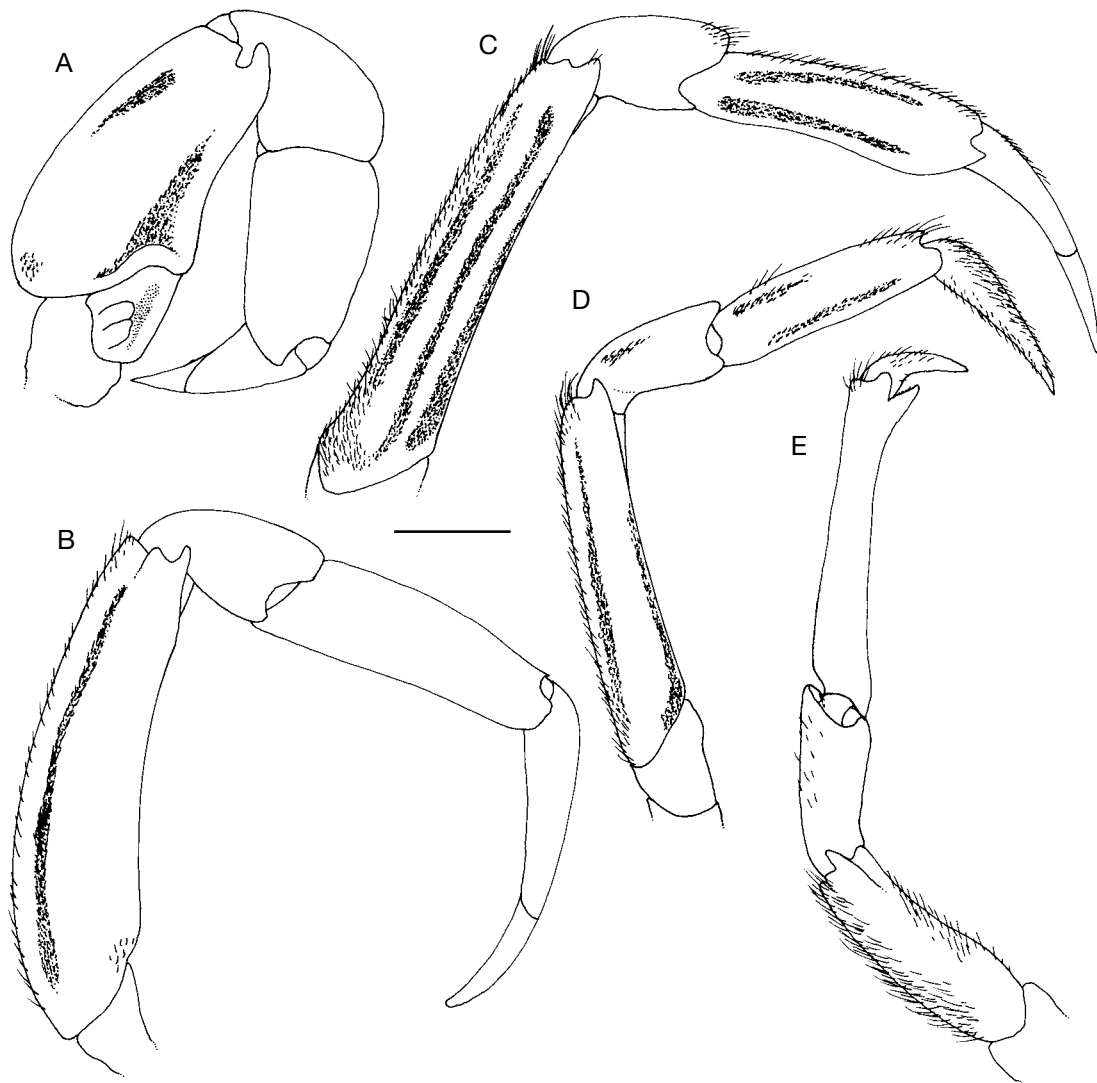


FIG. 40. — *Eduarctus pyrrhonotus* n. gen., n. sp., Madagascar, RV *Vauban*, stn CH 72, ovigerous ♀ paratype (MNHN-Pa 586); A-E, pereopods 1 to 5. Scale bar: 2 mm.

The epistome is not incised in the middle.

The first pereopods are more robust and shorter than the following. The dactylus, propodus and carpus are naked. The merus shows a wide hairy groove in the lower part of the outer surface; sometimes a trace of a similar, but shorter groove can be seen in the distal upper part of that surface. The dactylus of the first leg is about two thirds as long as that of P.2, but is much wider.

The dactylus of P.2 is longer than that of any of the other legs; the dactylus of P.3 is longer than that of P.4. In both sexes the dactylus of P.5 is shorter than that of P.4; in the female the fixed finger of the chela of P.5 is short and triangular and does not reach the middle of the dactylus, it has minute denticles on the cutting edge. P.2 has its segments naked except for the merus which has a row of short hairs on the dorsal margin and

two faint hairy grooves on the outer surface. In P.3 the dactylus has a few short hairs in the basal part of the upper margin; the propodus has a dorsal fringe of short hairs and shows a wide and shallow longitudinal hairy groove in the lower part of the outer surface and a vague one in the upper half. The propodus is somewhat compressed. The carpus and the merus of P.3 have a fringe of short hairs on the dorsal margin; the merus furthermore has two wide and shallow longitudinal hairy grooves on the outer surface, while the lower surface also shows such a groove. The dactylus of both P.4 and P.5 have some hairs in the basal part, sometimes these are restricted to the dorsal surface, sometimes covering also the rest of the basal part. The propodus of P.4 has a scraggly row of short dorsal hairs, and traces of two longitudinal hairy grooves on the outer surface. The carpus of P.4 has a very small tuft of hairs at the anterior end of the dorsal margin; it also shows a trace of a longitudinal hairy groove on the outer surface. The merus is provided with a dorsal fringe of hairs, a distinct wide hairy groove on the outer surface and one on the lower surface. P.5 has traces of two wide grooves on the outer surface of the propodus and carpus; on the merus these grooves are more distinct and a dorsal fringe of hairs is present.

The anterior margin of the thoracic sternum is very shallowly U-shaped, it is almost transverse. The anterolateral teeth are short and hardly reach beyond the anterior margin. The margin shows a median incision, which is flanked by a pair of low and wide tubercles. The median part of the first sternite is sunken because a wide ridge extends along the anterior margin and merges laterally with a carina which extends from the anterolateral teeth back. This lateral carina shows a tooth some distance behind the tip of the anterolateral tooth. Some small tubercles are visible in the sunken part. The surface of the thoracic sternum shows a short pubescence and an indistinct median tubercle may be seen on somites III, IV and V. The posterior margin of the sternum is straight and carries a row of some small tubercles, which are most distinct laterally. Behind the base of the last pereopod is a rounded carina; no teeth are present here.

The first pleopods of the male (placed on abdominal somite II) are elongate triangular, they are very slender and of about the same length; the exopod is slightly wider than the endopod. Pleopods 2 to 4 have the exopod broadly lamellar, the endopod is only a small bud.

Size

The two males examined have cl. 12 and 15 mm. The non-ovigerous females have cl. 15 to 20 mm, in ovigerous females cl. is 17 to 23 mm.

Colour

The colour of the holotype, when fresh, was described by Dr A. J. Bruce on the label with the material as follows: "Mottled patches of orange squames and inky plum coloured squames, with also scattered white squames. Pereiopods white, propodus and merus centrally purple, dactylus yellow. Abd[ominal somite] 6 and telson white, margin of uropods purple". In the preserved specimens very little of the original colour pattern is noticeable. A few specimens, however, show a large irregular reddish spot in the median area of the posterior post-rostral carina.

REMARKS

The species differs from *E. martensii* n. comb., *E. aesopius* n. comb. and *E. lewinsohni* n. comb. by the relatively low carina on the second and third abdominal somite and from *E. modestus* n. comb. by the straight lateral margin of the carapace.

Eduarctus marginatus n. sp.

(Figs 41; 42)

TYPE MATERIAL. — Holotype: ♀ 10 mm, SUVA 2, stn CP 46 (MNHN-Pa 1888).

TYPE LOCALITY. — Fiji Islands. Viti Levu, west lagoon, 17°52.5'S, 177°15.5'E, 25 m.

ETYMOLOGY. — The new specific name *marginatus* is derived from the latin word *margo* for border, in reference to the conspicuous whitish border of the abdominal pleura.

MATERIAL EXAMINED. — **Fiji Islands.** Viti Levu, west lagoon, SUVA 2, stn CP 46, 17°52.5'S, 177°15.5'E, 25 m, 19.X.1998, 1 ♀ holotype 10 mm (MNHN-Pa 1888).

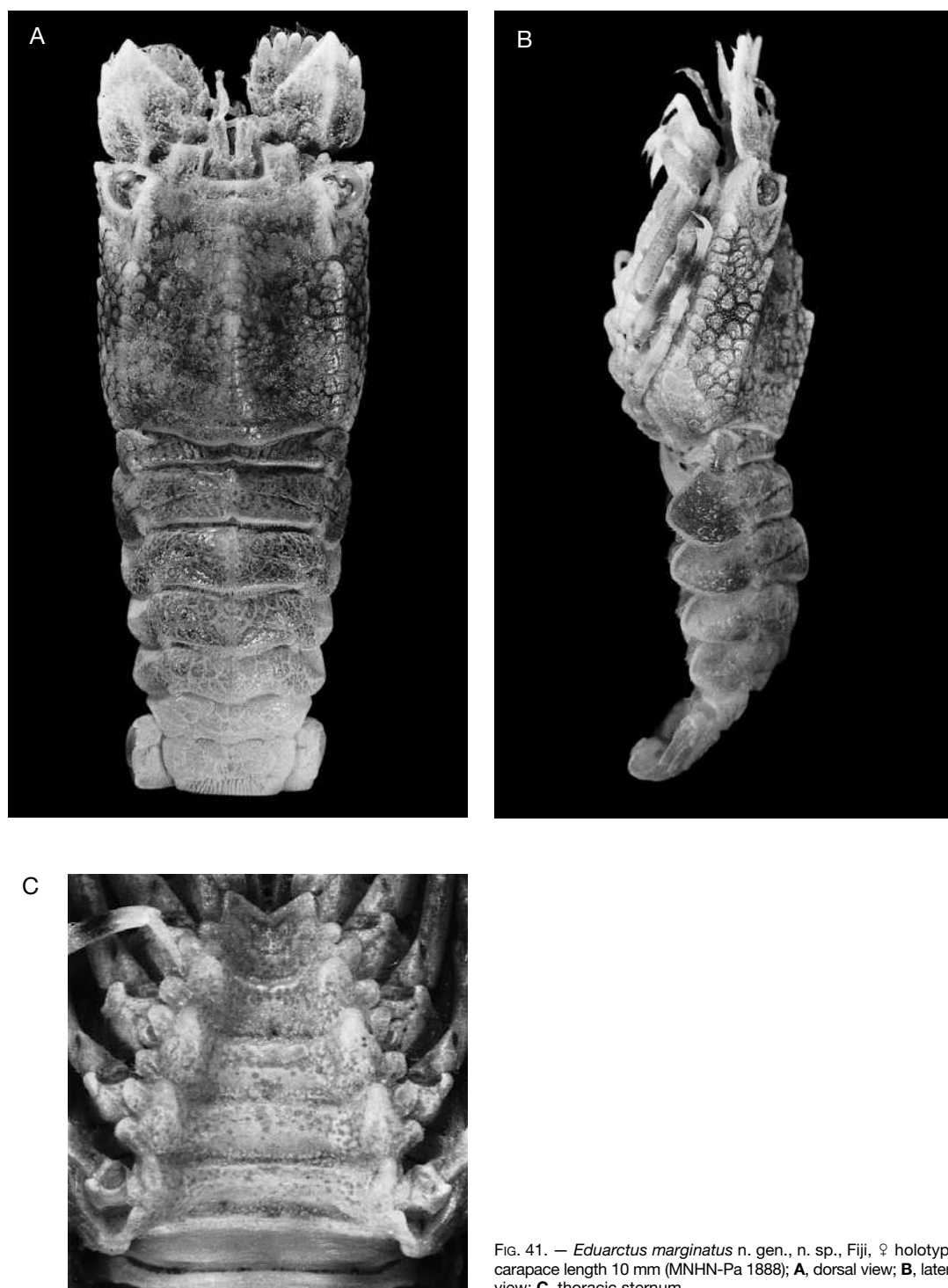


FIG. 41. — *Eduarctus marginatus* n. gen., n. sp., Fiji, ♀ holotype, carapace length 10 mm (MNHN-Pa 1888); **A**, dorsal view; **B**, lateral view; **C**, thoracic sternum.

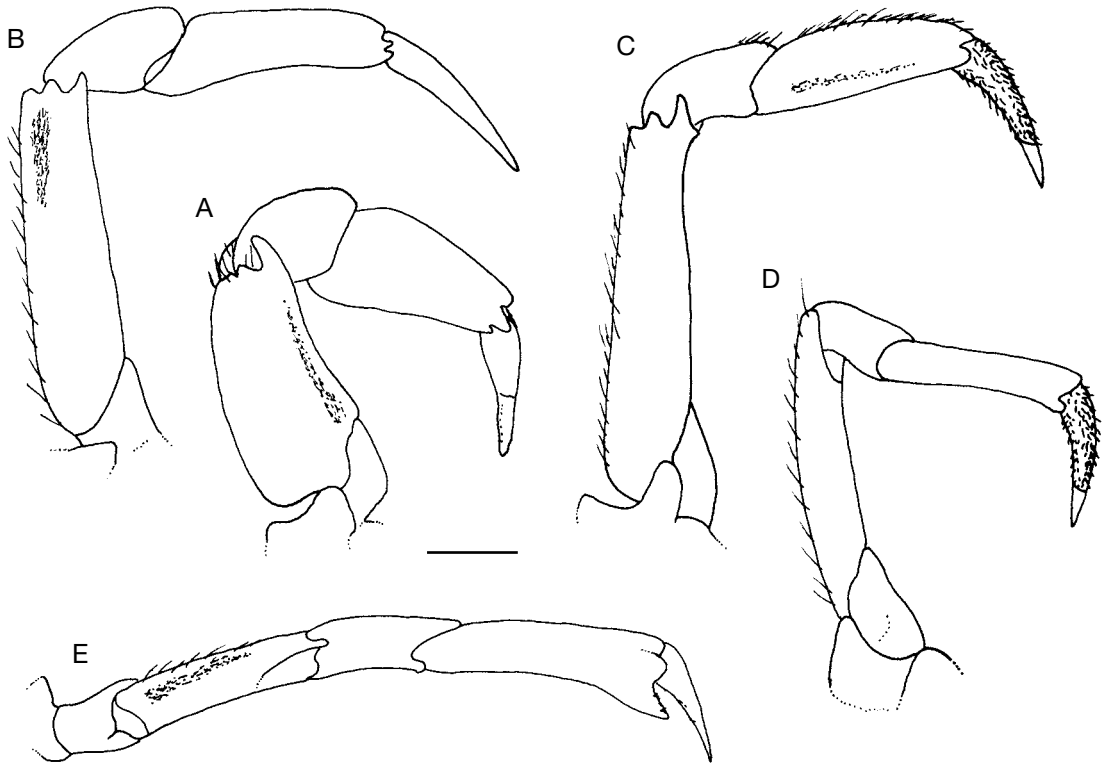


FIG. 42. — *Eduarctus marginatus* n. gen., n. sp., Fiji, ♀ holotype (MNHN-Pa 1888); A-E, pereopods 1 to 5. Scale bar: 1 mm.

DESCRIPTION

The rostrum is narrow and ends in a small low tubercle that is flanked at either side by the slightly smaller tuberculiform inner end of the visible part of the ophthalmic somite. Apart from this tubercle there is no true rostral tooth. The pregastric tooth is visible as a low and wide rounded squame with a hairy fringe on the anterior margin. The gastric tooth likewise is low, but slightly higher and more triangular in dorsal view than the pregastric; it is followed by two rows of four broad squamiform tubercles. The cardiac tooth is slightly higher than the gastric and has the tip broadly rounded, behind it there is a double row of six flat squamiform tubercles. Between the postrostral and the branchial carinae there are squamiform tubercles, some of these placed in transverse rows. These tubercles somewhat obscure the cervical groove. A rounded

smooth area is found in the space between the anterior postrostral and branchial carinae. The intermediate row of tubercles is present, but it is enclosed by the other tubercles. At the inner side of the spot where the cervical groove breaks through the branchial carina, two large tubercles are present. The anterior branchial carina ends in two teeth on the inner margin of the orbit. These teeth are low and blunt and not very distinct. The upper margin of the anterior branchial carina is smooth, on the sides it shows squamiform tubercles. There are some flattened squamiform postorbital tubercles. The intercervical ridge carries about 10 rather large squamiform tubercles. The posterior branchial carina ends in a distinct blunt anterior point that is followed by a row of about 10 squamiform tubercles, which form a continuous field with the other posterior tubercles of the carapace. The anterolateral angle

of the carapace is bluntly triangular and is followed by two obscure squamiform tubercles. The mediolateral margin of the carapace consists of three squamiform tubercles, the anterior being the largest. The mediolateral and posterolateral carinae are situated in a single line. The anterior tooth of the posterolateral margin is blunt and only slightly heightened anteriorly; it is followed by 10 blunt squamiform tubercles. Between this posterolateral margin and the posterior branchial carina many similar tubercles fill the entire space. The posterior marginal groove of the carapace is narrow. It is followed by two transverse rows of flat tubercles, while the extreme posterior margin of the carapace is smooth and has a small and shallow triangular median incision.

The first abdominal somite has a complete transverse groove over the middle. Before this groove the somite is smooth, behind it are about 20 longitudinal grooves, each carrying a row of short hairs. Some of these grooves are forked. The posterior margin of the somite is smooth; there is a very small median triangular incision. The anterior half of somites II to V shows indistinct shallow pits and irregular crenulated transverse grooves. The posterior half of these somites has a very low median longitudinal ridge, which on somites IV and V is hardly noticeable. In somites II and III there is an indistinct, interrupted median longitudinal groove in the posterior part of the ridge. The tergites of these somites show the normal arborescent pattern of narrow grooves in the posterior half. The posterior margins of somites II and III show a very small median triangular incision, which is absent in the following somites. The lateral margin of the pleuron of somite I has three broadly rounded lobes. The pleura of somites II to V are remarkable by having the margin perfectly entire, without lobes, teeth, or incisions. The tips of these pleura are broadly rounded; the pleura are furthermore remarkable by that they are bordered by a whitish band along their full circumference (see also the colour description below). The sixth abdominal somite shows a transverse and two oblique grooves on the upper surface, plus a number of squamiform tubercles. The hard part of the tel-

son also shows several squamiform tubercles; the posterior margin of this hard part carries two blunt teeth in either half. The two outer of these four teeth are widest and placed at the outer margin of the telson; they are about rectangular; the inner teeth are smaller and almost circular.

The anterior margin of the antennular somite is practically straight, with a small incision in the middle.

The sixth (last) segment of the antenna ends in five teeth. The outer tooth is widest with a broadly truncated top. The following four are much narrower with a bluntly rounded top; the inner of these teeth is slightly narrower and slightly more triangular than the previous four. The inner margin of the segment has a much smaller appressed triangular tooth. The fifth antennal segment is small and ends in a blunt tooth that carries a dorsal carina. The anterior margin of the fourth segment shows a distinct, but blunt, triangular tooth next to the articulation with the fifth segment. The rest of the anterior margin is occupied by five or six slightly smaller teeth (the apical tooth not included). The outer margin of the fourth segment has three rather large but rather appressed blunt teeth plus a small fourth at the base of the apical tooth. The upper surface of the fourth segment has a strong oblique median carina which ends in the apical tooth; it is slightly curved at the base and has a basal tubercle. The outer half of the upper surface shows a short curved row of tubercles.

The anterior margin of the epistome is almost straight, being at most slightly produced in the middle.

P.1 is robust and naked. The dactylus is about as long as the propodus. The carpus is rounded. The merus shows an irregular groove in the lower proximal half of the outer surface. The second leg is slender; its dactylus is longer than the dactyli of the other legs, being almost 1.5 times as long as the dactylus of P.1 or P.3. The dactylus of P.4 is shorter than that of P.3. In the only specimen examined, a female, the dactylus of P.5 is twice as long as the short and triangular fixed finger of the propodus. There are some very short hairs in the basal part of the upper surface of the dactylus of

P.2; in P.3 these hairs extend as far as the base of the horny tip of the segment. The propodus of P.3 has a dorsal fringe of hairs; such hairs are absent in P.2 and P.5, and very few in P.4. The carpus of P.2 is smooth, in P.3 it has an antero-dorsal fringe, while in the other legs there are at most a few hairs there. The merus of P.2 to P.5 has dorsal hairs. The outer surface of the merus of these legs is roughened by tiny pits, but does not show actual grooves.

The anterior margin of the thoracic sternum is U- or very shallowly V-shaped; the tubercle at either side of the median incision is very indistinct; the anterior margin is thickened. The sternites are pitted. No distinct median tubercles are visible; also the posterior margin of the sternum is without teeth or tubercles.

Size

The species is only known from the female type specimen, which has cl. 10 mm.

Colour

The colour of the carapace of the holotype, which is preserved in alcohol, is pale greyish brown with small darker brown spots. The abdomen is rather darker greyish brown with the margins of the pleura strikingly whitish.

REMARKS

The new species belongs to the group of *Eduarctus* n. gen. in which the three carinae of the lateral margin of the carapace lie in a single line. It furthermore is characterized by the fact that the third abdominal somite has the dorsal carina low, not or at most a very little higher than that of the second somite. The entire margins of the abdominal pleura and the whitish margin of these are quite characteristic, and different from those of *E. martensii* n. comb.

Eduarctus modestus (Holthuis, 1960) n. comb.
(Figs 43-46; 69A)

Scyllarus modestus Holthuis, 1960: 149. — M. W. Johnson 1971a: 80, figs 1-21. — A. Michel 1971: 472. — Berry 1974: 15. — Burukovsky 1974: 107. —

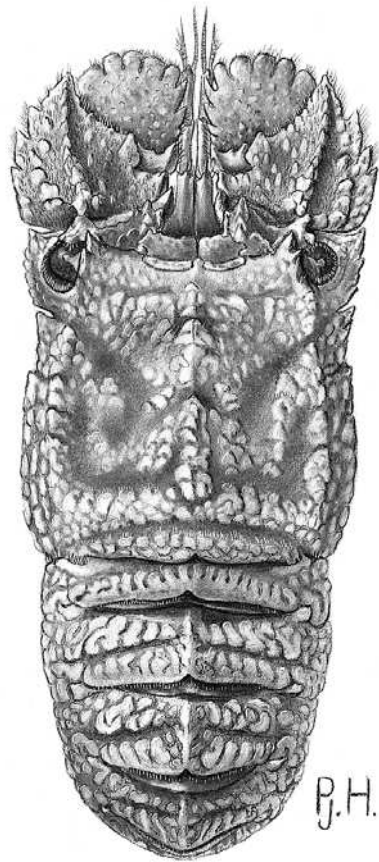


FIG. 43. — *Eduarctus modestus* (Holthuis, 1960) n. comb., Auau Channel, Hawaiian Islands, ♀ holotype, carapace length 14 mm (USNM), dorsal view. Mrs P. Hogue del.

Phillips *et al.* 1980: 70. — Sekiguchi 1986a: 1290; 1987a: 331; 1987b: 415, 417; 1992: 212. — Phillips & McWilliam 1989: 353, 358.

Scyllarus martensi — Rathbun 1906: 896, pl. 18 fig. 2. — Hiatt 1954: 30 [non *Scyllarus martensii* Pfeffer, 1881].

Scyllarus martensii — Edmondson 1933: 223; 1946: 258 [non *Scyllarus martensii* Pfeffer, 1881].

Scyllarus? — M. W. Johnson 1970: 18, fig. 16.

TYPE MATERIAL. — Holotype: ov. ♀ 14 mm, RV *Albatross*, stn D 3872 (USNM); paratypes: 2 ♂ 8 mm and 12 mm (USNM).

TYPE LOCALITY. — Hawaii. Mokuhooniki Islet, N. 3°, E. 16.6', Auau Channel between Maui and Lanai, 59-79 m.

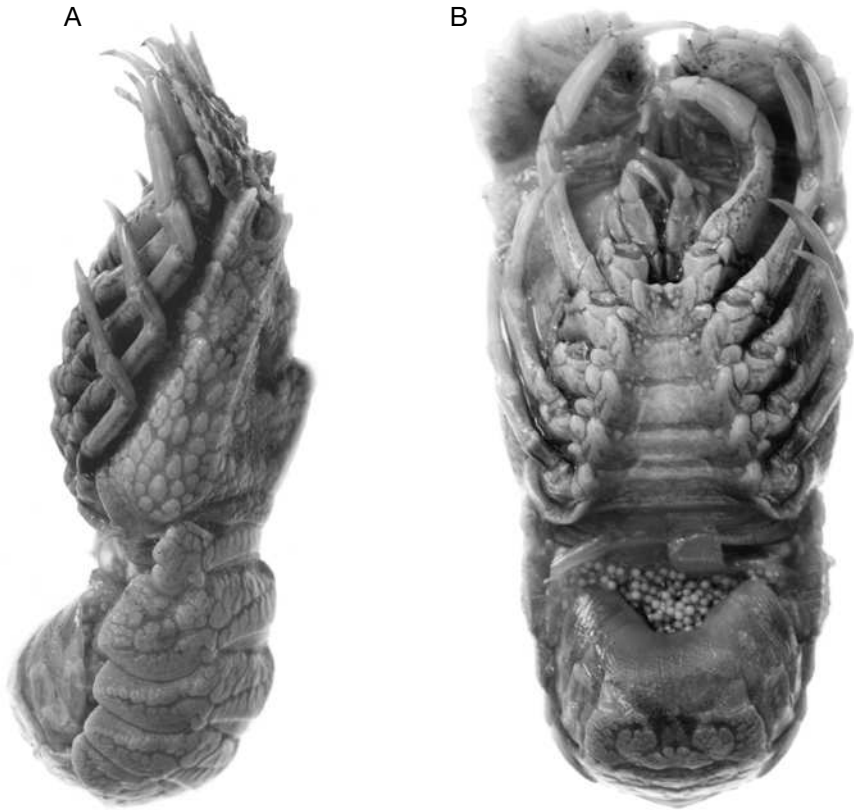


FIG. 44. — *Eduarctus modestus* (Holthuis, 1960) n. comb., Hawaiian Islands, Auau Channel, ♀ holotype, carapace length 14 mm (USNM); **A**, lateral view; **B**, ventral view.

MATERIAL EXAMINED. — **Hawaiian Islands.** RV *Albatross*, stn D 3850, Lae-o Ka Laau Light, N. 74°15', W. 22.2', south coast of Molokai, 79 m, coarse sand, broken shells, coral, 8.IV.1902, 1 ♂ paratype 12 mm (USNM). — Stn D 4002, Kapuai Point, S. 73°, E. 3.0', near Kauai Id, 97-402 m, fine coral sand, globigerina, coral, 16.VI.1902, 1 ♂ paratype 8 mm (USNM). — Stn D 3872, Mokuhooniki Islet, N. 3°, E. 16.6', Auau Channel between Maui and Lanai, 59-79 m, yellow sand, pebbles, coral, 22.IV.1902, 1 ov. ♀ holotype 14 mm (USNM).

Oahu, dredged, SW Tinker, 1 ♂ paratype 6 mm (AHF). — One mile off Rabbit Id (= Ford Id), Oahu, RV *Makua*, c. 21°22'N, 157°58'W, dredge, 37 m, 14.IV.1949, 1 ov. ♀ 11 mm (BPBM).

Pele Expedition, Pokai Bay, Oahu, 21°27'N, 158°12'W, 27-29 m, sand, algae, broken coral, 1.VIII.1959, 1 ♀ 13 mm (BPBM). — 1.5 miles off Sand Id, Oahu, 64-73 m, 17.VII.1959, 1 juv. 6 mm (BPBM). — 1.5 miles off Sand Id, Oahu, 110 m, 18.VII.1959, 1 juv. 6 mm (BPBM).

Marquesas Islands. MUSORSTOM 9. Eiao Island, stn DW 1154, 7°58.5'S, 140°43.7'W, 102 m, 23.VIII.1997, 1 ♀ 6 mm (MNHN-Pa 1824). — Stn CP 1156, 7°59.0'S, 140°43.7'W, 60 m, 23.VIII.1997, 1 ♂ 8 mm, 1 ov. ♀ 12 mm (RMNH D 48751). — Stn CP 1160, 7°57.8'S, 140°02.0'W, 49-55 m, 23.VIII.1997, 1 ♂ 7 mm (MNHN-Pa 1825). — Stn DW 1283, 7°53.8'S, 140°34.5'W, 55-56 m, 7.IX.1997, 3 ♂♂ 7-11 mm (MNHN-Pa 1829). — Stn CP 1284, 7°54.5'S, 140°35.8'W, 53-55 m, 7.IX.1997, 2 ♂♂ both 7 mm, 2 ♀♀ both 9 mm (1 ov.) (MNHN-Pa 1830).

Nuku Hiva Island, stn CP 1177, 8°45.1'S, 140°15.1'W, 108-112 m, 25.VIII.1997, 1 ov. ♀ 11 mm (photographed, MNHN-Pa 1826). — Stn CP 1178, 8°46.1'S, 140°14.5'W, 74-75 m, 25.VIII.1997, 1 ♂ 9 mm (MNHN-Pa 1827). — Stn CP 1188, 8°48.6'S, 140°03.4'W, 35-55 m, 26.VIII.1997, 4 ♂♂ 7-9 mm, 5 non-ov. ♀♀ 6-11 mm, 7 ov. ♀♀ 10-12 mm (MNHN-Pa 1828). — Stn CP 1189, 8°46.4'S, 140°05.6'W, 70 m, 26.VIII.1997, 2 ov. ♀♀

both 8 mm (RMNH D 48750). — Stn CP 1304, 8°54.4'S, 140°13.9'W, 50–58 mm, 10.IX.1997, 1 ♂ 6 mm (USNM 1000665).

Ua Huka Island, stn DW 1293, 8°54.3'S, 139°37.5'W, 50 m, 8.IX.1997, 1 ♀ 8 mm (MNHN-Pa 1831). — Stn CP 1295, 8°54.2'S, 139°37.5'W, 50–54 m, 8.IX.1997, 3 ♂♂ 7–9 mm, 2 ♀♀ 8 and 9 mm (MNHN-Pa 1832).

Ua Pou Island, stn DW 1142, 9°21.2'S, 140°02.7'W, 33–34 m, 22.VIII.1997, 2 juv. 4 and 5 mm (MNHN-Pa 1822). — Stn DW 1143, 9°20.9'S, 140°02.7'W, 18–55 m, 22.VIII.1997, 1 juv. 4 mm (MNHN-Pa 1823). — Stn DW 1260, 9°25.4'S, 140°07.3'W, 49–100 m, 3.IX.1997, 1 ♂ 7 mm (USNM 1000664). — Stn CP 1265, 9°20.4'S, 140°07.3'W, 90–92 m, 3.IX.1997, 1 ♀ 8 mm, 2 juv. 5 and 6 mm (RMNH D 48749).

Marquesas Expedition (National Geographic Society-Smithsonian-Bishop Museum), Nuka Hiva, stn NH IX, Haul 1, off Anaho Bay, 8°48'S, 140°2'W, 59 m, sand, 18.IX.1967, 1 ♂ 8 mm (WAM 241-70). — Stn NH XIV, Haul 2, 0.5 mile N of Matuhee Bay, c. 8°54'S, 140°06'E, 62 m, 22.IX.1967, 1 ov. ♀ 11 mm (WAM 2490-70).

DISTRIBUTION. — The species so far is only known from the Hawaiian and Marquesas Islands. The only previous records of adult material are by Rathbun (1906) who reported the above mentioned material from the RV *Albatross* stn 3850, 3872 and 4002.

HABITAT. — The species has been reported from depths between 29 and 112 m (one 27–29 m, and one 97–402 m), most between 50 and 100 m. It was found on rather coarse sandy bottoms (sand, algae, broken coral; yellow sand, pebbles, coral; coarse sand, broken shells, coral; fine coral sand, globigerina, coral; and sand).

DESCRIPTION

The rostrum is narrow and blunt, the tip sometimes is slightly curved up, it bears a small flat dorsal tubercle, but no tooth. The three large teeth on the postrostral carina are well-developed and distinct, they are triangular or rather blunt. The largest is the cardiac tooth, it ends in an almost rectangular single point and is followed by a double row of about five or six large blunt squamiform tubercles. The gastric tooth is lower and wider than the cardiac and is followed by a ridge or a single row of smallish tubercles. The pre-gastric tooth is lower than the gastric, but is still distinct. The branchial carina is narrowly interrupted by the cervical groove. There is a small tubercle in the groove just inside the gap.

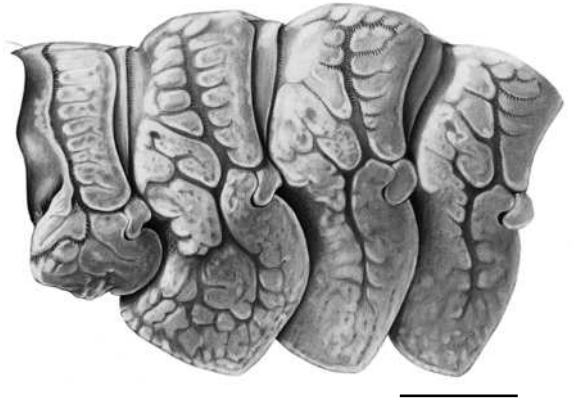


FIG. 45. — *Eduarctus modestus* (Holthuis, 1960) n. comb., Hawaiian Islands, off Rabbitt Island, Oahu, ovigerous ♀ (BPBM), abdominal somites I to IV, in lateral view. Scale bar: 2 mm. W. C. G. Gertenhaar del.

The anterior branchial carina ends in two teeth placed on the inner orbital margin; these teeth are about rectangular. Behind the posterior of these teeth the branchial carina shows some five to seven squamiform tubercles. Between the anterior part of the anterior branchial carina and the orbital margin a row of tubercles is visible. The rest of the orbital margin also is somewhat tuberculate. The posterior branchial carina bears eight to 12 squamiform tubercles. There are many smaller or larger tubercles between the postrostral and branchial carinae, especially in the anterior part. Between the posterior postrostral carina and the posterior branchial carina there is an intermediate row of four tubercles; between the anterior of these intermediate tubercles and the posterior branchial carina there is a single large tubercle, or a group of smaller ones. The lateral margin of the carapace is serrate, the cervical incision is very narrow and not deep, the postcervical incision is wider. On the lateral margin there are three to five anterolateral teeth, four or five mediolateral and six to eight posterolateral. Quite striking is the fact that these teeth do not lie in a single straight line as in most species, but that the posterior part of the mediolateral row of teeth ends below the anterior part of the posterolateral row, which is directed slightly up at the anterior end.

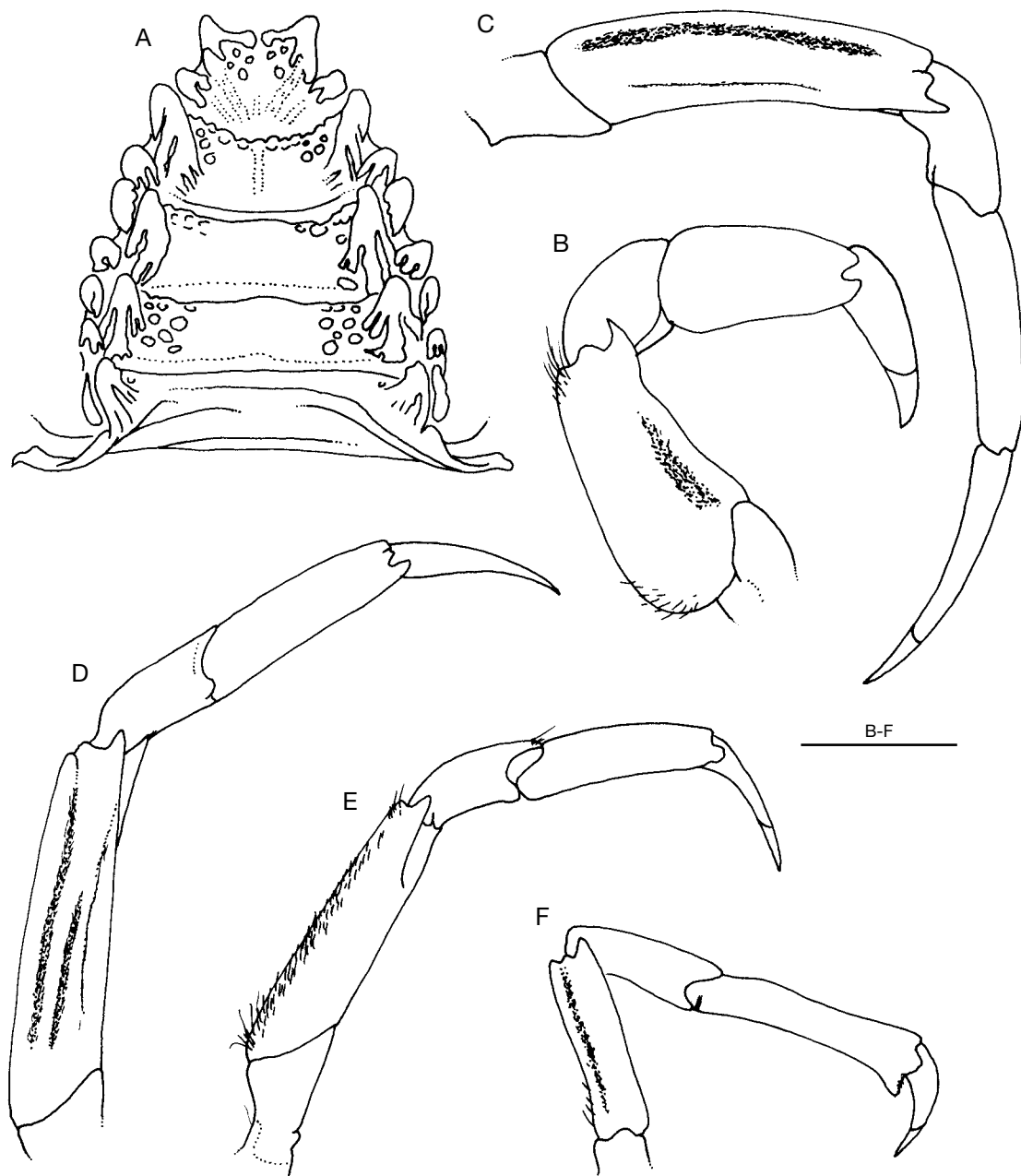


FIG. 46. — *Eduarctus modestus* (Holthuis, 1960) n. comb.; **A**, Hawaiian Islands, Auau Channel, ♀ holotype (USNM), thoracic sternum; **B-F**, Nuku Hiva, Marquesas, MUSORSTOM 9, stn CP 1188, ♀ (MNHN-Pa 1828), pereiopods 1 to 5. Scale bar: B-F, 2 mm.

The space between the lateral and branchial carinae is filled with broad tubercles. The marginal groove along the posterior margin of the carapace is narrow, before it there is a double and at some places treble, row of rather large flattened tubercles; a single row of such tubercles is placed behind the groove. The posterior margin is distinctly bluntly V-shapedly incised in the middle. The first abdominal somite has a complete transverse groove. Posteriorly this groove possesses about 20 posteriorly directed branches, which do not reach the posterior margin of the somite and are somewhat curved or straight and sometimes branched; they are far less rigid and less uniform than in *E. martensii* n. comb. The posterior margin of somites I to IV shows a median incision. The anterior part of the abdominal somites II to V gives a smooth impression but may be somewhat punctate; sometimes the pits are united to very short irregular transverse grooves. A median carina is present on somites II to IV; this carina is not highly elevated, its anterior end is slightly higher than the rest. Laterally the carina is lobulated; the carina of the third somite is slightly higher than those of somites II and IV. The abdominal somites show the usual arborescent pattern of narrow grooves. The pleura of the first somite is short and three-lobed, the incision between the first two lobes, however, is small and often inconspicuous. The pleura of somites II to V are broad with bluntly rounded apices which point down. Apart from a lobe on the anterior margin of pleuron II the margins of the pleura show no teeth or lobes. The dorsal surface of the sixth somite bears numerous squamiform tubercles; the posterior margin shows a few wide lateral lobes. The hard part of the telson shows numerous squamiform tubercles. Of the four teeth on the posterior margin of this calcified part the inner are semicircular, the outer are bluntly and widely truncated.

The anterior margin of the antennular somite is incised in the middle, bearing a blunt lobe at each side of the incision and an indistinct low and blunt tooth more externally.

The anterior margin of the sixth antennal segment is slightly convex and bears five or six broad

truncated teeth which are placed close together. The inner margin of the segment bears two (seldom three) small teeth. The upper surface bears scattered small tubercles, and a short pubescence. The fifth antennal segment has a blunt inner tooth which bears a blunt dorsal carina. The anterior margin of the fourth antennal segment carries six to 11 teeth, the inner of which is by far the largest, the others sometimes are extremely small. The outer margin of the segment bears three or four (mostly three) teeth (the apical tooth not included); the teeth show small dorsal ridges. The strong oblique median carina of the segment bears numerous squamiform tubercles. The inner half of the upper surface of the segment shows small squamiform tubercles, on the outer half there is a curved ridge-like row of five to seven quite large flattened tubercles. The upper surface of the segment may bear a very short pubescence.

The epistome is rather deeply sunken and shows a distinct median incision in the anterior margin. P.1 is heavier than the following. In the third leg the propodus is slightly narrower than the merus, being as broad as or narrower than the propodus of the second and broader than that of the fourth leg. In none of the legs the propodus bears a fringe of hairs on the lower margin and only in the third there is such a fringe on the upper margin. A short dorsal hair fringe is present on the carpus of both the third and fourth legs. The merus in the last four legs is hairy on the upper margin and has also a hairy groove in the upper half of the outer surface (in P.3 a second such groove is present in the lower half). The dactylus of the second leg is longer than either that of the first or third leg and almost twice as long as the one of the fourth leg. The dactyli are smooth or have a few very short velvety hairs in the basal part.

The anterior margin of the thoracic sternum is only very shallowly emarginate, the two tubercles on either side of the median incision of this margin are well-developed and reach almost as far forwards as the anterolateral teeth of the sternum. The anterior and lateral margin of the first somite of the sternum are somewhat swollen; some low tubercles are present behind the anterior margin.

A faint carina extends from the anterolateral teeth posteriorly and obliquely inward; these carinae become obsolete before they meet each other. Very vague median tubercles are visible in the anterior part of the third to fifth sternites. The lateral margin of the sternum is raised.

The first pair of pleopods of the male (= the pair of abdominal somite II) is normal in shape, the endo- and exopod are elongate, slightly falcate, with the endopod the longer of the two. In the three following pleopods the endopod is rudimentary, while the exopod is widely oval, being larger in the second pleopod than in the first, and becoming gradually slightly smaller in the following pleopods.

Size

The examined males had cl. 6-12 mm (Hawaiian material 6-12 mm; Marquesas specimens 6-11 mm); the non-ovigerous females had cl. 6-11 mm (Marquesas) and 13 mm (Hawaii); ovigerous females had cl. 11-14 mm (Hawaii), and 10-12 mm (Marquesas); in the juveniles cl. was 6 mm (Hawaii) and 4-6 mm (Marquesas). The Marquesas specimens seem to be slightly smaller than those from Hawaii, but the difference is extremely slight.

Colour

In most specimens there is little or no trace of the original coloration left. In the specimen from Pokai Bay the body is pale brown. Many of the tubercles have white tips, some are almost entirely white. A dark brown band traverses the carapace at the level of the cervical groove; small dark brown spots are observed on the rest of the carapace. The anterior half of the dorsal surface of the first abdominal somite has four large circular spots of an almost black colour, which are arranged in a transverse row. A conspicuous but not large reddish brown spot is placed in the middle of the pleuron of the second abdominal somite, but is not seen in any of the other somites. The anterior half of the third and fourth abdominal somites show a median dark spot. The last four pereopods have a dark band on the merus, carpus and propodus.

A coloured photograph of an ovigerous female from Nuku Hiva, Marquesas Islands (stn CP 1177) shows the body marbled with darker and lighter reddish brown, and white and with whitish spots and areas. A large heart-shaped white area is present in the median region of the carapace slightly before the cervical groove; it shows a small dark point in the middle of each half. The posterior postrostral carina and the branchial carinae are a paler brown. On the abdomen the lateral parts are rather pale brown, as are also the posterior margins of the somites. A bright white spot is present on the anterior part of the median carinae of somites IV and V. In the middle of each lateral half of abdominal somites II to V is a very small round dark spot surrounded by a small pale area. The tailfan is transparent with a few indistinct irregular brownish areas. The sixth antennal segment is brown with the teeth much paler. The fourth segment shows an orange-brown distal area that includes the apex and the distal lateral tooth; this orange area is separated from the brown basal part of the segment by a large white spot.

Type

The holotype specimen is the ovigerous female from Auau Channel. This is the specimen figured by Rathbun (1906).

Larvae

Scyllarid larvae provisionally identified with the present species were discussed by Johnson (1970) "from the Hawaiian area" and Johnson (1971a) from the Oahu area: 22°15'N, 157°43'W; 22°06'N, 157°44'W; 21°45'N, 157°46'W; 21°36'N, 157°46'W; 21°28'N, 158°36'W; 21°24'N, 158°23'W; 21°10'N, 158°19'W; 21°10'N, 158°10'W; 21°10'N, 157°50'W; 21°09'N, 158°21'W; 21°08'N, 158°25'W; 21°07'N, 158°21'W and 21°06'N, 158°14'W. Johnson (1971a) gave descriptions and figures of all stages (except stage VII).

REMARKS

The first known specimens of the species were reported from the Hawaiian Islands by Rathbun

under the name *Scyllarus martensii* Pfeffer, 1881, a species that indeed is closely related. The present species differs from *E. martensii* n. comb. by: 1) the short longitudinal grooves of the first abdominal somite, which are straight and unbranched in *E. martensii* n. comb. and of a whitish colour, while in the present species they are somewhat curved often with side branches and do not differ in colour from the surrounding area; 2) the median carinae of abdominal somites II and III, which are hardly raised in the present species, while they are high and conspicuously elevated in *E. martensii* n. comb.; 3) the anterior half of the abdominal somites, which is smooth and somewhat pitted in the present species and do not show a transverse ciliated groove in each half like in *E. martensii* n. comb.; and 4) by the lateral margin of the carapace, in which the posterolateral carina ends anteriorly above the posterior end of the mediolateral carina, while in *E. martensii* n. comb. all three lateral carinae are in a single line.

The specimens of the Marquesas Islands as a rule have the tubercles on the anterior half of the carapace smaller and often obscured by a very short pubescence; the cardiac, gastric and pregastric teeth in the Marquesas specimens are somewhat higher and more triangular than those from the Hawaiian Islands.

Eduarctus perspicillatus n. sp.
(Fig. 47)

TYPE MATERIAL. — Holotype: ♀ 13 mm, RV *Anton Bruun*, cruise 8, stn 4000 (USNM).

TYPE LOCALITY. — Mozambique. Vicinity of Ponta da Barra Falsa, 20°30'S, 35°43'E, 62 m.

ETYMOLOGY. — The new specific name is based on the latin word *perspicillum* for spectacles, in reference to the toothless spectacle-like rim of the orbits.

MATERIAL EXAMINED. — SE Africa. Mozambique. IOE, RV *Anton Bruun*, cruise 8, stn 4000, Vicinity of Ponta da Barra Falsa, 20°30'S, 35°43'E, shrimp trawl, 62 m, 3.X.1964, 1 ♀ holotype 13 mm (USNM).

DISTRIBUTION AND HABITAT. — The type locality is off Ponta da Barra Falsa, in southern Mozambique; the type specimen was taken at a depth of 62 m.

DESCRIPTION

The rostrum is rounded and ends in a narrow blunt top. No rostral tooth is present. The pre-gastric tooth ends in two blunt points and is small, but distinct; it is much smaller than the gastric tooth. The gastric tooth is triangular in lateral view, ending in a single rectangular point; in dorsal view it is rather wide and shows some three transverse rows of tubercles. The cardiac tooth is high and distinctly larger than the gastric; it ends in a double point. In dorsal view it is broadly triangular, with a double posterior submedian row of four or five broad and flat tubercles. Similar tubercles are found on the slightly swollen sides of the cardiac tooth. Apart from a roughly circular smooth area, there are several squamiform tubercles between the anterior postrostral and the anterior branchial carinae. The intermediate row between the posterior postrostral and posterior branchial carinae is distinct and consists of four squamiform tubercles. The cervical groove is narrow in the middle and widens laterally. In the gap that it forms in the branchial carina a distinct tubercle is visible. The anterior branchial carina is short and stops before reaching the orbital margin. Thereby the inner orbital carina lacks the two teeth found in most other scyllarine species, and ends in a rounded anterior curve. Behind the orbit are a number of smallish tubercles. The posterior branchial carina ends anteriorly in a blunt tooth that is followed by numerous squamiform tubercles, that fill the entire space between this carina and the posterolateral margin of the carapace. The anterolateral tooth of the carapace is blunt and followed by three distinct squamiform tubercles. The mediolateral margin bears a distinct blunt anterior tooth followed by six much smaller tubercles. This row of tubercles continues posteriorly below the anterior of the posterolateral teeth of the carapace. Hereby the lateral margin of the carapace does not form a straight line but is interrupted at the anterior end of the posterolateral ridge. The intercervical carina bears 10 to 12 rather high tubercles, which are elongate and form parallel lines. The marginal groove along the posterior margin of the carapace is deep and narrow; it is filled with short hairs. Both before and

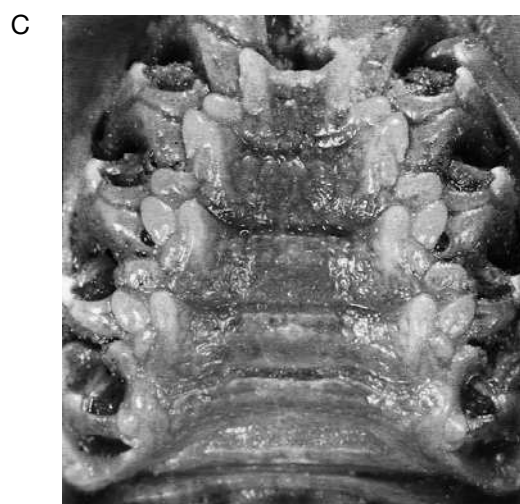
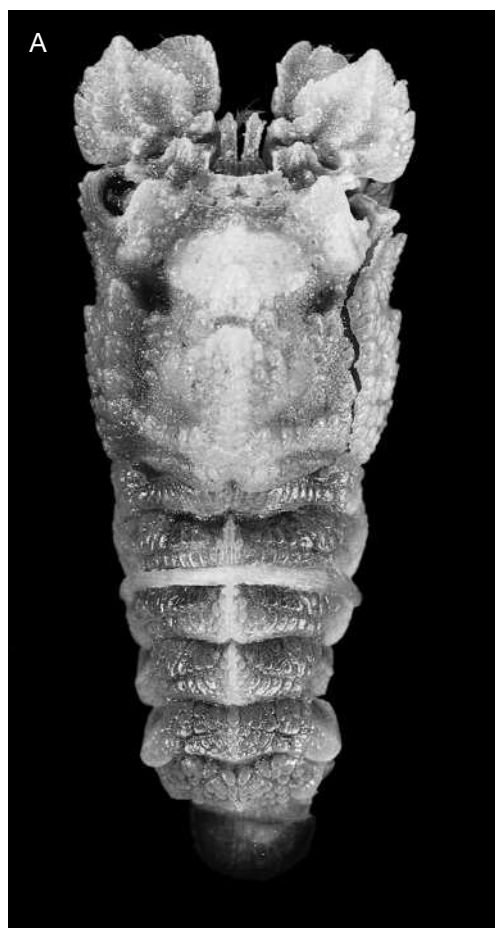


FIG. 47. — *Eduarctus perspicillatus* n. gen., n. sp., Mozambique, ♀ holotype, carapace length 13 mm (USNM); **A**, dorsal view; **B**, lateral view; **C**, thoracic sternum.

behind it there are two or three rows of squamiform tubercles. The posterior margin of the carapace is rather deeply and bluntly incised in the middle; the incision forms a wide triangle with a blunt top. The first abdominal somite has a complete transverse groove. Before the groove the somite is smooth, behind it there are about 18 longitudinal grooves, some of which are forked. The anterior half of abdominal somites II to V is smooth and ends in a straight transverse posterior margin without any trace of crenulation. Somites II to V have the arborescent markings of deep and narrow grooves on the posterior half. A median longitudinal carina is present in somites II to V. This carina is highest in somites III and IV where they are of about the same height. In somite II the carina shows a median groove, which does not quite reach the anterior end. The posterior margins of somites I to III have a very conspicuous triangular median incision; in somite IV such a median incision is hardly visible, while in somite V the posterior margin is widely and shallowly produced in the middle. The pleuron of abdominal somite I ends in two broad lobes, the anterior of which has an indistinct incision. All other pleura are broadly rounded at the top with the margins entire. The sixth somite is covered with squamiform tubercles and shows a transverse groove over the middle. The hard part of the telson also carries squamiform tubercles, its posterior margin shows four teeth: the outer two, placed at the lateral margin, are wide with a bluntly rectangular top; the two inner are much narrower and have a rounded top.

The anterior margin of the antennular somite has a low, broadly triangular tooth in the middle of each half.

The sixth (last) antennal segment has six rather short teeth on the anterior margin, all with the top bluntly rounded. The outer tooth, as usual, is the widest. The inner margin of the segment shows two triangular smaller teeth. The fifth segment is small and ends in a triangular tooth, which is carinate above. The fourth segment has the outer margin with three or four distinct broad teeth (the apex of the segment not included). The anterior margin has nine or 10 small teeth, the

inner of which is largest. The oblique median carina of the segment is distinct and ends in the blunt apex of the segment; the carina bears numerous small squamiform tubercles. A smaller curved ridge carrying several larger tubercles is visible on the outer half of the upper surface of the segment. Small tubercles and short hairs are scattered over the rest of the surface, and short low ridges are visible on the teeth of the outer margin.

In the single specimen available all legs are missing. The thoracic sternum has the typical U-shaped anterior margin with a low tubercle on either side of the median incision. The anterior margin is slightly swollen. The median part of the sternum is rather wide and slightly sunken; a faint tubercle is visible on the third sternite. The lateral edges of the sternum along the bases of the legs are slightly heightened and provided with wide and low tubercles.

Size and colour

The species is only known from the holotype female which has cl. 13 mm. There is no colour left in the specimen that has been preserved in alcohol for 36 years.

REMARKS

The species is closest to *Eduarctus modestus* n. comb., but can be distinguished easily by the absence of teeth on the orbit. Although the holotype is the only specimen available of this species, and moreover is incomplete by the loss of all legs, the characters that remain are such that they do not fit any other species, and I have no doubt that the species is new.

Eduarctus reticulatus n. sp. (Figs 48-50; 69B)

TYPE MATERIAL. — Holotype: ♀ 20 mm, RV *Cape St. Mary*, cruise 3/64, stn 48 (RMNH D 49578). For paratypes see Material examined.

TYPE LOCALITY. — South China Sea. Macclesfield Bank, 15°36.8'N, 114°15.4'E, 73-84 m.

ETYMOLOGY. — The new specific name refers to the reticulate pattern formed by the dense placement of

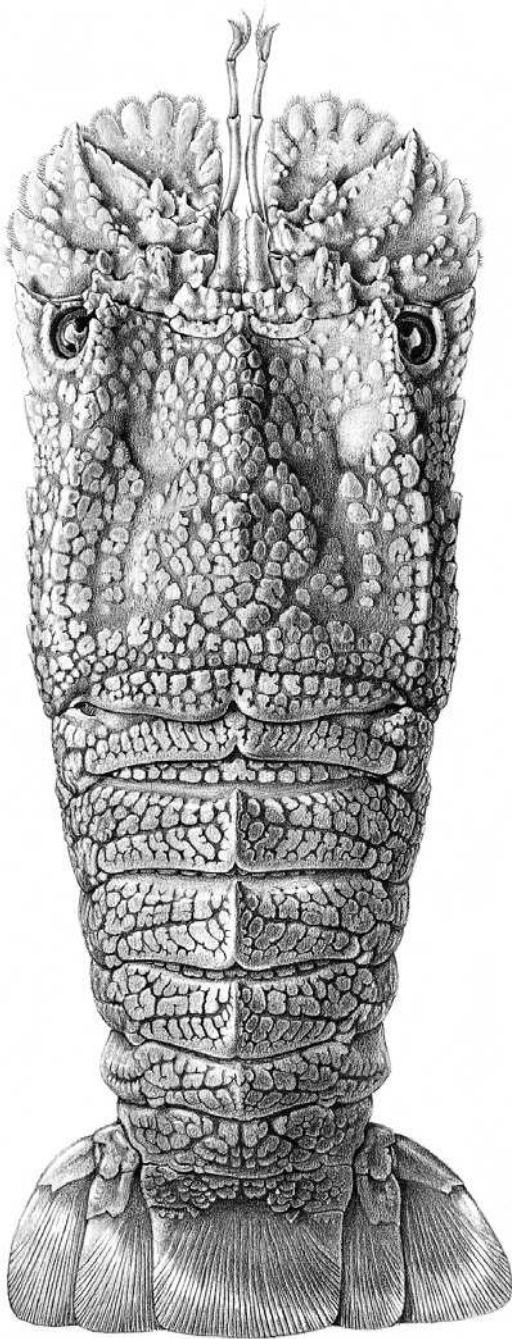


FIG. 48. — *Eduarctus reticulatus* n. gen., n. sp., Macclesfield Bank, ♀ holotype, carapace length 20 mm (RMNH D 49578), dorsal view. W. C. G. Gertenaar del.

the tubercles on most parts of the body, even on the usually smooth anterior half of the abdominal somites.

MATERIAL EXAMINED. — **Seychelles.** REVES 2, stn 21, 5°21.8'S, 56°10.4'E, trawl, 55-60 m, sand with calcareous algae (melobesiids), bottom almost flat, 6.IX.1980, 1 ♀ paratype 17 mm (photographed, MNHN-Pa 1833). — Stn 27, 4°55.6'S, 54°58.5'E, trawl, 53 m, sand with calcareous algae (melobesiids) and coral, bottom flat, 8.IX.1980, 1 ♂ paratype 14 mm (MNHN-Pa 1834).

South China Sea. Macclesfield Bank. RV *Cape St. Mary*, cruise 3/64, stn 48, 15°36.8'N, 114°15.4'E, trawl No. 169, 73-84 m, coral bottom, 17.VI.1964, A. J. Bruce leg., 1 ♀ holotype 20 mm (RMNH D 49578). — HMS *Egena*, 64-75 m, P. Bassett Smith leg., 1 ♀ paratype 12 mm (BM 93.11.3. 30/31). — 70 m, P. Bassett Smith, 2 ♂ ♂ paratypes 8 and 9 mm (BM 92.8.28. 53/54).

Chesterfield Islands. CHALCAL 1, stn DC 55, 21°23.9'S, 158°59.6'E, trawl, 55 m, *Halimeda* and Foraminifera, 25.VII.1984, 1 ov. ♀ paratype 17 mm, 1 juv. ♀ paratype 5 mm, 1 juv. ♂ paratype 9 mm (MNHN-Pa 771). — Île Longue, diving, 33 m, sand, 16.X.1986, P. Laboute, 1 soft ♂ paratype 12 mm (MNHN-Pa 1267). — AMUSIUM 1, station number unknown, depth probably about 60 m, date unknown, 1 ♀ paratype 16 mm (MNHN-Pa 1836).

Lansdowne Bank. 1.VIII.1988, 1 ov. ♀ paratype 16 mm (MNHN-Pa 1335).

New Caledonia. LAGON, stn 398, Grand Récif Sud, 22°37.0'S, 167°11.8'E, 71 m, coarse sand, Foraminifera and Gorgonaria, 23.I.1985, 1 ov. ♀ paratype 18 mm (RMNH D 48758).

SMIB 8, stn DW 186, Banc Azrèque, 23°24.9'S, 168°05.7'E, 57-59 m, 31.I.1993, 1 ♀ paratype 12 mm (photographed, MNHN-Pa 1835).

DISTRIBUTION. — So far this species is only known from the present material from the Seychelles, South China Sea and New Caledonia. It is likely that it eventually will also turn up in localities in-between.

HABITAT. — The species has been collected at depths between 33 and 73(-84) m, on flat sandy bottoms often with corals, Gorgonaria, calcareous algae, *Halimeda* and Foraminifera.

DESCRIPTION

The species is very close to *E. modestus* n. comb., especially as far as the shape of the lateral margin of the carapace is concerned. There are, however, several differences which make it necessary to consider this a new species.

There is no rostral tooth, the rostrum does bear dorsally a blunt tubercle. The pregastric and gastric teeth both are distinct and somewhat triangulo-

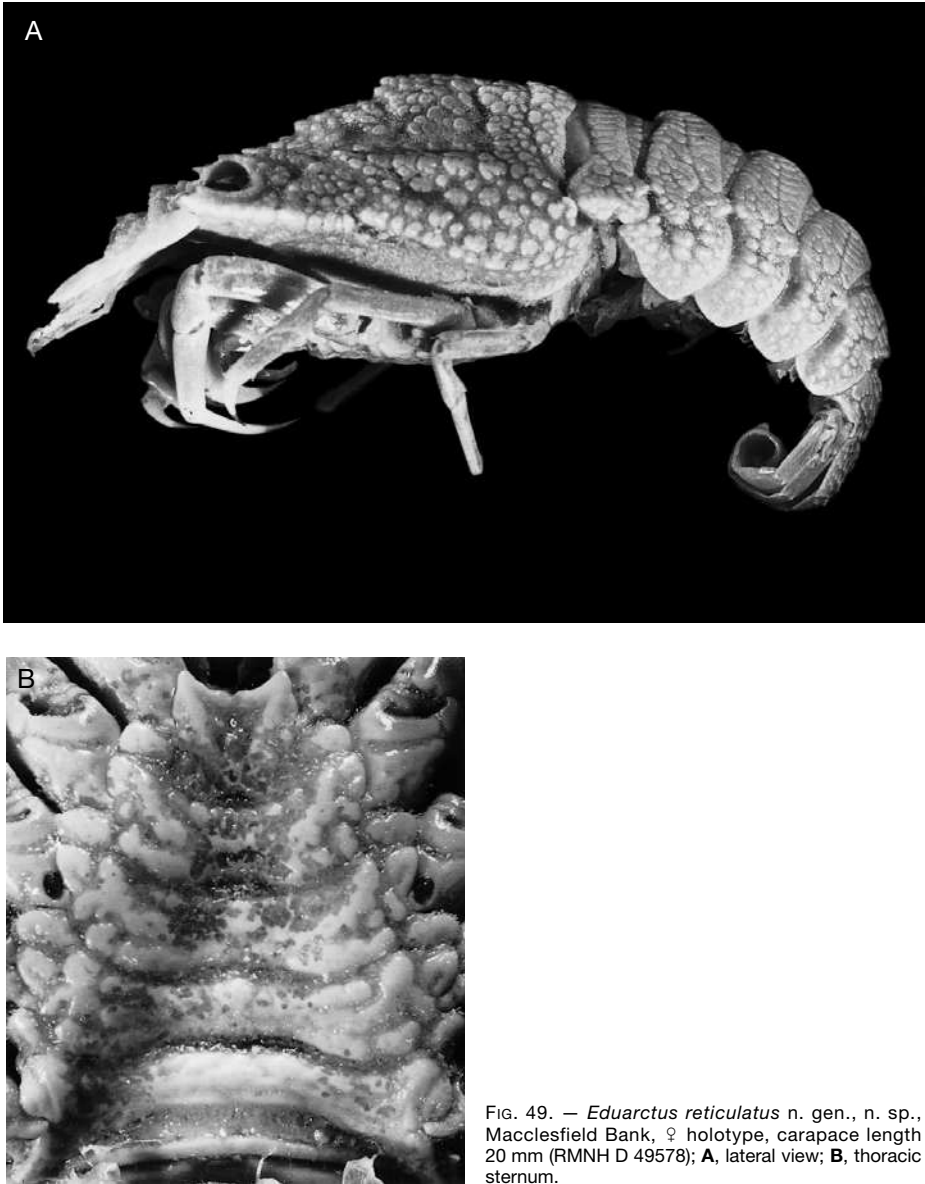


FIG. 49. — *Eduarctus reticulatus* n. gen., n. sp., Macclesfield Bank, ♀ holotype, carapace length 20 mm (RMNH D 49578); **A**, lateral view; **B**, thoracic sternum.

lar in lateral view. The cardiac tooth is distinctly triangular in lateral view, it is less elevated than in *E. modestus* n. comb. and is flanked at either side by a tubercle, which reaches farther forward than the cardiac tooth itself; in lateral view this tubercle shows below the cardiac tooth.

The branchial ridge is interrupted by the cervical groove, which, however, just mediad of the gap is

blocked by a large tubercle, followed by a smaller. At either side of the anterior postrostral carina and just before the cervical groove is a smooth, slightly sunken area without tubercles; this area often is of a dark colour.

The anterior end of the posterolateral carina ends in a strong tooth, which is placed slightly higher and slightly in advance of the posterior end of the

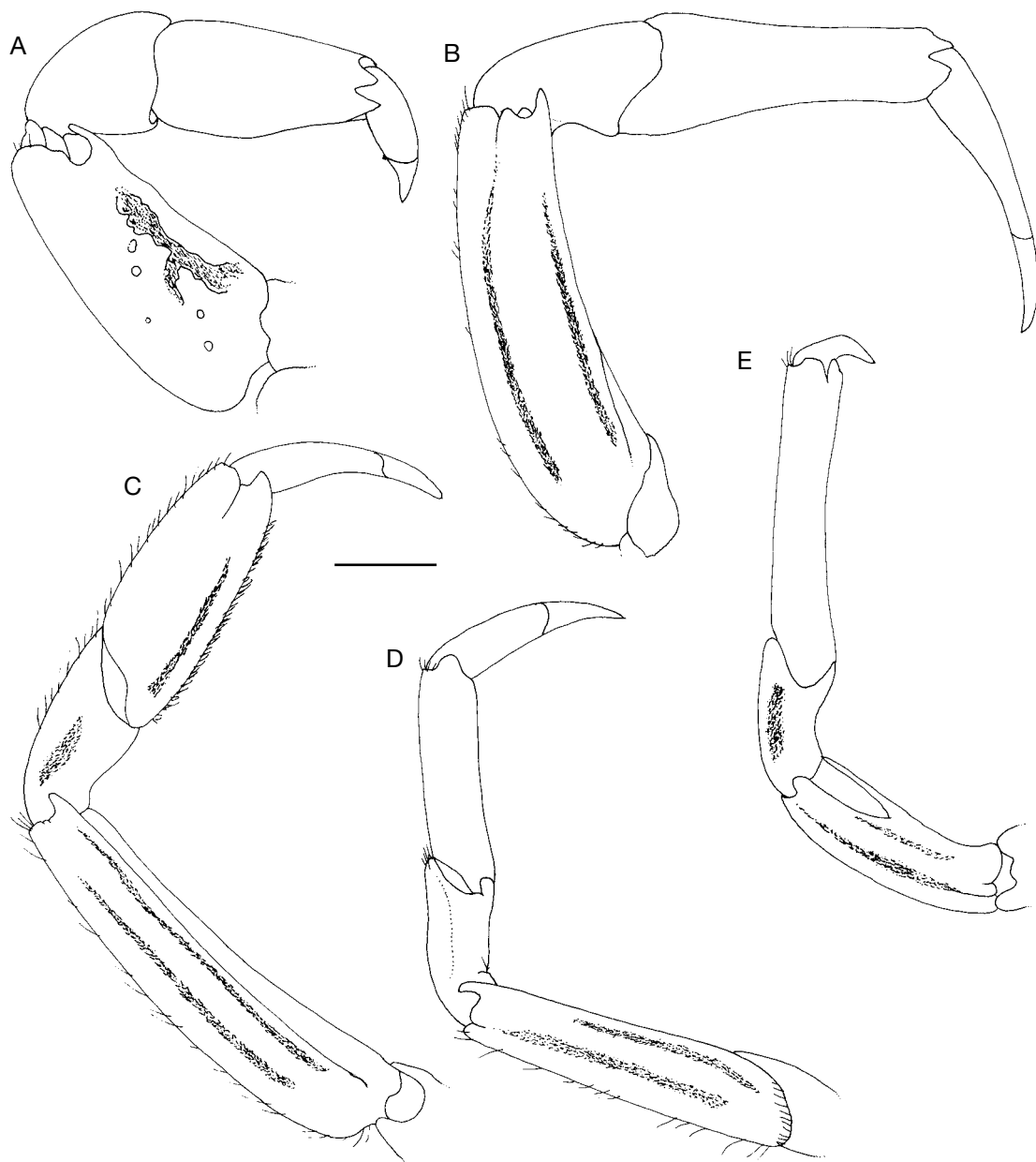


FIG. 50. — *Eduarctus reticulatus* n. gen., n. sp., Macclesfield Bank, ♀ holotype (RMNH D 49578); A-E, pereopods 1 to 5. Scale bar: 2 mm.

mediolateral carina. The lateral margin thereby is interrupted and makes a distinct angle here. There are three or four anterolateral, three or four mediolateral and eight or nine posterolateral teeth, which as a rule are very distinct.

The marginal groove along the posterior margin of the carapace is very narrow, the tubercles of the row before it and those behind it almost touch. The tubercles before and behind are numerous and not or not distinctly arranged in transverse rows.

Through the presence of numerous flattened tubercles, the upper surface of the body gives a somewhat reticulated impression.

The surface of the anterior half of the abdominal somites II to IV shows a reticulation of shallow hairy grooves. The posterior half of somite I shows about 20 longitudinal grooves, which are quite irregular and branched, often forming a reticular pattern of small tubercles. The median carinae of somites II to V are very low and inconspicuous, mostly they are not grooved, except that of somite II that may show such a longitudinal groove. Laterally the carina are somewhat lobulated. The carina of somite III is highest, that of somite IV is lowest, while the one of somite V is hardly elevated at all.

The anterior margin of the antennular somite has a median incision at either side of which there are four low broad lobes.

The sixth (last) antennal segment has four or five truncated teeth, only the inner being somewhat triangular; the inner margin of the segment shows two small triangular appressed teeth. The fourth segment has the anterior margin with about seven low and rather wide teeth, the inner of which is the most conspicuous. The lateral margin of the fourth segment has two or three large and sharp teeth (the apical tooth of the segment not included) and one or two much smaller incisions. The median oblique carina of the segment bears eight to 12 rather irregularly arranged tubercles; the outer half of the dorsal surface of the segment shows a curved row of eight to 10 rather large tubercles, which become smaller distally; there are also scattered tubercles on the rest of the surface.

The propodus of the third leg has a fringe of very short hairs on the upper and lower margins. In one specimen the outer surface of the propodus of the right third leg has a hairy longitudinal groove in the basal part just above the lower margin; in the left leg this groove is absent. A sunken longitudinal hairy groove is present on the outer surface of carpus and merus of legs 3 to 5. The merus of legs 1 to 3 has a lower carina. The fixed finger of the chela of the fifth leg of the adult females is half or less than half as long as the dactylus.

The anterior margin of the thoracic sternum has the normal shape as found in this genus: it is shallowly emarginate with a median incision that is flanked by a pair of low tubercles. The margin is thickened and from either anterolateral tooth a broad, low carina extends posteriorly and inward; these two carinae do not meet in the middle, in the space between them there are several small tubercles. The entire surface of the sternum is covered by low irregular tubercles and shallow short grooves. The posterior margins of the somites bear each a transverse row of small tubercles; on somites II, III and IV the median of these tubercles is slightly the largest.

The first pleopod of the male (namely that of abdominal somite II) from the Seychelles has the endopod and exopod narrow but distinct; the exopod is elongate oval and blunt, the endopod is slightly longer and ends in a rather sharp point, its anterior margin is straight, the posterior convex. In the following pleopods the exopod is broadly oval, the endopod reduced to a knob.

Size

The males have a carapace length between 12 and 14 mm, non-ovigerous females between 12 and 20 mm, and ovigerous females between 16 and 18 mm; juveniles with cl. 5 and 9 mm have been observed; the largest non-ovigerous female (the holotype) evidently was ovigerous shortly before as the pleopods still carry ovigerous setae. On the whole this species is larger than *E. modestus* n. comb.

Colour

A coloured photograph of the female from the Banc Aztèque shows the carapace of a pale greyish brown colour, partly covered with conspicuous spots. The dark smooth spot just before the cervical groove and between the anterior postrostral and anterior branchial carinae has already been mentioned. Between this spot and the posterior margin of the orbit extends a broad bright white band. Some small bright white spots are on the anterior part of the posterior branchial carina. The lateral margin of the carapace shows dark purple, extending over the full length of the carapace and even touching the postero-lateral

angle of the fourth antennal segment. Many of the tubercles on the antenna are white, while there also are white areas in the basal part and along the anterior and outer margins of the antenna, the rest is pale purple. The abdomen is variegated purple and bright white; the white colour is most conspicuous in the anterior median region; the fifth segment is almost entirely purplish. The sixth segment and the tailfan show as of an evenly whitish or pale purplish gray colour. Not shown on this photograph, because the animal is fully stretched, but what can be observed in rather fresh alcohol specimens is a row of four rather large rounded dark spots on the anterior half of the first somite. Furthermore such alcohol specimens also show a dark spot on the posterolateral angle of the sixth antennal segment and a rather broad dark band in the basal half of the propodi of P.3 to P.5, but not in the other segments of these legs.

Genus *Gibbularctus* n. gen.

TYPE AND ONLY SPECIES. — *Arctus gibberosus* De Man, 1905 by present designation.

ETYMOLOGY. — From the Latin *gibbulus* (= slight hump) and the generic name *Arctus* De Haan, 1849, referring to the slight, but unmistakable hump of the fourth abdominal somite.

DIAGNOSIS. — The midline of the carapace has rostral, pregastric, gastric and cardiac teeth. Abdomen without medio-dorsal carina. Dorsal margin of abdominal somite IV more convex than that of either somites II or III. Abdominal terga II to V with arborescent markings of very narrow grooves. Abdominal pleura with bluntly rounded top directed down. Fourth antennal segment with a curved row of tubercles in the outer half of the dorsal surface outside the main oblique carina. Anterior margin of thoracic sternum simply V-shaped, without submedian tubercles. Sternum without distinct median tubercles, its posterior margin entire. None of the legs with a ventral hairy fringe.

Gibbularctus gibberosus (De Man, 1905) n. comb. (Fig. 69C, D)

Arctus gibberosus De Man, 1905 [August]: 588.

Scyllarus gibberosus — De Man 1916: 64, 68, 70, 90, pl. 3 fig. 14. — Estampador 1937: 496; 1959: 41. —

Holthuis 1968: 288. — McNeill 1968: 25. — Burukovsky 1974: 107; 1983: 150. — Phillips *et al.* 1980: 70. — Vine 1986: 107. — McWilliam *et al.* 1995: 564.

Scyllarus Gundlachii — Paulson 1875: 96, pl. 12 fig. 5, 5a; 1961: 102, pl. 12 fig. 5 [non *Scyllarus gundlachi* von Martens, 1872].

Scyllarus sordidus Nobili, 1905b [30 May]: 160 [non *Scyllarus sordidus* Stimpson, 1858].

Arctus Nobilii De Man, 1905 [August]: 589.

Scyllarus Paulsoni Nobili, 1906b [30 January]: 395; 1906c: 88. — De Man 1916: 65, 68, 71.

Scyllarus Nobilii — Nobili 1906a [30 April]: 56, pl. 4 fig. 15. — Bouvier 1914: 704; 1915: 188. — De Man 1916: 65, 68, 70.

Scyllarus nitidus Nobili, 1906a [30 April]: 59, pl. 6 fig. 27.

Scyllarus paulsoni — Prasad & Tampi 1969: 84. — Phillips *et al.* 1980: 70.

Scyllarus nobilii — Prasad & Tampi 1969: 82. — C. Michel 1974: 256. — Phillips *et al.* 1980: 70.

TYPE MATERIAL. — Syntypes: 1 ♂, *Siboga* Expedition, stn 99 (ZMA); 1 ♂, *Siboga* Expedition, stn 164 (ZMA).

TYPE LOCALITY. — Philippines, off North Ubian, 6°7.5'N, 120°26'E, 16–23 m; Indonesia, NE of Misool, 1°42.5'S, 130°47.5'E, 32 m.

MATERIAL EXAMINED. — **Persian Gulf.** Persian Gulf, 1900, F. W. Townsend leg., 1 ♂ 8 mm (BM 1900.5.7-2). — Mission J. Bonnier and Ch. Pérez, stn XLVII, off Dubai, Arabia, 25°10'N, 55°10'E and 24°55'N, 54°40'E, 18–27 m, pearl oyster bank, 1901, 2 ov. ♀♀ syntypes of *Arctus nobilii* De Man, 1905 and also syntypes of *Scyllarus sordidus* Nobili, 1905, and *S. nitidus* Nobili, 1906 (MNHN).

Seychelles. *Tyro* Expedition, stn 719, E of Bird Id, 3°44'S, 55°14'E, rectangular dredge, 45 m, sandy bottom, 20.XII.1992, 1 ♂ 6 mm, 1 ♀ 14 mm (RMNH D 49574). — Stn 778, West of Poivre Atoll, 5°46'S, 53°11'E, 3.5 m, Agassiz trawl, 57 m, soft bottom, 1.I.1993, 1 ♀ 13 mm (RMNH D 49575).

REVES 2, stn 7, 4°52.8'S, 56°01.4'E, dredge, 57 m, hard coralligenous bottom, 3.IX.1980, 1 juv. 4 mm (MNHN-Pa 1908). — Stn 27, 4°57.8'S, 54°59.2'E, dredge, 52 m, coral bottom, 8.IX.1980, 1 ♂ 10 mm (MNHN-Pa 1858). — Stn 38, 5°02.6'S, 56°49'E, dredge, 44 m, bottom with hard rocks, 13.IX.1980, 1 ov. ♀ 15 mm (MNHN-Pa 1857).

Madagascar. Madagascar without more data, 1 ♂, preserved dry (MG). — Nosy Bé, NW coast, 1 ♂ 9 mm (MNHN-Pa 588). — Banc de Pracel, West coast, trawl, 55 m, bottom sand, VI.1954, A. Crosnier leg., 1 ♂ 6 mm, 1 ♀ 10 mm (MNHN-Pa 301).

Japan. Okinawa, Horseshoe Cliffs, 1 km WNW Onna village, 26°30.0'N, 127°50.9'E, diving, 12 m deep, 28.VIII.1981, R. F. Bolland leg., No. 903, 1 ov. ♀ 11 mm (USNM).

Burma. Gulf of Martaban, E. W. Oates leg., 1 ♂ 9 mm (BM 88.34).

Philippines. *Siboga* Expedition, stn 99, off N Ubian, 6°7.5'N, 120°26'E, 16-23 m, *Lithothamnion* bottom, 28-30.VI.1899, 1 ♂ syntype of *Arctus gibberosus* De Man, 1905 (ZMA).

RV *Albatross*, stn D 5165, Observation Id, N 70°W 6.40 miles, 4°58'20"N, 119°50'30"E, 16 or 33 m, coral or green mud, 24.II.1908, 1 ♂ 8 mm, 2 ♀♀ 10 mm (1 ov.) (USNM). — Stn D 5596, Sulu Archipelago, Zamboanga Light, N 31°W, 0.1 mile, 6°54'N, 122°04'30"E, 16 m, 10.X.1909, 1 ♀ 9 mm (USNM).

FV *Pele*, W of Malanipa Id, Basilan Strait, 12.II.1964, B. R. Wilson leg., 1 ♂ 10 mm (WAM 356-64). — One mile + 237° from Tangalan Id in Maluso Bay, Basilan Id, 15.II.1964, B. R. Wilson leg., 1 ♀ 13 mm (WAM 355-64).

Indonesia. *Siboga* Expedition, stn 164, NE of Misool, 1°42.5'S, 130°47.5'E, 32 m, bottom sand, small stones and shells, 20.VIII.1899, 1 ♂ syntype of *Arctus gibberosus* De Man, 1905 (ZMA).

Australia. Queensland. Great Barrier Reef Expedition, stn XVII, about 0.25 mile N of N Direction Id, off Lookout Point near Cape Flattery, dredge, 35 m, 9.III.1929, 1 ♂ 14 mm (BM).

Chesterfield Islands. CORAIL 2, stn DW 122, 19°28.17'S, 158°17.86'E, 32 m, 29.VIII.1988, 1 ♂ 8 mm, 1 ♀ 9 mm (MNHN-Pa 1285). — Stn DW 146, 19°37.0'S, 158°16.28'E, 44 m, 30.VIII.1988, 1 ♀ 7 mm (MNHN-Pa 1287). — Stn DW 160, 19°46.0'S, 158°23.0'E, 35-41 m, 1.IX.1988, 1 ♀ 9 mm (MNHN-Pa 1286).

New Caledonia. Surprise Atoll. LAGON, stn 455, 18°30'S, 163°08'E, 40 m, 28.II.1985, 1 juv. 5 mm (MNHN-Pa 1225).

Lagon Nord-Ouest. LAGON, stn DW 1014, 20°8.7'S, 163°53.4'E, 22-23 m, 3.IV.1988, 1 ♂ 10 mm (RMNH D 48757). — Stn DW 1050, 20°9.9'S, 164°9.4'E, 11-12 m, 4.V.1988, 1 ♀ 12 mm (MNHN-Pa 1319).

Lagon Est. LAGON, stn 836, 20°46.4'S, 165°15.75'E, 57 m, 11.I.1987, 1 ♂ 8 mm (photographed; MNHN-Pa 1284). — Stn 710, 21°24.0'S, 166°02.5'E, 30-31 m, 10.VIII.1986, 1 ♂ 10 mm (photographed; MNHN-Pa 1265).

Lagon Sud-Ouest. LAGON, stn 13, 22°20'S, 166°29'E, 20 m, 22.V.1984, 1 ♀ 10 mm (MNHN-Pa 1907). — Stn 62, 22°26'S, 166°26'E, 25 m, 20.VIII.1984, 1 ♂ 9 mm (MNHN-Pa 1000). — Stn 79, 22°29'S, 166°29'E, 16 m, 21.VIII.1984, 1 ♀ 14 mm (MNHN-Pa 1005). — Stn 155, 22°31'S, 166°38'E, 23 m, 24.VIII.1984, 1 ♂ 11 mm (RMNH D 48756). — Stn 233, 22°35'S, 166°46'E, 30 m, 22.X.1984, 1 ov. ♀ 13 mm (MNHN-Pa 1010). —

Stn 279, 22°20'S, 166°27'E, 29 m, 9.XI.1984, 2 ♂♂ 11 and 12 mm (MNHN-Pa 1905). — Stn 346, 22°45'S, 166°52'E, 40 m, 29.XI.1984, 1 ♂ 9 mm, 1 ♀ 10 mm (MNHN-Pa 1856). — Stn 553, 21°51'S, 166°55'E, 39 m, 16.VII.1985, 1 ♂ 7 mm, 1 ♀ 7 mm (MNHN-Pa 1247). — Stn 558, 22°46'S, 166°54'E, 43 m, 16.VII.1985, 1 ♂ 8 mm (MNHN-Pa 1906).

DISTRIBUTION. — The species has a rather wide distribution in the Indo-West Pacific region: it is known from the Red Sea to Madagascar east to the Ryukyu Islands, the Philippines, Indonesia and New Caledonia. The species seems to be rather scarce (or live in places that are not easily accessible) and so far has been reported from Tor (= Et Tur) or Ras Mohammed, Sinai Peninsula, Egypt (Paulson 1875, 1961), off Dubai, Persian Gulf, 25°10'N, 55°10'E and 24°55'N, 54°40'E (Nobili 1905b, 1906a), environs of Port Louis, Mauritius (Bouvier 1914, 1915), North Ubian Island, Sulu Archipelago, 6°7.5'N, 120°26'E and between Salawati and Misool, Indonesia, 1°42.5'S, 130°47.5'E (De Man 1905, 1916), Great Barrier Reef, Australia, about 0.25 mile N of N Direction Id, off Lookout Point near Cape Flattery, Queensland (McNeill 1968). The present material greatly extends the known range of the species.

HABITAT. — The species has been found at depths between 12 and 57 m. The bottoms on which it occurred were described as sand (twice), coral, green mud, hard bottom with corals, hard rocks, soft bottom. It seems as if the species prefers a hard coralligenous substrate, but too few observations have been made to allow any positive statement.

DESCRIPTION

The rostrum is rather broad, the anterior margin is bilobed and behind the top it is slightly constricted. Dorsally it bears a distinct blunt rostral tooth.

Apart from the rostral tooth there are three more teeth in the midline of the carapace. The cardiac tooth is broad and two-topped; behind it is a double row of four or five flattened scale-like tubercles. The gastric tooth is single-topped and slightly stronger and higher than the cardiac. Behind and slightly lateral of the gastric tooth there are rather large squamiform tubercles, which are arranged in three or four longitudinal series of about three. The pregastric tooth is lower and smaller than either the gastric or rostral teeth, it is often broadly rounded, sometimes two- or three-topped. The branchial carina is rather widely interrupted by the cervical groove.

No tubercle is placed in the gap, but a small one is present in the groove medially of the gap. Anteriorly the branchial carina ends in two about rectangular teeth of about equal size, which are placed one behind the other on the inner orbital margin. There is a row of three or four squamiform tubercles between the last of these orbital teeth and the cervical groove. The posterior branchial carina ends anteriorly in a blunt tooth, behind which there are several squamiform tubercles, often in three parallel rows of five to 10. At the place of the posterior submedian carina there is a group of squamiform tubercles. The intermediate row bears about three to five tubercles, some of which may be double; there are several other tubercles between the anterior branchial and the anterior postrostral carinae. The anterolateral angle of the carapace is rather blunt; behind it are two or three anterolateral tubercles. The lateral tooth behind the cervical groove is followed by one to three mediolateral tubercles. The tooth behind the postcervical incision is hardly larger than some of the six to eight posterolateral tubercles that follow it. Some tubercles may be seen between the posterior branchial and posterior lateral carinae. The intercervical carina is replaced by a group of squamiform tubercles which occupy the entire space between the cervical and postcervical grooves. There is a large, flattened often bilobed postorbital tubercle. The marginal groove at the end of the carapace is rather deep and narrow, before and behind it there are two transverse rows of tubercles. The posterior of these tubercles are often fused at their posterior end. The posterior margin of the carapace is shallowly incised in the middle.

The first abdominal somite has a complete transverse groove extending over its full breadth. Before this groove the surface of the somite is smooth, behind it there are about 20 longitudinal shallow grooves, which, however do not reach the posterior margin. The anterior half of the following somites also is smooth. The posterior half shows no median carina, but only the usual arborescent pattern of narrow, deep grooves. The median figure formed by the pattern is lobulated. The two halves of the dorsal surface of somites II

to V meet each other in the median line under a very blunt angle, and seen in lateral view this median line is slightly arched; this curvature is most strongly pronounced in the fourth somite, where it is distinctly more convex than in either the third or fifth somites. The posterior margin of the first to fourth somites is deeply incised in the middle; this margin of the fifth and sixth somites ends in a blunt median point or is rounded. The pleura of the first somite are short and bilobed, each lobe has its margin somewhat crenulated, this is more distinct in the anterior than in the posterior lobe. The other pleura end in a broad blunt, downward directed top. Apart from an indistinct lobe on the anterior margin of the second pleuron, the margins of the pleura II to V are entire. The arborescent pattern of the tergite extends on to the pleura. The sixth abdominal somite and the hard part of the telson bear several squamiform tubercles of various sizes. Of the two pairs of posterior teeth of the hard part of the telson the inner are slender and very distinct (sometimes their tip is rounded), they reach farther posteriorly than the outer teeth which usually are about rectangular and blunt.

Each half of the anterior margin of the antennular somite bears a blunt tooth in the middle; sometimes the margin shows one or two incisions at either side of this tooth.

The anterior margin of the last (sixth) segment of the antenna is only slightly convex; it bears five broad teeth, which have broad and blunt tops with little space in-between. The inner margin of the segment bears one or two blunt teeth. The antero-internal angle of the fifth antennal segment bears a blunt tooth which is carinate dorsally. The anterior margin of the fourth segment has five to seven teeth, the inner two of which are largest. The outer margin of this segment bears two or three blunt teeth (the apex of the segment not included), sometimes with an indication of a minute fourth tooth. This fourth segment has a strong oblique median carina running from the base of the segment to the apex; it shows tubercles over its full length. From its base a row of three or four tubercles extends outward and somewhat forward in the proximal half of the

segment, a few tubercles are scattered over the distal part.

The anterior margin of the epistome shows a shallow incision in the middle, which sometimes makes the entire margin somewhat V-shaped.

P.1 is distinctly more robust than P.2. The dactylus of the second is very slender, being far longer than either that of the first or third, and more than twice as long as the one of the fourth leg. The dactylus of the fifth leg is shorter than that of the fourth. None of the dactyli bear any hairy fringe. The propodus of P.3 has a dorsal fringe of hairs; it is wider and more robust than the propodus of the other legs, which do not show the dorsal hairy fringe either. However, the propodus of P.3 is not broader than the merus. A fringe of dorsal hairs is furthermore present on the carpus of P.3 and P.4, and the merus of all legs. There are no ventral hair-fringes on any of the legs. The outer surface of the propodus and merus of P.3 shows two longitudinal hairy grooves; such grooves are present also on the merus of P.4. The outer surface of the merus of P.1, P.2 and P.5 shows only one such groove, which sometimes is rather indistinct.

The anterior margin of the thoracic sternum is V-shapedly emarginate, sometimes the emargination is more rounded with a narrow incision in the middle. No submedian tubercles are present in the incision, as found in *Eduarctus* n. gen. The anterior margin of the sternum is somewhat swollen and from either anterolateral tooth a carina extends posteriorly, the two carinae converging and forming an elongate V. The sternum is concave and shows no median tubercles. The posterior margin of the sternum is entire.

The first pleopods of the male (placed on abdominal somite II) are normal in shape; the endopods are rather large and elongate. The following pleopods have the endopods and exopods rudimentary, although in some specimens the endopods are longer than the exopods.

Size

In the examined material the cl. varied between 4 and 15 mm. Juveniles with cl. 4 and 5 mm were seen, males with cl. 6 to 12 mm (mostly between

8 and 11 mm), non-ovigerous females with cl. 7-14 mm (mostly between 10 and 14 mm), and ovigerous females with cl. 11-15 mm. Paulson's two males were said to be 19 mm long (probably total length). The material of Nobili (1905a, 1906a) and De Man's (1905, 1916) specimens have been mentioned above. Bouvier (1915) gave the tl. of the adult female from Mauritius as 30 mm. McNeill's (1968) specimen has also been examined and is listed above.

Colour

De Man (1916: 92) described the colour as follows: "grayish coloured with a pale reddish tinge on the abdomen". Paulson (1961: 103) gave as only colour description that "every joint of the five pairs of legs has a violet stripe".

A colour photograph of the male specimen from Lagon Est, New Caledonia, stn 836, shows the carapace pale greyish brown with lighter and darker areas. Conspicuous are two rather small dark spots in the cervical groove one on either side of the cardiac tooth. Abdominal somites I to III also are pale brownish grey with a light area in the median part. Somites IV and V are reddish, somite IV with a whitish triangle (pointing back) in the middle, a similar but much smaller whitish triangle on somite V. Somite VI is rather evenly pale purplish grey, the tailfan is whitish. The dark band on the propodus of the visible walking legs is distinct.

An excellent coloured photograph was made of the male specimen from Lagon Nord-Ouest, New Caledonia (stn 1014). The ground colour of the body is a uniform grey olivaceous. Some very small white dots and many short whitish hairs show on the antennae. White dots are also scattered along the cervical groove and the posterior marginal groove. The abdomen shows a few very small white dots in the median line and near the base of the pleura. The two characteristic black dots mentioned in the previous description, are present here also, they show at either side of the cardiac tooth. On the pregastric tooth also a small dark dot can be seen. Furthermore there is a central small dark dot near the middle of the posterior marginal groove of the carapace. The first abdominal somite

shows two distinct submedian dark brown spots, which are fused anteriorly. At either side of this median figure the first somite shows two thin, but distinct longitudinal dark lines; a rather distinct white spot is placed at the base of the pleura of the first somite. The sixth somite and the tailfan are grey, probably transparent.

A third coloured photograph was made of the male (cl. 10 mm) from Lagon Est, New Caledonia, stn 70. It is much less distinct than the previous photograph and shows a dark brown somewhat variegated animal with some small dark and very small white spots on the antennae. The dark dots on the pregastric tooth, those at either side of the cardiac tooth and the one just before the middle of the posterior margin of the carapace, are noticeable. The central figure on the first abdominal somite is quite distinct it consists of two dark spots joined anteriorly, while one can also just distinguish the two lines at either side of this central figure.

The specimens from Okinawa, after preservation in alcohol, were whitish with small black dots on the last two segments of the antennular peduncle. Small black dots are also found in the distal part of the teeth of the sixth antennal segment and near the top of the fourth segment. The dorsal surface of the carapace shows two rather large black spots, which cover the intercervical area. Two smaller dots are present, one on either side of the cardiac tooth. Most characteristic is the colour pattern of the posterior half of the first abdominal somite: in the centre it shows a dark horseshoe shaped spot with the closed end anteriorly; when the posterior part of the carapace covers the anterior part of the horseshoe, it looks as if there are two parallel black submedian lines. On either side of the median horseshoe-shaped spot the first segment shows two dark longitudinal somewhat curved lines; so that sometimes it looks as if there are six more or less parallel lines distributed equally over the segment. The anterior half of the first somite is darker than the posterior. There is a large dark spot on the fourth abdominal somite on either side of the hump.

In some Seychelles specimens the fourth and sixth antennal segments are dark with a pale rim.

In the same specimens the carapace is quite dark with a white band along the anterior margin, and a light posterolateral area at each side; the tips of the larger teeth then often are also pale. The abdominal somites II to V are dark with a longitudinal whitish band in the median line; this band is widest on the second somite; here the tips of the pleura are whitish.

The legs have the usual dark band on ischium, merus, carpus and propodus, those of merus and propodus remain longest visible in preserved material, especially those of P.3 and P.4.

REMARKS

The nomenclature of the species is quite complicated. Paulson (1875), who was the first to report on the species, identified his Red Sea material as *Scyllarus gundlachi* von Martens, 1872 (= *S. americanus* S. I. Smith, 1869). Then, on 30 May 1905 Nobili, in a preliminary description of material from the Persian Gulf, published a description of the species, which he considered new, and used the name "*Scyllarus sordidus* nov. spec." for it; he actually meant to name it *S. nitidus* but erroneously wrote *sordidus*. The name *sordidus* (in the combination *Arctus sordidus*) had been used long before by Stimpson (1860) for a different species of *Scyllarus*. In August 1905 De Man described the species again as new (on material from Indonesia and the Philippines), using the name *Arctus gibberosus*. De Man realized that Nobili in May 1905 had made a mistake in naming his species *S. sordidus*, and he proposed *Arctus nobilii* as a new replacement name for *S. sordidus* Nobili, 1905 (*non* Stimpson, 1860). At the same time De Man noticed that *A. nobilii* was very close if not identical to his own *A. gibberosus*, and said that if the two should prove to be identical the name *gibberosus* should be used for the species in preference to *nobilii*. In his final paper on decapod and stomatopod Crustacea of the Persian Gulf, Nobili (30 April 1906a: 59) explained his error in writing *sordidus* instead of *nitidus*, and on his pl. 6 fig. 31 the name *nitidus* is used, evidently by mistake, as in the rest of the paper (pp. 56-59, pl. 4 fig. 15) Nobili accepted De Man's *Scyllarus nobilii*. He did not mention *S. gibberosus*.

De Man (1916: 90, pl. 3 fig. 14) gave his definite description of *Scyllarus gibberosus*; on p. 70 and 71 De Man discussed the possible synonymy of *Arctus gibberosus* De Man, 1905 and *Arctus nobilii* De Man, 1905 and concluded (p. 71): "When the two species afterwards once might prove to be identical, then the name of *gibberosus* has, of course, the priority". The oldest available names given to the present species thus are *Arctus gibberosus* De Man, 1905 and *Arctus nobilii* De Man, 1905. The relative precedence of these two names that were published simultaneously, is to be decided by the Principle of the First Reviser. The International Code of Zoological Nomenclature (ICZN 1999) says on this account: "If two or more names [...] are published on the same date [...] the precedence [...] is fixed by the First Reviser". The definition of "First Reviser" is given in Art. 24.2.1. of the Code (ICZN 1999) as follows "the first author citing in a published work those names [...] and selecting from them". In the present case De Man (1905), who on p. 589 remarked that his *Arctus gibberosus* probably is identical with Nobili's *Scyllarus sordidus* and in this case Nobili's species may henceforth bear the name of *gibberosus*; "when they are different, then I propose for the Persian species the name of *Nobilii*". Here De Man (1906) can be considered the first reviser himself as he gives precedence of *gibberosus* over *Nobilii*. There is a difficulty here as in the Glossary to the Code (ICZN 1999: 115) the First Reviser is defined as "The first author to subsequently cite names [...] published on the same date and select one of them to have precedence over the other(s)". The main difference with the definition given in Art. 24 of the Code (ICZN 1999) itself is in the word "subsequent", which figures in the Glossary but not in the Code. According to the Glossary De Man, 1906, cannot be the first reviser as his action of choice is simultaneously published with the two names, and not subsequently. Under the wording of the Glossary the First Reviser is De Man (1916: 71) who indeed is the first subsequent author who

cites both the names *gibberosus* and *Nobilii* and gives precedence to the first. As the "first reviser action" by De Man (1906) is the same as that of De Man (1916), it is quite immaterial who actually is the first reviser, but for uniformity's sake the Glossary should be adapted to the text of the Code. In the third edition (ICZN 1985: 24) of the Code the word "subsequently" is in Art. 24 (b) but has evidently been removed by the editorial Committee of the fourth edition, while they forgot to do so in the Glossary. As the Glossary forms part of the new (4th ed.) Code (see the Explanatory Note on p. xiii of the Code) there should be no differences in the definitions given in the two parts.

Anyhow, *Scyllarus gibberosus* is the valid name for the species; the names *Scyllarus sordidus* Nobili, 1905, *Arctus nobilii* De Man, 1905, *Scyllarus paulsoni* Nobili, 1906 and *Scyllarus nitidus* Nobili, 1906 all are invalid synonyms.

Genus *Biarctus* n. gen.

TYPE SPECIES. — *Arctus sordidus* Stimpson, 1860 by present designation.

OTHER SPECIES. — *Biarctus dubius* (Holthuis, 1963) n. comb., *B. pumilus* (Nobili, 1906) n. comb., *B. vitiensis* (Dana, 1852) n. comb.

ETYMOLOGY. — From the Latin *bi* (= two) and the generic name *Arctus* De Haan, 1849, referring to the fact that the median line of the carapace shows only two teeth before the cervical groove.

DIAGNOSIS. — Carapace with only two median teeth before the cervical groove: the rostral and the gastric teeth. Abdomen without median carina. Somites II to V with a distinct arborescent pattern of narrow and deep grooves. Abdominal pleura directed down, bluntly rounded at the top. Fourth segment of antennal peduncle with only a distinct sharp oblique carina on the upper surface, no additional carinae present. Thoracic sternum ending anteriorly in two teeth separated by a sharp V-shaped incision, without any tubercles on the margin of that incision. P.2 with dactylus and propodus elongate, dactylus about twice as long as dactylus of P.4. In none of the last four legs the propodus is conspicuously widened and compressed. First abdominal somite usually with a dark rounded median spot.

KEY TO THE SPECIES OF *BIARCTUS* N. GEN.

Species dealt with in this paper are in bold.

1. Cardiac tooth low, much lower and less triangular than the gastric tooth 2
- Cardiac tooth well-developed and triangular, as high as gastric tooth 3
2. Dorsomedian figure of second abdominal somite not lobulated laterally, consisting of two straight submedian ridges that are fused anteriorly ***B. pumilus*** n. comb.
- Dorsomedian figure on second abdominal somite with the lateral margins lobulated ***B. vitiensis*** n. comb.
3. Anterior submedian carina indistinct with few tubercles ***B. sordidus*** n. comb.
- Anterior submedian carina strong and reaching beyond gastric tooth ***B. dubius*** n. comb.

Biarctus pumilus (Nobili, 1906) n. comb.
(Figs 51; 52)

Scyllarus pumilus Nobili, 1906b: 396; 1906c: 87. — Balss 1915: 35. — De Man 1916: 65, 68, 70. — Holthuis 1968: 293. — Prasad & Tampi 1969: 84. — Burukovsky 1974: 107; 1983: 151. — Phillips *et al.* 1980: 70. — Vine 1986: 107. — Fransen *et al.* 1998: 68.

Scyllarus Thiriouxi Bouvier, 1914: 702; 1915: 188, text-figs 2-4, pl. 5 figs 5, 6.

Scyllarus thiriouxi – Ward 1942: 60. — Prasad & Tampi 1969: 84. — C. Michel 1974: 256.

Scyllarus thiriouxi – Al-Kholy 1960: 82, pl. 6 figs 152-156, pl. 7 figs 157-184. — Robertson 1968: 333.

TYPE MATERIAL. — Neotype: 1 ♂ 11 mm, Israel South Red Sea Expedition No. 1459 (RMNH D 24161). Neotype selected by Holthuis (1968: 295).

TYPE LOCALITY. — Southern Red Sea. Dahlak Archipelago. Manta Cliff between Landing Bay and Ras Papenfuss, Entedebir Id, 0-5 m.

MATERIAL EXAMINED. — **Red Sea.** Gulf of Aqaba. Elat, Israel, about 6 m deep, poisoned by chemicals from Elat harbour, 7.VII.1969, D. Popper leg., 1 ov. ♀ 18 mm (RMNH D 49556). — Ophir Bay, south of Solar Lake near Mersa Murach, Sinai Peninsula, The Hebrew University-Smithsonian Institution collections, stn SLR 284, 30.VIII.1967, 1 ♂ 20 mm (RMNH D 49557). — Ras el Burqa' (= Ras Burka, = White Cape), Sinai Peninsula, about 40 km S of Elat, poisoning, 5.X.1968, L. Fishelson leg., No. NS 4029, 1 ♀ 10 mm (RMNH D 49558). — Dahab, Sinai Peninsula, 28°29'N, 34°30'E, reef poisoning, 1.X.1968, L. Fishelson No. NS

3615, 1 juv. ♂ 8 mm (RMNH D 49559). — Marsa al At, Sinai Peninsula, 27°54'N, 34°20'E, poisoning, 16.X.1968, L. Fishelson No. NS 4494, 1 ♂ 11 mm (RMNH D 49560). — Tiran Id, entrance to Foul Bay, northern Red Sea, 11 m deep, 22.IX.1981, O. Kerman leg. [an error must have been made in the locality label, Tiran Id lies at the mouth of the Gulf of Aqaba, at 27°56'N, 34°34'E, while Foul Bay is on the Red Sea coast of Egypt at about 23°30'N, 35°39'E], 1 ♂ 14 mm (RMNH D 39375).

Dahlak Archipelago. Manta Cliff between Landing Bay and Ras Papenfuss, Entedebir Id, southern Red Sea, 0-5 m deep, pro-noxfish poisoning, 7.IV.1962, Israel South Red Sea Expedition No. 1459, 1 ♂ neotype of *Scyllarus pumilus*, 11 mm (RMNH D 24161). **Gulf of Aden.** Jibuti, II-III.1909, Wache, Konietzko leg., 1 ♀ 18 mm (ZMB, No. 15552).

Mauritius. Mauritius, IV.1884, V. de Robillard leg., 1 ov. ♀ 15 mm (BM). — Near Port Louis, 1913, M. Thirioux leg., P. Carié coll., 1 dry ♂ holotype of *Scyllarus thiriouxi* Bouvier, 1914, 17 mm (MNHN).

Madagascar. 1 dry ♂ 19 mm (MG).

DISTRIBUTION. — The species so far is only known from the Red Sea and the western Indian Ocean. The records in the literature are: Red Sea (Nobili 1906a, b; Al-Kholy 1960), Suakin, Kassala State, Egypt, Red Sea (Balss 1915), Manta Cliff, Entedebir Island, Dahlak Archipelago, Eritrea, Red Sea (Holthuis 1968), Mauritius (Ward 1942; Holthuis 1968), Port Louis, Mauritius (Bouvier 1914, 1915; Holthuis 1968), Madagascar (Holthuis 1968).

HABITAT. — Evidently this species lives in quite shallow water, the depths recorded are between 0 and 11 m. It has once been reported from a reef. Larvae were found in the plankton.

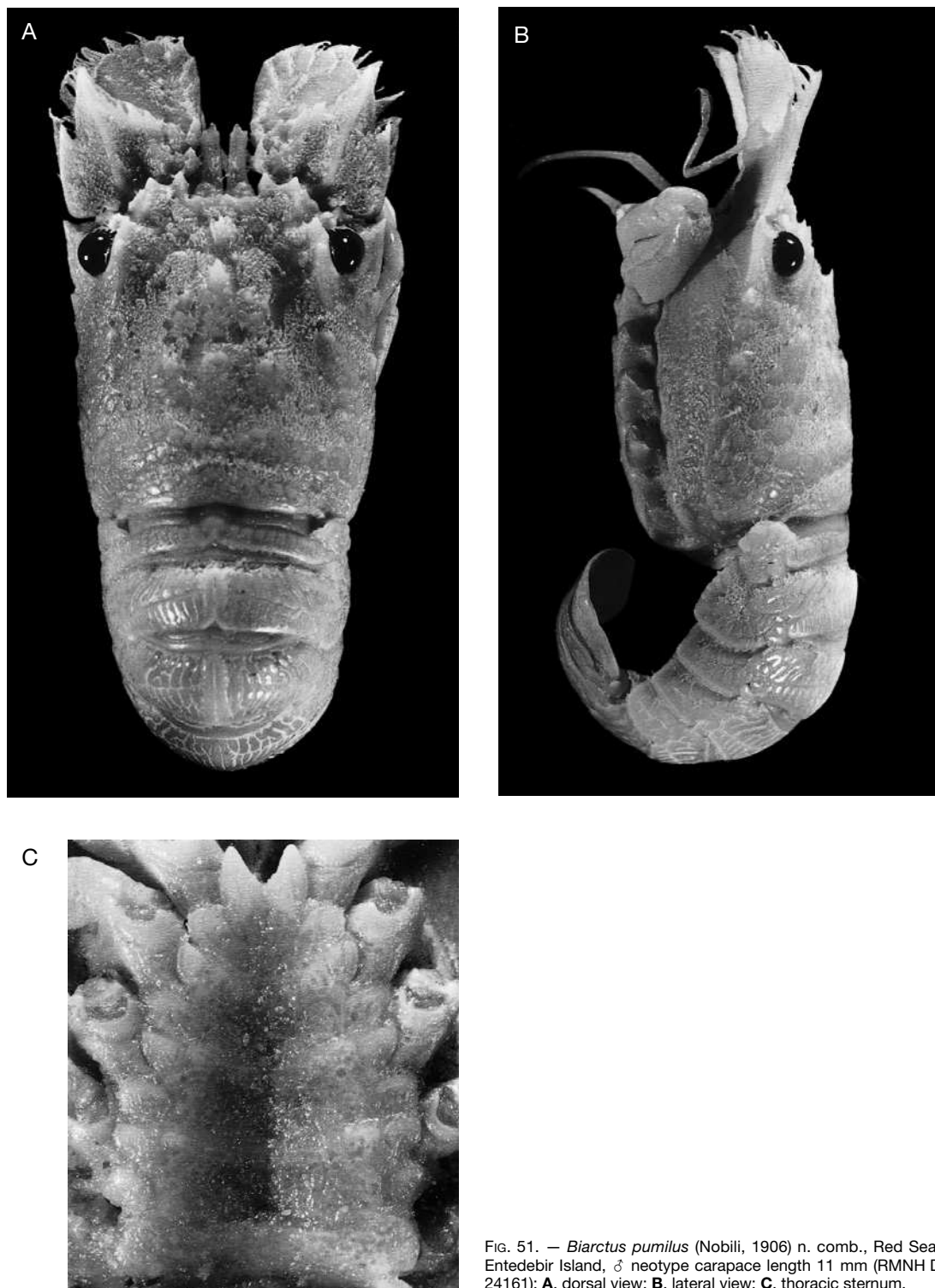


FIG. 51. — *Biarctus pumilus* (Nobili, 1906) n. comb., Red Sea, Entedebir Island, ♂ neotype carapace length 11 mm (RMNH D 24161); **A**, dorsal view; **B**, lateral view; **C**, thoracic sternum.

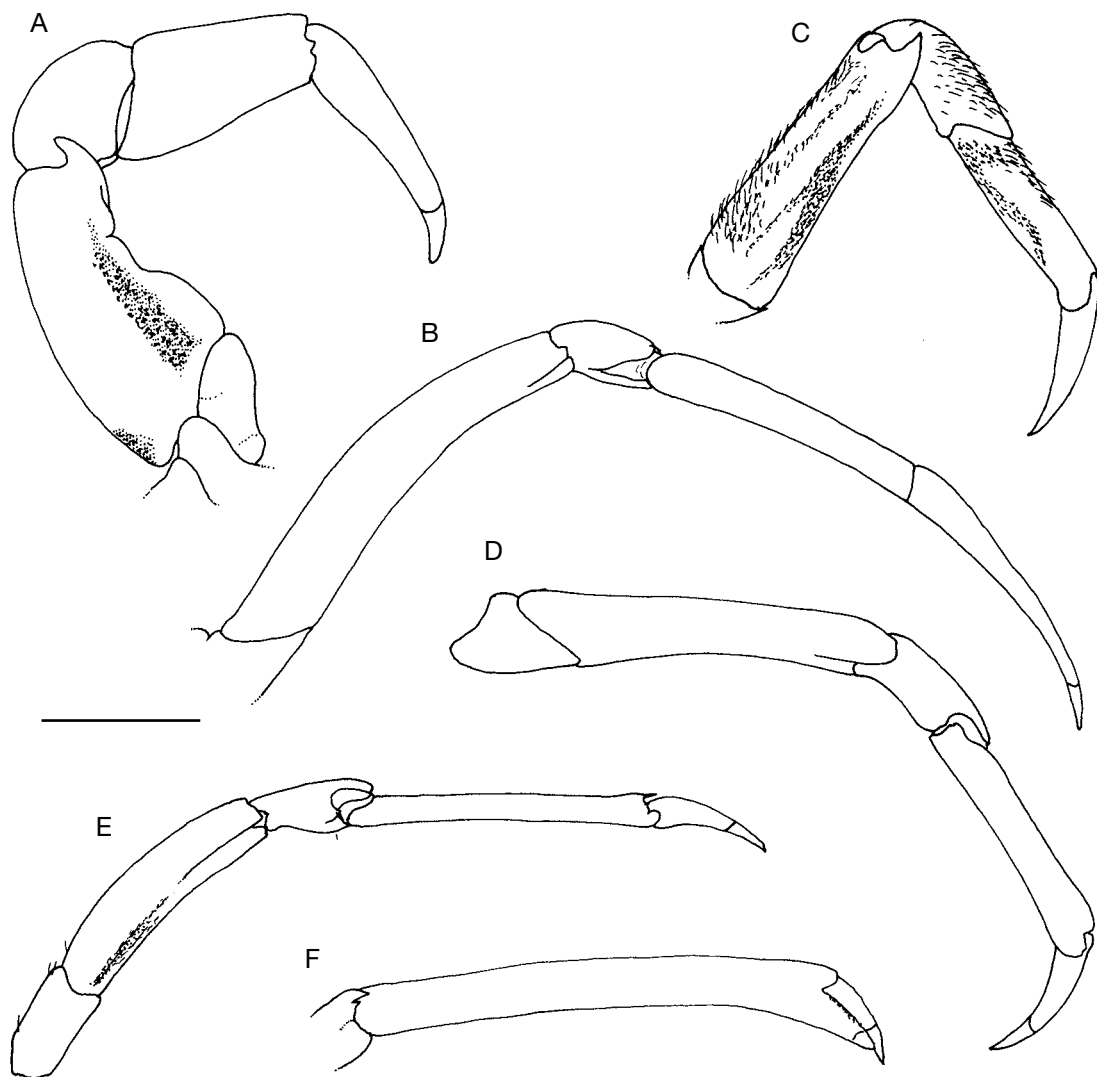


FIG. 52. — *Biarctus pumilus* (Nobili, 1906) n. comb.; **A, B, D, E**, Ophir Bay, Gulf of Aqaba, ♂; **A**, pereiopod 1; **B**, pereiopod 2; **D**, pereiopod 4; **E**, pereiopod 5; **C, F**, Elat, Israel, ♀; **C**, pereiopod 3; **F**, propodus and dactylus of pereiopod 5. Scale bar: A-E, 4 mm; F, 2 mm.

DESCRIPTION

This description is based on the holotype of *Scyllarus thiriouxi*.

The rostrum is rather broad, its anterior margin is trilobed and its base is constricted. It bears dorsally a very strong sharp rostral tooth. The median line of the carapace before the cervical groove shows only a single tooth behind the rostral; this tooth

should be considered the gastric; it is situated rather far anteriorly, and there is no tubercle between it and the rostral tooth. The two teeth are of about the same size. Behind the gastric tooth there are two pairs of flattened submedian squamiform tubercles followed by a single median one; all these tubercles are flat, rather broad and with the anterior margin rounded. The cardiac tooth is low,

broad and flattened, with a broadly rounded anterior margin; it is followed by submedian and median squamiform tubercles in the following order 2.2.1.2.1. The submedian tubercles of the last pair are placed wider apart than the others.

The branchial carina is rather widely interrupted by the cervical groove, the gap bears an inconspicuous tubercle in the extreme mediad part. The anterior branchial carina ends in two rather sharp teeth which stand one behind the other on the inner margin of the orbit; behind the posterior tooth there are indications of five very indistinct tubercles. The anterior tooth of the posterior branchial carina is wide and blunt and is followed by equally wide and blunt flattened squamiform tubercles, which are indistinctly arranged in two or three rows of three to 10 tubercles each. The posterior submedian carina bears two or three rows of one to three broad tubercles each. There are two intermediate tubercles, the posterior of which is wide and flattened, the anterior being of the more normal type. The anterior submedian carina bears a group of six to eight flattened tubercles that are arranged in two or three rows. There are no tubercles between the anterior submedian and branchial carinae. The anterolateral angle of the carapace is rather acute. There are four or five anterolateral teeth, which are not clearly separated from one another. The cervical incision is deep and the anterior mediolateral tooth is conspicuous and sharp, it is followed by about three mediolateral teeth. The post-cervical incision also is deep and the anterior posterolateral tooth consequently well-developed, the following eight posterolateral teeth are flat and blunt. The intercervical ridge bears a group of about eight blunt flattened tubercles. There are a few conspicuous but small postorbital tubercles. The upper postorbital ridge shows an inconspicuous tuberculation. The marginal groove before the posterior margin of the carapace is wide and rather deep. Before it are three transverse rows of flattened tubercles, behind it two rows which are separated by an almost continuous groove, while behind that there is an indication of a second groove in the median area.

The transverse groove over the middle of the first abdominal somite is interrupted in the middle,

being very distinct on the sides. The posterior half of the somite shows the normal longitudinal grooves, about 20 in number. These grooves are straight; they do not branch and do not reach the posterior margin of the somite. This margin shows a deep and very narrow incision in the middle, the incision being closed for a large part. The anterior part of the following somites, as far as is visible in the dry type, are smooth. The posterior half has the usual arborescent markings. The species is peculiar by that the central figure of the second abdominal somite consists of two longitudinal broad carinae lying side by side in close contact and separated by a deep narrow groove, these carinae are fused anteriorly; thereby they form a loop. The lateral margins of these carinae are straight and not lobulated as in many other species. In the following somites traces of some lateral lobulations of the central figure can be noted; also the median groove is less distinct; in the fourth somite it is slightly interrupted, and it is entirely absent in the fifth. The pleuron of the first somite is rounded with an incision at the top that divides it into two parts; the margin of the posterior part is entire, that of the anterior part is lobulated. The pleuron of the second somite has the top broadly rounded and directed ventrally. The anterior margin is faintly tuberculate. In the third and fourth somites the pleura are truncated at their top, that of the fifth is more oval. The margins are entire or practically so. The sixth abdominal somite and the hard part of the telson bear several squamiform tubercles. Of the four teeth at the posterior margin of the hard part of the telson, the inner are triangular and rather narrow, the outer are wider and blunter and reach less far backward.

The anterior margin of the antennular somite bears a tooth in the middle of each half and two smaller teeth at the anterolateral corners, while in the middle it is produced into two blunt teeth.

The anterior margin of the sixth antennal segment is only slightly convex; it bears four wide broadly truncated teeth, the inner margin bears a single narrower, bluntly rounded tooth. The fifth segment has an inner anterior tooth with a distinct dorsal carina; there is a second tooth in the

middle of the anterior margin; the two are separated by a very deep emargination. The fourth segment has about five teeth on the anterior margin, of which the second inner is the largest; the inner tooth is smaller and pressed more or less distinctly against the larger; the other three teeth are distinctly smaller again. The outer margin of the fourth segment bears a single tooth, the margin before or behind this tooth may show some indistinct incisions. The dorsal surface of the segment bears a single distinct oblique carina, the rest of the surface is smooth.

The epistome is deeply incised in the middle with both halves very convex.

P.1 is distinctly more robust than P.2. The dactylus, propodus and carpus are naked, but the merus has an inconspicuous dorsal fringe, while a longitudinal shallow hairy groove is present in the lower part of the outer surface. The dactylus is slightly shorter than the propodus and it is also somewhat shorter than the dactylus of the second leg, which is the longest of all dactyli, being almost twice as long as the dactylus of P.3. The dactylus of P.4 is slightly shorter than that of P.3 and longer than that of P.5. The propodus of P.2 is slightly shorter than the dactylus and more than twice as long as the carpus. The meri of P.2 to P.5 have two shallow hairy grooves on the outer surface, and a few hairs on the upper margin.

The anterior margin of the thoracic sternum is deeply V-shapedly incised in the middle, the margin shows no tubercles. A hairy groove extends from near the tip of the anterolateral tooth parallel with the sides of the incision, the two grooves converge in a V-shape. There are grooves between the sternites, filled with short hairs; the groove between the fourth and fifth somites being especially deep in the middle. The plastron is depressed in the middle. There are no median tubercles. The posterior margin of the fifth somite is straight, not crenulate and so are the other margins. No teeth are visible at the base of the fifth legs in either sex.

The first pleopod of the male (situated on abdominal somite II) has the endopod rather long and sabre-shaped, it reached well beyond the middle of the somite. The endopod of somite III is very

short and narrow, while that of somite IV is practically non-existent, as are all the exopods. In the specimen from Ophir Bay the endopods of the left pleopods on somites III and V are much longer than the right.

Size

Of the known specimens the cl. varies between 8 and 20 mm in the males, while the non-ovigerous females have cl. 10 to 18 mm, and the cl. of the two ovigerous females is 10 and 18 mm respectively.

Colour

The colour of a living specimen was described by Holthuis (1968: 294): "The upper surface is mottled greyish brown; the squamae are dark bluish grey, the hairs in-between are brown. The antennal segments are rather pale with darker teeth, the margins of these teeth are bluish. A darker spot is visible at the base of these teeth in the distal segment. A dark spot is present at the base of the oblique carina of the fourth antennal segment, while more to the outside there is a group of dark hairs on the upper surface of the segment. The large median dark spot on the first abdominal somite continues on the posterior part of the carapace. The center of this spot is light. Just in front of this large dark spot there is a smaller one in the median line of the carapace. The longitudinal grooves on the first abdominal somite are visible as very dark lines. The abdomen is mottled with greyish brown, a large pale median spot is visible on the second and third somite. The third to fifth pereopods have a dark ring on merus, carpus, propodus and dactylus. In the second leg such a ring is only found on the merus, while in the first leg the rings are absent or only visible as small spots. The lower surface of the body is of a pale colour". In preserved specimens the dark spot on the first abdominal somite (and part of the carapace) remains long visible. In the specimen from the Ophir Bay the spot has a red center surrounded by a broad black ring. Also the Madagascar specimen still shows a very dark ring on the first abdominal somite. The ring is always closed posteriorly, but may be open anteriorly.

Larvae

Al-Kholy (1960) states that the life history of this species consists of five phyllosoma stages, which he obtained from Red Sea plankton, presumably taken near Al-Ghardaqa, Egypt. All five stages were described and figured by him. As remarked by Robertson (1968), "no justification is given for this identification of the phyllosoma's".

Biarctus vitiensis (Dana, 1852) n. comb.
(Figs 53; 54; 69E)

Arctus vitiensis Dana, 1852a: 19; 1852b: 517; 1852c: 125; 1855: pl. 32 fig. 7. — De Man 1888: 485.

Non *Arctus vitiensis* — Ortmann 1897: 270 (= *B. sor didus* n. comb.).

Arctus Vitiensis — Weitenweber 1854: 9.

Scyllarus vitiensis — De Man 1916: 71, pl. 2 figs 9, 9a. — Burukovsky 1974: 107; 1983: 150. — Phillips *et al.* 1980: 70. — Morin 1982: 273. — Titgen 1988: 143.

Scyllarus longidactylus Harada, 1962: 124, text-figs 8, 9, pl. 11, pl. 12 fig. 16, pl. 13 fig. 20, pl. 14 fig. 22; 1965: 36, fig. 1j, k. — Nishimura & Suzuki 1971: 89. — Phillips *et al.* 1980: 70. — Miyake 1982: 85. — Chan & Yu 1986: 159, pl. 7, pl. 10 figs B, D; 1993: 211, fig. — Sekiguchi 1986a: 1289; 1986b: 15, 17; 1987a: 331; 1988: 3. — Huang 1994: 564.

Scyllarus amabilis Holthuis, 1963: 59. — Prasad & Tampi 1969: 84. — Burukovsky 1974: 107; 1983: 151. — Phillips *et al.* 1980: 69. — Prasad *et al.* 1980: 93, fig. 13. — Sekiguchi 1986a: 1290; 1987a: 331; 1987b: 417. — Barnett 1989: 123. — McWilliam *et al.* 1995: 564.

Scyllarides tumidus — Colin & Arneson 1995: 225, fig. 1071.

Scyllarus sp. — Hoover 1998: 247, fig.

TYPE MATERIAL. — Holotype (or less likely syntypes): at least one specimen, length 1 inch (USNM, now lost).

TYPE LOCALITY. — Feejee (Fiji) Islands.

MATERIAL EXAMINED. — **Philippines.** Cebu Strait W of Bohol, NW side of Cabilao Id, La Estrella Dive Resort, 9°53.20'N, 123°45.53'E, reef flat with eel grass, 0-6 m, a vertical wall with caves, shore collecting, snorkeling and diving, both in the daytime and at night, National Museum of Natural History, Leiden-University of San Carlos, Cebu Expedition, stn CEB

04, 6-18.XI.1999, 1 ov. ♀ 12 mm (RMNH D 49555).

Indonesia. Moluccas. Tandjung Totohuhur, Piru Bay, Ceram, 3°15'S, 128°8'E, 37-44 m, coral slough and rubble, 1.VI.1970, Mariel King Memorial Expedition, 1 juv. 7 mm (WAM).

Irian Jaya. 1 mile NE of Rumwakan, Auri Group, Geelvink Bay, W New Guinea, 37-46 m, 21.II.1956, National Science Foundation, 1 juv. 7 mm (RMNH D 49558).

Australia. Western Australia. Broome, 16.X.1962, J. Tapper leg., 1 ov. ♀ 19 mm (WAM 351-64). — Near entrance of Roebuck Bay near Broome, about 18°04'S, 122°17'E, dredged, 9-15 m, lithothamnion reef bottom, 26.IX.1929, A. A. Livingstone leg., 1 ♀ holotype of *Scyllarus amabilis* 17.5 mm (AM P.14517). — Roebuck Bay, Mrs. B. Grey leg., 1 ♂ 13 mm (BM 1932.11.30.158). — NE of Malus Id, Dampier Archipelago, FV *Davena*, Honolulu dredge, 18 m, 31.V.1960, R. D. Royce leg., 1 ♂ 9 mm (WAM 352-64). — Between Shark Bay and Pt. Samson, 1960-1962, M. Walker leg., 1 ♀ 15 mm (WAM 353-64). Northern Territory. Darwin, about 12°38'S, 130°50'E, before V.1903, Messrs Godfrey & Christie leg., 1 ov. ♀ 16 mm, paratype of *Scyllarus amabilis* Holthuis, 1963 (RMNH D 18703, don. AM).

Chesterfield Islands. CORAIL 2, stn DW 94, 19°6.0'S, 158°50.0'E, 36-53 m, 27.VIII.1988, 1 ♂ 13 mm (MNHN-Pa 1293). — Stn CP 127, 19°27.73'S, 158°27.30'E, 44-45 m, 29.VIII.1988, 1 ♂ 11 mm (MNHN-Pa 1340).

New Caledonia. Lagon Nord-Ouest. LAGON, stn DW 958, 20°26.2'S, 164°7.4'E, 18-19 m, 28.IV.1988, 1 ♂ 9 mm (MNHN-Pa 1330). — Stn DW 968, 20°22.9'S, 164°05.1'E, 21-22 m, 29.IV.1988, 1 ♀ 10 mm (MNHN-Pa 1322).

Lagon Est. LAGON, stn 606, 22°12.8'S, 167°00.5'E, 46-48 m, 5.VIII.1986, 1 juv. 7 mm (MNHN-Pa 1266; photographed). — Stn 625, 21°59.2'S, 166°53.6'E, 34-40 m, 6.VIII.1986, 1 ♂ 9 mm (MNHN-Pa 1264; photographed). — Stn 639, 21°55.5'S, 166°44.1'E, 48-50 m, 7.VIII.1986, 1 juv. ♀ 5 mm (MNHN-Pa 1179). — Stn 648, 21°52.8'S, 166°35.2'E, 22-25 m, 7.VIII.1986, 1 ♀ 6 mm (RMNH D 48753). — Stn 651, 21°48.0'S, 166°36.4'E, 48 m, 7.VIII.1986, 2 ♂ ♂ both 7 mm (MNHN-Pa 1183). — Stn 657, 21°48.2'S, 166°33.8'E, 40-42 m, 8.VIII.1986, 1 juv. 5 mm (MNHN-Pa 1186). — Stn 664, 21°43.9'S, 166°29.4'E, 28-30 m, 8.VIII.1986, 1 ♂ 7 mm (MNHN-Pa 1184). — Stn 686, 21°34.3'S, 166°15.8'E, 33-35 m, 9.VIII.1986, 1 ♀ 12 mm (USNM 1000648). — Stn 707, 21°25.3'S, 166°4.1'E, 34-38 m, 10.VIII.1986, 1 ♀ 6 mm (MNHN-Pa 1176). — Stn 723, 21°21.6'S, 165°56.7'E, 45 m, 12.VIII.1986, 1 juv. 4 mm (MNHN-Pa 1180). — Stn 816, 21°52.6'S, 165°25.4'E, 31 m, 10.I.1987, 1 juv. 6 mm (MNHN-Pa 1281).

Lagon Sud-Ouest. LAGON, stn 28, 22°15'S, 166°32'E, 9 m, 23.V.1984, 1 ♀ 8 mm (MNHN-Pa

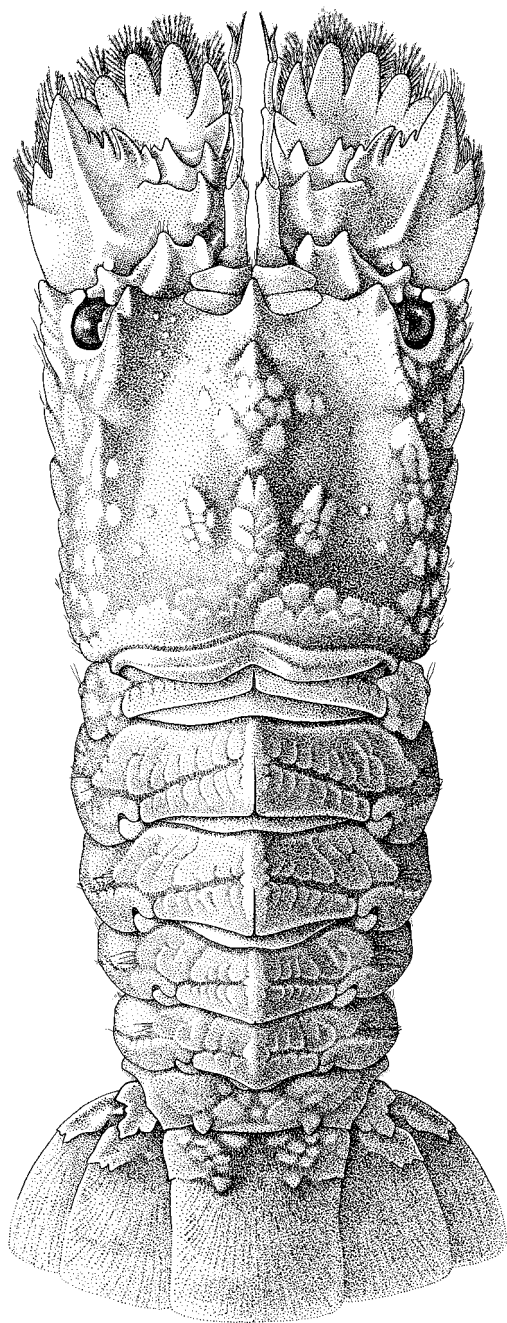


FIG. 53. — *Biarctus vitiensis* (Dana, 1852) n. comb., Western Australia, near entrance Roebuck Bay, ♀ holotype of *Scyllarus amabilis* Holthuis, 1963, carapace length 17.5 mm (AM P. 14517), dorsal view. Scale bar: 0.5 mm. W. C. G. Gertenaar del.

1220). — Stn 45, 22°11.9'S, 166°12.2'E, dredged, 12-14 m, 25.V.1984, 1 ♂ 10 mm (MNHN-Pa 780). — Stn 73, 22°18'S, 166°38'E, 15 m, 20.VIII.1984, 1 ♂ 11 mm (MNHN-Pa 1003). — Stn 77, 22°26'S, 166°32'E, 22 m, 21.VIII.1984, 1 ♂ 12 mm (RMNH D 48752). — Stn 101bis, 22°29'S, 166°37'E, 18 m, 22.VIII.1984, 1 ♀ 13 mm (MNHN-Pa 1019). — Stn 273, 22°12'S, 166°23'E, 9 m, 8.XI.1984, 1 ♂ 8 mm (MNHN-Pa 1016). — Stn 551, 23°00'S, 166°59'E, 9 m, 15.VII.1985, 1 ♀ 15 mm (MNHN-Pa 1249). Lagoon, diving at night, 8 m deep, 5.X.1987, P. Laboute CB 524, 1 ov. ♀ 15 mm (MNHN-Pa 1277). Récif Larégnère, 22°21'S, 166°19'E, diving, 3-12 m, 4.IX.1991, J.-L. Menou, 1 ♂ 9 mm, 1 ♀ 11 mm (MNHN-Pa 1909).

East coast, in the stomach of a fish, 65 m, 13.I.1907, 1 ov. ♀ 20 mm (damaged, identity not fully certain) (MNHN-Pa 1262).

Loyalty Islands. Ouvéa, Île Haute, 11 m, 19.XI.1991, J.-L. Menou, 1 ♀ 16 mm (MNHN-Pa 1910; photographed).

Hawaiian Islands. Off Kepuhi Point, Makaka, Oahu, c. 20°16'N, 155°50'W, depth c. 21 m, foraging in proximity of dendrophyllid corals at the base of a drop-off ledge, only specimen seen, collected at night, VI.1975, John L. Earle leg., 1 ov. ♀ 14 mm (BPBM).

DISTRIBUTION. — The type locality of *Arctus vitiensis* is "Feejee [Fiji] Islands" (Dana 1852a). The type locality of *Scyllarus longidactylus* is at Rinkai-Ura near Seto Marine Biological Laboratory at Sirahama, Japan (Harada 1962, 1965); and that of *S. amabilis* is Roebuck Bay near Broome, NW Australia. The other records of the species in the literature are: Pa-Tou-Tsu, Keelung City, Taiwan (Chan & Yu 1986, 1993), east side of Pajunga Island, Kwandang (= Kuandang) Bay, north coast of Sulawesi, Indonesia (De Man 1916), Ambon, Moluccas, Indonesia (De Man 1888), N Queensland (Barnett 1989), Guam (Chan pers. comm.), Hawaii (Morin 1982; Colin & Arneson 1995; Hoover 1998), off Kepuhi Point near Mahaka, and Waianae, both on W coast of Oahu, Hawaiian Islands (Titgen 1988), Puako, NW coast of Hawaii, Hawaiian Islands (Titgen 1988). The present material originates from the Philippines, NW Australia, the Chesterfield Islands, New Caledonia, the Loyalty Islands and the Hawaiian Islands. Larvae tentatively assigned to *Scyllarus amabilis* were reported from the eastern Indian Ocean by Prasad *et al.* (1980).

HABITAT. — The male holotype of *S. longidactylus* was collected "on the shore". The Taiwan female was taken by scuba diving at night at 20 m depth on a coral reef. The material examined as well as that reported upon in the literature came from depths between 6 and 48 m (with records of 0-6, 3-12 and 36-53 m, as well as an uncertain record from 65 m). The female specimen from Roebuck Bay was found on a lithothamnion reef bottom. The specimens from the Hawaiian Islands all were collected by diving, their habitats were

described by Titgen (1988) as “in cave”, “in cave at night, on sides and roof” and “base of dropoff ledge, near dendrophyllid coral, night dive”. The type of habitats (among coral, in caves, etc.) as well as the fact that most were taken at night, probably explains why so few records, especially of adult specimens, were published in the pre-scuba period.

DESCRIPTION

The species is very close to *B. pumilus* n. comb., and at first was thought to be synonymous with it. Like in *B. pumilus* n. comb. the rostral and gastric teeth are both distinct and sharp, they are of about the same size, while the pregastric tooth is completely absent: between the gastric tooth and the cervical groove there are a few small appressed squamae. The cardiac tooth is very low and blunt, it is distinctly bilobed. At either side of the cardiac tooth, just behind the cervical groove is a bluntly rounded, often double, tooth, almost as wide as the cardiac and standing at the same level as it, they often form an arc of six tubercles behind the cervical groove. The outer teeth form the end of the posterior submedian carinae. Like in *B. pumilus* n. comb. the posterior carina of the carapace is broad, covered by rather large but broadly flattened squamiform tubercles; it is interrupted in the middle. The marginal groove is wide and filled with short hairs. Behind the groove is a single, sometimes indistinct, transverse row of rounded tubercles, which is separated from the posterior margin by a smooth rim. The posterior margin shows a shallow and broad weak excavation. The anterior submedian carina consists of a few squamiform tubercles and is often indistinct. The posterior submedian carina likewise carries flattened squamiform tubercles but ends in a distinct rounded or bluntly pointed tooth placed immediately behind the cervical groove, as already described above. The branchial carina is widely interrupted by the cervical groove and, like in *B. pumilus* n. comb., the gap may bear a very small tubercle in the inner posterior part. The anterior branchial carina ends in the two usual teeth placed on the inner margin of the orbit; these teeth are rather small, blunt or somewhat pointed. Between the posterior orbital margin and the anterior branchial carina a rather sharp carina is present. On the pos-

terior part of the anterior branchial carina a few very faint squamiform tubercles are present. The posterior branchial carina ends in a distinct sharp anterior tooth; it is followed by a double row of about six distinct flattened squamiform tubercles, which merge with the tubercles of the posterolateral carina. The anterolateral teeth of the lateral margin of the carapace number three to six, the anterior being strongest. There are two or three mediolateral teeth. The posterolateral teeth are about eight in number, the anterior being the largest.

The pterygostomian region shows a row of about 14 small flattened tubercles which extends from the third posterolateral marginal tooth forward, at first slightly, then strongly deviating from the lateral margin and ending near the epistome; the rest of the pterygostomian region is pitted and covered with short hairs. In *B. pumilus* n. comb., apart from this row of tubercles, the pterygostomian region shows about three similar rows of distinct flattened tubercles arranged parallel to the first and starting near the posterior margin of the carapace.

The first abdominal somite shows a transverse groove over its full width, being only slightly interrupted in the middle. Before this groove the surface is smooth, behind it are about 20 short longitudinal grooves, which do not quite reach the posterior margin of the somite. The posterior margin of somite I shows a small triangular incision in the middle. The anterior half of somite II, which disappears under somite I when the abdomen is fully stretched shows a transverse ciliated line; on the anterior half of somites III and IV this line is usually broken up into small lines, and in somite V no such line is usually seen at all. There are no middorsal carinae on abdominal somites II to IV. The middorsal part of the posterior half of somite II shows a longitudinal groove. Like in *B. pumilus* n. comb. this groove is flanked by two flattened ridges (one on either side) which anteriorly are fused and posteriorly merge with the smooth posterior margin of the somite. In *B. pumilus* n. comb. this elongate loop has the outer margins straight and parallel to the median groove. In the present species a few (two or three) shallow incisions are found on either of the outer margins. In the third

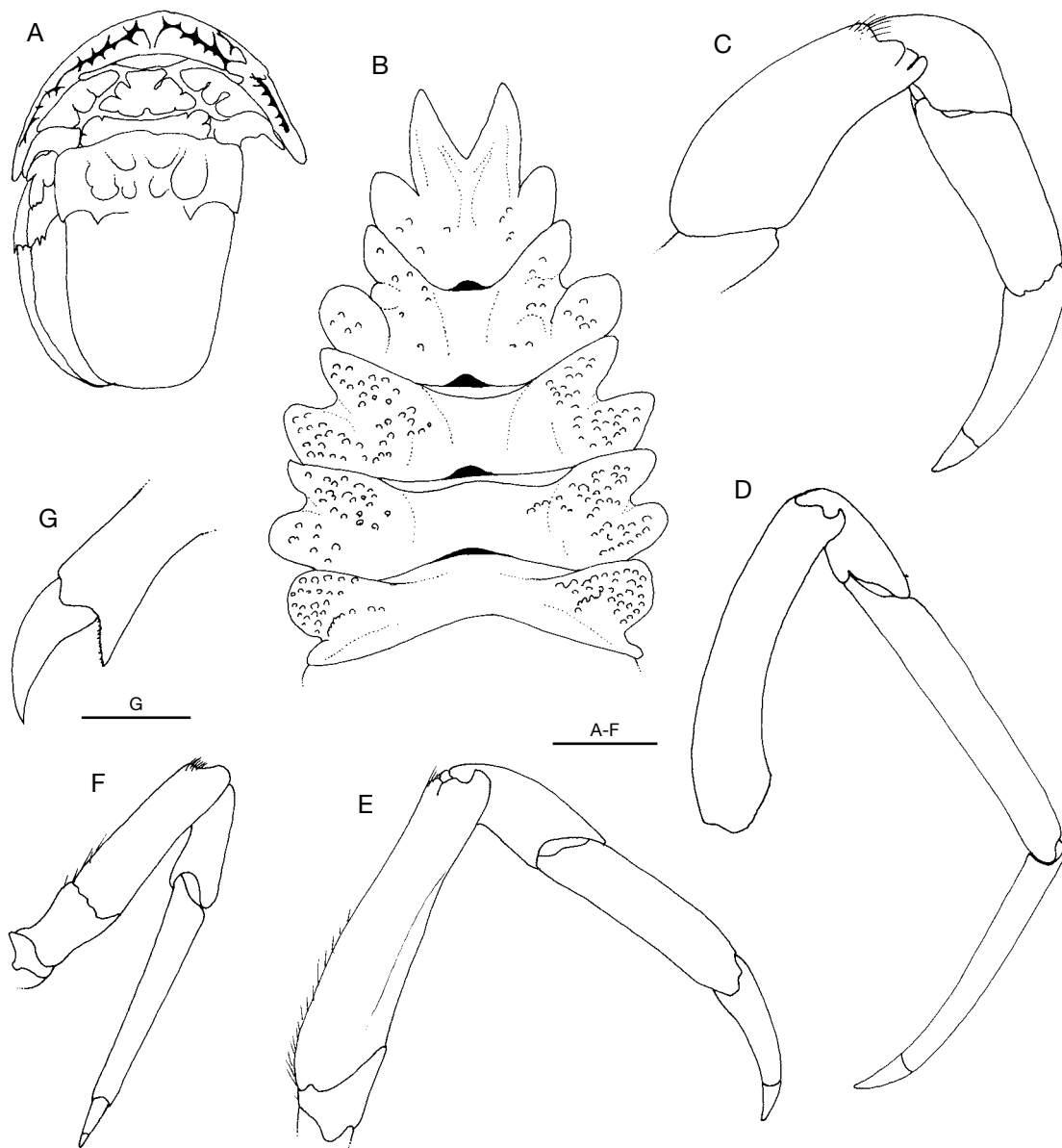


FIG. 54. — *Biarctus vitiensis* (Dana, 1852) n. comb., Hawaiian Islands off Kepuhi Point, Oahu, ovigerous ♀ (BPBM); **A**, tailfan; **B**, thoracic sternum; **C-E**, pereiopods 1 to 3; **F**, pereiopod 5; **G**, distal part of pereiopod 5. Scale bars: A, B, 4 mm; C-F, 2 mm; G, 1 mm.

somite this figure has four deeper lateral incisions and resembles somewhat the lobulated figures found in many other species of Scyllarinae. In the fourth and fifth somites the median figure is lobulated and widened in the middle. These median figures especially those of somites II and III may be

slightly elevated but never form carinae. The arborescent grooves on the upper surface of somites II to V are very distinct and the grooves are narrow and deep. The posterior margin of somites I to IV shows a distinct small triangular incision in the middle; in somite V the margin is uninterrupted or even

slightly convex in the middle. In somite VI the posterior margin is somewhat crenulated. The pleura of the first somite are short and bilobed; the anterior lobe may show a shallow incision. The following pleura have the top broadly and bluntly rounded.

The outer of the two pairs of teeth at the end of the solid part of the telson ends in a blunt triangular point, the inner teeth are placed somewhat farther posteriorly and are somewhat sharper.

The anterior margin of the basal antennular segment shows a median incision and two low teeth in either half.

The sixth segment of the antennal peduncle ends in five teeth of which the outer is the widest, the tooth on the inner margin is small and triangular. The other teeth have wide and broadly rounded tips. The dorsal surface of the fifth segment ends in two sharp triangular teeth of about the same size. The dorsal surface of the fourth segment has a single strong oblique carina, but otherwise is smooth; the outer margin bears two teeth, the proximal of which may be small or even absent; the anterior margin bears one sharp tooth in about the middle and two or three much smaller teeth in the distal part; sometimes there is one or a few small teeth medially of the large tooth; the short inner margin of the segment has a carina ending in a sharp tooth. The anterior margin of the third antennal segment carries two sharp teeth and a few tubercles; the outer of the teeth has a dorsal carina with a small dorsal denticle.

The epistome has a deep anteromedian incision.

P.1 is rather robust and reaches slightly beyond the antenna; it is smooth and bears a few scattered hairs on the merus only. The dactylus is slightly shorter than the propodus, which widens proximally. The carpus is rounded and cup-shaped, being much shorter than the propodus. The merus is somewhat longer than the propodus, smooth or slightly pitted, with a few hairs on the dorsal margin. The second leg reaches with about half the dactylus beyond the first, and with the entire dactylus beyond the antennae. The dactylus of the second leg is longer than any of the other dactyli, being about 1.5 times as long as the dactylus of the first leg and twice as long as that of the third. The propodus of the second leg is only

slightly longer than the dactylus, it is slender and widens slightly basally. The carpus is about half as long as the propodus. The merus is about as long as the propodus and shows a single shallow hairy groove on the outer surface. No grooves are present on carpus and propodus. P.3 is much shorter than P.2 and reaches only as far as the base of the dactylus of P.2. The dactylus of P.3 is about two thirds as long as the propodus. The carpus is half as long as the propodus and shows a few dorsal hairs. The merus is longer than the propodus and has a single rather wide hairy groove on the outer surface; its dorsal margin shows only a few hairs in the extreme basal part. P.4 reaches to the middle of the propodus of P.3. It is smaller than, but otherwise very similar to, P.3. P.5 is the shortest of the legs, reaching to the middle of the propodus of P.4. P.5 of the adult female bears a distinct chela, the fixed finger of which is slightly longer than half the dactylus, which is distinctly shorter than the dactylus of P.4. The propodus is about twice as long as the carpus; the other segments are similar to those of P.4.

The thoracic sternum ends in two flat triangular teeth, separated by a sharp V-shaped incision. Each tooth shows a median longitudinal ridge with a groove on the inner side. The surface of the sternum is hairy with slight pits and grooves. There are no teeth or spines on the sternum, and the ridge behind the base of P.5 is smooth.

The pleopods of the females are normal, they are broad and leaf-like on somite II and III, while the exo- and endopods of somites IV and V are narrower. In the males the pleopod of somite II has the exo- and endopod narrow and elongate and rather short, the exopod being somewhat longer than the endopod. In the following male pleopods both exo- and endopod are small and bud-like.

Size

The male holotype of *Arctus vitiensis* has a tl. of "one inch" (= 25.4 mm), which, judging by Dana's figure, would correspond to cl. 7.5 mm. The male holotype of *S. longidactylus* from Japan has cl. 9.9 mm, and the female holotype of *S. amabilis* has cl. 17.5 mm. In the present material the cl. of the males is 7 to 13 mm, of the non-ovigerous females

6 to 17.5 mm, and the ovigerous females have cl. 14, 15, 16, 19 and 20 mm; juveniles have cl. 4 to 7 mm. The Taiwanese female examined by Chan & Yu (1986, 1993) had a cl. of 12 mm. De Man's (1888) largest specimen, evidently still juvenile, had a tl. (including the antennae) of 23 mm, which corresponds to a cl. of c. 7 mm. His 1916 specimen was likewise juvenile (tl. 16.5 mm, cl. c. 5 mm).

Colour

A colour photograph of the female from stn 968 (Lagon Nord-Ouest) shows a generally dark brown animal partly mottled with grey. Most of the carapace is dark brown except for a broad transverse band along the anterior margin between the orbits, which is greyish. The antennae are mottled pale grey and dark brown, the paler colour dominating. A dark brown spot is seen on the inner posterior angle of antennal segment 6 and one near the tip of segment 4. The abdominal somites I to V are rather evenly dark brown, except for a small median area on somites I to III which is grey. Somite VI and the tailfan are a much paler brown. The most conspicuous colour character of the animal is the presence of a dark median circular spot on abdominal somite I. This very dark spot has a light spot in the center, which often extends backward, whereby the dark spot becomes more horseshoe-shaped. On either side of the median dark spot is a pale area of a grey or yellowish colour; in this pale area some curved dark lines (parallel to the outer margin of the circular spot) may be seen. In preserved specimens the central spot and the curved lines often persist for a long time. Like in many scyllarine species a dark ring is present on most of the segments of P.3 to P.5.

A colour photograph of the female from Ouvéa, Loyalty Islands (19.IX.1999) shows an animal that is bright brown with darker and lighter areas. The antennae are pale brown and have very small scattered white points. A distinct dark spot is present in the area of the fifth segment. A row of very small and well-spaced dark spots extends over the full length of the oblique median carina of the fourth segment. In the outer basal part of the fourth segment a rather large brownish spot is visible. The carapace has a broad transverse pale

band along the anterior margin between the orbits. The abdomen is rather evenly brown, it becomes paler posteriorly and ends in a whitish transparent tailfan. In this specimen the first abdominal somite shows the usual median dark spot. Behind this spot is a rather wide X-shaped pale area on somites I and II. The legs that are visible on the photograph, have the usual dark ring on propodus, carpus and merus.

A much less clear coloured photograph is that of the male of LAGON stn 625 (Lagon Est, New Caledonia). This photograph shows the animal quite dark brown. The lighting and the presence of shining and reflecting surfaces makes it impossible to give a good description.

The specimen from Roebuck Bay (Mrs Grey leg.) has the body mottled with bluish grey and yellowish. A very conspicuous dark violet, practically black circular spot is visible on the posterior half of the first abdominal somite. This spot stops at the transverse groove of that somite and does not reach the carapace, neither does it extend on to the second abdominal somite. P.3 to P.5 have a blue band over the middle of the propodus, carpus, merus and ischium. In P.2 such a band is only seen on the merus. The Philippines specimen, after preservation in alcohol for four months shows a pale brownish grey overall colour marbled with darker and lighter shades. Some of the lateral tubercles have whitish tips. The third antennal segment is somewhat reddish dorsally. The black central spot of the first abdominal somite extends over both halves of the somite, but is not seen on carapace or second somite. Its center is pale and at either side of the spot there are curved dark lines parallel to the outer margin of the spot. P.2 shows a dark ring in the distal half of the merus, and a faint one in the proximal part of the dactylus. In the fifth leg such bands are present on propodus, carpus, merus and ischium; legs 3 and 4 are missing.

Chan & Yu (1986, 1993) published coloured photographs of this species. According to Chan (pers. comm.) the Hawaiian specimens published by Colin & Arneson (1995: fig. 1071, as *Scyllarides tumidus*) and the one published by Hoover (1998: 274, as *Scyllarus* sp.), judging by the colour, are both *Biarcus vitiensis* n. comb.

REMARKS

The fact that *Biarctus vitiensis* n. comb. for such a long time was a rather enigmatic species, notwithstanding the fact that the original description and figures were not bad, probably is due in the first place that so few specimens were collected (because of the inaccessibility of their habitat), while moreover the specimens collected mostly were juveniles. This explains also that when adults were found they at first were considered new species. A study of the biology of the species might yield interesting results.

Biarctus sordidus (Stimpson, 1860) n. comb.
(Figs 55; 56)

Arctus sordidus Stimpson, 1860: 23. — De Man 1896: 497; 1898: 706, pl. 34 fig. 58.

Non *Arctus sordidus* — Bate 1888: 66, pl. 9 fig. 3 (= *Chelarctus cultrifer* n. comb.).

Scyllarus sordidus — Nobili 1903: 12. — Pearson 1905: 90. — De Man 1916: 78, pl. 2 fig. 11. — Balss 1921: 18. — Gee 1925: 159. — Estampador 1937: 496; 1959: 40. — Dawydoff 1952: 136. — Prasad & Tampi 1961: 250, fig. 1; 1968: 118, fig. 2; 1969: 84. — Naiyanetr 1963: 68; 1980: 22; 1998: 44. — Chhappgar & Deshmukh 1964: 206, fig. 6. — D. S. Johnson 1964: 73. — Bardach *et al.* 1972: 647. — Burukovsky 1974: 108; 1983: 151. — Sankolli & Shenoy 1974: 218, figs 1-8. — Tampi & George 1975: 31, figs 27, 28. — Tampi 1976: 560. — Ritz 1977: 229, 236, fig. 7. — Van Olst *et al.* 1980: 336. — Phillips *et al.* 1980: 70; 1981: 418. — Sekiguchi 1986a: 1290; 1987a: 331; 1987b: 415, 417. — Barnett 1989: 123, 124, fig. 2. — ?Mutchacheep 1990: 121, fig. 146 (possibly *Petrarctus rugosus* n. comb.); 1992: 25. — Huang 1994: 564. — McWilliam *et al.* 1995: 564. — George & Thomas 1997: 74, figs 1, 2. — Wang *et al.* 1998: 447, 448, fig. 4.

Non *Scyllarus sordidus* — Barnard 1926: 122, pl. 10 (= *Chelarctus cultrifer* n. comb.).

Scyllarides sordidus — Sekiguchi 1989b: 457; 1990b: 379.

Scyllarus cf. sordidus — Becker 1996: 96, 97.

Scyllarus insularis White, 1847: 67 (nom. nud.).

Arctus vitiensis — Ortmann 1897: 270 [non *Arctus vitiensis* Dana, 1852].

Scyllarus tutiensis Srikrishnadhas, Rahman & Anandasekaran, 1991: 418, fig. 1. — Anonymous 1992: 3.

TYPE MATERIAL. — Holotype now lost (USNM).

TYPE LOCALITY. — Hong Kong, 15 m.

MATERIAL EXAMINED. — **Persian Gulf.** On telegraph cable, 31 m, F. W. Townsend, 1 ♂ 11 mm, 1 ♀ 10 mm (BM 98.12.18). — Khor al Sabiya between Babiyan Id and Sabiya Peninsula, Kuwait, 29°33'N, 48°11'E, trawled, muddy sand with shell debris, 1 ♂ 13 mm (USNM).

South China. Foochow (Fuchou), X.1935, T. H. Cheng, 1 ov. ♀ 16 mm (BM). — Liuwutien near Amoy (Hsiamen) and Tsimei, 28.V.1924, S. F. Light, 6 ♂♂ 11-17 mm, 5 non-ov. ♀♀ 14-17 mm, 5 ov. ♀♀ 15-18 mm (USNM, RMNH).

Hong Kong, W. H. A. Putnam, 1 ♂ 12 mm, 1 ov. ♀ 22 mm (USNM). — Received from the Zoological Museum, Cambridge, 1 ♂ 14 mm, 1 ♀ 12 mm (MNHN). — E. Stephan's Ostasiatische Expedition, 1900-1901?, 5 ♂♂, 4 ♀♀ (1 ov.) (ZMB). — Behrendt leg., 3 ♂♂, 3 ♀♀ (ZMB).

Thailand. West coast of Gulf of Thailand. Koh Chan, Prachuap Khiri Khan province, 11°37'N, 99°47'E, 30.X.1961, P. Suchonthaman, 1 ♂ (RMNH).

North-eastern Gulf of Thailand. Off Chonburi province, between Si Racha (13°10'N, 100°56'E) and Pattaya (12°56'N, 100°52'E), c. 150 km SE of Bangkok, from trawlers, 1-40 m deep, A. C. J. Burgers & L. B. Holthuis leg., 14.III.1985, 2 specimens; 28-30.XII.1987, 4 ♂♂ 14-21 mm, 1 non-ov. ♀ 24 mm, 3 ov. ♀♀ 18-21 mm; 3-25.XI.1988, 3 ♂♂ 19-23 mm, 1 non-ov. ♀ 20 mm, 6 ov. ♀♀ 20-23 mm (RMNH D 37577); 15-16.XII.1988, 2 ♂♂ 20 and 25 mm, 4 ov. ♀♀ 21-24 mm (RMNH D 37563, 37573); 24.XII.1989-24.I.1990, 10+ specimens (RMNH D 37964); 1-10.I.1991, 15+ specimens (RMNH D 38710, 38668); 28.I.1992, 1 specimen (RMNH D 42056). — Koh Sichun, Chonburi province, 9.I.1981, P. Naiyanetr, 1 ♂ 18 mm, 1 ov. ♀ 20 mm (RMNH D 33967).

North-eastern Gulf of Thailand. Off Rayong province, near Sattahip, 12°40'N, 100°54'E, c. 180 km SE of Bangkok, trawled, 1-40 m, from fishermen, 16.XII.1988, A. C. J. Burgers & L. B. Holthuis, 1 ♂ 16 mm, 1 ov. ♀ 24 m (RMNH).

Eastern Gulf of Thailand. Expedition Th. Mortensen, 1 mile S of Koh Chuen, 12°31'N, 100°58'E, dredged, c. 18 m, bottom with shells, 1.II.1900, 1 ♀ 10 mm (UZM). — Koh Kahdat, 11°50'N, 102°32'E, dredged, bottom with sand and stones, 7-9 m, 16.II.1900, 1 juv. 4 mm (UZM).

Gulf of Thailand. Naga Expedition, stn 60-1103, 13°05'50"N, 100°26'10"E, 16 foot otter-trawl, 18.7 m, 13.XII.1960, 1 ov. ♀ 15 mm (RMNH). — Stn 61-128, 10°12'42"N, 103°55'15"E, 16 foot otter-trawl, 11 m, 10.II.1961, 2 ♀♀ 12 and 13 mm (RMNH).

Malaysia. Batu Muang, Penang, 5°17'N, 100°17'E, 16.I.1983, trawled, c. 30 m, from fishermen, Wong

Tat Meng & L. B. Holthuis leg., 1 ♂ 24 mm (RMNH).

Singapore. 1901, Emile Deschamps, Museum Turin don., 64 ♂ 7-18 mm, 97 ♀ 7-18 mm (USNM, MNHN, RMNH). — Mr Lee, 1905, 1 ♂ 12 mm (BM). — Low tide, 8.VI.1903, 15.VI.1905, 20.IV.1906, 27.XI.1907, consul S. Gad leg., 4 ♂ 10-12 mm, 3 ♀ 10-13 mm (UZM). — Bedok, 31 m, 5.XII.1956, 1 specimen (BM). — Angler Buoy, Singapore Straits, Agassiz trawl, 9 m, 20.VII.1956, 1 ♂, 1 ♀, 1 juv. (BM). — Singapore coast, stn B 149, 1 ♂ 16 mm, 1 ♀ 14 mm (BM).

Philippines. H. Cuming leg., 1 ♀ type of *Scyllarus insularis* White nom. nud., 20 mm (BM). — 3 dry specimens 13-20 mm (ANS). — Cebu, US Navy Eclipse Expedition to Ilo-Ilo, 1929, Lieut. H. C. Kellers, 2 ♂ 12 and 14 mm, 1 ♀ 15 mm (USNM). — Bohol, 27 m, 1863, C. G. Semper, 2 ♂, 2 ♀, 1 juv. (ZMB).

North Borneo. Berhala Channel, Sulu Sea off Sandakan, 5.5-37 m, 3.III.1964, FV *Pele*, B. R. Wilson, 1 ♀ 12 mm (WAM 354-64).

Indonesia. Danish Expedition to the Kei Ids, stn 95, Lampong Bay, S Sumatra, 5°44'S, 105°20'E, Sigsbee trawl, 25 m, loamy mud, 1.VIII.1922, Th. Mortensen, 1 ♀ 13 mm (UZM).

Siboga Expedition, stn 162, between Loslos Id and Broken Id west of Salawati, W New Guinea, dredged, depth 18 m, coarse and fine sand with clay and shells, 18.VIII.1899, 1 ♂, 2 ♀ (ZMA). — Off Pulu Jedan, NE Aru Ids, 13 m deep, bottom sand and shells, 23-26.XII.1899, 1 juv. ♂ (ZMA).

Mariel King Memorial Expedition, SW of Tandjong Ngaboroam Light Vessel, Trangan, Aru Ids, 7°02'S, 133°58'E, 26-29 m, coral and sponges, 20.VI.1970, 1 ♂ 14 mm (WAM 247-70).

Australia. Australia, E. Wilson, 2 dry ♂ 16 mm (ANS).

Western Australia. Between Cape Bossut and Broome, dredged, 9 m, 11.IX.1929, 1 ♀ 18 mm (AM). — Eighty Mile Beach, NW Australia, 1967, Mrs C. Wright leg., 1 ♀ (AM P.15615). — Begout Id, Dampier Archipelago, under stones at low tide, 10.VI.1960, B. R. Wilson leg., FV *Davena*, 1 juv. 9 mm (WAM 368-64). — Exmouth Gulf or Shark Bay, trawled, winter 1960, FV *Peron*, R. McKay, 1 juv. 5 mm (WAM 362-64).

Northern Territory. Darwin, 26-38 m, IX.1965, FV *Sloven*, E. Beuker, 1 ♀ 19 mm (WAM 102-66).

Queensland. SE corner of Gulf of Carpentaria, 17°25'55"S, 139°37'55"E, 3 m, FV *Rama*, Gulf of Carpentaria Prawn Survey, stn 548, CSIRO, 1 ov. ♀ 17 mm (AM P.15618). — Same locality, less than 25 m, 10.I.1964, 1 ♂ 18 mm (AM P.15619). — Low Isles, NE of Cairns, 20 m, 25.VIII.1984, Clive Jones, 1 ♂ 14 mm (RMNH D 39339). — Near Gatcombe Head, Facing Id, Port Curtis, 23°52'S, 151°23'E, dredge, 11 m, 14.I.1909, A. R. McCulloch,

1 ♂ 17 mm (AM P.1957); 16-22 m, XII.1929, M. Ward, 12 ♂ 8-21 mm, 10 ♀ 20-23 mm, largest ov. (AM P.14040); dredged, 9-12 m, VII.1929, M. Ward & W. Herdman, 3 ♂ 17-19 mm, 2 ♀ 19 and 20 mm (AM P.14039; RMNH). — Port Curtis, 23°55'S, 151°21.6'E, 13 m, 2 ♀ 11 and 14 mm, largest ov. (AM). — Port Curtis, No. 318, 1 dry ♀ 17 mm (AM). — Moreton Bay, 27°15'S, 153°15'E, II.1967, A. J. Bruce, 2 ♀ 22 and 23 mm (RMNH).

DISTRIBUTION. — The type locality is Hong Kong. The known range of the species extends from the Persian Gulf to Australia and southern China. The records in the literature are the following: Near Bombay, west coast of India (Chhapgar & Deshmukh 1964), Danda Island near Bombay (Sankolli & Shenoy 1974), Gulf of Manaar, south of Adam's Bridge, Sri Lanka (Pearson 1905), Gulf of Manaar near Mandapam, India (Prasad & Tampi 1961, 1968), Gulf of Manaar near Tuticorin, 08°44'18"N, 78°12'54"E (Srikishnadas *et al.* 1991; type locality of *Scyllarus tuiensis*), Chinese coast (Wang *et al.* 1998), Hong Kong (Stimpson 1860; Gee 1925), Hon Cha reef, Poulo Condore (= Con Son), Vietnam (Dawydoff 1952), Thailand (Naiyanetr 1963, 1980, 1998; Mutchacheep 1990, 1992), Chon Buri, Rayong, Koh Chan, Prachuap Khiri Khan, Pattani, Gulf of Thailand (Naiyanetr 1998), Ang Sila and Khao Samuk, Gulf of Thailand (Becker 1996), Singapore (Nobili 1903; D. S. Johnson 1964), Philippines (White 1847; Ortmann 1897; Estampador 1937, 1959), between Loslos and Broken Islands, W of Salawati, Irian Jaya, Indonesia and off Pulu Jedan, Aru Islands, Indonesia (De Man 1916), Java Sea, Indonesia (De Man 1896), Palau Island (Ortmann 1897), Western Australia between 24°30' and 35°S (Phillips *et al.* 1981), 45 miles WSW Cape Jaubert, Western Australia (Balss 1921), Gulf of Carpentaria, N Australia (McWilliam *et al.* 1995), N Queensland, Australia (McWilliam *et al.* 1995), Great Barrier Reef, 18°35'-19°10'S, 146°30'-147°00'E (Barnett 1989), Moreton Bay, Queensland, Australia (Ritz 1977).

HABITAT. — The examined material was collected at depths between 2.7 and about 40 m, but mostly between 10 and 20 m. The type specimen was collected at a depth of "8 org[lyal]" (15 m). The other depth records in the literature are: 7-73 m (Pearson 1905), 13 and 18 m (De Man 1916), 20 m (Balss 1921). The types of bottom from which the examined material of the species has been reported is mostly sand (coarse and fine) with shells, stones, coral and sponges and clay; one record is from loamy mud. The type was found on a shelly bottom ("f[undo]. conchoso"). Pearson (1905) and Dawydoff (1952) reported it from coral reefs; Pearson's material was found on a bottom of sand and living coral. Sankolli & Shenoy (1974) reported it from a muddy bottom in the littoral zone.

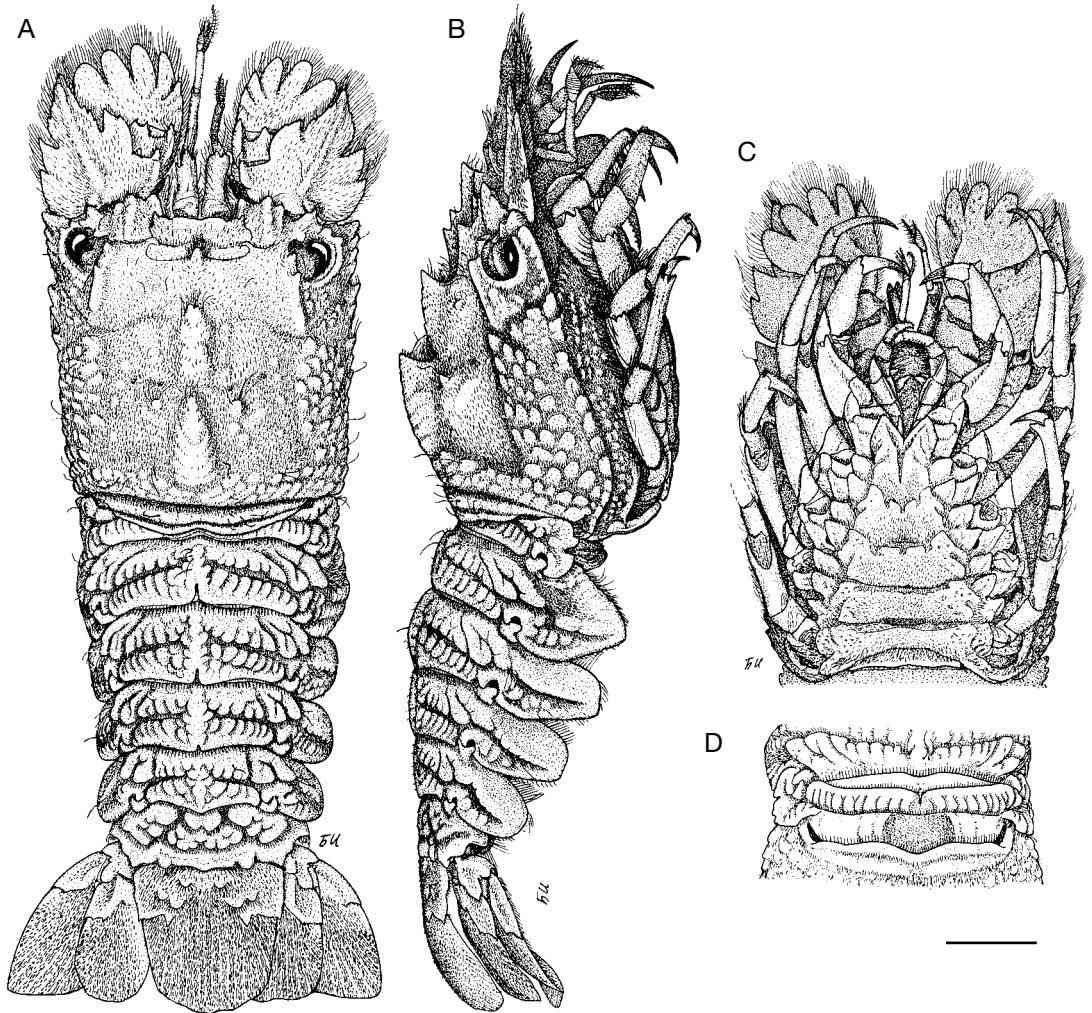


FIG. 55. — *Biarctus sordidus* (Stimpson, 1860) n. comb., off Bahrain, ♀; **A**, dorsal view; **B**, lateral view; **C**, ventral view of cephalothorax; **D**, dorsal view of abdominal somite I. Scale bar: 1 cm. B. G. Ivanov del.

Evidently the species prefers a hard sandy bottom with shells, etc. There are only two records from mud, and one of these is from hard loamy mud.

DESCRIPTION

The rostrum is rather broad, it is somewhat constricted behind the anterior margin. It bears a distinct dorsal rostral tooth. There are two more teeth in the median line of the carapace: the cardiac and the gastric. The cardiac tooth is fairly high and blunt or two-topped. It is followed by a

double row of about five flat tubercles. The tip of the cardiac tooth reaches distinctly beyond the end of the posterior submedian carinae. The gastric tooth is rather high also and blunt or faintly two-topped, and followed by a double or treble row of about five rather irregular tubercles. The branchial carina is interrupted by a rather deep and wide gap formed by the cervical groove. There is no tubercle in this gap. The anterior branchial carina bears two acute teeth placed on the inner orbital margin, these teeth are followed

posteriorly by some inconspicuous tubercles. The posterior branchial carina ends anteriorly in a blunt tooth that is followed by a great number of flattened tubercles which in the posterior half of the carina are arranged in four or five longitudinal rows. The posterior submedian carina bears two rows of one to five flattened tubercles, one of which is usually quite conspicuous, but is much smaller than the cardiac tooth and does not reach as far forwards. The intermediate row consists of four tubercles. The anterior submedian carina is indistinct and bears three tubercles, the posterior of which is widely separated from the rest and is placed near the base of the gastric tooth. The anterolateral angle of the carapace is distinct and followed by four or five flattened anterolateral tubercles. Both the mediolateral and the posterolateral part of the marginal carina end in a blunt tooth; the former is followed by two or three, the latter by seven or eight flattened tubercles. The intercervical carina bears two or three oblique rows of two to five flat tubercles. The marginal groove along the posterior margin of the carapace is rather wide and deep; before it there are two transverse rows of tubercles; behind it there are no distinct tubercles but an additional transverse groove. The posterior margin is shallowly incised in the middle.

The first abdominal somite bears a complete transverse groove in most specimens, sometimes this groove is slightly interrupted in the middle. The anterior half of the somite is smooth, the posterior half shows about 20 short longitudinal curved grooves, that are usually not forked. The anterior half of the following three somites as a rule is entirely smooth; in the fifth somite sometimes there are some short transverse hairy grooves. The posterior half of the abdominal somites shows no median carina but only the usual arborescent pattern of narrow grooves. The median figure of this pattern has the lateral margin lobulated. The posterior margin of somites I to IV shows a deep median incision. The pleuron of the first somite is short and bilobed. The pleura of the second and third somites end in a bluntly rounded downward directed top; those of the fourth and fifth somites are slightly more angular.

The posterior margins of the pleura are entire, the anterior may be obscurely serrate, while that of the second bears a shallow lobe. The sixth abdominal somite and the hard part of the telson bear flat squamiform tubercles. The outer of the four teeth on the posterior margin of the hard part of the telson are very broad and rectangular; the inner teeth are narrowly triangular and reach farther backward than the outer.

The anterior margin of the antennular somite bears two low tubercles and a narrow median incision.

The anterior margin of the sixth (last) segment of the antenna is convex. It bears four teeth which gradually narrow towards a rather broadly rounded tip. The inner margin has a single tooth, which in its basal part shows a trace of a second tooth. The antero-internal tooth of the fifth segment is blunt with a dorsal ridge. The anterior margin of the fourth segment bears a large tooth in the basal part, sometimes some denticles are visible on this tooth and on the rest of the margin. The outer margin of the fourth antennal segment bears two teeth, the anterior of which is placed in the middle of the margin, the posterior being usually much smaller than the anterior. Apart from the median carina, which is very strong, the upper surface of the fourth segment bears no other carinae or tubercles.

The anterior margin of the epistome shows a narrow incision in the middle.

The first pereopods are robust. The dactylus of the second is longer than any of the other dactyli, it is twice as long as the dactylus of the fourth leg, which is distinctly shorter than that of the third. The dactyli of P.1 and P.2 are naked, those of P.3 to P.5 have a very short velvety pubescence in the basal part. The third leg is about as slender as the fourth. The propodus of P.3 is slightly broader than those of P.2 and P.4, but is not conspicuously compressed and is not broader than the merus. A dorsal fringe of hairs is present on the propodus of P.3, the carpus of P.3, P.4 and P.5, and the merus of all legs; none of the segments of the legs shows a ventral fringe. The propodi and carpi do not show hairy grooves on the outer surface, but such a groove is present on the merus of all legs.

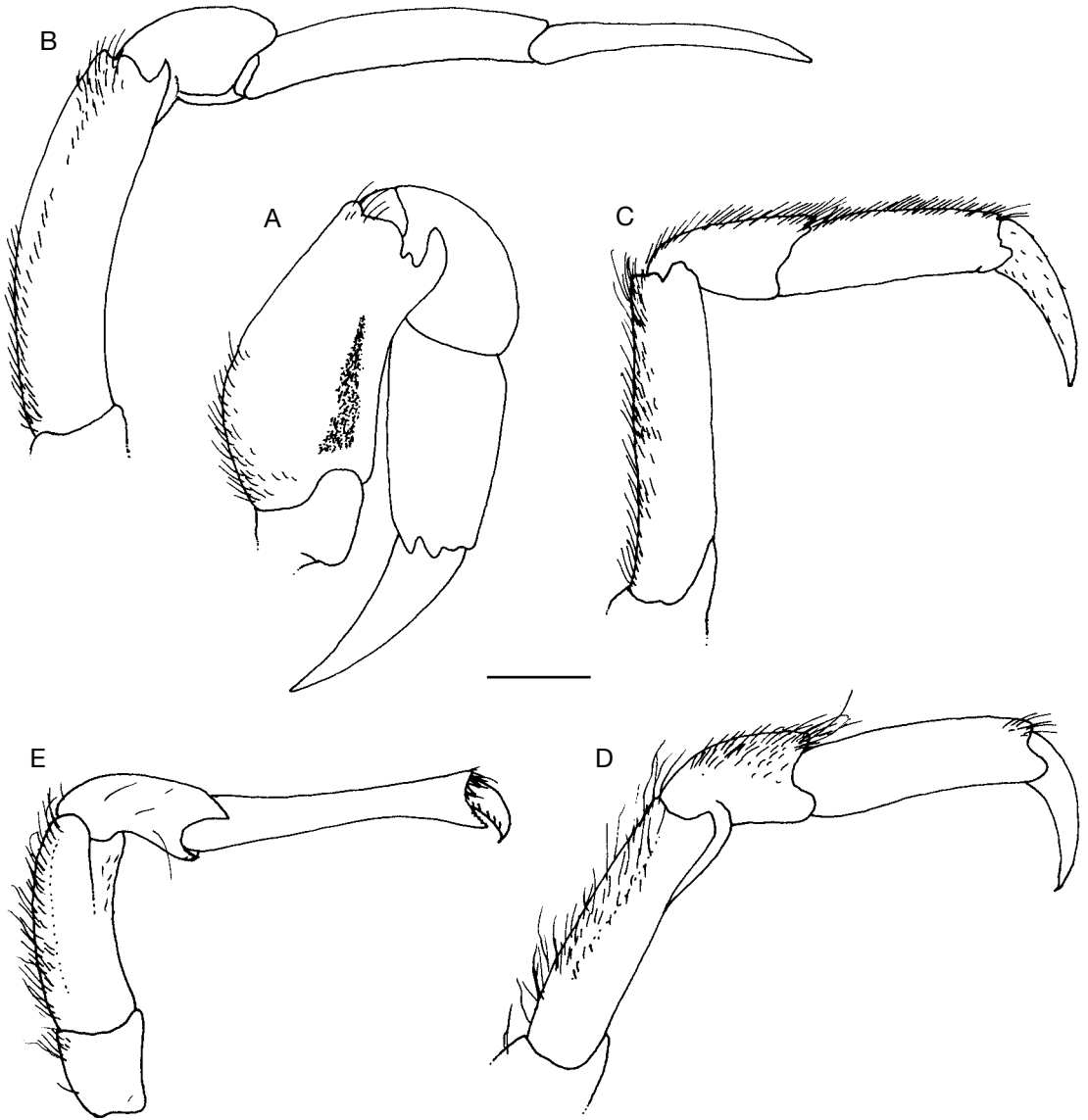


FIG. 56. — *Biarctus sordidus* (Stimpson, 1860) n. comb., Thailand, between Si Racha and Pattaya, 1989-1990, ♀; **A-E**, pereopods 1 to 5. Scale bar: 2.5 mm.

The anterior end of the thoracic sternum shows a deep triangular V-shaped incision with a median suture and a narrow groove leading back from it. None of the first four thoracic sternites bears a median tubercle; while a faint trace of such a tubercle may sometimes be seen on the fifth sternite.

The first pleopods of the male (placed on abdominal somite II) are normal. The following have both the exopod and endopod rudimentary.

Size

The cl. of the examined males varied from 7 to 25 mm (mostly between 10 and 20 mm); that of

the non-ovigerous females between 10 and 23 mm (mostly between 10 and 20 mm); the ovigerous females had cl. 14 to 24 mm (mostly between 16 and 24 mm); while specimens with cl. 4 to 7 mm were considered juveniles. The tl. of Stimpson's type specimen was "2.2 poll." (= 2.2 inch = 56 mm), which corresponds to a cl. of about 20 mm. The nisto stage described by Prasad & Tampi (1968: 118, fig. 2) had a tl. 10 mm, cl. 3.5 mm.

Colour

The most conspicuous colour feature of this species is the circular or oval central dark spot on the first abdominal somite, which is surrounded by a pale ring. Furthermore there is a dark band near the top of the fourth antennal segment, a dark spot before the gastric tooth, two lines at each side of that tooth and a dark spot on each side of the cardiac tooth. The legs show dark rings over the middle of propodus, carpus and merus, as is found in many scyllarine species. In the original description of the species Stimpson (1860: 23) described the colour as follows: "Fusco-luteus; pedes nigro quadri-annulata; abdominis segmentum primum nigro uni-maculatum". De Man (1897) also described the spot on the first abdominal somite, which he said "trägt in der Mitte einen quer ovalen, blass gesäumten, dunkler Fleck" which was twice as wide as long and occupied one third of the width of the first somite. In his later (1916: 79, 80, pl. 2 fig. 11a) paper De Man also gives a good description of the colour pattern and a separate figure of the spot on the first abdominal somite. Chhapgar & Deshmukh (1964: 206) describe the colour as follows: "Colour muddy grey: there is a prominent dark red oval spot (fading to black on preservation) in the middle of the first abdominal segment". A colour photograph has been published by Mutchacheep (1992: 25). It is possible that the specimen figured in colour by Mutchacheep at an earlier occasion (1990: 121, fig. 146) is not this species but *Petrarctus rugosus* n. comb.

Larvae

Prasad & Tampi (1961) raised the first phyllosoma of this species and described it. The same

authors in 1968 described and figured the nisto stage. Sankolli & Shenoy (1974) raised the species through six phyllosoma stages. Tampi & George (1975) discussed and figured phyllosoma stages V and VI from the Indian Ocean (off Somalia and S of Java), that they assigned to this species. Ritz (1977) provided a key to the phyllosoma stages. Barnett (1989) described and figured the last phyllosoma stage. In several general accounts of larval Scyllaridae the species is mentioned (Tampi 1976; Phillips *et al.* 1980; Sekiguchi 1986a, 1987a, b, 1989a, 1990a; McWilliam *et al.* 1995).

Biology

Bardach *et al.* (1972) reported the negative results of efforts to culture *B. sordidus* n. comb. George & Thomas (1997) described and figured a first stage phyllosoma larva found in the plankton off Vizhinjam, SW India. Becker (1996) when studying epibionts of various Malacostraca of the Gulf of Thailand found only Bacteria on the present species.

REMARKS

In 1991, Srikrishnadhas *et al.* described a new species from the Gulf of Manaar near Tuticorin. The description is very short and the illustrations not too detailed. I am unable to find any definite difference with *B. sordidus* n. comb., which is a common species in the Gulf of Manaar. A request to borrow some paratype specimens remained unanswered, and, therefore, for the time being I am inclined to consider *Scyllarus tutiensis* Srikrishnadhas, Rahman & Anandasekaran, 1991 a junior synonym of *Arctus sordidus* Stimpson, 1860. The figure of the type of *S. tutiensis*, namely, shows quite clearly the colour pattern of the present species.

Ortmann (1897: 270) and Balss (1921: 18) were of the opinion that the material from Thursday Island in Torres Strait, Australia, that Haswell (1882: 169, 170) assigned to "*Arctus ursus*" might belong to the present species. It seems more likely that the specimen belongs to *Crenarctus crenatus* n. comb. (see under that species). In the collection of the Australian Museum there is a specimen of

the latter species from Thursday Island, which indeed may be Haswell's specimen of "*Arctus ursus*".

Biartus dubius (Holthuis, 1963) n. comb.
(Fig. 57)

Scyllarus dubius Holthuis, 1963: 58. — Harada 1965: 36. — Burukovsky 1974: 108; 1983: 151. — Phillips *et al.* 1980: 69. — McWilliam *et al.* 1995: 564.

TYPE MATERIAL. — Holotype: dry ♀ 15 mm (AM 318); paratype: 1 ♂ 12 mm (AM).

TYPE LOCALITY. — Japan (locality probably incorrect).

MATERIAL EXAMINED. — **Japan.** 1 dry ♀ holotype 15 mm (AM 318).

Australia. Queensland. North end of Albany passage, Torres Strait, 10°44'S, 142°36'E, dredged, VIII-IX.1928, 1 ♂ 12 mm (AM P.14042).

Locality unknown. 1 ♂ paratype 12 mm (AM).

DISTRIBUTION. — The only reliable record of the species is that from Albany passage in the Torres Strait region of N Australia. The specimen with the indication "Japan" may have been mislabeled.

DESCRIPTION

The rostrum has the anterior margin truncate, its base is constricted, from each anterolateral angle a short carina may run obliquely posteriorly and inward, meeting at the base of the rostral tooth. The rostral tooth is well-developed, somewhat flattened but directed obliquely upward. Immediately behind it, or actually on its posterior surface some blunt tubercles may be seen. There is no pregastric tooth. The gastric tooth is strong, acute and high. Behind it, or practically on its posterior face there are two or three transverse rows of distinct squamiform tubercles. The cardiac tooth is of about the same size and shape as the gastric, it too is high and is somewhat compressed laterally. Behind it is a double row of three to five tubercles which form a distinct ridge. The posterior submedian ridge bears a longitudinal row of zero to two and one of two to four tubercles; one or two small tubercles furthermore may be present between the submedian ridge and the posterior end of the postrostral ridge. The anterior submedian ridge is quite prominent and set off sharply against the surface of the carapace, it extends anteriorly beyond the gas-

tric tooth, ending in a distinct rounded tooth behind which there are one to three distinct tubercles. Between the base of the anterior submedian ridge and the cervical groove there are a few small tubercles. To the outside of the anterior submedian ridge there is a short row of tubercles which may merge to a distinct ridge which then branches off from the anterior submedian ridge in an obliquely forwards direction. The branchial ridge is divided in two by the rather deep and narrow cervical groove; in the gap there is no tubercle, but one is visible in the cervical groove mediad of the branchial ridge. The anterior branchial carina bears two rather large and blunt teeth, placed on the inner orbital margin; behind these teeth there are some (two to five) inconspicuous tubercles on the ridge. From the ridge a narrower carina branches off, curving along the posterior margin of the orbit; this second ridge bears about four or five blunt tubercles. The posterior branchial ridge ends in a strong blunt tooth, behind which there is a double row of about six broad tubercles. The intermediate row bears two or three tubercles, between this row and the posterior branchial carina there are two or three large and a few small tubercles. The intercervical ridge carries five or six rather high tubercles, which are partly fused. The lateral margin of the carapace bears three to five anterolateral, three or four mediolateral and eight posterolateral teeth. The cervical and postcervical incisions are distinct. The posterolateral tubercles and those of the posterior branchial carina lie close together. The marginal groove along the posterior margin is distinct and rather wide. Before it is a double transverse row of flattened tubercles; behind it is a single row of tubercles followed by the broad and smooth posterior rim. The posterior margin of the carapace is shallowly incised in the middle.

The first abdominal somite bears a complete sharply delimited narrow transverse groove, before it the somite is perfectly smooth, behind it are about 20 longitudinal grooves, some of which are forked posteriorly. The anterior half of the following somites is smooth, without hairy grooves. The posterior half of these somites has no median carina,

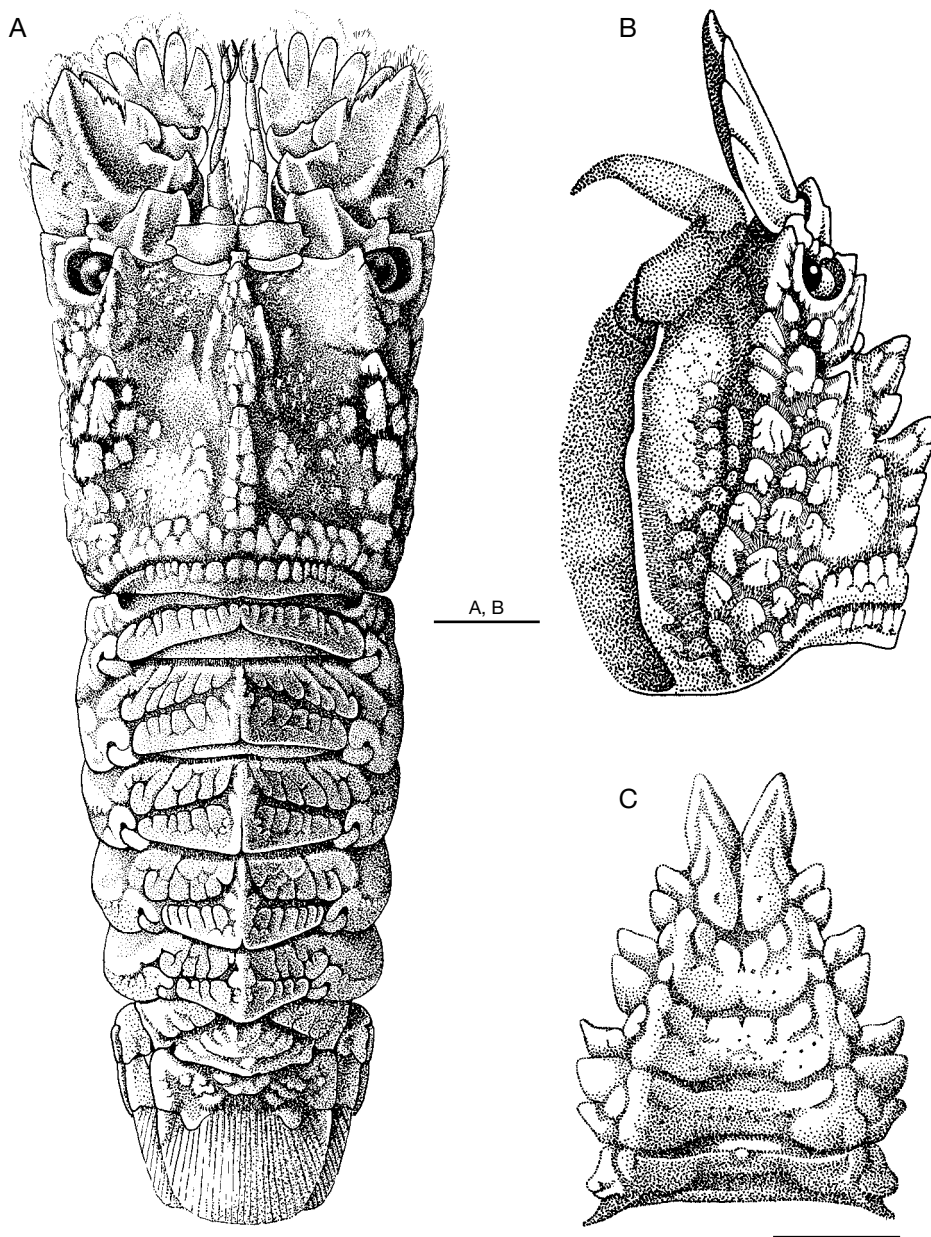


FIG. 57. — *Biarctus dubius* (Holthuis, 1963) n. comb., Japan?, holotype ♀ (AM 318); **A**, dorsal view; **B**, carapace in lateral view; **C**, thoracic sternum. Scale bars: A, B, 5 mm; C, 4 mm. W. C. G. Gertenaar del.

though they, and especially the second to fourth, may be slightly elevated in the middle. The usual arborescent pattern of narrow grooves is present. The median figure of this pattern has the lateral

margins lobulated, the lobes in the middle being distinctly larger than the others. The posterior margin of somites I to IV shows a deep median incision, those of the fifth and sixth somite are

broadly triangularly produced in the middle. The pleura of somite I are bilobed, with a short incision in the anterior lobe. The tips of the pleura of somites II to V are bluntly rounded and directed down; the margin of each pleuron is entire, only that of somite II bears a broad anterior lobe. The sixth somite and the hard part of the telson bear flat squamiform tubercles. The outer of the four teeth at the end of the hard part of the telson are about rectangular, the inner are triangularly rounded and reach far beyond the outer.

The anterior margin of the antennular somite bears a low tooth in each half, it is narrowly incised in the middle.

The anterior margin of the distal segment of the antenna is about straight and bears five or six teeth, which have rounded tips and are separated by triangular spaces. The inner margin of the segment shows a small triangular tooth. The antero-internal tooth of the fifth antennal segment bears a rather sharp dorsal carina. The anterior margin of the fourth segment bears one large blunt tooth in the basal half and about three or four smaller ones in the distal part; the outer margin of the segment bears two large bluntly topped teeth. The dorsal surface of the segment is provided with a very strong median carina; some small tubercles are present in the outer half of the surface outside the median carina; they are sometimes arranged in a more or less distinct row.

The anterior margin of the epistome is triangularly incised or shallowly emarginate in the middle; at each side of the incision the margin is convex.

The first pereopods are robust, the lower margin of the dactylus bears a shallow blunt tooth in about the middle, with about eight denticles distal of it. The dactylus of P.2 is distinctly longer than either that of the first or third leg and is almost twice as long as that of the fourth. The dactyli of P.1 and P.2 are naked, those of the other legs have a very short velvety pubescence in the basal part, but none shows any fringe of hairs. Dorsal hairy fringes are present on the propodus of P.3 and the carpus of P.3 and P.4, as well as on the merus of all pereopods. A longitudinal hairy groove is seen on the outer surface of the merus of the legs, but not on any of the other segments.

The anterior margin of the thoracic sternum is sharply V-shapedly incised in the middle, the triangle ends in a narrow groove. The two anterior teeth are rather sharply triangular. A ridge which starts somewhat behind the top of these teeth runs back and mediad. A median tubercle is present in the anterior part of the fifth sternite, but not on any of the other sternites.

The first pleopod of the male (placed on abdominal somite II) is normal with both the exo- and the endopod long and narrow. In the following pleopods the exo- and endopod both are rudimentary, still visible in the second, but no longer in the following pleopods.

Size

The two known males have the carapace length 12 mm, the only female 15 mm.

Colour

No data on the colour of the living animal are known so far.

REMARKS

B. dubius n. comb. is closest to *B. sordidus* n. comb. in the armament of the carapace and the lack of a dorsal median carina on the abdominal segments. It may be immediately distinguished from *B. sordidus* n. comb. by: 1) the strong anterior submedian carinae which anteriorly reach beyond the gastric tooth; 2) the absence of a secondary groove behind the marginal groove of the posterior margin of the carapace; and 3) the dentition of the fourth antennal segment. From *B. pumilus* n. comb. and *B. vitiensis* n. comb. it can be distinguished by the strongly elevated gastric tooth.

Genus *Acantharctus* n. gen.

TYPE SPECIES. — *Scyllarus ornatus* Holthuis, 1960 by present designation.

OTHER SPECIES. — So far only two species are known besides the type species: the West African *Acantharctus posteli* (Forest, 1963) and the eastern Pacific *A. delfini* (Bouvier, 1909) n. comb.

ETYMOLOGY. — From *akantha* (Greek, latinized to *acanthus*), thorn, in reference to the sharp median

thorn on the last segment of the thoracic sternum; and *Arctus* De Haan, 1849, a junior synonym of *Scyllarus* Fabricius, 1775.

DIAGNOSIS. — Carapace with rostral, pregastric, gastric and cardiac teeth; the pregastric tooth very small, smaller than any of the other teeth, sometimes hardly visible; the rostral tooth may be small, rather like a tubercle, or absent.

The abdomen has a distinct arborescent pattern of narrow grooves; the lobulated median figure is raised and forms a low median elevation, which on somites II

to IV is of about equal height. The fourth antennal segment bears a single oblique carina, no additional carinae or rows of tubercles are present. The dactylus of P.2 is longer than that of the other legs. P.2 to P.5 are slender and do not have the propodus broadened. There is no pubescence on the lower margin of any of the segments. The anterior margin of the thoracic sternum is rather widely U-shapedly incised and may show an indistinct tubercle on either side of the median incision. The last segment of the thoracic sternum shows in both sexes a strong median thorn.

KEY TO THE SPECIES OF *ACANTHARCTUS* N. GEN.

Species dealt with in this paper are in bold.

1. Cardiac tooth high, triangular and distinct. Anterior margin of the pleuron of abdominal somite II well-serrated 2
- Cardiac tooth low, two-lobed. Anterior margin of the pleuron of abdominal somite II entire. Juan Fernandez Island, Eastern Pacific *A. delfini* n. comb.
2. Rostral tooth distinct. Posterolateral angles of thoracic sternum without a triangular tooth either in the male or the female. Indo-West Pacific *A. ornatus* n. comb.
- Rostral tooth absent or obsolescent. Posterolateral angles of thoracic sternum in the male with a large triangular tooth at the base of P.5. West Africa.... *A. posteli* n. comb.

Acantharctus ornatus (Holthuis, 1960) n. comb.
(Figs 58; 59)

Scyllarus ornatus Holthuis, 1960: 151. — Prasad & Tampi 1969: 84. — Burukovsky 1974: 107; 1983: 150. — Berry 1974: 13, 15. — Phillips *et al.* 1980: 70. — McWilliam *et al.* 1995: 564.

Scyllarus arctus paradoxus – Ramadan 1938: 126 [non *Scyllarus (Arctus) arctus paradoxus* Miers, 1881].

? *Scyllarus* spec. C – Berry 1974: 15, figs 39, 40.

TYPE MATERIAL. — Syntypes: 2 ♂♂ 7 and 8 mm, John Murray Expedition, stn 45 (BM).

TYPE LOCALITY. — Arabian Peninsula. Off Muscat, 18°03'30"N, 57°02'30"E, 38 m.

MATERIAL EXAMINED. — **South Africa.** Natal, off Port Durnford, 28°55'S, 31°50'E, depth 20 m, from stomach of a catfish, *Tachysurus feliceps* (Valenciennes, 1840), 23.VI.1970, P. F. Berry don., 12 ♂♂ 8-10 mm, 13 ♀♀ 9-14 mm (of which 5 ov. 10-12 mm) (RMNH D 45640).

Arabian Peninsula. Off Muscat, John Murray Expedition, stn 45, 118°03'30"N, 57°02'30"E, triangular dredge, 38 m, *Lithothamnion* bottom, 29.X.1933, 2 ♂♂ syntypes 7 and 8 mm (BM).

Iran. Chah Bahar, Makran coast, 1899, 1 ♂ 10 mm (BM 1899.12.15.3).

Pakistan. Manora near Karachi, 1903, F. W. Townsend, 2 ♀♀ 10 and 13 mm (largest ov.) (BM 1903.7.29.5).

Sri Lanka. NW of True Vankali Paar, dredged, 14.III.1914, Pearl Bank Inspection, 1 ♂ 13 mm (AM).

Malaysia. In front of Penang Id, Fifth Thai-Danish Expedition, P. Naiyanetr leg., 26.I.1966, 1 ♂ 8 mm (PN).

Indonesia. Aru Ids, *Siboga* Expedition, stn 274, 5°28.2'S, 134°53.9'E, Blake dredge, 57 m, bottom sand and shells, stones, 26.XII.1899, 1 ♂ 9 mm (ZMA).

Australia. Western Australia. Dampier Archipelago, 2 miles off Legendre Id, FV *Davena*, Honolulu dredge, 40 m, bottom sponges, 7.VI.1960, B. R. Wilson, 1 ♀ 11 mm (WAM 366-64). — 2 miles W of

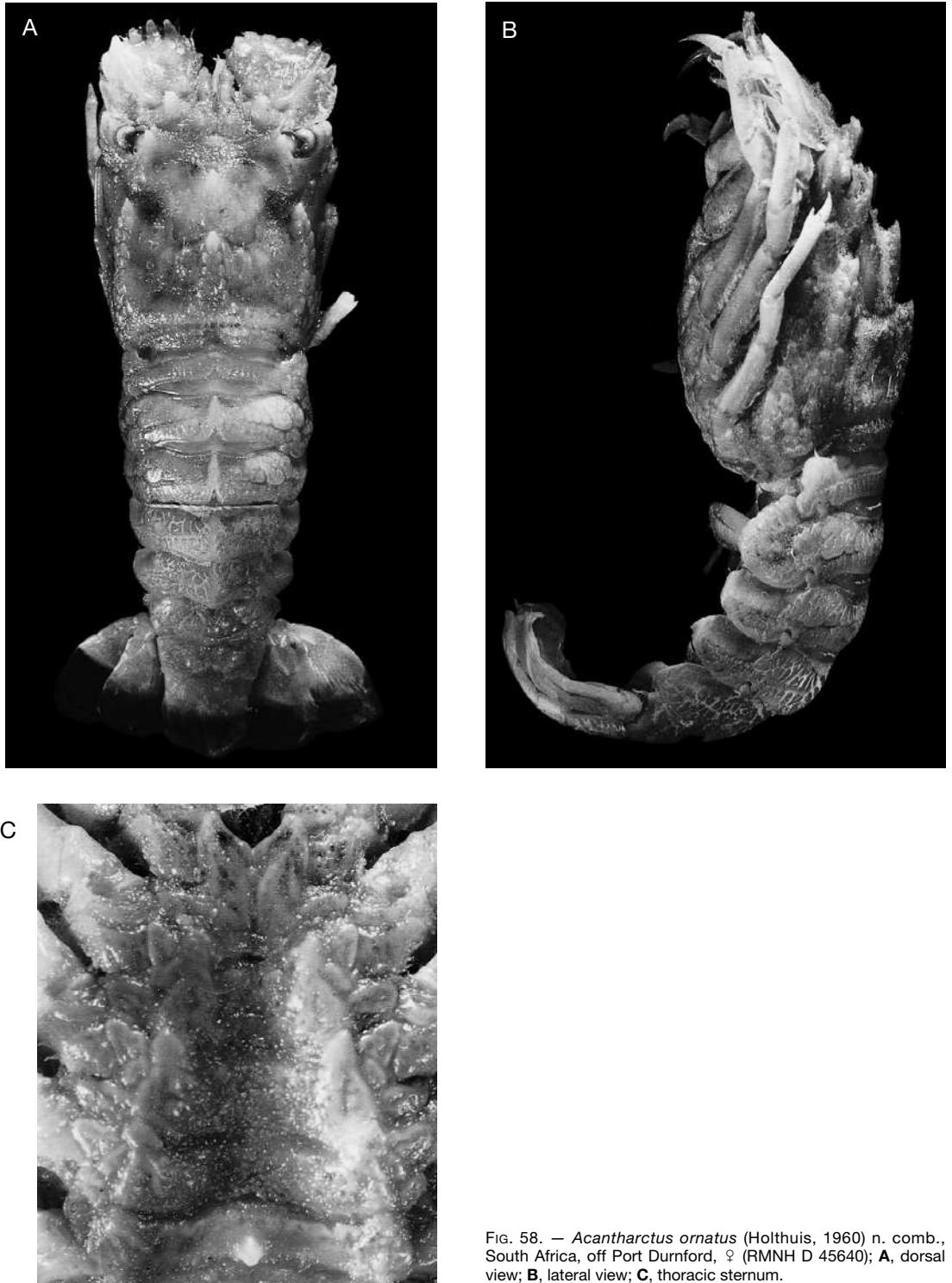


FIG. 58. — *Acantharctus ornatus* (Holthuis, 1960) n. comb., South Africa, off Port Durnford, ♀ (RMNH D 45640); **A**, dorsal view; **B**, lateral view; **C**, thoracic sternum.

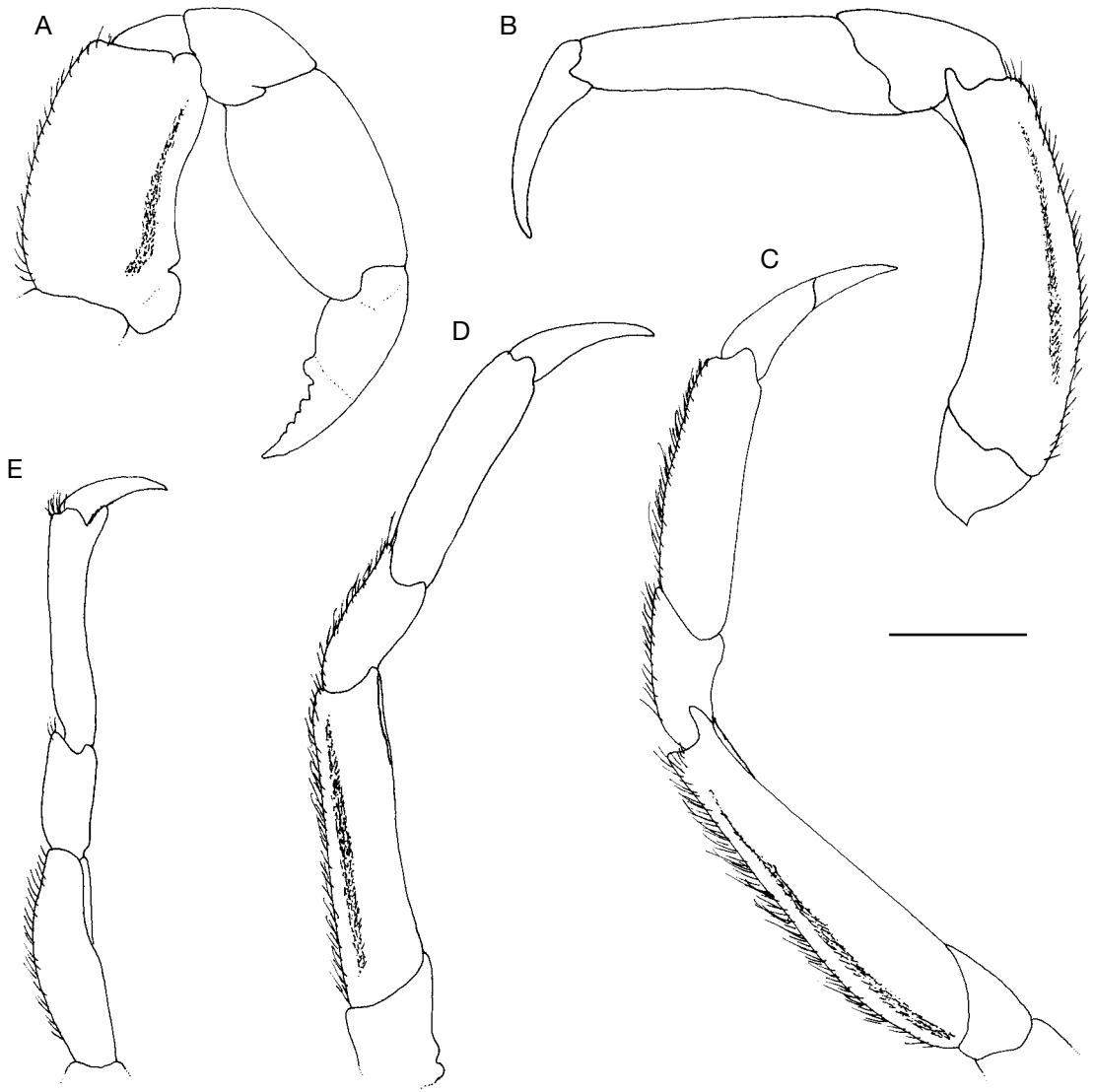


FIG. 59. — *Acantharctus ornatus* (Holthuis, 1960) n. comb., off Port Durnford, South Africa, ♀ (RMNH D 45640); **A-E**, pereopods 1 to 5. Scale bar: 2 mm.

Legendre Id, Honolulu dredge, 42 m, bottom sponges and rubble, 9.VI.1960, FV *Davena*, B. R. Wilson, 1 ♀ 12 mm (WAM 365-64).

DISTRIBUTION. — So far the species is known from the Indian Ocean and Indonesia only. The records are from South Africa (Natal), Arabia, Iran, Pakistan, Sri Lanka, Indian Ocean coast of Malaysia, Aru Islands and Western Australia.

HABITAT AND BIOLOGY. — The depths from which the species has been reported lie between 20 and 57 m.

The bottom was reported as sand and shells with stones, sponges and rubble and *Lithothamnion*. As far as is known the samples were dredged. A large sample from Natal was found in the stomach of a catfish *Tachysurus feliceps* (Valenciennes, 1840).

DESCRIPTION

The median line of the carapace carries four teeth. The cardiac tooth is well-developed and ends in a rather sharp point, which is minutely bilobed in

dorsal view, acute in lateral view. Behind the cardiac tooth is a double row of four or five squami-form tubercles, in the extreme posterior part there often are three rows. The gastric tooth is as large as the cardiac; behind it there are four rows of tubercles. The pregastric and rostral teeth are much smaller than the cardiac and gastric, but still are quite distinct; the pregastric is broader than the rostral. The cervical groove forms a deep and wide gap in the branchial carina; in this gap a small tubercle is present. The anterior branchial carina bears anteriorly the two usual teeth that are placed on the inner orbital margin. Behind these teeth the anterior branchial carina bears some inconspicuous tubercles. The posterior branchial carina ends anteriorly in a rather sharp tooth and bears dorsally a double row of seven to nine flattened tubercles, more posteriorly a third row is visible. The posterior submedian carina bears a double row of small tubercles. Between these and the postrostral carina one or two additional tubercles may be observed. The carapace is rather deeply sunken between the postrostral and branchial carinae. The intermediate row consists of five or six tubercles, it lies in the deepest part of the sunken region; there is a single tubercle between it and the branchial carina. The anterior submedian carina bears one or two small tubercles. The anterolateral angle of the carapace is rather sharp and is followed by about four small anterolateral teeth. The anterior mediolateral tooth is distinct and followed by one or a few very inconspicuous tubercles. The anterior posterolateral tooth is followed by about eight well-spaced tubercles. The intercervical carina bears two longitudinal or slightly oblique rows of broad tubercles, one of these has about four to six, the other zero to two tubercles. The marginal groove along the posterior margin is narrow and deep. There is one transverse row of larger and one or more of much smaller tubercles both before and behind it; these tubercles may form a rather irregular pattern. The median incision of the posterior margin of the carapace is rather deep and wide, being bluntly V-shaped.

The first abdominal somite bears a complete and distinct transverse groove. The anterior half of

the somite is smooth. The posterior half bears about 20 longitudinal grooves, some of which are forked posteriorly. In the following four somites the smooth anterior half shows a transverse groove, which is interrupted in the middle and bears a row of often dark hairs. The posterior half of somites II to V bears the usual arborescent pattern of narrow and deep grooves. The median figure is elevated and forms a low median longitudinal ridge over the segments; the ridges of somites II to IV are of about equal height, that of somite V is lower. The lateral margins of the median figures are lobulated. The posterior margin of somites I to III shows a deep and narrowly V-shaped incision in the middle; this incision is less conspicuous in somite IV. The posterior margins of somites V and VI are tooth-like produced in the middle. The pleura of the first somite are bilobed, the anterior lobe being again divided into three or four very small lobes. The pleura of somites II and III end in triangular but not sharply pointed tips. The posterior margin of the pleura of somite II and both margins of those of somites III and IV are minutely serrate distally, being entire proximally; the anterior margin of pleura II is serrate over its full length or entire distally. The calcified part of the telson ends posteriorly in four sharp teeth; the inner of these are larger and reach farther backward than the outer. The anterior margin of the antennular somite is about straight and bears a single distinct tubercle on each half, while a second less distinct tubercle may be seen more medially.

The anterior margin of the last (sixth) antennal segment is convex; it bears five or six teeth which, with the exception of the outer, are slender and narrow, tapering to a rather narrowly rounded top. The inner margin bears a single triangular tooth which in its basal part shows the indication of a second tooth. The antero-internal tooth of the fifth segment of the antenna is strongly produced forward and bears a dorsal ridge. The anterior margin of the fourth segment bears a large tooth in the inner part and two to four smaller teeth externally of it; sometimes a denticle may be seen on the inner margin of the large tooth. The outer margin of the

fourth antennal segment bears two large teeth, the proximal of which is placed in the basal half of the edge, sometimes a small third tooth is seen below it. The dorsal carina of the fourth segment is very strong; there are no additional carinae or tubercles in the outer half of the segment.

The anterior margin of the epistome is practically straight, showing only a minute notch in the middle.

The first pereopods are robust. A dorsal fringe of hairs is present on the propodus of P.3, the carpus of P.3, P.4 and P.5 and on the merus of all legs. The dactylus of P.2 is somewhat longer than that of any of the other legs; it is only about one third longer than the dactylus of P.4. The pubescence of the dactyli is like that in other species of Scyllarinae: in P.3 to P.5 they have a very short pubescence in the basal part, in P.1 and P.2 the dactyli are smooth. The pubescent groove on the merus is very indistinct, there is no such groove on the propodus. The segments of P.3 are somewhat more compressed than those of the other legs; the propodus of P.3 is slightly wider than those of P.2 and P.4, but narrower than the merus of P.3.

The anterior margin of the thoracic sternum shows a rather deep U-shaped emargination, which ends in a narrow median incision. The anterolateral teeth of the sternum are directed somewhat outward; from the tip of each a carina extends obliquely posteriorly and medially. The last thoracic sternite shows a strong median thorn-like tooth in the middle. The posterior margin of the thoracic sternum shows a blunt angle at the base of P.5, which is slightly more acute in the males than in the females, but does not form a true tooth.

The first pleopods of the male (placed on abdominal somite II) are normal. The following have the exopod broadly leaf-shaped, the endopod being rudimental.

Size

The examined males had cl. 7 to 13 mm, the females had cl. 9-14 mm and the ovigerous females 10 to 13 mm.

Colour

No colour descriptions of the species are known to me.

REMARKS

The present species differs from *Acantharctus posteli* n. comb., which like it has a strong spine on the last segment of the thoracic sternum, in the following points: 1) by the presence of a distinct rostral tooth; 2) by the less deep incision of the posterior margin of the carapace; 3) by the blunter tips of the abdominal pleura II, III and IV; and 4) by not having the posterolateral angles of the thoracic sternum tooth-like produced in either males or females. *A. posteli* n. comb. is a West African species.

Before Forest (1963) showed *Acantharctus posteli* n. comb. to be a good species, several authors assigned it to *Scyllarus paradoxus* Miers, 1881. Ramadan (1938) evidently saw the close resemblance of the present species to *A. posteli* n. comb. (which he incorrectly named *Scyllarus paradoxus*), and therefore identified the Indo-West Pacific species with the West African.

A third species of the genus, *Acantharctus delfini* (Bouvier, 1909) n. comb., is known from the East Pacific.

Acantharctus delfini (Bouvier, 1909) n. comb.
(Figs 60; 61)

Arctus Delfini Bouvier, 1909: 213, fig. 30.

Scyllarus delfini – Rathbun 1910: 603. — De Man 1916: 64. — Balss 1924: 333. — Holthuis 1952: 80. — Chirichigno Fonseca 1970: 23. — M. W. Johnson 1971c: 161, figs 1-8; 1974: 639. — Baez 1973: 115, 122, figs 5, 6. — Burukovsky 1974: 106; 1983: 148. — Phillips *et al.* 1980: 69. — Retamal 1981: 16, fig. 44. — Manning 1982: 362. — Andrade 1985: 111-113. — Sekiguchi 1986a: 1290; 1987a: 331; 1987b: 417; 1989a: 292.

Especies [...] de [...] Scyllaridae – Porter 1905: 27.

TYPE MATERIAL. — Holotype: ov. ♀ 14 mm, F. T. Delfin leg. (MNHN-Pa 268).

TYPE LOCALITY. — Chile. Juan Fernandez Island, 55 m.

MATERIAL EXAMINED. — Chile. Juan Fernandez Island. IV.1904, 55 m, F. T. Delfin leg., C. Porter



FIG. 60. — *Acantharctus delfini* (Bouvier, 1909) n. comb., Chile, Cumberland Bay, Juan Fernandez, ♂ carapace length 15 mm (USNM); **A**, dorsal view; **B**, lateral view; **C**, thoracic sternum.

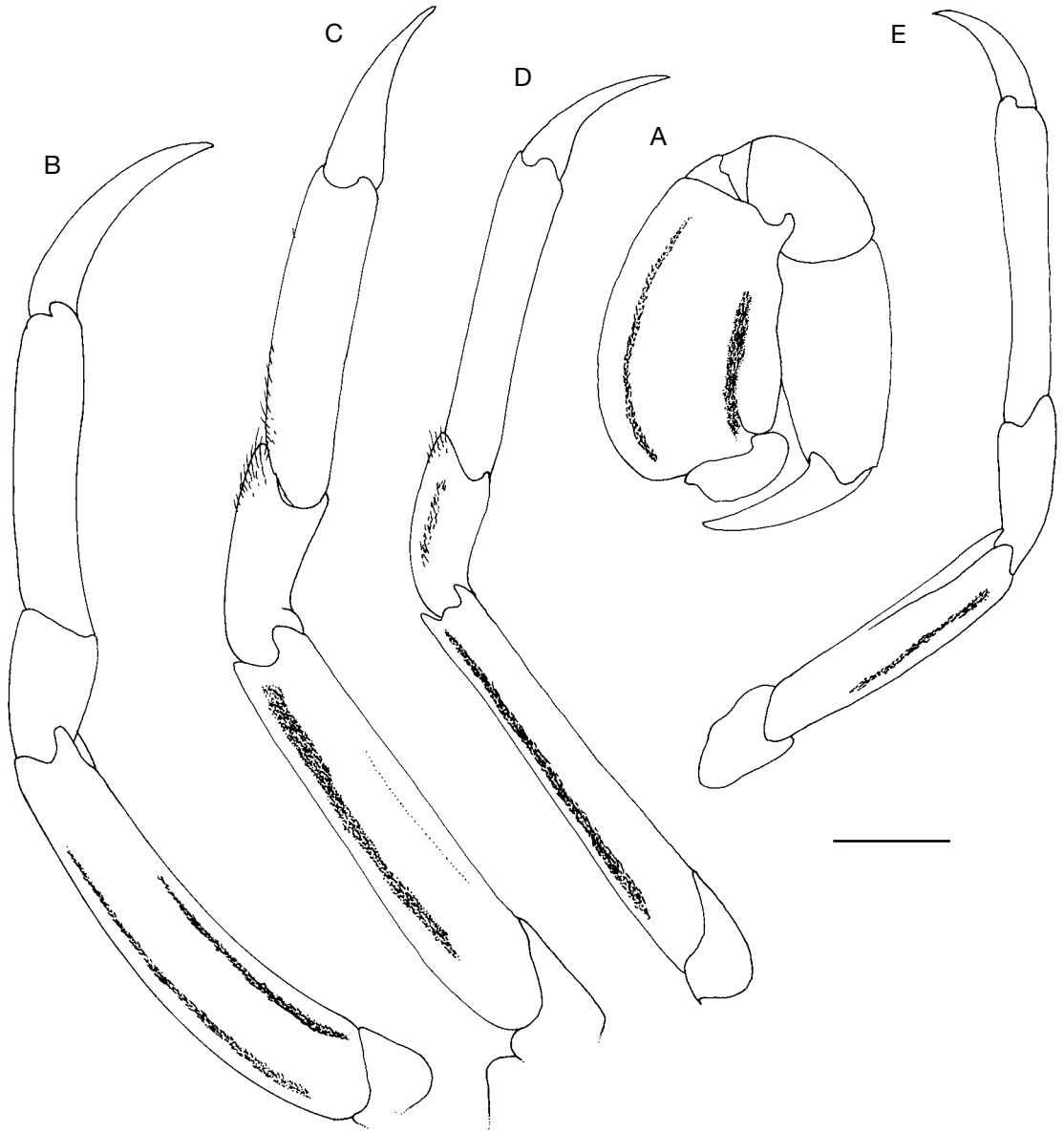


FIG. 61. — *Acantharctus delfini* (Bouvier, 1909) n. comb., Chile, Cumberland Bay, Juan Fernandez, ♂ (USNM); **A-E**, pereopods 1 to 5. Scale bar: 2 mm.

don., 1 ov. ♀ holotype 14 mm (MNHN-Pa 268). — Cumberland Bay, 33°37'S, 78°49'W, II.1957, 1 ♂ 15 mm (USNM). — Near Juan Fernandez, RV *Anton Bruun*, cruise 12, stn MV65, 33°57.5'S, 78°49.7'W, trawl, no depth noted, 12.XII.1965, 1 juv. 8 mm (USNM).

DISTRIBUTION. — So far the species is only known from the Juan Fernandez Archipelago, Chile. The type locality is "Juan Fernandez". Other records are Masatierra Island (= Mas a Tierra, = Robinson Crusoe Island, Juan Fernandez) (Balss 1924). Most later recordings of the species are just references to these

older reports. Retamal (1981: 17), who figured the species, and thus must have had material of it, reported it from Isla Robinson Crusoe (= Isla Mas a Tierra). The locality of the present record, Cumberland Sound, is also at Mas a Tierra. Rathbun (1910) in her "The stalk-eyed Crustacea of Peru and the adjacent coast" listed the species in her "List of species occurring from Panama to the island of Chiloé". This probably induced Chirichigno Fonseca (1970: 23) to include the species, with a question mark, in her list of Peruvian Decapoda, while Retamal (1981: 17) also gave the record "Peru?" in the range of the species. So far, however, the only definite records of adult specimens of the species all have been from Isla Mas a Tierra, Juan Fernandez Archipelago. For the larvae, see below.

HABITAT. — The records of the habitat of the species are extremely scarce. Bouvier (1909) remarked that the holotype was found at a depth of 55 m. So far as I know no more information about the habitat has been reported since.

DESCRIPTION

The rostrum is broad and somewhat constricted behind the top; dorsally it bears a blunt tubercle, which represents the rostral tooth. The pregastric tooth is very small, being a mere sharp tubercle in front of the gastric tooth, which is well-developed, high and pointed. On the posterior slope of the gastric tooth there are several squamiform tubercles, that are more or less clearly arranged into two or three longitudinal rows; two of these squamiform tubercles are slightly more prominent than the others; they are placed side by side in the median area. They are more distinct in juvenile than in adult specimens. The cardiac tooth is replaced by two small and low submedian teeth each of which is followed by a row of about four flattened tubercles. At either side of the cardiac tooth and at about the same level is a rounded tubercle (the anterior of the posterior submedian tubercles) forming a transverse row of four with the cardiac tubercles.

The branchial carina is widely interrupted by the cervical groove. In the gap no distinct tubercle is visible, though one may be found in the groove slightly medially of the gap. The anterior branchial carina bears two distal teeth that are placed on the inner orbital margin, behind these teeth the carina shows about five rather inconspicuous

tubercles. The posterior branchial carina ends anteriorly in a distinct tooth, which is followed by two slightly diverging rows of seven to 10 squamiform tubercles. The posterior submedian carina bears a few broad squamiform tubercles, the anterior of which reaches almost as far forwards as the cardiac tooth, as described above. There are about four intermediate tubercles, while one or two squamiform tubercles are present between the intermediate row and the posterior branchial carina. The anterior submedian carina bears two well-sized squamiform tubercles, with a third lying more externally. The lateral margin of the carapace ends anterolaterally in a strong tooth, which is followed by four or five less distinct anterolateral teeth; there are three intermediate and nine or 10 posterolateral teeth. The anterior of these is much larger than the rest. Behind the orbit there is a single post-orbital tubercle and a distinct post-orbital ridge. The intercervical ridge bears a row of three to five broad and short squamiform tubercles, to the medial side of which are two smaller rounded tubercles. The outer anterior angle of the orbit ends in a distinct, although small, tooth. The marginal groove along the posterior margin of the carapace is rather wide and deep; before and behind it there are two or three transverse rows of tubercles. The posterior margin of the carapace is shallowly emarginate in the middle.

The first abdominal somite shows a transverse groove, which is interrupted in the middle. Before this groove the surface of the somite is smooth, behind it there are about 16 longitudinal grooves that are not bifurcated and do not quite reach the posterior margin of the somite. There is no median carina on any of the abdominal somites. The anterior half of the somites is smooth, the posterior half of somites II to V shows the characteristic arborescent pattern of narrow and deep grooves. The transverse groove on the tergum has only about four or five side grooves at each side, on the pleura there are slightly more. The central dorsal median figure of somites II to V has the lateral margins distinctly lobulated, but it is hardly at all raised. The posterior margin of somites I to IV is deeply incised in the middle. In the fifth

somite the posterior margin is slightly produced in the middle and this is still more true of somite VI, where the margin shows three blunt teeth: one in the middle and one near each lateral angle. The pleura of the first abdominal somite are broadly bilobed. The margins of pleura II to V are entire; the tip is about rectangular and in the second and third may be directed slightly backward. The upper surface of the sixth somite and the hard part of the telson are provided with squamiform tubercles. The hard part of the telson ends in four sharp and rather slender teeth, the outer of which reach slightly farther back than the inner.

The anterior margin of the antennular somite bears four teeth, the inner two being somewhat smaller than the outer.

The anterior margin of the last (sixth) segment of the antenna is rounded, it bears four rounded teeth which narrow gradually distally; the inner margin bears two narrower and sharper teeth, the distal of which is the larger. Below the proximal tooth a trace of a third tooth is visible. The antero-internal angle of the fifth segment bears a sharp tooth with a dorsal carina. The anterior margin of the fourth segment bears a strong tooth on the inner part; this tooth bears a dorsal carina; on its inner flank there is a much smaller tooth. On the rest of the anterior margin of the fourth segment there are five small sharp teeth. The outer margin of the segment has two large teeth (the apical tooth not included). The dorsal surface of the fourth segment bears a single distinct oblique carina, no other carinae or tubercles are present there. The anterior margin of the epistome shows a blunt median emargination.

P.1 is more robust than P.2. The dactylus of P.2 is longer and more slender than those of P.1 or P.3. The dactylus of P.4 is again shorter than that of P.3; in the male it is about as long as the dactylus of P.5, but in the female it is longer than the P.5 dactylus. None of the dactyli has a hairy fringe. The propodus of P.1 is heavy, somewhat swollen and smooth, without setae or grooves. In P.2 the propodus is slender, likewise without hairy fringes or grooves. The propodus of P.3 is slightly wider and somewhat more compressed than that of P.2; its dorsal margin shows a fringe of short hairs,

which is absent in the propodi of P.4 and P.5. The outer surface of the propodus of P.3 to P.5 may show a faint longitudinal groove. The carpus of P.1 and P.2 is entirely smooth. The carpus of P.3 and P.4 has a short fringe in the distal part of the upper margin, but not in P.5. The outer surface of the carpus of P.3 to P.5, may have a longitudinal groove. In all legs the merus shows a hairy groove in the upper part of the outer margin, but no dorsal hairy fringe is present, at the most there are a few scattered short hairs in the extreme basal part. The distal margin of the thoracic sternum is widely V-shapedly incised. In the bottom of the V there are two distinct tubercles, which by a groove are separated from the main body of the sternum. The anterolateral teeth show a tubercle on the outer margin near the top. This peculiar shape of the top of the sternum distinguishes the present species from all known scyllarine species. From either of the anterolateral teeth a carina goes obliquely inward, the two meet at about the end of the first sternite, and then continue backward side by side, separated by a narrow median groove. In the male a distinct thorn-like tooth is placed in the middle of the last sternite. Behind the implantation of P.5 the posterior margin of the sternum shows a blunt tooth. The lateral margin of the sternum has a blunt tooth at the base of each of the pereopods; these teeth are more distinct in the juveniles than in the adults.

In the male the first pleopods (implanted on the second abdominal somite) have the exopod and endopod of about equal length, they are elongate, highest in the middle and taper to a long narrow point. The male pleopods of somites III to V have the exopod about half as long as the endopod of the first pair; they are lamellate and broadly oval. The endopod of pleopods two to four are reduced to a very short finger-like appendix.

Size

The ovigerous female holotype has cl. 14 mm; the examined male has cl. 15 mm. Balss (1924) gave the tl. of his female specimen as 62 mm. The cl. of the specimen figured by Retamal (1981: 51, fig. 44), judging by the scale given, should be almost 30 mm. No other measurements are known to me.

Colour

I have not been able to obtain any information about the colour or colour pattern of the species.

Larvae

Surprisingly the larvae of the species have been given a relatively closer attention than the adults. M. W. Johnson (1971c: 161-164, figs 1-8) extensively described and figured the last phyllosoma stage of the species, which was collected "at 33°31'S, 78°48'W a short distance north of the Juan Fernandez Islands from whence it most likely drifted in the northward flowing Peru Current" (M. W. Johnson 1971c: 161). Baez (1973: 122-126, figs 5, 6) described two phyllosoma stages of the species (which he named Stage A and B) from North (33°36'-33°34'S, 79°32'-79°48'W) and North-East (33°37'S, 78°49'W) of the Juan Fernandez Archipelago.

Vernacular name

Retamal (1981: 16) gave the vernacular name "Langosta chata" for this species, while Chirichigno Fonseca (1970: 23) gave that same name to *Evibacus princeps* Smith, 1866, therefore this probably is a general name for Scyllaridae.

REMARKS

So far the present species is the only scyllarine taxon reported from the East Pacific region.

Genus *Crenarctus* n. gen.

TYPE SPECIES. — *Arctus bicuspidatus* De Man, 1905 by present designation.

OTHER SPECIES. — So far two species are assigned to this new genus: *Crenarctus crenatus* (Whitelegge, 1900) n. comb. and the type species *C. bicuspidatus* (De Man, 1905) n. comb. As *Arctus crenatus* is based on a juvenile specimen, *A. bicuspidatus* is chosen here to be the type species of the genus *Crenarctus* n. gen.

ETYMOLOGY. — From the Latin *crena* (= notch) and the generic name *Arctus* De Haan, 1849, in reference to *Arctus crenatus* Whitelegge, 1900, the first species of the genus to become known.

DIAGNOSIS. — The rostral tooth is distinct and so is the pregastric tooth. The gastric tooth is represented by two tubercles on the posterior margin of the pregastric tooth. The cardiac tooth is low and two-topped; it is distinctly lower than the pregastric tooth. The anterior tooth of the posterior submedian ridge is almost as strong as the cardiac tooth and lies in about one transverse line with it. The abdominal somites show the typical arborescent grooves and have no median carina.

The upper surface of the fourth antennal segment bears a single strong oblique carina, there are no additional carinae or rows of tubercles. P.1 is much more robust than P.2. The dactylus of P.2 is longer than the other dactyli. None of the dactyli shows a hairy fringe. The propodus of P.3 but not of the other legs has a dorsal fringe of hairs. The carpus of P.3 and P.4 have a dorsal fringe of hairs. Such a fringe is also seen on the merus of P.2 to P.5.

The anterior margin of the sternum is shallowly U-shapedly concave and shows a tubercle at either side of the median incision.

KEY TO THE SPECIES OF *CRENARCTUS* N. GEN.

Species dealt with in this paper are in bold.

- Anterior submedian carina ending in a strong anterior tooth. Median area of second abdominal somite elevated anteriorly and ending in a blunt lobe..... *C. crenatus* n. comb.
- Anterior submedian carina with a few inconspicuous flat tubercles, none of which ends in an elevated tooth. Median area of second abdominal somite not elevated but flush with the rest of the surface, no anterior median elevation *C. bicuspidatus* n. comb.

Crenarctus crenatus (Whitelegge, 1900) n. comb.
(Figs 62; 63)

Arctus crenatus Whitelegge, 1900: 194, text-fig. 14.

Scyllarus crenatus — De Man 1916: 69. — Dakin & Colefax 1940: 173, pl. 2 fig. 1. — Burukovsky 1974: 107; 1983: 150. — Phillips *et al.* 1980: 69. — Barnett 1989: 123. — McWilliam *et al.* 1995: 564.



FIG. 62. — *Crenarctus crenatus* (Whitelegge, 1900) n. comb., Australia, New South Wales, off Minnie Water near Grafton, ovigerous ♀ carapace length 22 mm (AM P.15601); **A**, dorsal view; **B**, lateral view; **C**, thoracic sternum.

Arctus ursus – Haswell 1882: 169 [non *Arctus ursus* Dana, 1852 = *Scyllarus arctus* (Linnaeus, 1758)].

Scyllarus bicuspidatus – Jones & Morgan 1993: 148 [non *Crenarctus bicuspidatus* (De Man, 1905) n. comb.].

TYPE MATERIAL. — Syntypes: 2 syntypes, now lost (AM).

TYPE LOCALITY. — Australia. New South Wales, off Wata Mooli.

MATERIAL EXAMINED. — **Australia.** South Western Australia. Cathedral Rocks off Rottnest Id, on top of some weed, I.1960, G. Dietmar leg., Western Australian Museum don. (340-64), 1 ♀ 22 mm (RMNH D 47797).

Queensland. Thursday Id. 10°35'S, 142°13'E, 1 ♂ 13 mm (AM).

New South Wales. Woody Head (= Wooded Bluff), Clarence River mouth, 29°22'S, 153°22'E, 1 foot (= 30 cm) of water below low tide level, under rock, I.II.1965, A. A. Cameron leg., 1 ♀ 15 mm (AM P.14930). — Off Minnie Water near Grafton, about 29°41'S, 152°56'E, from crayfish pot, 11 m, X.1966, G. Biddle leg., 1 ov. ♀ 22 mm (AM P.15601). — Newcastle, 32°55'S, 151°45'E, from crayfish pot, D. G. Stead, 1 ♀ 13 mm (AM). — Off Norah Head, 33°17'S, 151°34'E, trawled, 48-70 m, F. A. McNeill & A. Livingstone, 1 juv. 7 mm (AM P.5355). — Long Bay, coast N of Sydney, reef between tide marks, F. A. McNeill, 1 ♀ 10 mm (AM P.12130). — Bottle and Glass Rocks, Port Jackson, Sydney, about 33°51'S, 151°15'E, G. P. Whitley, 1 ♀ 10 mm (AM P.10294). — Off North Head, entrance Port Jackson, Sydney, W. E. J. Paradise, 1 ♂ 10 mm (AM P.8822). — Off Green Point, Port Jackson, Sydney, dredged in shallow water, CSIRO, 1 juv. 6 mm (AM P.12141). — Near Sow and Pigs, Port Jackson, Sydney, dredged, c. 7 m, F. A. McNeill & M. Ward, 1 ♂ 10 mm (AM P.9438). — La Perouse, Botany Bay, Sydney, 33°58'S, 151°10'E, J. Douglas leg., 1 juv. 5.5 mm (AM C.1797). — Little Bay near Botany Bay, under damp rock shelf between tide marks, Australian Museum Party, 4 juv. 6-8 mm (AM P.8469). — Coogee, S of Sydney, cavity in wall of Wylie's Baths, under water, F. A. McNeill, 1 juv. 8 mm (AM). — Shellharbour, 34°35'S, 150°52'E, between tide marks, 2 ov. ♀♀ 19 and 21 mm (AM P.8440). — Shellharbour, reef between tide marks, 4 ♂♂ 10-15 mm (AM P.8441). — Shellharbour, coastal reef between tide marks, 1 ♂ 13 mm, 1 ♀ 11 mm (AM P.6855). — Shellharbour, coastal reef between tide marks, G. McAndrew, 1 ♀ 14 mm (AM P.6765). — Off Wata Mooli, between Port Jackson and Jervis Bay, 34°44'S, 150°39'E, FV *Thetis*, stn 57, 99-108 m, mud, 22.III.1898, E. R. Waite leg., 2 ♂♂, 1 ♀ 12 mm, 1 juv. 7 mm. (AM G.2393). — Shoalhaven Bight, 34°53'S, 150°53'E, 27-82 m, RV *Endeavour*, stn E 282, 1 ♂ 12 mm (USNM). — Jervis Bay, 35°05'S, 150°45'E, trawled, CSIRO, 1 ♂ 9 mm (AM P.12147).

DISTRIBUTION. — The type locality is off Wata Mooli, New South Wales somewhat south of Sydney. The material listed above has been collected at numerous localities along the east coast of Australia from Thursday Island, Queensland (10°35'S, 142°13'E) to Jervis Bay, New South Wales (35°05'S, 150°45'E). Barnett (1989) listed the species from N Queensland. Dakin & Colefax (1940) reported it from New South Wales, and McWilliam *et al.* (1995) from the Gulf of Carpentaria, Queensland and New South Wales. That the species also occurs in Western Australia is shown by the specimens from Rottnest Island.

HABITAT. — The present material was found from between the tide marks to depths of between 7 and 99-108 m; it was mentioned from reefs, under a damp rock shelf, from under-water cavities, and from mud. A more intensive study of this species is highly desirable, the more as it does not seem very rare along the E Australian coast.

DESCRIPTION

The rostrum is broadly rounded at the tip and is constricted at the base; dorsally it bears a distinct sharp rostral tooth. The pregastric tooth is well-developed and is slightly larger than the rostral tooth. Immediately behind the pregastric tooth there are some small squamiform tubercles, which are arranged in about three longitudinal rows of one to five tubercles; these rows may diverge somewhat posteriorly. The gastric tooth is represented by two submedian tubercles that are situated on the posterior margin of the pregastric tooth, and are somewhat larger than the other tubercles. The cardiac tooth is low and ends in two broad blunt tops, it is slightly larger than the pregastric tooth. Behind the cardiac tooth there are two rows of two to four larger and several smaller tubercles. The posterior submedian carina shows two to four larger and a few smaller tubercles, the anterior being very strong, almost as strong as the cardiac tooth, with which these teeth lie in almost a single transverse line. The anterior submedian carina bears two or three larger and one to three smaller tubercles, here too the anterior tubercle is largest and pointed. The branchial carina is divided in two by the deep and rather wide cervical groove; there is no tubercle in the gap. The anterior branchial carina ends in the inner margin of the orbit, where it has the two usual teeth. Behind the posterior of this pair

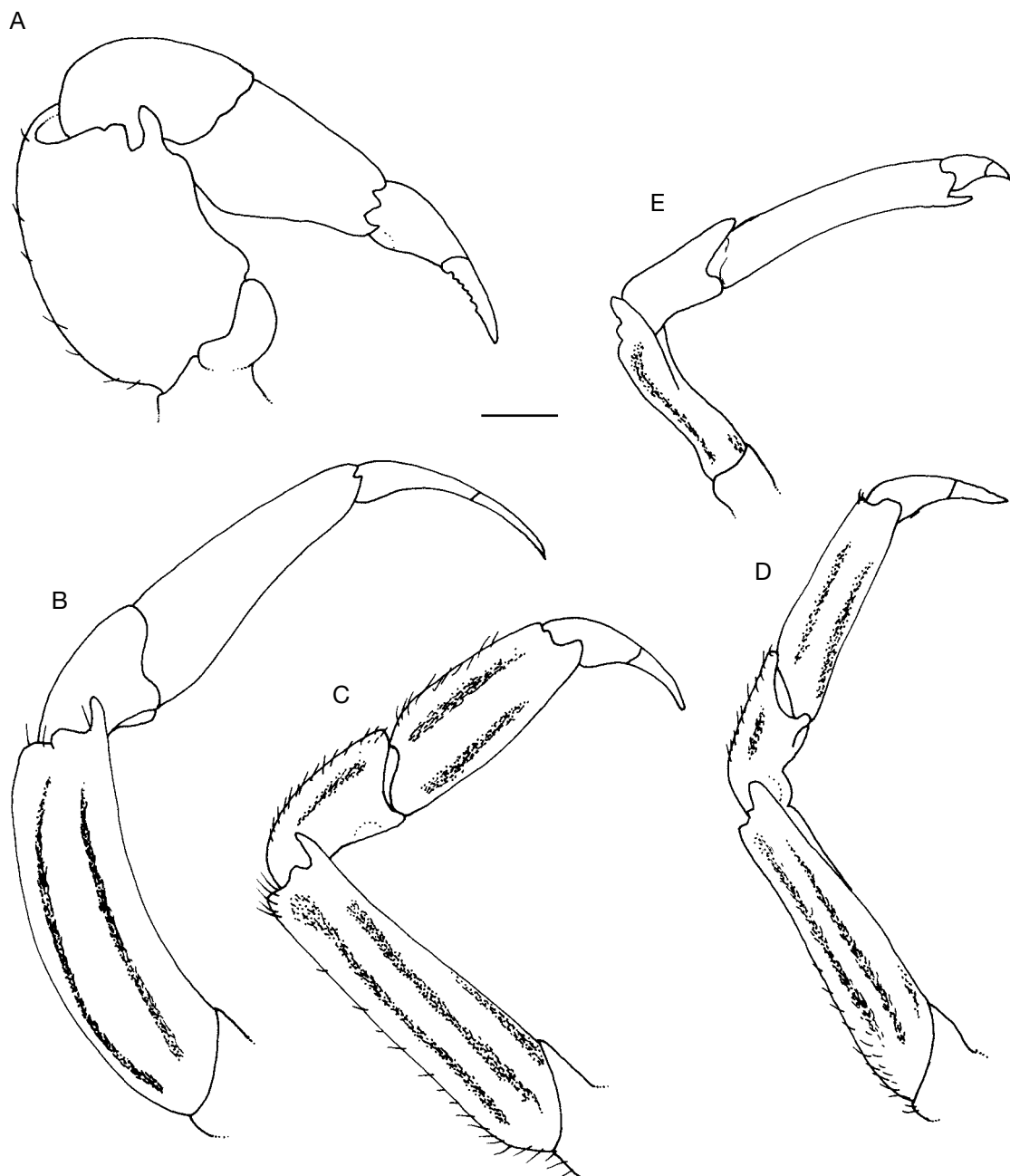


FIG. 63. — *Crenarctus crenatus* (Whitelegge, 1900) n. comb., Cathedral Rocks, Rottnest Island, W Australia, ♀ carapace length 22 mm (RMNH D 47797); **A-E**, pereopods 1 to 5. Scale bar: 1 mm.

there are three smaller, but still distinct tubercles on the anterior branchial carina. A row of small and indistinct tubercles runs behind and parallel to the posterior orbital margin. Between this row and the anterior branchial carina sometimes a second row of very small tubercles may be seen. The posterior branchial carina ends anteriorly in a strong pointed tooth, behind which it bears a double row of about eight to 10 large squami-form tubercles. The intermediate row consists of four tubercles; between this intermediate row and the posterior branchial carina a rather large tubercle is present. The lateral margin of the carapace bears four to six anterolateral, three medio-lateral and 10 to 12 posterolateral teeth. The intercervical ridge bears about six to eight irregularly arranged tubercles. The marginal groove along the posterior margin of the carapace is rather narrow and deep; before and behind it there is a double, in some places treble, row of tubercles. On either side of the median carina of the carapace one of the tubercles before the marginal groove is distinctly larger than the rest. The posterior margin of the carapace bears a wide and shallow triangular median incision.

The first abdominal somite has an uninterrupted and distinct transverse groove. Before this groove the surface of the somite is smooth, behind it are about 30 longitudinal short grooves, some of which may show side grooves in their distal part. The abdomen has no dorso-median ridge. The surface of the posterior halves of somites II to V have the usual arborescent pattern of narrow and deep grooves; the dorsomedian figure has the lateral margins deeply incised, being thereby lobulated. This dorsomedian figure of somite II is elevated anteriorly and ends in a blunt lobe. The posterior margins of somites II to IV show a median incision, which lacks in somites V and VI. The anterior half of somites II to V shows a reticular pattern of very shallow grooves. The pleura of the first abdominal somite have the lateral margin bilobate, the anterior lobe has its margin incised. The surface of the pleura has tubercles, which on the anterior pleura are smaller and more distinct than on the more posterior. The tips of the pleura II and III are more triangu-

lar, the posterior bluntly rounded; they do not have a sharp tooth. The four teeth at the end of the solid part of the telson are sharp and of about the same length.

The anterior margin of the antennular somite bears four teeth in each half; all of these are triangular, the inner are broadest, the outer are in contact with the third antennal segment.

The distal margin of the last (sixth) segment of the antenna is convex and bears six elongate teeth, which gradually taper towards the rather narrowly rounded apex. The spaces between the teeth are narrowly triangular but distinct; the inner margin of the segment bears a single small tooth. The antero-internal angle of the fifth antennal segment bears a sharp tooth, which carries a dorsal carina on which a low tooth is visible. The anterior margin of the fourth antennal segment bears four or five teeth, the second from the inner margin being largest; all teeth are sharply triangular. The outer margin of the fourth segment bears two large teeth (the apical tooth not included), while sometimes a small additional third tooth is present at the base of the apical tooth. The upper surface of the segment bears a single sharp median carina.

The anterior margin of the epistome shows a rather deep median triangular incision, the top of which may be either sharp or blunt. On either side of the incision the margin is convex and ends laterally in a triangular tooth.

P.1 is far more robust than P.2. The merus bears a distinct curved groove in the upper part of the outer surface and a straight groove in the lower part; both grooves are filled with short hairs. The carpus shows some short hairy grooves in the upper outer part, while the propodus has a longitudinal hairy groove there. The dactylus of P.2 is slightly longer than that of P.1, and much longer than that of P.3; it is almost twice as long as that of P.4; the dactylus of P.5 is the shortest of all. None of the dactyli shows a hairy fringe: those of P.1 and P.2 are totally naked, while the others have an extremely short pubescence in the basal part. The propodus and carpus of P.2 are entirely naked and without grooves. The propodus of P.3, but not of the other legs has a heavy

dorsal fringe of hairs; this propodus is somewhat broader than those of P.2 and P.4, but not broader than the merus of P.3; its outer surface has two distinct longitudinal hairy grooves. Two such grooves are also found in the propodus of P.4 and one on that of P.5. The carpus of P.3 and P.4, but not that of P.5, have a dorsal fringe of hairs (those of P.4 being shorter than the ones of P.3). The outer surface of the carpus of P.3 to P.5 shows a longitudinal hairy groove. The merus of P.2 to P.5 bears a dorsal fringe of hair. The outer surface of the merus of P.2 to P.4 has two, that of P.5 one hairy groove. A ventral hairy groove is present on the merus of P.3 to P.5.

The anterior margin of the sternum is shallowly U-shaped with a triangular incision in the middle. The two anterolateral teeth are rather short and blunt; the submedian tubercles are distinct, in smaller specimens they are far more distinctly pronounced than in larger specimens. Obliquely behind the anterolateral teeth the ventral surface of the sternum shows two flattened teeth which are situated closer to each other than to the anterolateral teeth. A median tubercle, sometimes rather distinct, is visible on the fifth sternite, it is rather short and wide, being antero-posteriorly somewhat compressed. Near the bases of the legs the sternum shows a squamiform sculpturation. The posterior margin of the fifth sternite is smooth.

The first pleopods of the male, placed on the second abdominal somite, are normal in shape with the endo- and exopod well-developed. In the following pleopods the exopod is rather distinct and foliaceous, the endopod being reduced to a mere bud.

Colour

In some of the preserved specimens a dark circular spot can be seen in the middle of the first abdominal somite. The body is somewhat mottled. A dark spot may be seen in the outer basal angle of the fourth antennal segment. Dark bands have been noted over the middle of merus and carpus and over the basal half of the propodus of P.2 to P.5.

Size

In the examined material males had cl. 10 to 15 mm, non-ovigerous females had cl. 10 to 14 mm and ovigerous females had cl. 19-22 mm; juveniles had the carapace 6 to 9 mm long.

REMARKS

It seems most likely that the specimen of the present species from Thursday Island present in the collection of the Australian Museum is the one reported upon by Haswell (1882) under the name *Arctus ursus* from that locality. *Arctus ursus* Dana, 1852 is a junior synonym of *Scyllarus arctus* (Linnaeus, 1758), a species from the NE Atlantic. De Man (1916) and Balss (1921) thought it is possible that Haswell's specimen could be *Scyllarus sordidus* Stimpson, 1860 (= *Biarctus sordidus* n. comb.) (see also there). It seems most likely that it actually is *C. crenatus* n. comb., certainly when the present Thursday Island specimen is the one seen by Haswell.

Whitelegge's two type specimens were evidently juveniles. The original description fits juveniles of the present species, while adult topotypic material belongs certainly to it. Therefore I have no hesitation to assign the name *crenatus* to this species. The specimens from Rottneest Island, which I had at first identified as *Scyllarus bicuspidatus*, and as such were mentioned by Jones & Morgan (1993), upon a subsequent re-examination proved to belong to *C. crenatus* n. comb.

Crenarctus bicuspidatus

(De Man, 1905) n. comb.

(Figs 64; 65; 69F)

Arctus bicuspidatus De Man, 1905: 589.

Scyllarus bicuspidatus – De Man 1916: 80, pl. 2 fig. 12. — Parisi 1917: 9. — Holthuis 1946: 95, pl. 7 fig. e. — Harada 1962: 111, text-figs 1, 2, pl. 10, pl. 12 fig. 15, pl. 13 fig. 19, pl. 14 fig. 21; 1965: 36, fig. 1 e-g. — Shojima 1963: 350. — Saisho 1964: 1, fig. 1; 1966: 177, 194, 196, figs 4, 5. — Utinomi 1967: 117. — Robertson 1968: 333. — Holthuis & Sakai 1970: 92. — Nishimura & Suzuki 1971: 89. — Bardach *et al.* 1972: 647. — Burukovsky 1974: 107; 1983: 150. — Tampi 1976: 561. — Phillips *et al.* 1980: 69; 1981: 418, 422, 427, figs 4, 11, 13, 14. — Phillips & Sastry 1980: 34. — Van Olst *et al.* 1980:



FIG. 64. — *Crenarctus bicuspidatus* (De Man, 1905) n. comb., Madagascar, ovigerous ♀ carapace length 20 mm (MNHN-Pa 302) in lateral view.

336. — Miyake 1982: 85. — Polz 1984: 35. — Sekiguchi 1986a: 1289-1291; 1986b: 15, 17; 1986c: 289, 293-295, figs 4-6; 1987a: 331; 1987b: 415-418, fig. 49; 1988: 3; 1992: 212. — Pearce *et al.* 1992: 1, 9, fig. 7c. — Yamaguchi 1993: 588. — Yamaguchi & Baba 1993: 254, fig. 61. — Fransen *et al.* 1998: 66.

Non *Scyllarus bicuspidatus* – Jones & Morgan 1993: 148. — McWilliam *et al.* 1995: 564 (= *Crenarctus crenatus* n. comb.).

Scyllarus Arctus var. – De Haan 1841: 154.

Scyllarus Arctus var. a – Herklots 1861: 142.

? *Scyllarus* sp. A – M. W. Johnson 1971b: 262, fig. 47-56.

Scyllarus sp. – Lovett 1981: 95, fig. 195.

TYPE MATERIAL. — Holotype: ♀ 7.5 mm, *Siboga* Expedition, stn 310 (ZMA).

TYPE LOCALITY. — Indonesia. Flores Sea, 8°30'S, 119°7.5'E, 73 m.

MATERIAL EXAMINED. — **South Africa.** Natal, off Port Durnford, 28°55'S, 31°50'E, 20 m, in stomach of catfish *Tachysurus feliceps* (Valenciennes, 1840), 23.VI.1970, P. F. Berry leg. et don., 1 ♂ 12 mm, 1 ♀ 20 mm, in poor condition (RMNH D 49562).

Madagascar. 1 ov. ♀ 20 mm (MNHN-Pa 302). — Near Fort Dauphin, SE Madagascar, 25°04.8'S,

46°55.7'E, trawled, 28 m, 4.III.1973, RV *Vauban*, stn CH 74, 1 juv. 6 mm (MNHN-Pa 582).

Japan. Wakayama Prefecture, off Taiji, F. Yanagisawa leg., 1 specimen 20 mm (SUF). — Moriura Bay, Taiji, 20.XII.1981, F. Yanagisawa leg., 1 juv. ♀ 12 mm (SUF). — Nachikazaki, Kii Peninsula, scuba diving, 2 m depth, 14.VI.1973, K.-I. Hayashi leg. et don., 1 ♀ 16 mm (RMNH D 38517).

Okino Shima S 79°W, 75 miles, 34°16'N, 130°16'E, RV *Albatross*, stn D 4880, 108 m, fine grey sand and broken shells, 2.VIII.1906, 1 ♂ 16 mm (USNM).

Off Sone, Munakata-oshima, Fukuoka Prefecture, 3.VII.1957, Y. Motomatsu leg., 1 ♂ 13 mm, 1 ♀ 11 mm (ZLK).

Japan (possibly near Nagasaki), 1823-1834, P. F. von Siebold & H. Bürger leg., 1 ♀ 25 mm, dry (RMNH D 5513).

Indonesia. Flores Sea, 8°30'S, 119°7.5'E, *Siboga* Expedition, stn 310, 73 m, bottom sand with few pieces of dead coral, 12.II.1900, 1 juv. ♀ holotype 7.5 mm (ZMA).

New Caledonia. Nouméa, IX.1890, navy chaplain, Abbé Culliéret leg., 1 ♂ 17 mm (MNHN-Pa 1897).

North of New Caledonia. MUSORSTOM 4, stn 187, 19°08.3'S, 163°29.3'E, 65-120 m, 19.IX.1985, 1 ov. ♀ 13 mm (MNHN-Pa 1154).

LAGON. Lagon Est, stn 641, 21°53.0'S, 166°43.0'E, 50-52 m, 7-8.VIII.1986, 1 juv. 5 mm (MNHN-Pa 1190). — Stn 836, 20°46.4'S,

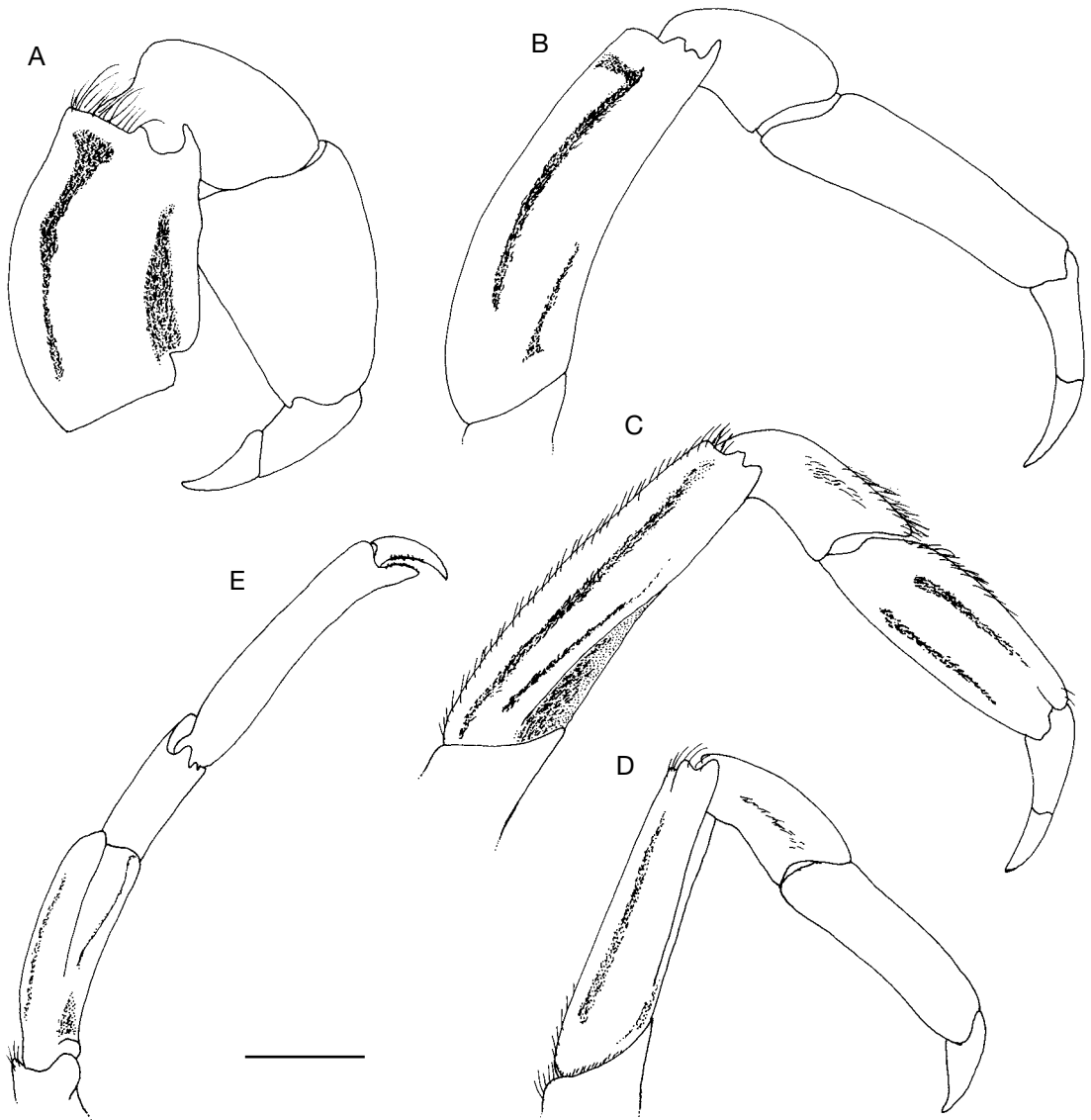


FIG. 65. — *Crenartus bicuspidatus* (De Man, 1905) n. comb., Île Ouen, Baie du Prony, New Caledonia, stn 127, ovigerous ♀ carapace length 17 mm (MNHN-Pa 1028); A-E, pereopods 1 to 5. Scale bar: 2 mm.

165°15.75'E, 57 m, 11.I.1987, 2 ♀♀ 14 and 15 mm (MNHN-Pa 1280).

Lagon Sud-Ouest, stn 112, 22°23'S, 166°48'E, 42 m, 22.VIII.1986, 1 ♀ 11 mm (RMNH D 48755). — Stn 114, 22°24'S, 166°50'E, 37 m, 22.VIII.1984, 1 ♀ 10 mm (MNHN-Pa 1024). — Stn 127, 22°31'S, 166°46'E, 55 m, 23.VIII.1984, 1 ov. ♀ 17 mm, 2 ♂♂ 9 and 11 mm (MNHN-Pa 1028). — Stn 277, 22°17'S, 166°16'E, 30 m, 8.XI.1984, 1 juv. 5 mm

(MNHN-Pa 1899). — Stn 336, 22°41'S, 166°51'E, 26 m, 28.XI.1984, 1 juv., 1 ♀ 11 mm (MNHN-Pa 1207). — Stn 347, 22°43'S, 166°53'E, 46 m, 29.XI.1984, 1 juv. 5 mm (MNHN-Pa 1231). — Stn 385, 22°36'S, 167°10'E, 75 m, 22.I.1985, 1 ♀ 11 mm (RMNH D 48754). — Stn 401, 22°32'S, 167°15'E, 49 m, 23.I.1985, 1 ♀ 12 mm (MNHN-Pa 1214). — Stn 404, 22°37'S, 167°18'E, 35 m, 23.I.1985, 1 ♀ 12 mm (MNHN-Pa 1271). — Stn

416, 22°38'S, 167°14'E, 40-50 m, 24.I.1985, 1 ♀ 9 mm, 1 juv. 6 mm (MNHN-Pa 1210). — Stn 424, 22°45'S, 167°24'E, 55 m, 25.I.1985, 1 ♂ 10 mm (MNHN-Pa 1217). — Stn 572, 22°52'S, 167°00'E, 65 m, 17.VII.1985, 1 juv. 6 mm (MNHN-Pa 1896).

Île des Pins, stn 586, 22°48'S, 167°30'E, 57 m, 18.VII.1985, 1 ov. ♀ 12 mm (MNHN-Pa 1898).

Canal Woodin. 22°24'S, 166°48'E, 30 m, 29.VII.1987, 2 ♂♂ 10 and 14 mm (MNHN-Pa 1327).

HABITAT. — The species has been obtained from depths between 2 and 108 m, most (75%) between 26 and 65 m. Only two descriptions of the bottom on which the species was found are known: fine grey sand with broken shells, and sand with few pieces of dead coral. Utinomi (1967) reported the species from low tide in a coral reef area.

DISTRIBUTION. — The species has a wide distribution which ranges from South Africa and Madagascar to Japan, Indonesia and New Caledonia. The type locality is in the Flores Sea, Indonesia, 8°30'S, 119°7.5'E (De Man 1905, 1916). The other records in the literature are all from Japan: Japan (De Haan 1841; Herklots 1861; Holthuis 1946; Holthuis & Sakai 1970; Nishimura & Suzuki 1971; Miyake 1982; Yamaguchi & Baba 1993; Yamaguchi 1993), Sagami Bay, Honshu (Parisi 1917), Tanabe Bay, Wakayama-ken (c. 33°42'N, 135°22'E) (Harada 1962), Japan Sea near Mihonoseki, Honshu (c. 35°34'N, 133°19'E) (Harada 1962), Kanae Bay, Oita-ken, NE Kyushu (c. 38°54'N, 141°35'E) (Utinomi 1967), Nisi-no-umi, Amakusa, Kyushu (Harada 1962), Kaimon-cho, Kagoshima-ken, Kyushu (Saisho 1964). Larvae assigned with greater or lesser certainty to this species have been reported from an area off the Pacific coast of Japan between 32°20'-34°45'44"N and 135°44'75"-138°45'50"E (Sekiguchi 1986a), Kaimon-cho, Kagoshima-ken, Kyushu (Saisho 1964), from the entrance of Nagasaki Harbour, Kyushu, Japan (Shojima 1963) and from the area of the Marianas, 23°14.7'N, 150°16.0'E (Sekiguchi 1990a). Furthermore Sekiguchi (1990a: 245) considered the larvae described and figured by M. W. Johnson (1971b) as *Scyllarus* spec. A, collected in the South China Sea off the coast of Vietnam and in the mouth of the Gulf of Siam, to belong to the present species.

DESCRIPTION

The rostrum is rather broad and is hardly constricted behind the anterior margin. Dorsally it bears a distinct and sharp anteriorly directed rostral tooth. Sometimes a tubercle can be seen on the back of this tooth. Apart from the rostral tooth there are two more teeth in the median

line of the carapace. The cardiac tooth is two-topped and divided in two by a longitudinal groove; it is followed by a double row of three or four tubercles. The pregastric tooth is well-developed, single and pointed; it bears posteriorly a double row of five tubercles, the third pair of which are higher than the rest, often conspicuously so; they may represent the gastric tooth, which otherwise is absent. At each side of the double row of tubercles there is another single row. The branchial carina is rather widely interrupted by the cervical groove; the gap shows no tubercle. Anteriorly the carina bears the usual two teeth that are distinct and acute, and placed on the inner margin of the orbit; behind the posterior of these teeth there are three diverging rows of obscure tubercles. The posterior branchial carina ends anteriorly in a blunt tooth, behind which there is a double row of eight or nine flattened tubercles. The posterior submedian carina bears two or three longitudinal rows of one to three blunt tubercles. The intermediate row bears four tubercles. A large tubercle is placed between the intermediate row and the lateral carina. The anterior submedian carina bears a group of four to seven low indistinct tubercles of different size none of which is elevated and pointed. The anterolateral angle of the carapace is acute, behind it are four or five anterolateral tubercles, three mediolateral and a double row of eight or nine posterolateral tubercles. In the space between the posterior branchial and the posterior lateral carinae two tubercles are visible. The intercervical carina bears a group of one large and two to four small tubercles. The marginal groove along the posterior margin of the carapace is narrow and deep, there are two transverse rows of tubercles both before and behind it; the latter are not very distinct. The posterior margin of the carapace is shallowly incised in the middle. The dorsal surface of the carapace has a cover of short hairs between the tubercles; slightly behind the anterior margin of the carapace there is a narrow naked strip, which gives the impression of a groove, extending behind the rostrum over a large part of the carapace.

The first abdominal somite has a complete transverse groove extending over its full width. Before the groove the somite is smooth, behind it are about 24 distinct longitudinal grooves, most are single, a few are forked. The anterior half of the following somites is smooth but for a transverse crenulated or irregular groove carrying a row of short hairs. The posterior half of the somites shows no median carina, but only the usual arborescent pattern of narrow and deep grooves, that in the median area forms an elongate lobulated figure. This median lobulated area of the second somite is not elevated anteriorly, but is flush with the rest of the surface; this in contrast to the situation in *C. crenatus* n. comb. The posterior margin of somites I to IV are deeply incised in the middle; the median part of the posterior margin of somites V and VI is broadly and bluntly produced. The pleura of the first abdominal somite are short and bilobed. Those of the second somite are broad and end in a small sharp point, which, however, is not tooth-like produced; the anterior margin shows an indistinct lobe, but the rest of the margins is entire or slightly serrate. In the pleura of the third and fourth somites the tip is directed slightly posteriorly, in the fifth it is about rectangular. The sixth abdominal somite and the hard part of the telson show squamiform tubercles of various sizes. The two pairs of teeth on the posterior margin of the hard part of the telson are acutely pointed; the inner pair is widest and reaches farther backward than the outer.

The anterior margin of the antennular somite bears four distinct rounded teeth.

The last (sixth) segment of the antenna is rather narrow. The anterior margin is convex and bears six teeth, the inner five of which gradually taper to a rounded tip; the inner margin bears one tooth. The antero-internal tooth of the fifth segment bears a dorsal carina. The anterior margin of the fourth segment shows three to six teeth, the innermost of these is longest and unequally two-topped, the inner being the smaller. The rest of the teeth are of irregular size, but much smaller than the first. The outer margin of the fourth segment bears two teeth (the apical tooth not includ-

ed). The median carina of this segment is strong and there are no additional carinae or rows of tubercles on the upper surface. The anterior margin of the basal segment of the antennal peduncle ends in a narrow point.

The anterior margin of the epistome is incised in the middle.

P.1 is distinctly more robust than P.2. The dactyli and propodi of P.1 and P.2 are naked; in the other legs the dactyli show an extremely short pubescence in the basal part. The dactylus of the second leg is longer than that of any of the other legs, and is somewhat less than twice as long as that of the fourth. The propodus and carpus of P.3 have a dorsal fringe of hairs. The carpus of P.4 has a row of hairs in the extreme distal part of the upper margin. The other legs show no hairy fringes on the dorsal margin of either propodus or carpus, while in none of the legs there is a hairy fringe on the ventral margin of the propodus. The propodus of P.3 is somewhat compressed, but it is not conspicuously broadened, being about as wide as the merus; it has two hairy grooves on the outer surface. On the propodus of P.4 there is one hairy groove; such a groove is also present on the carpus of P.3 to P.5. The meri of all legs have a dorsal fringe of hairs, while the outer surface of the merus carries two hairy grooves (in P.2 and P.3), or one (in P.4 and P.5). The anterior margin of the thoracic sternum is emarginate, U-shaped, the antero-lateral teeth reach far beyond the central part, and sometimes have a corneous tip. The central part of the margin shows a deep median incision, at either side of which there is a low tubercle. The median incision continues posteriorly as a groove which is flanked by two ridges; these ridges end behind the anterolateral teeth in a blunt tooth. A median tubercle is placed on the fifth thoracic sternite. The posterior margin of the sternum, both in males and females, is unarmed, but makes a sharply triangular curve just behind the base of P.5.

The first pleopods of the male are normal in shape. In the following pleopods the endopods are rudimentary, while the exopods are rather small and leaf-shaped.

Size

The examined males had cl. 10 to 17 mm, the non-ovigerous females had cl. 7.5 to 25 mm, the ovigerous females had cl. 12-20 mm, while the specimens of less than 7 mm were considered juvenile. Parisi's (1917: 9) female had cl. 24 mm. Harada (1962: 111) mentioned a male with cl. 11.8 mm, and 4 ovigerous females with cl. 17.3 to 22.4 mm. The specimen (of unknown sex) examined by Utinomi (1967) had cl. 18 mm.

Colour

The type specimen was described by De Man (1916: 84) as follows: "This specimen presents a uniform yellowish colour; the smooth, underlying part of the 1st abdominal tergum is marked with a dark fleck in the middle, nearly as in *Scyll. sordidus*, but less distinctly defined and a dark fleck exists also near the inner border of the distal antennal squame". Parisi (1917: 9) observed in his material a dark spot in the anterior part of the first abdominal somite, and spots of a similar colour on the side of the carapace in the anterior branchial region; the latter, however, had almost disappeared through the action of the alcohol.

A colour photograph made of the female from LAGON stn 836 (Lagon Est, New Caledonia, 11.I.1987) shows a rather uniform pale orange brown animal. A large dark reddish brown broadly oval spot is visible on the anterior half of the first abdominal somite. This spot is surrounded by a wide pale ring. A striking short dark stripe is present on the fourth antennal segment. The antennulae and the inner margin of the antennae are spotted with dark dots. On the carapace a few paler areas show, but this may be due to light effects during the photography. The tailfan and the sixth abdominal somite are whitish. Of the pereopods that are visible in the photograph, the propodus and merus have the usual dark ring in the middle.

Larvae

Although in the literature many references are found to larvae of this species, there are only few original records. Saisho (1964: 1; 1966: 177, 194, 196, figs 4, 5) in 1964 described the first

phyllosoma stage of the species, raised from the egg of an ovigerous female from Kaimon-cho, Kagoshima prefecture, Japan. In his 1966 paper Saisho discussed rearing of the species to the 9th instar, which was figured by him. Sekiguchi (1990a) described and figured the two last phyllosoma stages, and referred to M. W. Johnson's (1971b) account of the larval *Scyllarus* spec. A, which he considered to probably belong also the present species. Phyllosoma stages I-IV and VII-IX supposedly of this species were reported by Pearce *et al.* (1992) from the Leeuwin Current off Geraldton, Western Australia; the younger stages were found closer to the coast than the older. The larvae from Australian waters considered by them and by McWilliam *et al.* (1995) as belonging to the present species might well be actually *C. crenatus* n. comb.

Commensalism

Utinomi (1967) found a new species of pedunculate cirriped (*Paralepas scyllarusi* Utinomi, 1967) attached to the base of the uropod of a specimen of the present species.

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In the first place I have to thank Fenner A. Chace Jr for suggesting this study and for all the valuable help that he has given me during its preparation. To Alain Crosnier I am much indebted for his encouragement, without which the paper would never have been finished; he also was always ready to assist with many problems that arose during this study, especially in the later stages; also the considerable time and effort that he spent in getting the manuscript in good order is acknowledged here with profound thanks. Bertrand Richer de Forges has organized all the French cruises since more than 10 years; without him we should not have all the material studied here. The personnel of the institutions listed in the Abbreviations cannot be thanked enough for the time they gave in sending me the material that forms the basis for this study; and also for information about this material. Charles H. P. M. Fransen, who succeeded me as curator of Crustacea of the Leiden Museum, helped and encouraged me in every way possible

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material for comparison and even let me describe a new species that he had discovered. Thanks to him this account has much improved. Also I am much indebted to him for several of the excellent colour photographs of some of the species reproduced here. Likewise I am most thankful to Marco Tavares of Rio de Janeiro, who read the manuscript, and also suggested numerous improvements of the text.



FIG. 66. — **A, B**, *Bathyarctus rubens* (Alcock & Anderson, 1894) n. comb.; **A**, Loyalty Islands, MUSORSTOM 6, stn DW 395, ♀ carapace length 14 mm (MNHN-Pa 1348), photo P. Laboute; **B**, Fiji Islands, BORDAU 1, stn CP 1446, ♀ (MNHN-Pa 1885), photo J. S. Philippe; **C**, *Bathyarctus chani* n. gen., n. sp., NW Taiwan, Su-Aou fishing port, photo T. Y. Chan; **D, E**, *Scammарctus batei* (Holthuis, 1946) n. comb.; **D**, Fiji Islands, MUSORSTOM 10, stn CP 1318, ♀ carapace length 16 mm (MNHN-Pa 1886), photo B. Richer de Forges; **E**, Fiji Islands, N of Vanua Levu, BORDAU 1, stn CP 1402, ♂ carapace length 16 mm (MNHN-Pa 1846), photo J.-S. Philippe.

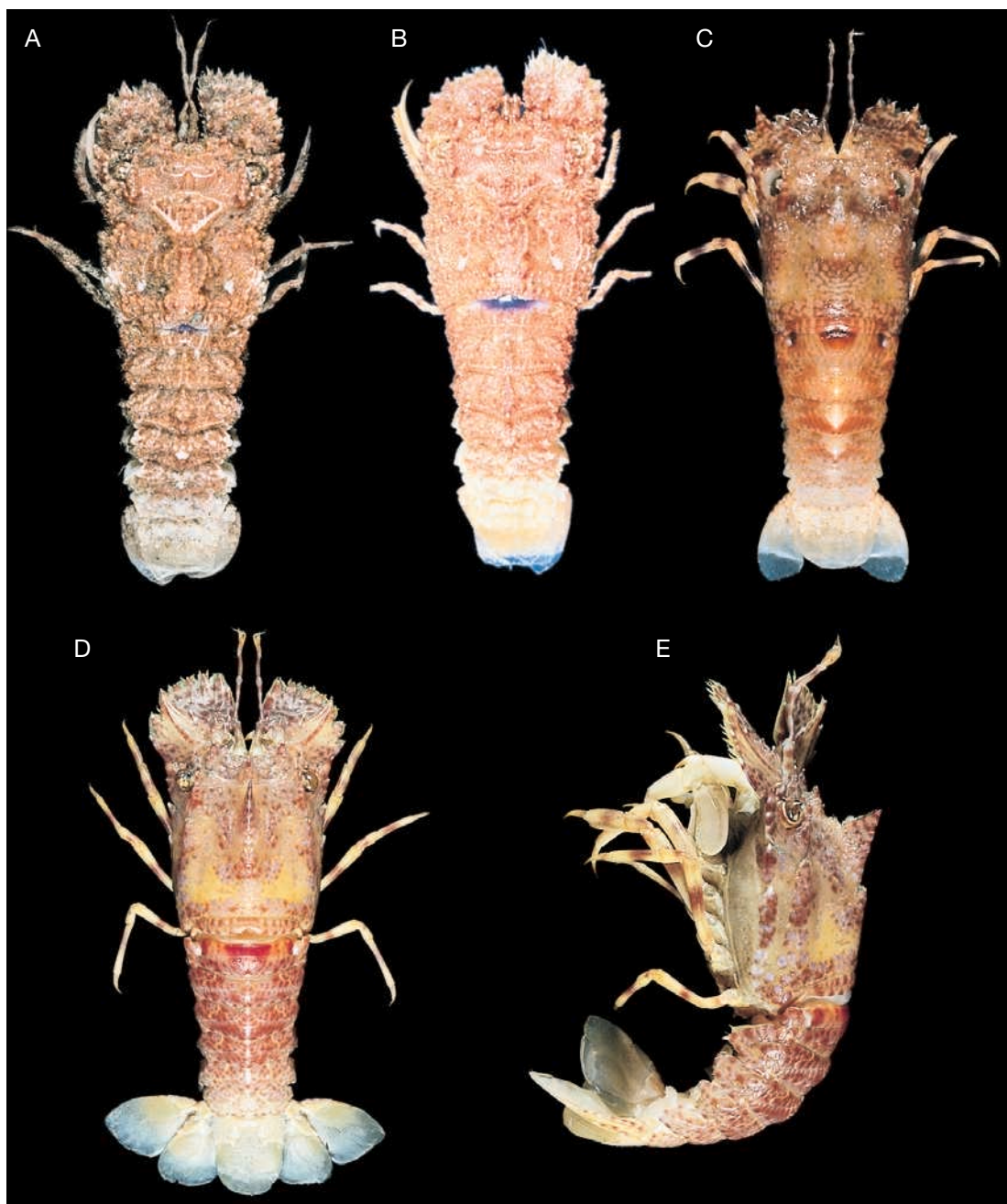


FIG. 67. — **A, B**, *Petrarctus brevicornis* (Holthuis, 1946) n. comb.; **A**, Vanuatu, MUSORSTOM 8, stn CP 1071, ♀ carapace length 8 mm (RMNH D 48760), photo J.-L. Menou; **B**, New Caledonia, Lagon Est, stn 835, ♂ carapace length 17 mm (MNHN-Pa 1279), photo J.-L. Menou; **C-E**, *Galearctus timidus* (Holthuis, 1960) n. comb.; **C**, Vanuatu, MUSORSTOM 8, stn CP 1077, ♀, carapace length 17 mm (MNHN-Pa 1851), photo J.-L. Menou; **D, E**, SW Taiwan, Tong Kong fishing port, 21.X.1995, ♂ in dorsal and lateral views, photos T. Y. Chan.

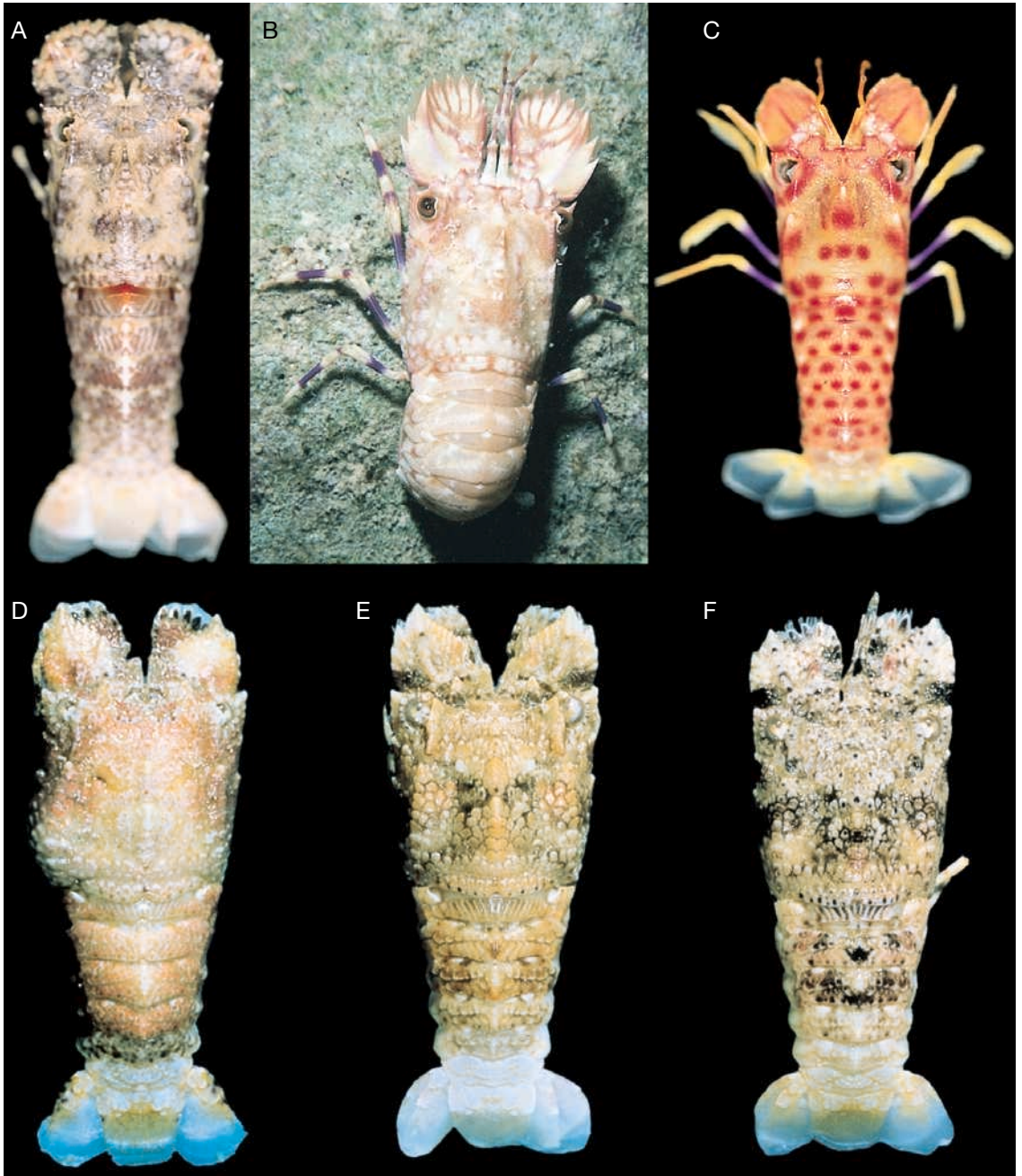


FIG. 68. — **A, B**, *Galearctus aurora* (Holthuis, 1982) n. comb.; **A**, Fiji Islands, SE of Viti Levu, MUSORSTOM 10, stn CP 1349, ♀ carapace length 24 mm (MNHN-Pa 1890), photo B. Richer de Forges; **B**, off Haputo, Guam, 125 m, 8.X.1997, photo G. Paulay, det. T. Y. Chan; **C**, *Chelarctus crosnieri* n. gen., n. sp., Tonga Islands, SW of Tongatapu, BORDAU 1, stn CP 1541, ♂ holotype carapace length 72 mm (MNHN-Pa 1887), photo J.-S. Philippe; **D-F**, *Eduarctus martensii* (Pfeffer, 1881) n. comb., New Caledonia, Lagon Nord-Ouest, photos P. Laboute; **D**, LAGON, stn DW 919, bopyrized ♂ carapace length 8 mm (MNHN-Pa 1306); **E**, LAGON, stn DW 933, ♀; **F**, LAGON, stn DW 1024, ♂ carapace length 10 mm (MNHN-Pa 1321).



FIG. 69. — **A**, *Eduarctus modestus* (Holthuis, 1960) n. comb., Marquesas Islands, Nuka Hiva, MUSORSTOM 9, stn CP 1177, ovigerous ♀ carapace length 11 mm (MNHN-Pa 1826), photo P. Laboute; **B**, *Eduarctus reticulatus* n. gen., n. sp., New Caledonia, SMIB 8, stn 186, ♀ paratype, carapace length 12 mm (MNHN-Pa 1835), photo J.-L. Menou; **C**, **D**, *Gibbularctus gibberosus* (De Man, 1905) n. comb.; **C**, New Caledonia, LAGON, stn 1014, ♂ carapace length 10 mm (RMNH D 48757), photo P. Laboute; **D**, New Caledonia, Lagon Est, LAGON, stn 710, ♂ carapace length 10 mm (MNHN-Pa 1265), photo P. Laboute; **E**, *Biarctus vitiensis* (Dana, 1852) n. comb., New Caledonia, LAGON, stn 968, photo P. Laboute; **F**, *Crenarctus bicuspidatus* (De Man, 1905) n. comb., New Caledonia, Lagon Est, LAGON, stn 836, ♀, photo J.-L. Menou.

REFERENCES

- ALCOCK A. 1899. — A summary of the deep-sea zoological work of the Royal Indian Marine Survey Ship *Investigator* from 1884 to 1897. *Scientific Memoirs by Medical Officers of the Army India* 11: 1-49.
- ALCOCK A. 1901. — *A Descriptive Catalogue of the Indian Deep-Sea Crustacea Decapoda Macrura and Anomala in the Indian Museum. Being a Revised Account of the Deep-Sea Species Collected by the Royal Indian Marine Survey Ship Investigator*. Trustees of the Indian Museum, Calcutta: 286 + iv p., 3 pls.
- ALCOCK A. & ANDERSON A. R. S. 1894. — An account of a recent collection of deep sea Crustacea from the Bay of Bengal and Laccadive Sea. Natural history notes from H. M. Indian Marine Survey Steamer "Investigator", commander C. F. Oldham, R. N., commanding, Series II, No. 14. *Journal of the Asiatic Society of Bengal* 63 (2): 141-185, pl. 9.
- AL-KHOLY A. A. 1960. — Larvae of some macruran Crustacea (from the Red Sea). *Publications of the Marine Biological Station Al-Ghardaqa, Egypt* 11: 72-86, pls 1-7.
- ANDERSON A. R. S. 1896. — An account of the deep sea Crustacea collected during the season 1894-95. Natural history notes from the R. I. M. Survey Steamer "Investigator", commander C. F. Oldham, R. N., commanding, Series II, No. 21. *Journal of the Asiatic Society of Bengal* 65 (2): 88-106.
- ANDRADE V. H. 1985. — Crustáceos decápodos marinos del Archipiélago de Juan Fernandez, in ARANA P. (ed.), *Investigaciones marinas en el Archipiélago de Juan Fernandez*. Universidad Católica de Valparaíso, Valparaíso: 109-116, fig. 1.
- ANONYMOUS 1992. — New species of slipper lobster. *Lobster Newsletter* 5 (1): 3.
- BABA K., HAYASHI K.-I. & TORIYAMA M. 1986. — *Decapod Crustaceans from Continental Shelf and Slope around Japan. The intensive Research of Unexploited Fishery Resources on Continental Slopes*. Japanese Fisheries Resource Conservation Association, Tokyo, 336 p., 22 figs, 176 col. figs.
- BAEZ R. P. 1973. — Larvas phyllosoma del Pacífico Sur Oriental (Crustacea, Macrura, Scyllaridae). *Revista de Biología marina, Valparaíso* 15 (1): 115-130, figs 1-6.
- BALSS H. 1914. — Ostasiatische Decapoden II. Die Natantia und Reptantia, in DOFLEIN F. (ed.), Beiträge zur Naturgeschichte Ostasiens. *Abhandlungen der königlichen bayerischen Akademie der Wissenschaften* (suppl.) 2 (10): 1-101, text-figs 1-50, pl. 1.
- BALSS H. 1915. — Die Macruren. Die Decapoden des Roten Meeres. I. Expeditionen S. M. Schiff "Pola" in das Rote Meer. Nördliche und südliche Hälfte 1895/96-1897/98. Zoologische Ergebnisse XXX. Berichte der Kommission für ozeanographische Forschungen. *Denkschriften der Akademie der Wissenschaften zu Wien* 91 (suppl.): 1-38, figs 1-30.
- BALSS H. 1921. — Stomatopoda, Macrura, Paguridea und Galatheidea. Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia 1910-13. XXIX. *Kongelige Svenska Vetenskaps Akademiens Handlingar* 61 (10): 1-24, text-figs 1-12.
- BALSS H. 1924. — Decapoden von Juan Fernandez, in SKOTTSBERG C. (ed.), *The Natural History of Juan Fernandez and Easter Island* 3: 329-340, figs 1-3.
- BARDACH J. E., RYTHER J. H. & MCLARNEY W. C. 1972. — *Aquaculture. The Farming and Husbandry of Freshwater and Marine Organisms*. Wiley-Interscience, New-York; London; Sydney; Toronto, xii + 868 p., text-figs, pls.
- BARNARD K. H. 1926. — Report on a collection of Crustacea from Portuguese East Africa. *Transactions of the Royal Society of South Africa* 13: 119-129, pls 10, 11.
- BARNARD K. H. 1947. — Descriptions of new species of South African Decapod Crustacea, with notes on synonymy and new records. *Annals and Magazine of Natural History* (11) 13: 361-392.
- BARNARD K. H. 1950. — Descriptive catalogue of South African Decapod Crustacea. *Annals of the South African Museum* 38: 1-837, figs 1-154.
- BARNETT B. M. 1989. — Final-stage phyllosoma larvae of *Scyllarus* species (Crustacea: Decapoda: Scyllaridae) from shelf waters of the Great Barrier Reef. *Invertebrate Taxonomy* 3 (2): 123-134, figs 1-9.
- BARNETT B. M., HARTWICK R. F. & MILWARD N. E. 1986. — Descriptions of the nisto stage of *Scyllarus demani* Holthuis, two unidentified *Scyllarus* species, and the juvenile of *Scyllarus martensii* Pfeffer (Crustacea: Decapoda: Scyllaridae), reared in the laboratory; and behavioural observations of the nistos of *S. demani*, *S. martensii* and *Thenus orientalis* (Lund). *Australian Journal of Marine and Freshwater Research* 37 (5): 595-608, figs 1-5.
- BATE C. S. 1888. — Report on the Crustacea Macrura collected by H. M. S. *Challenger* during the years 1873-76. *Report on the Scientific Results of the Voyage of H. M. S. Challenger, during the Years 1873-76* (Zool.). Her Majesty's Stationery Office, London, 24, xc + 942 p., 76 text-figs, 150 pls.
- BECKER K. 1996. — Epibionts on carapaces of some malacostracans from the Gulf of Thailand. *Journal of Crustacean Biology* 16 (1): 92-104, figs 1, 2.
- BERRY P. F. 1974. — Palinurid and scyllarid lobster larvae of the Natal coast, South Africa. *Investigational Report of the Oceanographic Research Institute Durban* 34: 1-44, figs 1-68.
- BERTHOLD A. A. 1845. — Ueber verschiedene neue oder seltene Reptilien aus Neu-Granada und Crustaceen aus China. *Nachrichten von der königlichen Gesellschaft der Wissenschaften zu Göttingen* 1845: 37-49.
- BERTHOLD A. A. 1846. — Ueber verschiedene neue oder seltene Reptilien aus Neu-Granada und Crustaceen aus China. *Abhandlungen der*

- Gesellschaft der Wissenschaften zu Göttingen* 3: 3-32, pls 1-3.
- BORRADAILE L. A. 1904. — The Hippidea, Thalassinidea and Scyllaridea. Marine Crustaceans. XIII, in GARDINER J. S. (ed.), *The Fauna and Geography of the Maldive and Laccadive Archipelagoes. Being the Account of the Work carried on and of the Collections made by an Expedition during the years 1899 and 1900*. Cambridge University Press, Cambridge, England, 2: 750-754, pl. 58.
- BOURDON R. 1967. — Sur deux nouveaux Épicarides (Isopoda) parasites de Crustacés Décapodes. *Zoologische Mededelingen, Leiden* 42 (17): 167-174, figs 1-5.
- BOUVIER E. L. 1909. — *Arctus Delfini* sp. nov. *Revista Chilena de Historia natural* 13: 213-215, fig. 30.
- BOUVIER E. L. 1914. — Sur la faune carcinologique de l'île Maurice. *Comptes rendus hebdomadaires des Séances de l'Académie des Sciences, Paris* 159: 698-704.
- BOUVIER E. L. 1915. — Décapodes marcheurs (Reptantia) et Stomatopodes recueillis à l'île Maurice par M. Paul Carié. *Bulletin scientifique de la France et de la Belgique* 48: 178-318, text-figs 1-42, pls 4-7.
- BOUVIER E. L. 1917. — Crustacés décapodes (Macroures marcheurs) provenant des campagnes des yachts *Hirondelle* et *Princesse-Alice* (1885-1915). *Résultats des Campagnes scientifiques accomplies sur son Yacht par Albert I, Prince souverain de Monaco* 50: 1-140, pls 1-11.
- BOUVIER E. L. 1925. — Les Macroures marcheurs. Reports on the results of dredging under the supervision of Alexander Agassiz in the Gulf of Mexico (1877-78), in the Caribbean Sea (1878-79), and along the Atlantic coast of the United States (1880), by the U.S. Coast Survey Steamer "Blake". Lieut.-Com. C. D. Sigsbee, U. S. N., and Commander J. R. Bartlett, U. S. N., commanding. XLVIII. *Memoirs of the Museum of Comparative Zoölogy at Harvard College* 47: 397-472, text-figs 1-28, pls 1-11.
- BRUCE A. J. 1965. — On the portunid crab *Podophthalmus minabensis* Sakai, 1962. *Zoologische Mededelingen, Leiden* 40: 287-291, figs 1, 2.
- BRUCE A. J. 1966. — *Periclimenes tosaensis* Kubo. Notes on some Indo-Pacific Pontoniinae. I. *Crustaceana* 10: 15-22, figs 1-4.
- BURTON T. E. 1996. — Comparative spermiomorphism and taxonomic implications within the genus *Thenus* (Decapoda: Scyllaridae). *Journal of Submicroscopic Cytology and Pathology* 28 (4): 499-506, figs 1-19.
- BURUKOVSKY R. N. 1974. — *Keys for the Identification of Shrimps, Spiny Lobsters and Lobsters*. Pishchevaya Promyshlennost Publishers, Moscow, 126 p., 189 figs (in Russian).
- BURUKOVSKY R. N. 1983. — Key to shrimps and lobsters. *Russian Translation Series* 5, A. A. Balkema, Rotterdam: i-xi, 1-174, figs 1-189 (English translation of Burukovsky 1974).
- CHAN T.-Y. 1997. — Crustacea Decapoda: Palinuridae, Scyllaridae and Nephropidae collected in Indonesia by the KARUBAR Cruise, with an identification key for the species of *Metanephrops*, in CROSNIER A. & BOUCHET P. (eds), *Résultats des campagnes MUSORSTOM*, volume 16. *Mémoires du Muséum national d'Histoire naturelle* 172: 409-431, figs 1-5.
- CHAN T.-Y. 1998. — Lobsters. The living marine resources of the western Central Pacific, 2 (Cephalopods, crustaceans, holothurians and sharks). *FAO Species Identification Guide for Fishery Purposes*: 973-1043, figs.
- CHAN T.-Y. & YU H.-P. 1986. — A report on the *Scyllarus* lobsters (Crustacea: Decapoda: Scyllaridae) from Taiwan. *Journal of the Taiwan Museum* 39 (2): 147-174, text-figs 1, 2, pls 1-10.
- CHAN T.-Y. & YU H.-P. 1992. — *Scyllarus formosanus*, a new slipper lobster (Decapoda, Scyllaridae) from Taiwan. *Crustaceana* 62 (2): 121-127, pls 1, 2.
- CHAN T.-Y. & YU H.-P. 1993. — *The Illustrated Lobsters of Taiwan*. SMC Publishing Inc., Taipei, x + 247 p., figs.
- CHHAPGAR B. F. & DESHMUKH S. K. 1964. — Further records of lobsters from Bombay. *The Journal of the Bombay Natural History Society* 61 (1): 203-207, 1 pl.
- CHIRICHIGNO FONSECA N. 1970. — Lista de Crustáceos del Peru (Decápoda y Stomatópoda) con datos de su distribución geográfica. *Informe Instituto del Mar del Peru* 35: 1-95, figs 1-193.
- CLARKE T. A. 1972. — Collections and submarine observations of deep benthic fishes and Decapod Crustacea in Hawaii. *Pacific Science* 26: 310-317.
- COLIN P. L. & ARNESON C. 1995. — *Tropical Pacific Invertebrates. A Field Guide to the Marine Invertebrates Occurring on Tropical Pacific Coral Reefs, Seagrass Beds and Mangroves*. Coral Reef Press, Beverly Hills, California, viii + 296 p., 1354 col. figs.
- COUTURES E. 1996. — Phyllosome larvae in the south-west lagoon of New Caledonia. *Abstracts of the Second European Crustacean Conference*: 132.
- DAKIN W. J. & COLEFAX A. N. 1940. — The plankton of the Australian coastal waters off New South Wales. Part I. With special reference to the seasonal distribution, the phyto-plankton, and the planktonic Crustacea, and in particular, the Copepoda and Crustacean larvae, together with an account of the more frequent members of the groups Mysidacea, Euphausiacea, Amphipoda, Mollusca, Tunicata, Chaetognatha, and some reference to the fish eggs and fish larvae. *Publications of the University of Sydney Department of Zoology monograph* 1: 1-215, text-figs 1-303, pls 1-4.

- DANA J. D. 1852a. — Conspectus Crustaceorum quae in orbis terrarum circumnavigatione, Carolo Wilkes e classe Reipublicae Foederatae duce, lexit et descripsit. *Proceedings of the Academy of Natural Sciences of Philadelphia* 6: 10-28.
- DANA J. D. 1852b. — *Crustacea. United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842 under the command of Charles Wilkes, U. S. N. C.* Sherman, Philadelphia 13: 1-1620.
- DANA J. D. 1852c. — Paguridea, continued, Megalopidea and Macroura. Conspectus of the Crustacea of the Exploring Expedition under Capt. C. Wilkes, U. S. N. *The American Journal of Science and Arts* (2) 14: 116-125.
- DANA J. D. 1855. — *Crustacea. United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842 under the Command of Charles Wilkes, U. S. N. C.* Sherman, Philadelphia 13 (atlas): 1-27, pls 1-96.
- DAWYDOFF C. 1952. — Contribution à l'étude des Invertébrés de la faune marine benthique de l'Indochine. *Bulletin biologique de la France et de la Belgique* (suppl.) 37: 1-158, charts 1, 2.
- DEBELIUS H. 1999a. — *Crustacea Guide of the World. Atlantic Ocean. Indian Ocean. Pacific Ocean.* IKAN, Frankfurt am Main, 321 p., col. figs.
- DEBELIUS H. 1999b. — *Guía de Crustáceos del Mundo. Gambas. Cangrejos. Anfipodos. Langostas.* Gambas Mantis. Grupo Editorial M & G Difusión, Elche, Alicante, 321 p., col. figs (Spanish edition of Debelius 1999a).
- DEBELIUS H. 2000. — *Krebsführer. Garnelen. Krabben. Langusten. Hummer. Fangschreckenkrebe.* Jahr Verlag, Hamburg, 321 p., col. figs (German edition of Debelius 1999a).
- DE HAAN W. 1833-1850. — Crustacea, in SIEBOLD P. F. VON (ed.), *Fauna Japonica sive descriptio animalium, quae in itinere per Japoniam, jussu et auspiciis superiorum, qui summum in India Batava Imperium tenent, suscepto, annis 1823-1830 collegit, notis, observationibus et adumbrationibus illustravit.* J. Müller & Co., Amsterdam: ix-xvi, vii-xvii, i-xxxii, 1-243, pls 1-55, A-Q, 2.
- DE MAN J. G. 1888. — Bericht über die von Herrn Dr. J. Brock im indischen Archipel gesammelten Decapoden und Stomatopoden (2). *Archiv für Naturgeschichte* 53 (2): 289-600, pls 11-22a. (Pt. 1: 215-288, pls 7-10 was published in 1887).
- DE MAN J. G. 1896. — Bericht über die von Herrn Schiffscapitän Storm zu Atjeh, an den westlichen Küsten von Malakka, Borneo und Celebes sowie in der Java-See gesammelten Decapoden und Stomatopoden. Vierter Theil. *Zoologische Jahrbücher (Systematik)* 9: 459-514, pls 33, 34.
- DE MAN J. G. 1898. — Bericht über die von Herrn Schiffscapitän Storm zu Atjeh, an den westlichen Küsten von Malakka, Borneo und Celebes sowie in der Java-See gesammelten Decapoden und Stomatopoden. Sechster (Schluss-) Theil. *Zoologische Jahrbücher (Systematik)* 10: 677-708, pls 28-38.
- DE MAN J. G. 1905. — Diagnoses of new species of macrurous Decapod Crustacea from the "Siboga-Expedition". *Tijdschrift der Nederlandsche dierkundige Vereeniging* (2) 9: 587-614.
- DE MAN J. G. 1916. — Families Eryonidae, Palinuridae, Scyllaridae and Nephropsidae. The Decapoda of the Siboga Expedition. Part III. *Siboga Expeditie Monographie* 39 (a2): 1-122, pls 1-4.
- DE MAN J. G. 1924. — On a collection of macrurous Decapod Crustacea, chiefly Penaeidae and Alpheidae from the Indian Archipelago. *Archiv für Naturgeschichte* 90 (1): 1-60, figs 1-20.
- DOFLEIN F. 1900. — Weitere Mitteilungen über dekapode Crustaceen der K. Bayerischen Staatssammlungen. *Sitzungsberichte der Bayerischen Akademie der Wissenschaften* 30: 125-145, figs 1-3.
- EDMONDSON C. H. 1933. — Reef and shore fauna of Hawaii. *Special Publications of the Bernice P. Bishop Museum, Honolulu* 22 (1st ed.): 1-295, figs 1-163.
- EDMONDSON C. H. 1946. — Reef and shore fauna of Hawaii. *Special Publications of the Bernice P. Bishop Museum, Honolulu* 22 (2nd ed.): i-iii, 1-381, figs 1-223.
- ESTAMPADOR E. P. 1937. — A check list of Philippine Crustacean Decapods. *Philippine Journal of Science* 62: 465-559.
- ESTAMPADOR E. 1959. — Revised check list of Philippine Crustacean Decapods. *Natural and Applied Science Bulletin, Manila* 17: 1-127.
- FABRICIUS J. C. 1775. — *Systema Entomologiae, sistens insectorum classes, ordines, genera, species, adiectis synonymis, locis, descriptionibus, observationibus.* Kortius, Flensburg; Leipzig, 832 p.
- FRANSEN C. H. J. M., HOLTHUIS L. B. & ADEMA J. P. H. M. 1998. — Type-catalogue of the Decapod Crustacea in the collections of the Nationaal Natuurhistorisch Museum, with appendices of pre-1900 collectors and material. *Zoologische Verhandelingen, Leiden* 311: 1-344, figs 1-79.
- FRIESE U. E. 1973. — *Marine Invertebrates in the Home Aquarium.* T. H. F. Publications, Neptune, New Jersey, 240 p., figs.
- GEE N. G. 1925. — Tentative list of Chinese Decapod Crustacea including those represented in the collections of the United States National Museum (marked with an *) with localities at which collected. *Lingnaam Agricultural Review* 3: 156-163.
- GEORGE M. J. 1969. — Two new records of scyllarid lobsters from the Arabian Sea. *Journal of the Marine Biological Association of India* 9: 433-435.
- GEORGE R. M. & THOMAS P. A. 1997. — The early stages of *Scyllarus sordidus* (Stimpson) from the inshore plankton off Vizhinjam together with a note on their distribution. *Journal of the Marine Biological Association of India* 38: 74-79, figs 1, 2.

- GIBBES L. R. 1850. — On the carcinological collections of the cabinets of natural history in the United States. With an enumeration of the species contained therein, and descriptions of new species. *Proceedings of the American Association for the Advancement of Science* 3: 165-201.
- GILL T. 1898. — The crustacean genus *Scyllarides*. *Science, New York* (n. s.) 7: 98, 99.
- HARADA E. 1962. — On the genus *Scyllarus* (Crustacea Decapoda: Reptantia) from Japan. *Publications of the Seto Marine Biological Laboratory* 10: 109-132, text-figs 1-9, pls 8-14.
- HARADA E. 1965. — Zoogeographical aspects of *Palinura* collected in the Kii district. *Nankiseibutu* 7 (2): 35-42, figs 1-3 (in Japanese).
- HARADA E. 1968. — Seasonal changes in distribution and abundance of some Decapod Crustaceans. Ecology and biological production of Lake Nakumi and adjacent regions. *Special Publications of the Seto marine biological Laboratory* (2) 2 (5): 75-103, figs 1-28.
- HASWELL W. A. 1882. — *Catalogue of the Australian Stalk- and Sessile-Eyed Crustacea*. F. W. White, Sydney, xxiv + 324 p., 4 pls.
- HAYASHI K.-I. 1995. — *Palinuridea in NISHIMURA S. (ed.), Guide to Seashore Animals of Japan with Color Pictures and Keys*. Hoikusha Publishing Co., Osaka, 2: 342-347, text-fig. 21.262, pl. 92.
- HERKLOTS J. A. 1861. — *Symbolae carcinologicae*. I. Catalogue des Crustacés qui ont servi de base au système carcinologique de M. W. De Haan, rédigé d'après la collection du Musée des Pays-Bas et les Crustacés de la Faune du Japon. *Tijdschrift voor Entomologie* 4: 116-156.
- HIATT R. W. 1954. — *Hawaiian Marine Invertebrates. A Guide to their Identification*. University of Hawaii, Honolulu, viii + 140 p., 29 pls.
- HIGA T. & SAISHO T. 1983. — Metamorphosis and growth of late-stage phyllosoma of *Scyllarus kitaniviriosus* Harada (Decapoda, Scyllaridae). *Memoirs of the Kagoshima University Research Center for the South Pacific* 3 (2): 86-98, figs.
- HOLTHUIS L. B. 1946. — The Stenopodidae, Nephropsidae, Scyllaridae and Palinuridae. The Decapoda Macrura of the Snellius Expedition. I. Biological results of the Snellius Expedition. XIV. *Temminckia* 7: 1-178, text-figs 1, 2, pls 1-11.
- HOLTHUIS L. B. 1952. — The Crustacea Decapoda Macrura of Chile. Reports of the Lund University Chile Expedition 1948-49. 5. Con resumen en español. *Lunds Universitets Årsskrift* (n. s.) (2) 47 (10): 1-110, figs 1-19.
- HOLTHUIS L. B. 1960. — Preliminary descriptions of one new genus, twelve new species and three new subspecies of Scyllarid lobsters (Crustacea Decapoda Macrura). *Proceedings of the Biological Society of Washington* 73: 147-154.
- HOLTHUIS L. B. 1963. — Preliminary descriptions of some new species of Palinuridea (Crustacea Decapoda, Macrura Reptantia). *Proceedings Koninklijke Nederlandse Akademie van Wetenschappen* (C) 66: 54-60.
- HOLTHUIS L. B. 1967. — Some new species of Scyllaridae. *Proceedings Koninklijke Nederlandse Akademie van Wetenschappen* (C) 70: 305-308.
- HOLTHUIS L. B. 1968. — The Palinuridae and Scyllaridae of the Red Sea. The Second Israel South Red Sea Expedition, 1965, report No. 7. *Zoologische Mededelingen, Leiden* 42: 281-301, pls 1, 2.
- HOLTHUIS L. B. 1977. — Two new species of scyllarid lobsters (Crustacea Decapoda, Palinuridea) from Australia and the Kermadec Islands, New Zealand. *Zoologische Mededelingen, Leiden* 52: 191-200, text-figs 1, 2, pls 1, 2.
- HOLTHUIS L. B. 1982. — A new species of *Scyllarus* (Crustacea Decapoda Palinuridea) from the Pacific Ocean. *Bulletin du Muséum national d'Histoire naturelle, Paris* 4^e sér., 3, section A n°3: 847-853, figs 1, 2 (dated 1981, published 1982).
- HOLTHUIS L. B. 1984. — Lobsters. Western Indian Ocean (Fishery Area 51). *FAO Species Identification Sheets for Fishery Purposes* 5, 62 p., figs.
- HOLTHUIS L. B. 1985. — A revision of the family Scyllaridae (Crustacea: Decapoda: Macrura). I. Subfamily Ibaciniae. *Zoologische Verhandelingen, Leiden* 218: 1-130, figs 1-27.
- HOLTHUIS L. B. 1991. — Marine lobsters of the world. An annotated and illustrated catalogue of species of interest to fisheries known to date. *FAO Fisheries Synopsis* 13 (125): i-viii, 1-292, figs 1-459.
- HOLTHUIS L. B. 1993. — *Scyllarus rapanus*, a new species of locust lobster from the South Pacific (Crustacea, Decapoda, Scyllaridae). *Bulletin du Muséum national d'Histoire naturelle, Paris* 4^e sér. 15, section A n°1-4: 179-186, figs 1-3.
- HOLTHUIS L. B. & SAKAI T. 1970. — *Ph. F. von Siebold and Fauna Japonica. A History of Early Japanese Zoology*. Academic Press of Japan, Tokyo, 18 + 323 p., 32 + 7 pls, 1 map.
- HOOVER J. P. 1998. — *Hawai'i's Sea Creatures. A Guide to Hawai'i's Marine Invertebrates*. Mutual Publishing, Honolulu, xviii + 366 p., col. figs.
- HU C.-H. & TAO H.-J. 1996. — *Crustacean Fossils of Taiwan*. Ta-Jen Printers Ltd, Taipei, iv + 228 p., 41 text-figs, 68 pls.
- HUANG Z.-G. 1994. — *Marine Species and their Distributions in China's Seas*. China Ocean Press, Beijing, 11 + 141 p.
- HWANG J. J. & YU H. P. 1983. — Report on the scyllarid lobsters (Crustacea: Decapoda: Scyllaridae) from Taiwan. *Bulletin of the Institute of Zoology, Academia Sinica, Taipei* 22 (2): 261-267, figs 1-8.
- ICZN 1985. — *International Code of Zoological Nomenclature*. 3rd ed. International Trust for Zoological Nomenclature, London, 338 p.
- ICZN 1999. — *International Code of Zoological Nomenclature*. 4th ed. International Trust for Zoological Nomenclature, London, 306 p.

- IKEMATSU W. 1963. — Ecological studies on the fauna of Macrura and Mysidacea in Ariaké Sea. *Bulletin of the Seikai Regional Fisheries Research Laboratory* 30: i-iv, 1-124, figs 1-94, pls 1-7.
- ITO M. & LUCAS J. S. 1990. — The complete larval development of the scyllarid lobster, *Scyllarus demani* Holthuis, 1946 (Decapoda, Scyllaridae), in the laboratory. *Crustaceana* 58 (2): 144-167, figs 1-10.
- JOHNSON D. S. 1964. — *An Introduction to the Natural History of Singapore*. Rayirath (Raybooks) Publications, Singapore, x + 106 p., 86 figs.
- JOHNSON M. W. 1970. — On the phyllosoma larvae of the genus *Scyllarides* Gill (Decapoda, Scyllaridae). *Crustaceana* 18: 13-20, figs 1-16.
- JOHNSON M. W. 1971a. — The phyllosoma larvae of slipper lobsters from the Hawaiian Islands and adjacent areas (Decapoda, Scyllaridae). *Crustaceana* 20: 77-103, figs 1-92.
- JOHNSON M. W. 1971b. — On palinurid and scyllarid lobster larvae and their distribution in the South China Sea (Decapoda, Palinuridae). *Crustaceana* 21: 247-282, figs 1-92, charts 1-4.
- JOHNSON M. W. 1971c. — The phyllosoma larva of *Scyllarus delfini* (Bouvier) (Decapoda, Palinuridae). *Crustaceana* 21: 161-164, figs 1-8.
- JOHNSON M. W. 1974. — On the dispersal of lobster larvae into the East Pacific Barrier (Decapoda, Palinuridae). *Fishery Bulletin, U. S. Fish and Wildlife Service* 72 (3): 639-647, figs 1-4.
- JONES D. S. 1990. — Annotated checklist of marine Decapod Crustacea from Shark Bay, Western Australia, in BERRY P. F., BRADSHAW S. D. & WILSON B. R. (eds), *Research in Shark Bay, Report of the France-Australe Bicentenary Expedition Committee*. Western Australian Museum, Perth: 169-208.
- JONES D. S. & MORGAN G. J. 1993. — An annotated checklist of Crustacea from Rottnest Island, Western Australia, in WELLS F. E., WALKER D. I., KIRKMAN H. & LETHBRIDGE R. (eds), *The Marine Flora and Fauna of Rottnest Island, Western Australia* 1: 135-162.
- KATO S. & OKUNO J. 2001. — *Shrimps and Crabs of Hachijo Island*. TBS-Britannica Co., Tokyo: 1-157, figs.
- KENSLEY B. 1981. — On the zoogeography of Southern African Decapod Crustacea, with a distributional checklist of the species. *Smithsonian Contributions to Zoology* 338: i-iii, 1-64, figs 1-4.
- KIM H. S. 1976. — A checklist of Macrura (Crustacea, Decapoda) of Korea. *Proceedings of the College of natural Science of Seoul National University, Korea* 1 (1): 131-152, fig. 1.
- KIM H. S. 1977. — *Macrura. Illustrated Flora & Fauna of Korea*. Ministry of Education, Seoul, 19, 416 p., 162 text-figs, 56 pls.
- KIM H. S. & PARK K. B. 1972. — Faunal studies on the Macrurans in Korea, in *Floral Studies on some Taxa of Plants and Faunal Studies on some Taxa of Animals in Korea*. Ministry of Science and Technology, Seoul: 185-222, pls 1-6.
- KONISHI K. & SEKIGUCHI H. 1990. — First-stage phyllosoma of *Scyllarus cultrifer* (Ortmann) (Decapoda, Scyllaridae). *Bulletin of the Plankton Society of Japan* 37 (1): 77-82, figs 1-3.
- KUBO I. 1960. — Macrura, in OKADA Y. K. & UCHIDA T. (eds), *Encyclopaedia Zoologica Illustrata in Colours*. Hokuryu-kan Publishing Co., Tokyo 4: 98-113, pls 49-56.
- KUBO I. 1965. — Macrura, in *The new illustrated encyclopedia of the fauna of Japan*. Hokuryu-kan Publishing Co., Tokyo 2: 591-629, figs 892-1031, 3 unnumbered figs.
- LANCHESTER W. F. 1902. — Brachyura, Stomatopoda, and Macrura. On the Crustacea collected during the "Skeat" Expedition to the Malay Peninsula, together with a note on the genus *Actaeopsis*. Part I. *Proceedings of the Zoological Society of London* 1901 (2): 534-574, pls 33, 34.
- LATREILLE P. A. 1825. — *Familles naturelles du Règne animal, exposées succinctement et dans un Ordre analytique, avec l'Indication de leurs Genres*. J. B. Baillière, Paris, 570 p.
- LEACH W. E. 1815. — *The Zoological Miscellany: being Descriptions of New, or Interesting Animals*. E. Nodder & Son, London 2, 154 p., pls 61-120.
- LEWINSOHN C. 1983. — Crustacea Decapoda. Coast of Elat, in FISHELSON L., Aquatic life, in ALON A. (ed.), *Plants and Animals of the Land of Israel. An Illustrated Encyclopedia*. Israel Defense Ministry, Ramat Gan, 4: 200-209, 25 figs (in Hebrew).
- LIU J. Y. 1963. — Zoogeographical studies on the macrurous crustacean fauna of the Yellow Sea and the East China Sea. *Oceanologia et Limnologia Sinica* 5 (3): 230-244.
- LIU J. Y. & HSU F. S. 1963. — Preliminary studies on the benthic fauna of the Yellow Sea and the East China Sea. *Oceanologia et Limnologia Sinica* 5 (4): 306-321, fig. 1.
- LLOYD R. E. 1907. — Contributions to the fauna of the Arabian Sea, with descriptions of new fishes and Crustacea. *Records of the Indian Museum* 1: 1-12.
- LOVETT D. L. 1981. — A guide to the Shrimps, Prawns, Lobsters, and Crabs of Malaysia and Singapore. *Faculty of Fisheries and Marine Science, University Pertanian Malaysia, Occasional Publications* 2: i-iv, 1-156, figs 1-337.
- MCNEILL F. A. 1968. — Crustacea, Decapoda & Stomatopoda. *Scientific Reports of the Great Barrier Reef Expedition* 7 (1): 1-98, text-figs 1, 2, pls 1, 2.
- MCWILLIAM P. S., PHILLIPS B. F. & KELLY S. 1995. — Phyllosoma larvae of *Scyllarus* species (Decapoda, Scyllaridae) from the shelf waters of Australia. *Crustaceana* 68 (5): 537-566, figs 1-11.
- MANAC'H F. & CARSIN J.-L. 1985. — Deep fishing on the outer slope of atolls. *Pêche profonde sur la*

- penne externe des atolls. *Proceedings of the Fifth International Coral Reef Congress, Tahiti* 5: 469-474.
- MANNING R. B. 1982. — Langostas, in CHIRICHIGNO N. (ed.), *Pacifico centro y suroriental. Infopesca. Catalogo de especies marinas de interes economica actual o potencial para America Latina*. FAO, Rome, 2: 359-362, 3 figs.
- MASUDA H., HAYASHI K.-I., NAKAMURA H. & KOBAYASHI A. 1986. — *Marine Invertebrates* (1st ed.). Tokai University Press, 255 p., col. figs.
- MASUDA H., HAYASHI K.-I., NAKAMURA H. & KOBAYASHI A. 1996. — *Marine Invertebrates* (2nd ed.). Tokai University Press, 256 p., col. figs.
- MATSUZAWA K. 1977. — *Sea Shore Animals of Muroto*. Publishing Committee of Sea Shore Animals of Muroto, Kansai-Insatsu-Kogyo Co, Ltd, Kochi City, 7 + 15 p., 126 pls.
- MATTHEWS D. C. 1954. — A comparative study of the spermatophores of three scyllarid lobsters (*Parribacus antarcticus*, *Scyllarides squammosus*, and *Scyllarus martensii*). *Quarterly Journal of Microscopical Science* 95 (2): 205-215, figs 1-10.
- MICHEL A. 1971. — Note sur les puerulus de Palinuridae et les larves phyllosomes de *Panulirus homarus* (L.). Clef de détermination des larves phyllosomes récoltées dans le Pacifique équatorial et sud-tropical (Décapodes). *Cahiers ORSTOM, (Océanographie)* 9: 459-473, figs 1-6.
- MICHEL C. 1974. — Notes on marine biology studies made in Mauritius. *Mauritius Institute Bulletin* 7 (2): 1-287.
- MILNE EDWARDS H. 1837. — *Histoire naturelle des Crustacés, comprenant l'Anatomie, la Physiologie et la Classification de ces Animaux* 2. Librairie encyclopédique de Roret, Paris, 532 p.
- MILNE EDWARDS H. 1838. — Mémoire sur la distribution géographique des crustacés. *Annales des Sciences naturelles, Paris* (Zool.) 2 (10): 129-174.
- MINEMIZU R., TAKEDA M. & OKUNO J. 2000. — *Marine Decapod and Stomatopod Crustaceans mainly from Japan*. Bun-Ichi Sogo Shuppan Co Ltd, Tokyo, 344 p., col. figs.
- MIYAKE S. 1961. — *Decapod Crustacea. Fauna and Flora of the Sea around the Amakusa Marine Biological Laboratory* 2. The Amakusa Marine Biological Laboratory of Kyushu University, Amakusa, iv + 30 p.
- MIYAKE S. 1972. — Decapoda, in *Aquatic Animals. Genshoku gakushu waido zu kan* [= Picture encyclopedia. Coloured illustrations of wide learning] 6: 62-99, col. figs.
- MIYAKE S. 1975. — Macrura and Anomura, in UTINOMI H. (ed.), *Aquatic Invertebrates*. Gakken Chukosei Zukan, Tokyo, 9: 98-119, figs.
- MIYAKE S. 1982. — *Macrura, Anomura and Stomatopoda. Japanese Crustacean Decapods and Stomatopods in Color*. Hoikusha Publishing Co., Osaka, 1: vii + 261 p., text-figs, 56 pls.
- MIYAKE S., SAKAI K. & NISHIKAWA S. 1962. — A fauna-list of the Decapod Crustacea from the coasts washed by the Tsushima warm current. *Records of Oceanographic Works in Japan spec. No. 6*: 121-131.
- MORICE A. 1875. — Coup d'œil sur la faune de la Cochinchine française. *Compte-Rendu de l'Association lyonnaise des Amis des Sciences naturelles* 1874: 25-121.
- MORIN T. D. 1982. — A new record of slipper lobster *Scyllarides* in Hawaii. *Pacific Science* 35 (3): 273.
- MOTOH H. 1972. — A faunal list of the Macrura Decapoda from Nanao Bay, Ishikawa Prefecture, Middle Japan. *Bulletin of the Ishikawa Prefectural Marine Culture Station* 2: 29-52, text-figs 1-8, pls 1-16.
- MOTOH H. 1999. — *Edible Crustaceans in the Sea of Japan*. Ashigara Printing Co., Minami-Ashigara City, 98 p., col. figs.
- MUTCHACHEEP S. 1990. — *Animals from the Seashore of Thailand*. Phraephitaya, Thailand, 2 + 270 p., 371 figs.
- MUTCHACHEEP S. 1992. — *Marine Benthic Animals from Thai Waters*. Phraephitaya, Thailand, 152 p., figs.
- NAIYANETR P. 1963. — Scyllarid lobsters and their phyllosoma larvae in the Gulf of Thailand. *Journal of the National Research Council of Thailand* 4: 63-72, 1 pl.
- NAIYANETR P. 1980. — *Crustacean Fauna of Thailand (Decapoda and Stomatopoda)*. Department of Biology, Chulalongkorn University, Bangkok, iv + 73 p.
- NAIYANETR P. 1998. — Checklist of Crustacean fauna in Thailand (Decapoda and Stomatopoda). *OEPP Biodiversity Series* 5: 1-161, 21 figs.
- NGUYỄN VĂN CHUNG & PHAM THI DU 1995. — *Danh Mục Tôm Biển Việt Nam. Check List of Marine Shrimps and Lobster in Vietnam*. Science and Technics Publishing House, Vietnam, 170 p.
- NISHIMURA S. & SUZUKI K. 1971. — *Common Seashore Animals of Japan in Color*. Hoikusha Publishing Co., Osaka, xii + 196 p., 20 text-figs, 1, 2 (and many unnumbered), 64 pls. (16th printing in 1990).
- NOBILI G. 1903. — Crostacei di Singapore. *Bolletino dei Musei di Zoologia ed Anatomia comparata delle R. Università di Torino* 18 (455): 1-39, 1 pl.
- NOBILI G. 1905a. — Crostacei di Zanzibar. *Bolletino dei Musei di Zoologia ed Anatomia comparata delle R. Università di Torino* 20 (506): 1-12, 1 fig.
- NOBILI G. 1905b. — Décapodes nouveaux des côtes d'Arabie et du Golfe Persique. (Diagnoses préliminaires). *Bulletin du Muséum d'Histoire naturelle, Paris* 11: 158-164, 1 fig.
- NOBILI G. 1906a. — Crustacés Décapodes et Stomatopodes. Mission J. Bonnier et Ch. Pérez (Golfe Persique 1901). *Bulletin scientifique de la*

- France et de la Belgique 40: 13-159, text-figs 1-3, pls 2-7.
- NOBILI G. 1906b. — Diagnoses préliminaires de 34 espèces et variétés nouvelles, et de 2 genres nouveaux de Décapodes de la Mer Rouge. *Bulletin du Muséum d'Histoire naturelle, Paris* 11: 393-411.
- NOBILI G. 1906c. — Faune carcinologique de la Mer Rouge. Décapodes et Stomatopodes. *Annales des Sciences naturelles, Paris (Zool.)* (9) 4: 1-347, text-figs 1-12, pls 1-11.
- ORTMANN A. E. 1891. — Die Abteilungen der Reptantia Boas: Homaridea, Loricata und Thalassinidea. Die Decapoden-Krebse des Strassburger Museums, mit besonderer Berücksichtigung der von Herrn Dr. Döderlein bei Japan und den Liu-Kiu-Inseln gesammelten und z.Z. im Strassburger Museum aufbewahrten Formen. III. Theil. *Zoologische Jahrbücher (Systematik)* 6: 1-58, pl. 1.
- ORTMANN A. E. 1897. — Carcinologische Studien. *Zoologische Jahrbücher (Systematik)* 10: 258-372, pl. 17.
- PARISI B. 1917. — Galatheidea e Reptantia. I Decapodi Giapponesi del Museo di Milano. V. *Atti delle Società Italiana di Scienze naturali e del Museo Civico di Storia naturale in Milano* 56: 1-24, figs 1-7.
- PAULSON O. 1875. — *Issledovanija Rakoobraznyh Krasnago Morja s zametkami otnocitelno Rakoobraznyh drugih Morei*. [Investigations on the Crustacea of the Red Sea with Notes on Crustacea of the Adjacent Seas]. Part I. *Podophthalmata and Edriophthalmata (Cumacea)*. Typografia S.V. Kulzhenko, Kiev, xiv + 144 p., 21 pls (in Russian).
- PAULSON O. 1961. — *Studies on Crustacea of the Red Sea with Notes regarding Other Seas*. Part I. *Podophthalmata and Edriophthalmata (Cumacea)*. Israel Program for scientific translations, Jerusalem, 10 + 164 p., 21 pls (translations of Paulson 1875).
- PEARCE A. F., PHILLIPS B. F. & CROSSLAND C. J. 1992. — Larval distributions across the Leeuwin Current: report on RV *Franklin* cruise FR8/87 in August/September 1987. *CSIRO Marine Laboratory Report* 217: 1-13, figs 1-7.
- PEARSON J. 1905. — Report on the Macrura collected by Professor Herdman, at Ceylon, in 1902, in HERDMAN W. A. (ed.), *Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar* 4: 65-92, pls 1, 2.
- PFEFFER G. 1881. — Die Panzerkrebse des Hamburger Museums. *Verhandlungen des naturwissenschaftlichen Vereins in Hamburg* 5: 22-55.
- PHILLIPS B. F. & MCWILLIAM P. S. 1986. — Phyllosoma and nisto stages of *Scyllarus martensii* Pfeffer (Decapoda, Scyllaridae) from the Gulf of Carpentaria, Australia. *Crustaceana* 51 (2): 133-154, figs 1-11.
- PHILLIPS B. F. & MCWILLIAM P. S. 1989. — Phyllosoma larvae and the ocean currents off the Hawaiian Islands. *Pacific Science* 43 (4): 352-361, figs 1, 2.
- PHILLIPS B. F. & SASTRY A. N. 1980. — Larval ecology, in COBB J. S. & PHILLIPS B. F. (eds), *The Biology and Management of Lobsters*, 2. Academic Press, New York; London; Toronto; Sydney; San Francisco: 11-57, figs 1-8.
- PHILLIPS B. F., COBB J. S. & GEORGE R. W. 1980. — General biology, in COBB J. S. & PHILLIPS B. F. (eds), *The Biology and Management of lobsters*, 1. Academic Press, New York; London; Toronto; Sydney; San Francisco: 1-82, figs 1-23.
- PHILLIPS B. F., BROWN P. A., RIMMER D. W. & BRAINE S. J. 1981. — Description, distribution and abundance of late larval stages of the Scyllaridae (Slipper Lobsters) in the south-eastern Indian Ocean. *Australian Journal of Marine and Freshwater Research* 32: 417-437, figs 1-14.
- POLZ H. 1984. — Krebslarven aus den Solnhofener Plattenkalken. *Archaeopteryx, Jahreszeitschrift der Freunde des Jura-Museums Eichstätt* 1984: 30-40, figs 1-4.
- PORTER C. E. 1905. — Sobre algunos Crustáceos de Juan Fernandez. Materiales para la fauna carcinológica de Chile. IV. *Revista Chilena de Historia natural* 9: 27-35, text-fig. 1, pls 2-4.
- POUPIN J. 1996a. — Atlas des Crustacés marins profonds de Polynésie Française. Récoltes du navire *Marara* (1986/1996). Service mixte de surveillance radiologique et biologique, Monthery, 59 p., 20 pls.
- POUPIN J. 1996b. — Crustacea Decapoda of French Polynesia (Astacidea, Palinuridea, Anomura, Brachyura). *Atoll Research Bulletin* 442: i-iv, 1-114, 1 map, 1 text-fig.
- PRASAD R. R. 1983. — Distribution and growth. Studies on the phyllosoma larvae from the Indian Ocean: 1. *Journal of the Marine Biological Association of India* 20: 143-156, figs 1-13.
- PRASAD R. R. & TAMPPI P. R. S. 1961. — On the newly hatched phyllosoma of *Scyllarus sordidus* (Stimpson). *Journal of the Marine Biological Association of India* 2: 250-252, fig. 1.
- PRASAD R. R. & TAMPPI P. R. S. 1968. — Nistos of two species of *Scyllarus*. *Journal of the Marine Biological Association of India* 9: 116-120, figs 1, 2.
- PRASAD R. R. & TAMPPI P. R. S. 1969. — On the distribution of Palinurid and Scyllarid lobsters in the Indian Ocean. *Journal of the Marine Biological Association of India* 10: 78-87, figs 1, 2.
- PRASAD R. R., TAMPPI P. R. S. & GEORGE M. J. 1980. — Phyllosoma larvae from the Indian Ocean collected by the Dana Expedition 1928-1930. *Journal of the Marine Biological Association of India* 17 (2): 56-107, figs 1-17.
- RAMADAN W. W. 1938. — The Astacura and Palinura. *Scientific Reports the John Murray Expedition 1933-34* 5 (5): 123-145, 12 figs.

- RATHBUN M. J. 1906. — The Brachyura and Macrura of the Hawaiian Islands. *Bulletin of the U. S. Fish Commission* 23: 827-930, text-figs 1-79, pls 1-24.
- RATHBUN M. J. 1910. — The stalk-eyed Crustacea of Peru and the adjacent coast. *Proceedings of the U. S. National Museum* 38: 531-620, text-figs 1-3, pls 36-56.
- RETAMAL M. A. 1981. — Catalogo ilustrado de los Crustaceos Decapodos de Chile. Illustrated catalog for the decapod crustaceans of Chile. *Gayana Zool.* 44: 1-110, figs 1-208.
- RICHER DE FORGES B. & LABOUTE P. 1996. — Langoustes, langoustines et cigales de mer de Nouvelle Calédonie, in RICHER DE FORGES B. (ed.), *Les fonds meubles des lagons de Nouvelle-Calédonie (sédimentologie, benthos)*. ORSTOM Éditions, Paris 2: 45-82, pls 1-4, text-figs 1-10.
- RITZ D. A. 1977. — The larval stages of *Scyllarus demani* Holthuis, with notes on the larvae of *S. sordidus* (Stimpson) and *S. timidus* Holthuis (Decapoda, Palinuridea). *Crustaceana* 32: 229-240, figs 1-8.
- ROBERTSON P. B. 1968. — The complete larval development of the Sand Lobster, *Scyllarus americanus* (Smith), (Decapoda, Scyllaridae) in the laboratory, with notes on larvae from the plankton. *Bulletin of Marine Science, University of Miami* 18: 294-342, figs 1-20.
- SAISHO T. 1964. — Notes on the first stage phyllosoma of scyllarid lobster, *Scyllarus bicuspidatus*. *Memoirs of the Faculty of Fisheries, Kagoshima University* 13: 1-4, fig. 1.
- SAISHO T. 1966. — Studies on the phyllosoma larvae with reference to the oceanographical conditions. *Memoirs of the Faculty of Fisheries, Kagoshima University* 15: 177-239, figs 1-29.
- SAKAI K. & NAKANO T. 1983. — List of Decapod Crustacea in laboratory of Crustacea, Shikoku Women's University, Tokushima. I. *Bulletin of Shikoku Women's University* 3 (1): 73-94, map 1.
- SAKAI H. & TOKAI T. 1992. — Settlement of larvae of *Scyllarus kitanoviriosus* Harada (Palinura Decapoda) in the Seto Inland Sea. *Researches on Crustacea, Tokyo* 21: 97-105, figs 1-7.
- SANKOLLI K. N. & SHENOY S. 1974. — On the laboratory hatched six phyllosoma stages of *Scyllarus sordidus* (Stimpson). *Journal of the Marine Biological Association of India* 15: 218-226, figs 1-8.
- SEKIGUCHI H. 1982. — Scavenging Amphipods and Isopods attacking the spiny lobster caught in a gill-net. *Report of the Fisheries Research Laboratory, Mie University* 3: 21-30, figs 1-3.
- SEKIGUCHI H. 1986a. — Identification of late-stage phyllosoma larvae of the scyllarid and palinurid lobsters in the Japanese waters. *Bulletin of the Japanese Society of Scientific Fisheries* 52 (8): 1289-1294.
- SEKIGUCHI H. 1986b. — Life histories of the scyllarid and palinurid lobsters - 1. *Aquabiology, Tokyo* 8 (1): 13-18, figs 1-4.
- SEKIGUCHI H. 1986c. — Spatial distribution and abundance of phyllosoma larvae in the Kumano- and Enshu-Nada Seas north of the Kuroshio current. *Bulletin of the Japanese Society of Fisheries and Oceanography* 50 (4): 289-297, figs 1-6.
- SEKIGUCHI H. 1987a. — Life histories of the scyllarid and palinurid lobsters - 11. *Aquabiology, Tokyo* 9 (5): 330-335, figs 46, 47.
- SEKIGUCHI H. 1987b. — Life histories of the scyllarid and palinurid lobsters - 12. *Aquabiology, Tokyo* 9 (6): 415-419, figs 48-50.
- SEKIGUCHI H. 1988. — Taxonomical and ecological problems associated with phyllosoma larvae. *Benthos Research, Bulletin of the Japanese Association of Benthology* 33/34: 1-16, figs 1-9.
- SEKIGUCHI H. 1989a. — Life histories of the scyllarid and palinurid lobsters - 22. *Aquabiology, Tokyo* 11 (4): 288-293, figs 85-88.
- SEKIGUCHI H. 1989b. — Life histories of the scyllarid and palinurid lobsters - 24. *Aquabiology, Tokyo* 11 (6): 454-460, fig. 92.
- SEKIGUCHI H. 1990a. — Life histories of the scyllarid and palinurid lobsters - 26. *Aquabiology, Tokyo* 12 (2): 110-115, figs 100-102.
- SEKIGUCHI H. 1990b. — Life histories of the scyllarid and palinurid lobsters - 29. *Aquabiology, Tokyo* 12 (5): 379-384, figs 110, 111.
- SEKIGUCHI H. 1992. — Life histories of the scyllarid and palinurid lobsters - 37. *Aquabiology, Tokyo* 14 (3): 208-215, figs 123, 124.
- SEKIGUCHI H. & TAGAWA M. 1987. — Two *Scyllarus* species (Crustacea, Decapoda, Scyllaridae) collected from the East China Sea. *Benthos Research, Bulletin of the Japanese Association of Benthology* 31: 10-17, text-fig. 1, pls 1, 2.
- SEKIGUCHI H., YAMAMOTO T. & KIMURA S. 1989. — *Scyllarus aurora* (Crustacea, Decapoda, Scyllaridae) collected off Kii-Nagashima, Kii Peninsula, Japan. *Nankaiseibutu* 31 (2): 81, 82, text-fig. 1, pl. 1.
- SERÈNE R. 1937. — Inventaire des Invertébrés marins de l'Indochine (1^{re} liste). *Notes de l'Institut océanographique de l'Indochine* 30: 1-83.
- SEWELL R. B. S. 1955. — A study of the sea coast of southern Arabia. *Proceedings of the Linnean Society of London* 1952-1953: 188-210, figs 1-10.
- SHEEHY M. R. J. 1990. — Widespread occurrence of fluorescent morphological lipofuscin in the Crustacean brain. *Journal of Crustacean Biology* 10 (4): 613-622, fig. 1.
- SHIRAI S. 1980. — *Ecological Encyclopedia of the Marine Animals of the Ryukyu Islands in Colour* (revised ed.). Okinawa Kyoiku Shuppan, Okinawa, 636 p., figs.
- SHOJIMA Y. 1963. — Scyllarid phyllosoma's habit of accompanying the jelly-fish. (Preliminary report). *Bulletin of the Japanese Society of Scientific Fisheries* 29: 349-353, pls 1, 2.
- SRIKRISHNADHAS B., RAHMAN M. K. & ANANDASEKARAN A. S. M. 1991. — A new species

- of scyllarid lobster *Scyllarus tutiensis* (Scyllaridae: Decapoda) from the Tuticorin Bay in the Gulf of Mannar. *Journal of the Marine Biological Association of India* 33: 418-421, fig. 1.
- STEBBING T. R. R. 1920. — The Malacostraca of Durban Bay. *Annals of the Durban Museum* 2: 263-278, pls 28-32.
- STEPHENSON W., WILLIAMS W. T. & LANCE G. N. 1970. — The macrobenthos of Moreton Bay. *Ecological Monographs* 40: 459-494, figs 1-9.
- STIMPSON W. 1860. — Prodromus descriptionis animalium evertibratorum, quae in expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, C. Ringgold et J. Rogers ducibus, observavit et descripsit. *Proceedings of the Academy of Natural Sciences of Philadelphia* 1860: 22-47.
- SUZUKI S. 1979. — *Marine Invertebrates of Yamagata Prefecture*. Chuo-Insatsu Co Ltd, Yamagata City, 370 + 17 p., 285 figs.
- TAKEDA M. 1982. — *Keys to the Japanese and Foreign Crustaceans fully illustrated in Colors* (1st ed.). Hokuryukan, Tokyo, vi + 58 + 284 p., 779 col. figs, b/w figs.
- TAMPI P. R. S. 1976. — The phyllosoma larvae of the Indian Ocean. *Journal of the marine biological Association of India* 15: 560-565, fig. 1.
- TAMPI P. R. S. & GEORGE M. J. 1975. — Phyllosoma larvae in the IIOE (1960-65) collections - Systematics. *Mahasagar* 8 (1, 2): 15-44, figs 1-45.
- TINKER S. W. 1965. — *Pacific Crustacea. An illustrated Handbook on the Reef-Dwelling Crustacea of Hawaii and the South Seas*. C. E. Tuttle Co., Rutland, Vermont, 134 p., 52 pls.
- TITGEN R. H. 1988. — New Decapod records from the Hawaiian Islands (Crustacea, Decapoda). *Pacific Science* 41: 141-147.
- UTINOMI H. 1956. — *Coloured Illustrations of Sea Shore Animals of Japan*. Hoikusha Publishing Co., Osaka, xvii + 167 p., pls 1-64, i-xii.
- UTINOMI H. 1965. — *Coloured Illustrations of Seashore Animals of Japan* (2nd ed.). Hoikusha Publishing Co., Osaka, xvii + 168 p., pls 1-64, i-xii.
- UTINOMI H. 1967. — Occurrence of a new pedunculate Cirriped on a small Spanish Lobster *Scyllarus bicuspidatus* (De Man) from Kamae Bay, northeastern Kyusyu. *Publications of the Seto Marine Biological Laboratory* 15 (2): 117-120, figs 1, 2.
- UTINOMI H. 1978. — *Coloured Illustrations of Seashore Animals of Japan* (3rd ed.). Hoikusha Publishing Co., Osaka, xxiii + 166 p., text-figs 1, 2, pls 1-64, i-xii.
- VAN OLST J. C., CARLBERG J. M. & HUGHES J. T. 1980. — Aquaculture, in COBB J. S. & PHILLIPS B. F. (eds), *The Biology and Management of Lobsters*, 2. Academic Press, New York; London; Toronto; Sydney; San Francisco: 333-384, figs 1-19.
- VINE P. 1986. — *Red Sea Invertebrates*. Immel Publishing, London, 224 p., figs.
- WANG B. 1991. — Natantia (exception of Palaemonidae), Palinura, Astacura, Appendix I, in DONG Y. (ed.), *Fauna of Zhejiang. Crustacea*. Zhejiang Science and Technology Publishing House, Zhejiang: 148-186, 195-221, 444-446, figs 111-144, 154-180.
- WANG B., QIAN Z. & DONG Y. 1998. — Studies on the family Scyllaridae (Crustacea Decapoda) from Chinese coast. *Journal of Xiamen University (Natural Science)* 37 (3): 443-453, figs 1-5.
- WARD M. 1942. — Notes on the Crustacea of the Desjardins Museum, Mauritius Institute, with descriptions of new genera and species. *Mauritius Institute Bulletin* 2: 49-109, pls 5, 6.
- WEITENWEBER W. R. 1854. — Aus James Dana's Conspectus of the Crustacea. *Lotos, Praha* 4: 5-14, 35-38, 60-63, 107-115, 153-157, 251-254.
- WHITE A. 1847. — *List of the Specimens of Crustacea in the Collection of the British Museum*. Trustees of the British Museum, London, viii + 143 p.
- WHITELEGGE T. 1900. — Crustacea. Part I. Scientific results of the trawling expedition of H. M. C. S. "Thetis", off the coast of New South Wales, in February and March, 1898. *Memoirs of the Australian Museum* 4 (2): 135-199, text-figs 11-14, pls 33-35.
- YAMAGUCHI T. 1993. — A list of species described in the Crustacea volume of Fauna Japonica as belonging to the Japanese fauna, in YAMAGUCHI T. (ed.), *Ph. F. von Siebold and Natural History of Japan. Crustacea*. The Carcinological Society of Japan, Tokyo: 571-598, figs 1, 2.
- YAMAGUCHI T. & BABA K. 1993. — Crustacean specimens collected in Japan by Ph. F. von Siebold and H. Bürger and held by the Nationaal Natuurhistorisch Museum in Leiden and other museums, in YAMAGUCHI T. (ed.), *Ph. F. von Siebold and Natural History of Japan. Crustacea*. The Carcinological Society of Japan, Tokyo: 145-570, text-figs 1-200, IIA-F, 7 portraits, col. pls 3-14.
- YOKOYA Y. 1933. — On the distribution of Decapod Crustaceans inhabiting the continental shelf around Japan, chiefly based upon the materials collected by S. S. Sôyô-Maru, during the years 1923-1930. *Journal of the College of Agriculture Imperial University of Japan, Tokyo* 12: 1-226, text-figs 1-71.
- ZARENKOV N. A. 1971. — K vidovomu sostavu i ekologii desjatinogih rakoobraznyh Krasnogo Morja [On the species composition and ecology of the Decapod Crustacea of the Red Sea] in *Bentos shelfa Krasnogo Morja* [Benthos of the shelf of the Red Sea]. Naukova Dumka, Kiev: 155-203, figs 63-88 (in Russian).

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