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THE SECOND ISRAEL SOUTH RED SEA EXPEDITION, 1965,
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THE PALINURIDAE AND SCYLLARIDAE OF THE RED SEA

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With two plates

The present paper is intended to be the first in a series revising the various families of Decapod Crustacea known from the Red Sea. This series is based in the first place on the material brought together by the 1962 and 1965 Israel South Red Sea Expeditions ¹⁾ (hereafter indicated as ISRSE I and II respectively), in both of which the author took part. Also Red Sea material from other sources is included, foremost among this is the material from near Elat on the Israel coast of the Gulf of Aqaba brought together by the Zoology Departments of the Universities of Tel-Aviv and Jerusalem. Also all the literature dealing with Red Sea representatives of these groups, as far as known to me, is taken into account. In this way it is hoped to give an accurate picture of our present knowledge of the Red Sea Decapoda.

Under each species, in addition to the original reference, all references to Red Sea specimens of that species are cited.

In the enumeration of the examined material first that collected by the ISRSE is listed, followed by the rest arranged according to the institutions where the material is kept. Of the ISRSE material the first series is held by the Rijksmuseum van Natuurlijke Historie at Leiden, duplicates are in the collections of the Zoology Departments of the Tel-Aviv and Jerusalem Universities while eventual further duplicates are donated to the U.S. Natio-

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nal Museum, the British Museum, and the Museum for Central Africa (Tervuren, Belgium).

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In the following text the abbreviation cl. is used for carapace length.

PALINURIDAE

Only three species of spiny lobsters, all belonging to the genus *Panulirus* White, 1847, are known from the Red Sea, all were collected by the ISRSE.

A fourth species, *Panulirus homarus* (L.), has been erroneously reported from the Red Sea. Nobili (1906: 90, 91) mentioned 3 very young specimens (18 to 20 mm long) of *Panulirus* sp. and 3 very young specimens (up to 19 mm long) of *Puerulus spiniger* Ortmann, all of which were collected by Dr. Jousseume in "Mer Rouge". The fact that Nobili described the grooves of the abdominal somites in his *Panulirus* sp. to be "crénelés sur leur bord antérieur" clearly shows that they belong to *Panulirus homarus* (L.). This is also the conclusion reached by Bouvier (1913: 84), who assigned both Nobili's *Panulirus* sp. and his material of "*Puerulus spiniger*" to *Panulirus dasyptus*, which name is a junior synonym of *P. homarus* (L.); Nobili's *Panulirus* sp. being the young stages and his *Puerulus spiniger* the postlarval stages of that species. This seems to establish a firm record of *P. homarus* from the Red Sea, but Bouvier (1914a: 192), when dealing with the same material stated: "En capturant à Djiboutil [sic] les puerulus du *Panulirus dasyptus*, M. Jousseume a recueilli plusieurs jeunes de l'espèce...". This shows that the material was not caught in the Red Sea but at Jibuti, Gulf of Aden. Very often in the work by Nobili and by contemporaneous authors the mistake has been made to consider Jibuti, Obock and Perim as being situated in the Red Sea. As the present series will deal exclusively with the Red Sea proper, species so far only found in the Gulf of Aden and not north of the Strait of Bab-el-Mandeb are left out of consideration.

Panulirus penicillatus (Olivier, 1791)

Astacus penicillatus Olivier, 1791: 343.

Panulirus penicillatus White, 1847: 69; Nobili, 1906: 88; Schmitt, 1931: 94, pl. 34; Gruvel, 1936: 195; Holthuis, 1946: 125; André, 1957: 111; Liebman, 1961: 108, 126, fig. 95; Ben-Tuvia, 1963: 23.

Palinurus Ehrenbergi Heller, 1861: 25; Heller, 1861a: 260, pl. 2 fig. 8.

?*Palinurus* Klunzinger, 1878: 357.

Palinurus (*Panulirus*) *penicillatus* Miers, 1878: 410.

Palinurus penicillatus De Man, 1880: 185.

ISRSE

Romia Island, Dahlak Archipelago, southern Red Sea; 29 March 1962; no. 1406. — 1 ♂, 1 ovigerous ♀.

British Museum

Red Sea. — 2 specimens (dry).

Gulf of Aqaba; Major Burton, no. 78.25. — 1 ♂, 1 ♀.

Dahab, Gulf of Aqaba; 2 February 1949; "Manihine" Expedition, no. 1951.1.17.77. — 1 ♀.

Museum Leiden

Jidda, Red Sea; 1880; J. A. Kruyt. — 1 ♂.

Several specimens of this species were collected at Romia Island by skindivers of ISRSE I; only the two above specimens (now in the collection of the Leiden Museum) were preserved, the rest was eaten.

Panulirus penicillatus shows a rather great variability in the colour pattern of its legs and in its pubescence. In all specimens of a large material from over the whole range of the species, which I have examined, the legs show longitudinal pale bands, but in some specimens these bands are wide and few, in others narrow and numerous. The density of the pubescence of the carapace is likewise quite variable. Furthermore, in some specimens also the dorsal surface of the abdomen is hairy, sometimes showing a hair-filled transverse depression before the transverse groove of somites II and III. The pleura of somites II to IV of the abdomen show teeth, which in some specimens are very distinct and acute, while in others they are much less conspicuous. All these features seem to vary independently from each other and therefore probably are not of taxonomic importance. Though some of these characters are more distinct in some populations than in others (so specimens from the Eastern Pacific seem on an average more hairy than most specimens from other areas), it proved impossible to recognize even subspecies in the very extensive material which I have been able to examine.

Panulirus penicillatus has a range that extends over the entire Indo-West Pacific area (Red Sea and E. Africa to Japan and Polynesia) and even pene-

trates into the Eastern Pacific region (Clipperton Island, Revillagigedo Islands, Cocos Island, Galapagos Islands), but does not attain the American mainland. The previous records from the Red Sea are ¹⁾: Red Sea (White, 1847!; Nobili, 1906), Gulf of Aqaba (Miers, 1878!), El Qoseir, Egypt (Heller, 1861, 1861a; ? Klunzinger, 1878; Gruvel, 1936), Jidda (De Man, 1880!; Holthuis, 1946!). Liebman (1961) mentioned the present species in his popular account and stated that, though found in the Red Sea, it was not yet known from the Gulf of Aqaba. Schmitt (1931) and André (1957) pointed out that *Panulirus penicillatus* is shown in the walldecorations of the temple of Deir-el-Bahari, Egypt, which depict the expedition to Punt on the Red Sea carried out under the auspices of Queen Hatsheput of Egypt (1580-1530 BC). Ben-Tuvia (1963) reported this species from Harmil Island in the northern Dahlak Archipelago, actually his record is based on the above material collected during ISRSE I at Romia Island and not at nearby Harmil. Neither was the species taken during the expedition at Entedebir Island or in Massawa as suggested by Ben-Tuvia's text. Klunzinger (1878) dealt with the marine fauna of Qoseir, Egypt, in his chapter "The Natural Treasures of the Red Sea" where he gave the following description (p. 356, 357): "A huge block of stone which has been detached by mighty storm-waves or by the hand of man from the region of the reef-slope, and has rolled into this quieter zone, rests in a slight depression of the reef, the edges of which now afford it secure support . . . If we roll the stone over we will often find . . . some very large-sized lobsters (*Palinurus*). The latter, however, are best caught at night when they leave their lurking-places". The large size of the animals and the fact that *Panulirus penicillatus* is the commonest spiny lobster in the northern Red Sea, make it likely that Klunzinger's *Palinurus* actually belonged to the present species.

Thanks to the kindness of Messrs. Ch. Lewinsohn and F. D. Por, I received colour slides of a large male specimen of this species (cl. ca. 145 mm), which was caught in the Gulf of Aqaba near Elat, Israel. This specimen is at present preserved in the collection of the Zoology Department of the Hebrew University, Jerusalem. This is the first record of the species from Israel waters.

Panulirus penicillatus is of economic importance in the Red Sea, as shown by Gruvel's (1936) remark that it is the only species of spiny lobster found on the Egyptian fish markets.

1) An exclamation mark(!) after the author's name indicates that I have examined the material reported upon by that author.

Panulirus versicolor (Latreille, 1804)*Panulirus versicolor* Latreille, 1804: 394.*Panulirus versicolor* Ben-Tuvia, 1963: 23.*Panulirus* sp. Stella, 1955: 55, fig.; Roghi & Baschieri, 1957: 244.

ISRSE

Rocky shore near Massawa, Eritrea; 0-2 m deep; 6-8 March 1962; no. 1514 — 1 ♀.

Cundabilu Island, N. of Entedebir Island, Dahlak Archipelago; in rock crevice, 2-3 m deep; 16 March 1962; no. 1342. — 1 ♂; among coral and rock, 0-3 m deep, pro-noxfish poisoning; 25 March 1962; no. 1393. — 2 ♂♂, 1 ♀.

Landing Bay, Entedebir Island; north of entrance; among corals, 2-3 m deep; 13 March 1962; no. 1320. — 1 ♂.

Seil Ambar, islet E. of Museri Island, southern Dahlak Archipelago; 25 October 1965. — dried fragments found on the shore.

Haifa Fisheries Research Station

North Massawa Channel, southern Red Sea; 9 December 1957; A. Ben-Tuvia; E 57/429. — 1 ♀.

Museum Leiden

S. Massawa channel, southern Red Sea, 14° 18' N 41° 38' E; trawl; 8 October 1957; A. Ben-Tuvia, E 57/428. — 1 ♂.

The specimens collected by the first Israel South Red Sea Expedition are all rather small (cl. 28 to 38 mm). They were mostly found in rock crevices, their brilliantly white antennal flagella often sticking out. The characteristic colour pattern distinguishes this species immediately from all other spiny lobsters. This is also why the animal collected by the 1953 Italian National Underwater Expedition to the Red Sea and reported upon by Stella (1955) and Roghi & Baschieri (1957) as *Panulirus* sp. can be identified with certainty as this species. The photograph of the animal provided by these authors, leaves not the least doubt as to its identity with *P. versicolor*. Stella (1955: 55) remarked that the absence of a flagellum on the second maxillipede made it impossible for her to assign the specimen to *P. versicolor*, even though it had the colour pattern of that species. As has been pointed out before (Holthuis, 1946: 140, 141) the exopod of the second maxillipede in *P. versicolor* sometimes actually does lack the flagellum and the character of the presence or absence of flagellar articles is too variable to be relied upon. Stella's specimen came from Cundabilu ("su fondi madreporici") where ISRSE I found the species to be quite common.

The fragments from Seil Ambar consist of the basal part of the antennae only, they are quite large and must have been from a specimen of considerable size. It is possible that the fragments that we found were the remnants of a meal as they were lying rather far from the sea. A comparison of these fragments with corresponding parts in the various species

of *Panulirus* which might be found in the Red Sea, showed that they resemble those of *P. versicolor* most closely.

Like in *P. versicolor* the present fragments have the upper anterior margin of the penultimate antennal segment between the dorsal articulation and the strong inner anterior spine without a trace of spines. In *P. penicillatus*, however, a strong spine is placed there, slightly behind the anterior margin. The antepenultimate antennal segment in these fragments has on the anterior margin, below the external articulation, two spines of which the upper is considerably larger than the lower. In *P. penicillatus* these two spines are of practically the same size. The anterior margin of the same segment, to the inner side of the large mediodorsal spine, shows no spinules in our fragments, neither does it in our specimens of *P. versicolor*, but in *P. penicillatus* there are several very sharp spinules there. The resemblance of the fragments to the antennal peduncle of *P. ornatus* is very close, as *P. ornatus* differs from *P. penicillatus* in practically the same points as does *P. versicolor*. But, while *P. versicolor* has the anterior margin of the antepenultimate antennal segment provided below the outer articulation with 2 (or even 3) spines, in the specimens of *P. ornatus* seen by me only a single spine is present there. Most specimens of *P. homarus* (L.) resemble in this respect *P. ornatus*, though in very spiny specimens (of the "burgeri" type) a very small additional spinule may be present. I feel quite justified therefore to assign the Seil Ambar fragments to the present species.

The species is widely distributed in the Indo-West Pacific area from the southern Red Sea and S.E. Africa to Japan and Polynesia. Though it appears to be not rare in the southern Red Sea as shown by the present material, the only published records are those by Stella (1955) and Roghi & Baschieri (1957) from Cundabilu Island, Dahlak Archipelago, and that by Ben-Tuvia (1963), whose report was based on the above listed specimens from Massawa and Entedebir.

Panulirus ornatus (Fabricius, 1798)

Palinurus ornatus Fabricius, 1798: 400.

Panulirus ornatus Holthuis, 1946: 138, pl. 7 fig. i, pl. 9 fig. d; Ben-Tuvia, 1963: 23.

ISRSE

Massawa; 7 March 1962; received from Italian fishermen; no. 105. — 1 ♀.

Museum Leiden

Jidda; 1882; J. A. Kruyt. — 2 ♂♂, 1 ♀.

The single specimen obtained by the Israel South Red Sea Expedition I is a large female with a carapace length of 97 mm. The species has been

reported from the Red Sea only twice before, viz., by Holthuis (1946) who dealt with the above specimens from Jidda, and by Ben-Tuvia (1963) whose record is based on the above specimen from Massawa.

Panulirus ornatus has a wide distribution in the Indo-West Pacific region, being reported from the Red Sea and East Africa to Formosa, Australia, and Polynesia. In the collections of the musea in Amsterdam, Leiden, London and Washington I have seen specimens of this species from E. Africa (Bagamoyo, Tanganyika; Zanzibar), Madagascar (Nosy Bé), the Seychelles, Indonesia (Sabang Bay, Sumatra; Djakarta Bay, Java; Tandjong Senubing, Great Natuna Islands; Makassar, Celebes; Amboina, Moluccas; Kei Islands; New Guinea), Philippines (Zamboanga and Rio Grande, Mindanao; Iloilo, Panay; Cebu); Formosa (Takao); Shanghai, China; Upolu, Samoa Islands; and Pipon Islands.

SCYLLARIDAE

This family is represented in the Red Sea by three genera, all of which are present in the collections studied.

Thenus orientalis (Lund, 1793)

Scyllarus orientalis Lund, 1793: 22.

Thenus orientalis Nobili, 1906: 88; ?Santucci, 1927: 9, pl. 3 fig. 5; Holthuis, 1946: 106; Ben-Tuvia, 1963: 23, fig.

ISRSE

Archico Bay, S. of Massawa; trawled; 8 April 1962. — 1 ♂, 1 ovigerous ♀.
Howakil Bay, S. Red Sea, 15° 17' N 40° 10' E; 10-12 fathoms; bottom flat and hard; 16 October 1965; "Negus Salomon" Sta. 2; no. 2077. — 1 ♂.
Howakil Bay, 15° 05' N 40° 18' E; 5 fathoms; bottom flat and rather hard; 17 October 1965; "Negus Salomon" Sta. 3; no. 0197, 2076. — 1 ♂, 3 damaged ♀♀.
Howakil Bay, 15° 58' N 40° 19' E; 5-6.5 fathoms; bottom soft mud; 17 October 1965; "Negus Salomon" Sta. 4; no. 1449. — 1 ♀.

Haifa Sea Fisheries Research Station

Massawa Channel; trawled; April 1961; E. Gilat. — 1 ♂, 1 ♀.

Museum Amsterdam

Kamaran; February 1924; leg. G. J. Terwiel. — 2 ♀♀ (one of which ovigerous).

The carapace length of the specimens varies between 41 and 55 mm, those of the ovigerous females are 51 and 54 mm.

This characteristic species, the only one so far known of the genus, has a wide distribution, which extends from the Red Sea and S. E. Africa to China, the Pescadores Islands and N. E. Australia. It has once been reported from the Mediterranean. The records from the Red Sea are few

and all are from the southern part. Nobili (1906) reported about ten specimens from Massawa, Holthuis (1946) had two specimens from Kamaran, while Ben-Tuvia (1963) dealt with the commercial catch of these animals in the southern Red Sea. Santucci (1927) reported what he thought to be larvae of this species from the Red Sea.

Ben-Tuvia (1963) explained that *Thenus* is caught by Israeli trawlers operating in the southern Red Sea (Massawa area) and that they are sold on the Israel markets where they make good prices; however, on the total catch of fishes, *Thenus* is only of minor importance. In the Massawa area the species is also fished for by local fishermen in smaller quantities, the animals usually being then obtained by diving. The species is reported to be of excellent taste.

Scyllarus rugosus H. Milne Edwards, 1837

Scyllarus rugosus H. Milne Edwards, 1837: 283.

Museum Leiden

Near Massawa, Ethiopia; 21 March 1958; A. Ben-Tuvia and O. H. Oren. — 3 ♂♂.

ISRSE

E. of Museri Island, Dahlak Archipelago, 15° 35' N 40° 44' E; 20 fathoms; bottom flat with sponges; 23 October 1965; "Negus Salomon" Sta. 12; no. 1960. — 1 ♀.

The above female has a carapace length of 11 mm, in the three males this length varies from 14 to 16 mm.

The specimens are quite characteristic and agree well with the published descriptions of the species.

Scyllarus rugosus has been confused by some authors with other closely related species. Hereby the actual range of the species is not quite certain. However, it is known positively from East Africa, India, Indonesia, the Philippines, Thailand, Formosa, and Hongkong. It is now reported for the first time from the Red Sea.

Scyllarus gibberosus (De Man, 1905)

Arctus gibberosus De Man, 1905: 588.

Scyllarus Gundlachi Paulson, 1875: 96, pl. 12 fig. 5; Paulson, 1961: 102, pl. 12 fig. 5.

Scyllarus Paulsoni Nobili, 1906a: 395; Nobili, 1906: 88; De Man, 1916: 65, 68, 71.

The present species, which is not represented in the Red Sea collections studied by me, was first described and figured by Paulson under the name *Scyllarus Gundlachi* Von Martens. As Nobili (1906a: 395) later pointed out, Paulson's specimen certainly is different from Von Martens's (1872) *Scyllarus gundlachi*. The latter species, which was originally described from Cuba, proves to be identical with *S. americanus* (Smith, 1869) and ranges

from the northern Caribbean north to about Massachusetts, U.S.A. Nobili (1906a) erected a new species *S. Paulsoni* for Paulson's material. In the meantime, however, three other names had been given to the species in rapid succession. On 30 May 1905 Nobili (1905: 160) described from the Persian Gulf a species which he intended to name *S. nitidus*, but which through some lapsus in his paper got the name *S. sordidus*. De Man (August, 1905: 589) finding that *S. sordidus* Nobili is preoccupied by *S. sordidus* Stimpson, 1860, proposed the new name *Arctus Nobilii* for Nobili's species, at the same time expressing his feeling that this species actually might be the same as *Arctus gibberosus* which he (De Man, August 1905: 588) had described on the previous page. In my opinion *Scyllarus gundlachi* sensu Paulson, 1875 (not Von Martens, 1872), *Scyllarus sordidus* Nobili, 30 May 1905 (not Stimpson, 1860), *Arctus gibberosus* De Man, August 1905, *Arctus nobilii* De Man, August 1905, *Scyllarus paulsoni* Nobili, 30 January 1906a, and *Scyllarus nitidus* Nobili, 30 April 1906b, are synonyms. The latter name was published by mistake on a plate illustrating the species for which in the text Nobili (30 April 1906) used the name *Scyllarus Nobilii* (De Man). For purposes of nomenclature the names *Arctus gibberosus* De Man, 1905, and *Arctus nobilii* De Man, 1905, have equal standing and it is the first reviser who has to decide which of the two names should be used. This first reviser was De Man (1905: 589) himself as he then stated clearly that if the two species should prove to be synonymous the name *gibberosus* should be used, this action being again confirmed by De Man (1916: 71).

Scyllarus gibberosus is known from the Red Sea, the Persian Gulf, Mauritius, Burma, New Guinea, the Philippine Islands, and the Great Barrier Reef. The only Red Sea record is the one by Paulson.

***Scyllarus lewinsohni* Holthuis, 1967**

Scyllarus lewinsohni Holthuis, 1967: 307; Bourdon, 1967: 168.

Museum Leiden

Gulf of Aqaba off shore N. of Elat, Israel; 22-25 fathoms; 6 September 1966; dredge; fishing vessel "La'merkhaw", Ch. Lewinsohn, Sta. 4, nos. NS. 1164 and 1165. — 1 ♂ (holotype), 1 ♀.

Elat, Israel; from plankton; 16 May 1959; Ch. Lewinsohn no. NS. 1064. — 1 postlarva.

The female specimen, cl. 10 mm, has a Bopyrid parasite in the right branchial chamber, the carapace being strongly deformed there. The male, cl. 8 mm, is the holotype. The carapace length of the postlarva is 3 mm.

This species is very close to *Scyllarus martensii* Pfeffer and actually at first was thought to be identical with that species.

The rostrum is short and blunt, it is somewhat elevated but does not bear

a tubercle behind the tip. Like in *S. martensii* there are three median teeth, all of which, however, are far higher and more distinct than in that species. The cardiac tooth is high and laterally compressed and is distinctly undercut by the cervical groove. It has a single rectangular top and is followed by 5 or 6 pairs of distinct, broad, squamiform teeth. The gastric tooth also is high and laterally compressed, being similar to and only slightly smaller than the cardiac tooth. It is followed by three or four small blunt obscure median teeth, the last of which is flanked on either side by a wider squamiform tooth. The pregastric tooth is very well developed, wide and anteriorly rounded, it is much elevated, pointing obliquely upward; two small submedian squamiform teeth are placed on its posterior slope. Some very small tubercles may be present between the pregastric tooth and the rostrum. In *S. martensii* the median teeth of the carapace are much lower, especially the pregastric tooth is very low and inconspicuous, while between it and the rostrum tubercles are present. The branchial carina is narrowly interrupted by the cervical groove. The gap shows a distinct tubercle in its inner part. The anterior branchial carina ends in two distinct teeth that are placed over the orbit and are followed by about 5 indistinct squamiform tubercles. The posterior branchial carina ends in a distinct tooth which is followed by 5 to 11 squamiform tubercles. These tubercles are flatter than in *S. martensii* and less distinctly separated from the neighbouring tubercles. The area between the postrostral and branchial carinae bears several broad and narrow squamiform tubercles, no distinct submedian carinae are recognisable; the small tubercles are especially concentrated along the anterior margin of the carapace and before the cervical groove. The intermediate tubercles are also broad and squamiform, they number 4 or 5, and do not differ much from the rest. The lateral margin shows the cervical and precervical incisions very distinctly. There are 3 anterolateral, 2 mediolateral and about 8 or 9 posterolateral teeth, some of which may be subdivided. In lateral view all these lateral teeth are placed in a single line. The space between the lateral and posterior branchial carinae is filled with squamiform tubercles. The posterior groove of the carapace is distinct, though somewhat narrower than in *S. martensii*. Before it there is a double transverse row of squamiform tubercles, and behind it a similar double row, the tubercles of which are smaller while those of the posterior row are partly fused with each other and with the smooth posterior margin. The posterior margin shows a sharply pointed, wide, median triangular notch; at each side of this notch the margin is sinuous being first convex and then concave.

The first abdominal somite bears a distinct uninterrupted transverse groove over the middle of its length. The posterior half of the somite bears

about 20 longitudinal grooves which are less straight than in *S. martensii* and some of which may even be forked. The posterior margins of somites I and II show a distinct median incision. In the other somites the margin is straight, though that of the fourth does show a slight notch. The anterior half of somites II to V is smooth, apart from a narrow transverse groove which bears a row of posteriorly directed short hairs. This groove is long and complete in the anterior somites, in the posterior becoming shorter and interrupted in the middle. The posterior margin of the anterior half of somites I to IV is straight, in somite V it is slightly crenulate. Somites II to V have a median dorsal carina in the posterior half. This carina is very high in somite III, being about half as high as long. The carina of somite II is less than half as high as the one of somite III, but is still conspicuously elevated, while the carina of somite IV is still lower and that of somite V almost level with the surface of the somite. Like in *S. martensii* the carina of the second somite shows a double ridge dorsally, those of the third to fifth somites a single one. Arborescent markings similar to those of *S. martensii* are found on the posterior halves of somites II to V. Also the pleura are very similar to those of that species. Here, like in the sixth somite and the telson, the sculpturation is as in *S. martensii*, only less strongly pronounced, the lobes being flatter and the teeth blunter.

The epistome shows a small and shallow median notch flanked by two equally inconspicuous triangular teeth.

The anterior margin of the sternum is very shallowly emarginate, being almost straight. It has a sharp triangular median incision, which is flanked at either side by a pearly tubercle. From each of the anterolateral angles of the sternum a carina runs obliquely mediad and posteriorly forming a kind of V-shaped ridge. The two halves of this ridge extend to the extreme anterolateral angles of the sternum and do not stop short before these as in *S. martensii*. A median tubercle is present on the fifth thoracic sternite but is not seen in any of the other segments of the sternum in the male, while some faint indications of such a tubercle may be noticed on sternites 3 or 4 of the female.

The anterior margin of the antennular segment is straight with only a very slight indication of a tooth in the middle of each half. The anterior margin of the last antennal segment is convex with 5 teeth, the outer three of which are broadly truncated, the inner more narrowly rounded at the top. The inner margin of the segment bears 2 distinct teeth with an indication of a third at the basis of the inner tooth. Some scattered small tubercles are present on the upper surface of the segment. The fifth segment has a blunt inner tooth with an inconspicuous dorsal carina. The anterior margin of the

fourth segment bears a large triangular tooth at the inner end. Between this tooth and the apex of the segment the margin bears 8 to 10 small but usually distinct teeth. The outer margin bears 3 teeth (the apex not included), the proximal of which is the smallest. The upper surface bears the usual oblique carina which extends the full length of the segment and bears a tubercle near the outer part of its base. A small additional carina, bearing 3 squamiform tubercles is placed to the outside of the main carina.

The first pereopod is rather heavy, being very similar to that of *S. martenii*. The second is more slender. The dactylus measures about $\frac{5}{3}$ of that of the fourth leg, being also distinctly longer than that of the third leg. The propodi of the second and third legs are of about equal width and slightly narrower than the merus. Those of the fourth and fifth legs are still more slender. None of the legs bears ventral fringes of setae on any of the segments; dorsal fringes are present on the merus of all legs and the propodus and carpus of the third legs. The merus of legs 1 to 4 shows a longitudinal groove on the outer surface; such a groove is also found on the propodus of leg 3.

In the male the pleopods of the second abdominal somite have the exo- and endopod of the same length. They are elongately triangular, the endopod being narrower than the exopod. In the following somites the endopod is reduced to a small bud, but the exopod in all is leaf-shaped and distinct. In the female the endo- and exopod are rather well developed in all pleopods.

The postlarva is only tentatively assigned to this species. Except for the postrostral branchial and lateral ridges the carapace is smooth. The rostrum is elevated to a conspicuous tubercle. The gastric tooth is very distinct and about rectangular in lateral view, there is no pregastric tooth. The cardiac area is swollen and the cardiac tooth is visible as two small submedian tubercles. The anterior branchial ridge shows the two anterior teeth clearly, the rest of the ridge is very obscurely serrate. The posterior branchial ridge is distinctly serrate throughout, showing about 9 teeth. Also the lateral margin is serrate and divided in three by the cervical and precervical incisions. A few denticles are present between the posterior ends of the branchial and lateral carinae.

The abdomen is smooth. A median ridge is present on somites II to V, these ridges are somewhat elevated, most conspicuously so in somite III, least in somite V.

The last antennal segment bears rather broad teeth at the distal margin, and 2 small teeth on the inner margin. The fifth segment has two sharp teeth on the anterior margin. The anterior margin of the fourth segment bears one large and 6 or 7 very small teeth; the lateral margin is finely serrated with indications of 2 or 3 large teeth.

Affinities. — *S. lewinsohni* belongs to the group of *Scyllarus martensii*. It differs from *S. martensii* by the much higher and more distinct teeth on the postrostral ridge, by the more irregular longitudinal grooves on the first abdominal somite, by the far higher median ridge on the second, and especially on the third abdominal somite, by the more numerous and more narrowly pointed teeth on the last antennal segment, by the more numerous teeth on the anterior margin of the fourth antennal segment, by the median incision in the epistome, by the shape of the thoracic sternum, and by the absence of a dorsal fringe of hairs on the propodus of the fourth leg.

It differs from *S. aesopius* Holthuis by that the rostrum does not have a rostral tooth, by that there are no tubercles on the anterior half of the abdominal somites, by that the anterior margin of the groove separating the two halves of the abdominal somites is not crenulate in somites II to IV, and by having the median carina of somite II double.

Parasites. — The larger specimen, the female paratype of this species, is remarkable by being parasitized by a Bopyrid isopod, which caused a very conspicuous deformity of the posterior part of the right half of the carapace. The parasite was lodged in the right branchial chamber and so well enclosed by the carapace that it could only be removed after cutting the carapace. The Bopyrid has been recently described by Bourdon (1967: 168) as a new species, *Dactylocepon holthuisi*.

***Scyllarus pumilus* Nobili, 1906**

Scyllarus pumilus Nobili, 1906a: 396; Nobili, 1906: 87; Balss, 1915: 35; De Man, 1916: 65, 68, 70.

Scyllarus Thiriouxi Bouvier, 1914: 702; Bouvier, 1915: 188, text figs. 2-4, pl. 5 figs. 5, 6.

Scyllarus thiriouxi Ward, 1942: 60.

ISRSE

Manta Cliff between Landing Bay and Ras Papenfuss, Entedebir, Dahlak Archipelago; 0.5 m deep; pro-noxfish poisoning; 7 April 1962; no. 1459. — 1 ♂.

The specimen has a carapace length of 11 mm. It agrees very well with Bouvier's (1915) description and figures of *S. thiriouxi* and after having directly compared it with the type of that species, I am fully convinced that it belongs to the same species.

The species is very close to *S. sordidus*, but differs in the much lower teeth of the postrostral carina of the carapace; especially the cardiac tooth is very low and is not raised higher than the posterior submedian carinae, while in *S. sordidus* this tooth is high and laterally compressed. The present species furthermore shows the median dorsal figure of abdominal somites II to IV as a simple loop with straight lateral margins, while in *S. sordidus*,

like in most species of the genus, the figure is distinctly lobulated laterally. The fourth segment of the antenna in the present species has only a single tooth on the external margin, in *S. sordidus* there are two distinct teeth there.

Like in *S. sordidus*, alcohol specimens of the present species have a circular dark spot in the middle of the first abdominal somite. The center part of this spot is lightest.

The colour of the living animal was noted to be as follows. 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 antennal 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.

Nobili (1906a: 395) published a preliminary description of his new species *Scyllarus pumilus*, which he compared to *S. bicuspidatus* De Man. His later definite description (Nobili, 1906: 87) did not give more details of the species, which was described after a dry specimen from the Red Sea preserved in the collection of the Turin Museum. Judging by the data given by Nobili *S. pumilus* is identical with either *S. thiriouxi* or *S. sordidus*, but his information is too meagre to make the identity certain. Bouvier (1915: 191) thought *S. thiriouxi* to differ from *S. pumilus* and *S. bicuspidatus* "par les squames dont sa carapace est presque totalement recouverte, par les dessins non arborescents des segments abdominaux, par les dents moins nombreuses du grand article des pedoncles antennaires". In his description Nobili (1906: 87) did not mention the shape of the arborescent markings of the abdomen, and neither that of the fourth antennal segment. As far as the first character is concerned Nobili stated that his *S. pumilus* resembles *S. bicuspidatus* "par les écailles faibles sur la région gastrique et la cordiale". This one character is so vague that it is of extremely little help for the identification of *S. pumilus*. Only the reexamination of the type could solve that

question. Unfortunately, however, the type is no longer extant as Prof. U. Parenti of the Istituto e Museo di Zoologia della Università in Turin was so kind to inform me (in litt. 27 Februari 1967). In order to definitely fix the identity of *Scyllarus pumilus* it has become necessary to select a neotype for it. As shown above the holotype of *Scyllarus pumilus* belongs either to *S. thiriouxi* or to *S. sordidus*. As *Scyllarus sordidus* has so far not been reported from the Red Sea, while of *S. thiriouxi* Red Sea material is available, I take this opportunity to designate as the neotype of *Scyllarus pumilus* Nobili the present male from Manta Cliff, Entedebir Island (ISRSE no. 1459) which is preserved in the collection of the Rijksmuseum van Natuurlijke Historie under Reg. No. Crust. D. 24161.

In this way the name *Scyllarus pumilus* Nobili, 1906, becomes an older synonym of *Scyllarus thiriouxi* Bouvier, 1914, and has to replace the latter name.

Distribution. — The type locality of *Scyllarus pumilus* is "Red Sea"; it is here now restricted to Manta Cliff, Entedebir Island, Dahlak Archipelago, S. Red Sea, 0-5 m depth. Balss (1915) reported the species from Suakin, Sudan coast of the Red Sea. His material is no longer in the Vienna Museum and is evidently lost (Dr. G. Pretzmann, in litt., 1967). The type locality of *Scyllarus thiriouxi* is the environment of Port Louis, Mauritius. Ward (1942: 60) reported a male of 16 mm from Mauritius. The Geneva Museum holds a dry specimen of this species from Madagascar, the British Museum a spirit specimen from Mauritius. No other localities are known for the species.

Scyllarus spec.

Scyllarus sp. Murina, 1966: 108.

Murina (1966), in a paper on the quantitative distribution of zoobenthos in the Red Sea, mentioned the presence of *Scyllarus* in material trawled in the Straits of Bab-el-Mandeb on a bottom of slightly muddy sand. No details are given of her specimen(s).

Scyllarides tridacnophaga Holthuis, 1967 (pls. 1, 2)

Scyllarides haami Holthuis, 1958: 35, fig.

Scyllarides tridacnophaga Holthuis, 1967: 307.

Museum Leiden

Elat, Gulf of Aqaba, Israel; April 1951; leg. M. Avizohar; no. E.51/104, 105. — 2 juveniles.

Elat, April 1954; leg. L. Fishelson & C. Lewinsohn; no. NS. 111. — 1 Pseudibacus stage.

Elat; 1960-1965. — 1 ♂ (dry).

Elat; 1965; D. Friedmann; NS 1099. — 1 ♀ (holotype).

Elat; April 1963; NS. 1208. — 1 ♂.

The total length of the juveniles is 30 and 110 mm, that of the *Pseudibacus* stage 25 mm. The two adult males have a carapace length of 100 and 119 mm, the dry specimen being the largest; the female has cl. 108 mm.

In the adults the carapace is broadest anteriorly. It is 1.03 to 1.05 times as long as wide. The rostrum is distinctly constricted in the basal part and thereby T-shaped. It reaches to the end of the widened basal part of the antennular somite. The inner orbital margin bears two teeth which are placed rather close together and between which a small denticle is visible; these two teeth may have a horny tip. At the inner orbital angle a third tooth is present which stands slightly behind the orbital margin. The lobe of the inner orbital angle is distinct and partly covers the intercalated plate. The latter forms the anterior wall of the orbit. The pregastric elevation bears two very distinct horny tipped tubercles. The gastric elevation is lower and less conspicuous. The cardiac elevation is very low and wide, it is separated from the gastric elevation by a narrow and shallow, but distinct, cervical groove. There are no tubercles on the branchial region that are conspicuously larger than the rest, neither are such tubercles present before the marginal groove. The cervical groove is narrow and shallow in its median part, becoming wider laterally, and there resembles the branchiocardiac grooves. The postcervical groove is very wide and is interrupted in the middle. The anterolateral angle of the carapace is large and ends in a pointed tooth, which is directed obliquely forward. It is followed by 7 or 8 smaller teeth. The cervical incision is not very distinct and the carapace is not much constricted there. The tooth behind the cervical incision is not larger than the other teeth of the lateral margin. The margin bears larger and smaller denticles, which often alternate. The tubercles of the carapace are distinct but somewhat flattened, they are surrounded by short stiff hairs, which gives the carapace a rugose appearance. The lateral part of the branchial region shows a short somewhat depressed area near the posterolateral corner of the carapace, and another just behind the cervical groove, but otherwise it is convex or flat up to the lateral margin.

The upper surface of the first abdominal somite is smooth for the larger part and bears three large well-defined red spots, one median and two lateral; they are all about circular in outline. The interspaces between the spots are about as wide as the spots themselves. The pleura of the first somite end in a triangular point, before which there is a broadly rounded lobe; behind it is a smaller triangular tooth. The upper surface of the following somites in the posterior part is as rugose as the carapace; the anterior part is smooth, showing low and slightly flattened smooth tubercles, which may

give the surface a tessellated appearance. The second, third and fourth somites show a distinct median longitudinal carina, which is distinct and rather narrow, being well set off from the rest of the surface. These carinae are of about equal height. The pleura of the second somite are broadly rounded. There are 4 or 5 larger teeth on the anterior margin, 6 to 8 much smaller ones posteriorly. In the basal part of the posterior margin, just above the smaller teeth there is a large tooth, which breaks the rounded outline of the pleuron. The pleura of the third abdominal somite end in two or three blunt teeth. The anterior margin is somewhat concave and only slightly crenulate or serrate, the posterior margin is convex and shows more distinct teeth. The next two pleura are elongate and end in two or three blunt teeth; their anterior margin is straight or slightly concave in the fourth, slightly convex in the fifth somite; their posterior margin is somewhat convex.

The last antennal segment is rounded, with the angles hardly at all indicated; its margin is evenly crenulated. The fourth segment has the anterolateral angle dentiform, lying in the same plane as the rest of the segment. The anterior margin bears 8 or 9 teeth of which the second or third inner tooth is the largest. The outer margin shows two angles, which sometimes resemble a tooth, the margin itself is bluntly serrate.

The lateral teeth of the epistome are not very distinct, and sometimes hardly or not at all larger than the teeth external to them on the margin. The central teeth are large, and broadly triangular. The median incision of the epistome is narrowly V-shaped or closed.

The propodus of the first pereiopod bears an indistinct dorsal carina. The carpus is not swollen in the basal part and has a distinct longitudinal dorsal groove, which is not flanked by ridges. The merus bears a strong wing-like dorsal carina, which ends anteriorly in a distinct tooth. The propodus may have a dorsal carina, which is most distinct in the third and fourth legs, in which sometimes a trace of a second carina is visible. The carpus in legs 2 to 5 shows a dorsal groove, which may be flanked by two carinae. These carinae are most distinct in leg 3. In leg 4 and 5 the dorsal carina is elevated at the base and in the distal part. The meri of the second and third legs are winged dorsally, in the fourth and fifth leg the dorsal carina may be low.

The tubercles on the basal parts of the legs and on the sternum are not very conspicuous and have small horny tips.

Colour. — The living animal is of a yellowish brown colour, being paler below than above. The margins of the antennae and most of the larger tubercles are reddish. The antennular flagella are a deep purple. The distal

part of the propodus and the proximal part of the dactylus of the last four pairs of pereopods are also purple. The pubescence of the dorsal surface of the body is dark greenish grey.

The species is very close to *Scyllarides haanii* (De Haan), but may immediately be distinguished by that in the adult specimen the fourth abdominal somite is not hump-like produced in the middle. Also in *S. tridacnophaga* the pregastric area of the carapace is more distinct than the post-gastric, while in *S. haanii* the reverse is true. The carapace in *S. haanii* is widest in its posterior half and the cervical constriction is far more distinct. In *S. haanii* the central of the three spots on the first somite of the abdomen is very indistinct. From *Scyllarides latus* the present species is distinguished by that the pleura of the second abdominal somite are rounded at the top instead of ending in a distinct, sharp, posteriorly directed point. The fourth segment of the antenna in *S. latus* furthermore is not flat but has the anterolateral tooth curved up above the level of the rest of the segment. One of the most conspicuous differences of course is the colour pattern of the first abdominal somite, which in *S. latus* shows a median circular red spot surrounded by a yellow ring to the outside of which there is again a large red spot at each side.

The juvenile specimens listed above were reported upon by me in 1958 under the name *Scyllarides haanii*. In these specimens, like in the adults of *S. haanii*, the fourth abdominal somite is hump-like produced. This evidently is a juvenile character. Also the carapace of the juveniles is much more deeply sculptured than in the adults, while on the legs the carinae are much better developed. The shallowness of the central part of the cervical groove as well as the distinctness of the precervical area makes me now inclined to consider these juveniles as belonging to *S. tridacnophaga*. However, only a better knowledge of the development of the two species can decide this matter.

Biology. — Mr. Douglas Faulkner, of Summit, New Jersey, U.S.A., when diving near Elat at night, made the following observations (in litt., 3 January 1967): "The lobster was actually perched on the *Millepora* when I came upon him at night. There is a possibility that he was eating something on the coral". Mr. Faulkner's picture of the animal is reproduced here. I take this opportunity to thank Mr. Faulkner for his interesting observations and for his kind permission to publish his excellent photograph.

In the aquarium of Elat, Israel, some specimens of the present species were kept alive and some very interesting observations on the feeding habits of these animals were made by Israel zoologists. The fact that this *Scyllarides* attacks live *Tridacna* and eats them was the reason to propose for it

the specific name *tridacnophaga*. Mr. Ch. Lewinsohn of the Zoology Department, University of Tel-Aviv, Israel, provided me with the following account of the feeding activities of *Scyllarides tridacnophaga*, for which I express here my profound gratitude: "Die in das Aquarium gelegte *Tridacna* (ca. 10 cm lang) wird von *Scyllarides* wahrscheinlich hauptsächlich durch das Abtasten des Bodens mit den Peraeopoden gefunden. Dabei werden auch Steine durch abtasten und umdrehen geprüft. Wenn die Muschel sich bei der Berührung des Krebses schliesst, erfolgt eine sofortige Reaktion des Krebses. Die Muschel wird mit Hilfe der drei ersten Peraeopoden-Paare umklammert und dann langsam umgedreht (d.h. die Schalenöffnung wird nach unten gedreht). Neben dem Schloss der Muschel klafft eine Spalt, durch welchen hauptsächlich die Byssusfäden (bei jungen Tieren) austreten. Nach Kaestner (1965: 420, fig. 376) ist dies bei *Tridacna* der Fusspalt. Dieser Spalt kann von der Muschel nicht geschlossen werden und bildet den Angriffspunkt für *Scyllarides*. Dieser Spalt wird meist mit den 1. Peraeopoden abgetastet und gleich darauf wird einer der 2. Peraeopoden, die schlanker sind, dort eingeführt, d.h. der Dactylus desselben hineingesteckt. Dann wird dieser Dactylus hin und hergeschoben, wobei wahrscheinlich innere Organe der Muschel verletzt werden (Nerven? Schliessmuskel?). Nach ca. 2 bis 3 Minuten öffnet sich dann die Muschelschale. Nun wird die Muschel welche unter dem Krebs, im Bereich der ersten und zweiten Peraeopoden Paare liegt, wieder gedreht. Die Schalenöffnung zeigt sich nun nach vorn und etwas nach oben. Die ersten Peraeopoden werden nun als Hebel zum weiteren öffnen der Muschel benutzt. Der Dactylus eines des Füsse drückt nach unten auf eine Schalenhälfte, während der andere nach oben zieht. Von aussen wird die Schale mittels der 3. Peraeopoden festgehalten und schliesslich wird wieder einer der 2. Peraeopoden in die Muschel eingeführt. Dieser beginnt mit der Lösung des Weichkörpers von der Schale. Der weitere Verlauf ist schwer zu sehen, da der Krebs sich nun mit seinen Mundwerkzeugen dicht über die Muschel legt. Es konnte noch festgestellt werden, das später die Teile des Weichkörpers der nun vollkommen geöffneten Schale, mit Hilfe der ersten beiden Füsse zu den Mundwerkzeugen geführt wurden. Nach ca. 1½ bis 2 Stunden war der ganze Fressakt beendet und nur die vollkommen saubere Muschelschale blieb zurück. Fische, welche sich dem Krebs während dieser Zeit näherten, wurden mit aufwärts Schlägen der Antennen zurückgeschreckt". As far as is known to me this is the first detailed account of the feeding of any species of *Scyllarides*. Furthermore Mr. Lewinsohn informed me that in the aquarium the species also feeds on other molluscs like *Meleagrina* and *Ostrea*, while pieces of dead fish are not declined either.

Distribution. — The species so far was only known from the area of Elat in the northern Gulf of Aqaba. It is likely that it has a wider distribution in the Red Sea, as recently, through the kindness of Dr. R. W. George of the Western Australian Museum, I could examine an adult female of the species (cl. 92 mm) collected by him in April 1963 at Qusaiyir, East Aden Protectorate, at a depth of 15 feet. No other species of this genus are known from the Red Sea.

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Scyllarides tridacnophaga Holthuis, male paratype, Elat, 1960-1965. $\times \frac{1}{2}$.



Scyllarides tridacnophaga Holthuis. Living specimen perched on *Millepora dichotoma* Forskål;
Elat, Israel, April 1965; phot. Douglas Faulkner.