

## REVISION OF *PSEUDOSQUILLANA* CAPPOLA & MANNING, 1995 (CRUSTACEA: STOMATOPODA: PSEUDOSQUILLIDAE)

Shane T. Ahyong

Department of Marine Invertebrates, Australian Museum 6 College St, Sydney, New South Wales 2010, Australia

Raymond B. Manning<sup>†</sup> and K. Reed

Department of Invertebrate Zoology, National Museum of Natural History Smithsonian Institution, Washington D.C. 20560, U.S.A. (†) deceased.

**ABSTRACT.** - *Pseudosquillana* Cappola & Manning, 1995, was recognized for *Pseudosquilla megalophthalma* Bigelow, 1893, and its presumed synonym, *P. richeri* Moosa, 1991. Restudy of types and other material of *P. megalophthalma* and *P. richeri* revealed both species to be distinct; *P. richeri* is removed from synonymy. The generic definition of *Pseudosquillana*, previously based on diagnostic characters of both species, is redefined and an amended key to the genera of the *Pseudosquillidae* is given. Both species have wide Indo-West Pacific distributions, but most records of *Pseudosquillana megalophthalma* are based on *P. richeri*. *Pseudosquillana richeri* is known from the western Indian Ocean, eastwards to Indonesia, New Caledonia and now Australia, Japan, and French Polynesia. *Pseudosquillana megalophthalma* is known from the type locality, Mauritius, and now from New Caledonia. The ectoparasitic gastropod, *Caledoniella montrouzieri* Souverbie is reported from *P. richeri* and constitutes the first record for a member of the *Pseudosquillidae*.

**KEY WORDS.** - *Pseudosquillana*, *Pseudosquillidae*, Stomatopoda, taxonomy.

---

### INTRODUCTION

Cappola & Manning (1995) recognized three genera and Manning (1995) subsequently recognised a fourth genus for species previously assigned to *Pseudosquilla* Dana, 1852. *Pseudosquilla* was restricted to the type species, *Squilla ciliata* Fabricius, 1787. *Pseudosquillisma* Cappola & Manning, 1995, and *Raoulserenea* Manning, 1995, were recognized for those species bearing a pair of large, 'eye' spots on the carapace. *Pseudosquillana* was recognized for *Pseudosquilla megalophthalma* Bigelow, 1893, and its presumed synonym *P. richeri* Moosa, 1991. Study of a large series of *Pseudosquillana*, principally from the collections of the National Museum of Natural History, Smithsonian Institution, Washington D.C., has shown that *P. megalophthalma* and *P. richeri* are distinct species, requiring emendation to the generic definition.

Several factors have probably hindered recognition of the two species: Bigelow (1893, 1894) neither illustrated nor noted the colour pattern of

*P. megalophthalma*, which is apparently less common than *P. richeri*, and Kemp (1915) reported on and figured a specimen of *P. richeri* (as *P. megalophthalma*) including colour pattern. Thus, the large dorsal spot on the carapace and narrower cornea of the eye erroneously became 'established' as characteristic of *P. megalophthalma*. Since then, nearly all reports of *P. megalophthalma* have been based on *P. richeri*, including those reported from New Caledonia by Moosa (1991) alongside his description of *P. richeri*. Subsequently, *P. richeri* was synonymised with *P. megalophthalma* by Cappola & Manning (1995). The definition of *Pseudosquillana*, stated as the bearing combination of strongly bilobed eyes, the large dorsal spot on the carapace and bispinous intermediate carina on AS6, was therefore composite, comprising diagnostic characters of both species, and therefore reliable for neither. Re-examination of the type material of both species of *Pseudosquillana*, with additional specimens of both species, has permitted us to revise the genus and clarify its taxonomy.

In our descriptions of telson carinae, the carina lateral to the accessory median carina is termed the anterior

submedian carina following Manning (1969, 1977a). In adults, the anterior submedian carina in pseudosquillids is not continuous with the submedian teeth of the telson, but we retain the terminology because in postlarval pseudosquillids, the anterior submedian carinae appear to correspond to the submedian teeth. Only in subsequent moult stages do the anterior submedian carinae diverge. The anterior submedian carina of the telson in pseudosquillids may ultimately prove not to be homologous with the anterior submedian carina of other families; should this prove to be the case, the carina lateral to the accessory median carina will be a synapomorphy of the Pseudosquillidae.

All measurements are in millimetres (mm). Terminology and size descriptors generally follow Manning (1969, 1977a). Total length (TL) is measured along the midline from the apex of the rostral plate to the apices of the submedian teeth of the telson. Carapace length (CL) is measured along the midline and excludes the rostral plate. Corneal index (CI) is given as 100CL divided by corneal width. Propodal index (PI) of the raptorial claw is given as 100CL divided by propodus length. The raptorial claw propodus length-depth index (PLDI) is given as 100 times the propodus length divided by the greatest propodus depth. Other abbreviations: antennule (A1), antenna (A2), abdominal somite (AS), maxilliped (MXP), median (MD), intermediate (IM), lateral (LT), marginal (MG), submedian (SM), thoracic somite (TS), International Indian Ocean Expedition (IIOE).

Specimens are deposited in the Australian Museum, Sydney (AM); American Museum of Natural History, New York (AMNH); Macleay Museum, University of Sydney (MM); Musèum National d'Histoire Naturelle, Paris (MNHN); Naturhistorisches Museum, Vienna (NHMV); Museum & Art Gallery of the Northern Territory, Darwin (NTM); Queensland Museum, Brisbane (QM); Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt (SMF); Zoological Museum, Tel-Aviv University (TAU); the National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM); and the Zoologische Staatssammlung, Munich (ZSM).

## SYSTEMATICS

PSEUDOSQUILLIDAE Manning, 1977

Key to genera of Pseudosquillidae

1. Telson with 3 carinae either side of MD carina .....2
- Telson with 4 carinae either side of MD carina .....3
2. Cornea subglobular, not broadened anteriorly. Carapace lacking pair of large dark spots. TS8 anterolateral margin blunt, with anterior notch. Uropodal protopod with inner spine longer .....*Pseudosquilla*
- Cornea flattened, broadened anteriorly. TS8 anterolateral margin lacking anterior notch. Carapace with pair of large dark spots. Uropodal protopod with inner spine shorter .....*Raoulserenea*
3. Rostral plate lacking anterior spinule. Telson with long LT carina .....*Pseudosquillana*
- Rostral plate with anterior spinule. Telson with short anterior IM carina. ....*Pseudosquillisma*

### *Pseudosquillana* Cappola & Manning, 1995

*Pseudosquillana* Cappola & Manning, 1995: 282-283.  
Type species *Pseudosquilla megalophthalma* Bigelow, 1893, by original designation and monotypy. Gender feminine.

**Diagnosis.** - Raptorial claw with propodus slender, longer than CL. Telson dorsal surface with distinct MD carina and 4 carinae either side of midline (accessory MD, anterior SM, LT and MG). TS8 anterolateral margin blunt, with anterior notch. Uropodal protopod terminating in 2 slender spines, outer longer; inner margin smooth, lacking angled shelf proximally.

**Description.** - Dorsal integument smooth, polished. Eye with cornea broadened anteriorly or strongly bilobed; not extending beyond A1 peduncle segment 2. Ophthalmic somite anterior margin with median spinule. Ocular scales narrow, separate, appressed medially.

A1 somite dorsal processes low, obsolete. A2 protopod lacking papillae; dorsally with ventrally carinate, articulated plate. A2 scale slender, length exceeding 4.0 width; entire margin setose.

Carapace with broadly rounded anterolateral angles; posterior margin unarmed.  
Raptorial claw dactylus with 3 teeth; carpus dorsally

unarmed; propodus longer than CL, opposable margin with movable spines proximally, distal margin with small tooth, often obscured by articular membrane; PLDI exceeding 548; merus outer inferodistal angle unarmed; ischium unarmed inferodistally.

Mandibular palp 3-segmented. MXP1-5 with epipod. MXP5 basal segment unarmed.

Pereiopods 1-3 with basal segment unarmed; endopod segments fused, distal segment styliform.

Male PLP1 endopod with tube process slightly exceeding hook process; hook process with acute hook; posterior distal endite with broad, non-setose lateral lobe.

Body subcylindrical, strongly convex dorsally; articulation compact. TS6-8 each lacking dorsal carinae. TS5 lateral process narrow, rounded, directed ventrally; ventral spine absent. TS6 with angular, ventrally directed lobe anteromesial to pereopodal articulation. TS6-7 lateral process broadly rounded. TS8 anterolateral margin blunt, with anterior notch.

AS1-5 each lacking dorsal carinae, excepting indistinct indication of MG carina. AS6 with SM, IM and LT spines; with obtuse ventrolateral projection anterior to uropodal articulation; sternum posterior margin unarmed, with sinuous transverse groove anteriorly.

Telson trianguloid; as broad as or slightly broader than long; with 3 pairs of primary teeth (SM, IM and LT); SM teeth appressed, bases separated by shallow emargination, with long, movable apices; with 2 IM and 1 LT denticles. Telson dorsal surface with distinct MD carina and 4 pairs of carinae (accessory MD, anterior SM, LT and MG) in addition to carinae of SM and IM teeth; MD carina uninterrupted proximally, armed posteriorly; accessory MD carina irregular; anterior SM carina uninterrupted, divergent posteriorly; LT carina uninterrupted, extending onto lateral tooth, divergent posteriorly; marginal carina uninterrupted; ventral surface smooth, lacking postanal carina.

Uropodal protopod terminating in 2 slender spines, outer longer; unarmed dorsally excepting spine above proximal exopod articulation; lacking ventral spine anterior to endopod articulation; inner margin smooth, lacking angled shelf proximally.

Uropodal exopod articulation terminal. Proximal

segment unarmed dorsally; inner margin straight with short, shallow proximal concavity; outer margin with graded movable spines, spiniform, distalmost exceeding midlength and occasionally apex of distal segment; distal margin with slender ventral spine. Exopod distal segment ovate, shorter than proximal segment. Endopod unarmed dorsally, entire margin setose.

**Remarks.** - Unlike other pseudosquillids, both *Pseudosquillana* and *Pseudosquillisma* bear four carinae lateral to the median carina of the telson. *Pseudosquillana* differs from *Pseudosquillisma* in bearing a long, posteriorly divergent lateral carina instead of the short anterior intermediate carina; the figure of the holotype of *P. richeri* (Moosa, 1991: fig.5) showing an intermediate carina on the telson is erroneous. Also, the propodus of the raptorial claw is generally more slender in *Pseudosquillana* than in other pseudosquillids (PLDI exceeds 529) and the distal spine is smaller and usually obscured by articular membrane, a feature overlooked by Moosa (1991) and Ah Yong & Norrington (1997).

In specimens of *Pseudosquillana richeri* (and presumably *P. megalophthalma*) less than around TL 20 mm, the lateral carina of the telson may be indistinct (Manning & Lewinsohn, 1986; Cappola & Manning, 1995; and as figured by Moosa, 1991: fig. 5) rendering the above key difficult to use. Nevertheless, species of *Pseudosquillana* may be recognized individually by other characters, given below under the species diagnoses.

Whereas both *P. richeri* and *P. megalophthalma* attain a similar size, *Pseudosquillana richeri* shows several apparently neotenous characters in comparison to *P. megalophthalma*: the narrower cornea, fewer posterolateral spines on the abdominal somites, less sharply developed carinae on the ventral surface of the uropodal protopod and dorsal surface of the telson. Taking other pseudosquillid genera as outgroups, the narrower cornea, and reduced spination and carination in *P. richeri* are likely plesiomorphic.

#### Key to species of *Pseudosquillana*

1. Eye with cornea strongly bilobed. Carapace dorsum lacking dark median 'eye spot'. AS2-5 each with posterolateral spine. AS6 with accessory inner spine at base of IM spine in adults ..... *P. megalophthalma*
- Eye with cornea broadened anteriorly, not

strongly bilobed. Carapace dorsum with dark median 'eye spot', often pale in outline, occasionally obscured by transverse band of pigment. AS1-3 each lacking posterolateral spine. AS6 lacking accessory inner spine at base of IM spine.....*P. richeri*

***Pseudosquillana megalophthalma* (Bigelow, 1893)**

(Fig. 1)

*Pseudosquilla megalophthalma* Bigelow, 1893: 101; 1894: 500-502 [type locality: Mascarene Islands, Mauritius]. - Kemp, 1913: 3, 10, 96 [key]. - ?Manning, 1977b: 285. - Moosa, 1984: 39 [list].

*Pseudosquillana megalophthalma*. - Cappola & Manning, 1995: fig. 4.

**Type material examined.** - Holotype: USNM 18003, male (TL 68 mm), Mascarene Islands, Mauritius.

**Other material examined.** - USNM 268579, 1 male (TL 93 mm), New Caledonia, 22°20'30"S, 166°14'45"E, 3-6.4 m, RW91-19, coll. R. Winterbottom, 11 Sep.1991; USNM 268581, 1 male (TL 94 mm), New Caledonia, 21°38'20"S, 166°17'45"E, 3-6.1 m, RW91-04, coll. R. Winterbottom, 31 Aug.1991; USNM 268580, 1 female (TL 42 mm), New Caledonia, 22°16'50"S, 166°10'30"E, 9.1-13.7 m, RW91-17, coll. R. Winterbottom.

**Diagnosis.** - Eye large; cornea strongly bilobed. Carapace dorsum lacking median circular patch of dark pigment. AS2-5 each with posterolateral spine. AS1-5 sternal keel each produced as a sharp, posteriorly directed spine. AS6 with accessory inner spine at base of IM spine in adults. Telson LT carina sharp, extending anteriorly almost to anterior margin of telson. Terminal spines of uropodal protopod each with distinct ventral carina.

**Description.** - Eye large, cornea strongly bilobed, not extending beyond A1 peduncle segment 2; CI 274-325.

A1 peduncle 0.61-0.77CL. A2 scale slender, length 0.60-0.64CL; entire margin setose.

Rostral plate broader than long, cordiform; apex obtusely angled; with slight anteromedian depression. Carapace dorsum lacking median circular patch of dark pigment.

Raptorial claw propodus with 3 movable spines proximally. PI 075-080. PLDI 607-679.

AS1 rounded posterolaterally. AS2-5 each with posterolateral spine. AS1-5 sternal keel each produced as a sharp, posteriorly directed spine. AS6 with accessory inner spine at base of IM spine in adults.

Telson with sharp LT carina, extending anteriorly almost to anterior margin of telson.

Terminal spines of uropodal protopod each with distinct ventral carina. Uropodal exopod proximal segment outer margin with 10-12 graded movable spines, distalmost exceeding midlength of distal segment.

**Colour pattern in alcohol.** - Overall pale yellowish olive green, dorsal surface evenly speckled with small dark chromatophores. A1 flagella pale orange. Carapace with gastric grooves dark. Antennal protopod dark dorsally. Raptorial claw merus with dark upper margin; carpus dark; propodus with dark upper, lower and distal margin. TS6-8 each with dark spot at base of pereopod. TS5-8 and AS1-5 with dark posterior margin. AS1-5 with dark spot in intermediate position; posterolateral margin darker than adjacent surface. AS6 with dark SM, IM, and LT spines. Telson dark. Uropodal protopod darkest proximally across articulations with exopod and endopod. Endopod dark proximally and distally. Exopod with movable spines on outer margin of proximal segment, articulation with distal segment and inner half of distal segment dark.

**Measurements.** - Males ( $n = 3$ ) TL 68-94 mm, female ( $n = 1$ ) TL 42 mm.

**Remarks.** - *Pseudosquilla megalophthalma* differs from *P. richeri* by the strongly bilobed cornea, absence of the large dorsal median spot on the carapace, absence of the dark 'eye spot' on the posterolateral angle of AS5, the presence of an accessory inner spine at the base of the IM spine of AS6, a posterolateral spine on AS2-3 and the longer LT carina on the telson, which reaches almost to the anterior margin of the telson. Further, in *P. megalophthalma*, the articulated dorsal process on the antennal protopod is relatively shorter, the teeth on the dactylus of the raptorial claw are more divergent than in *P. richeri*, the telson carinae are sharper, and the terminal spines of the uropodal protopod both bear a distinct ventral carina.

The identity of a specimen from Mauritius reported by Manning (1977b) as *P. megalophthalma* requires verification.

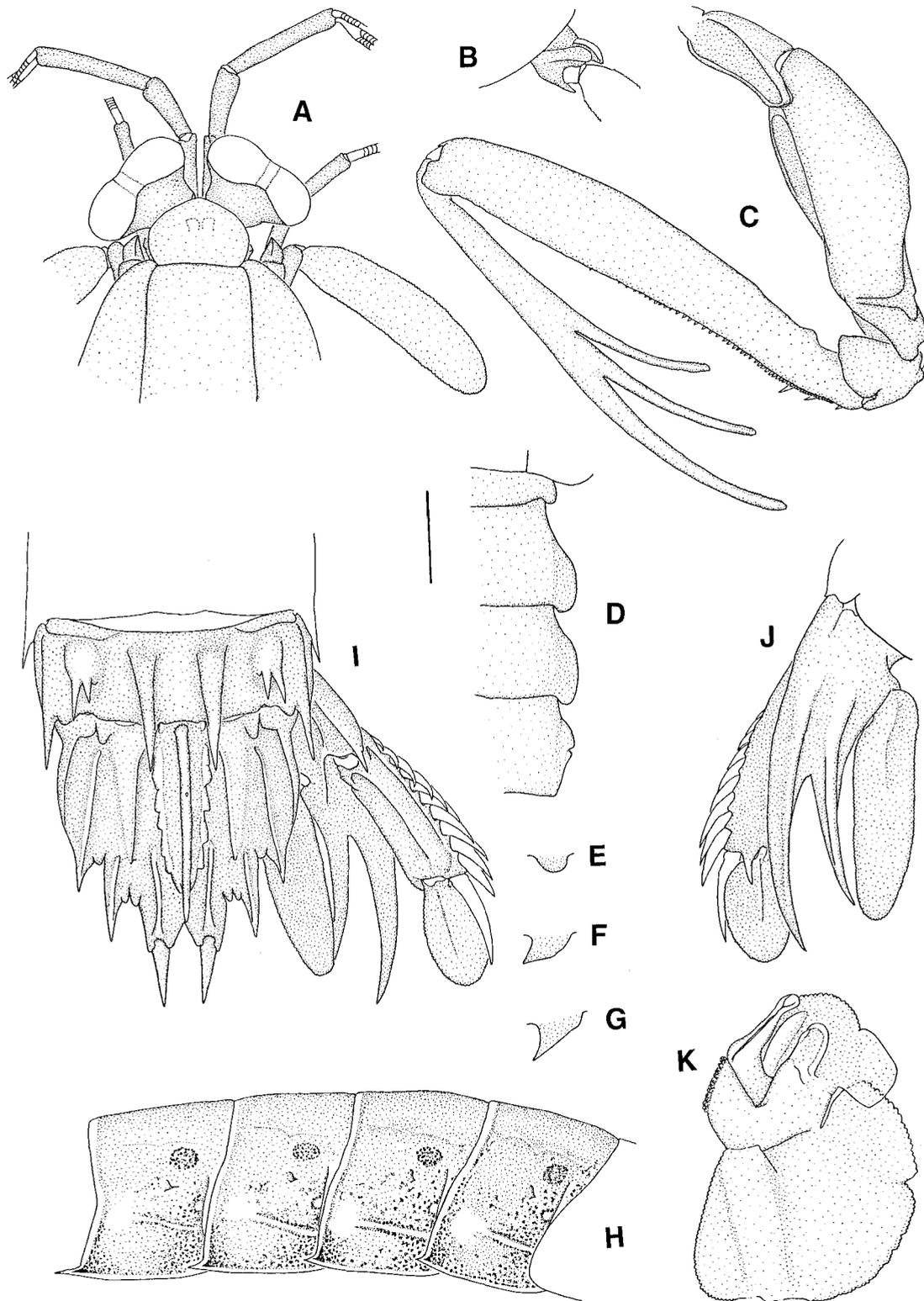


Fig. 1. *Pseudosquilla megalophthalma* (Bigelow), USNM 268581, male (TL 94 mm), New Caledonia. A, anterior cephalon, dorsal. B, antennal protopod, right lateral. C, raptorial claw, right lateral. D, TS5-8, right dorsal. E, TS8 sternal keel, right lateral. F, AS1 sternal keel, right lateral. G, AS2 sternal keel, right lateral. H, AS2-5, right lateral showing colour pattern. I, AS6, telson & uropod, dorsal. J, uropod, right ventral. K, pleopod 1 endopod, right anterior. Scale: A-J = 5 mm, K = 1.7 mm.

**Distribution.** - Indo-West Pacific from Mauritius and now New Caledonia. Previous records of *P. megalophthalma* from New Caledonia (Moosa, 1991) are all referable to *P. richeri*. Known only from shallow water, less than 14 m.

***Pseudosquillana richeri* Moosa, 1991**  
(Figs. 2-3)

*Pseudosquilla richeri* Moosa, 1991: 175-176, fig. 5 [type locality: New Caledonia, 18°27.2'S, 163°02.3'E].

*Pseudosquilla ornata*. - Borradaile, 1907: 213 [part, not *Pseudosquilla ornata* Miers, 1880].

*Pseudosquilla megalophthalma*. - Nobili, 1906: 336-337. - Kemp, 1915: 172, pl. 1, fig. 1. - Tattersall, 1921: 357, pl. 27, figs 1-3. - Holthuis, 1941: 267-268; 1967: 40 [list]. - Roxas & Estampador, 1930: 109, pl. 2, fig. 1, 2. - Dollfus, 1938: 201; 1959: fig. 9. - Ingle, 1963: 21-22, figs 19, 37, 38, 69. - Manning & Lewinsohn, 1986: 12, 15 [list], fig. 4. - Vine, 1986: 98. - Moosa, 1991: 174 [not *Pseudosquilla megalophthalma* Bigelow, 1893].

*Pseudosquillana megalophthalma*. - Cappola & Manning, 1995: 283-284, fig. 5, non fig. 4. - Ahyong & Norrington, 1997: 104-105 [not *Pseudosquillana megalophthalma* (Bigelow, 1893)].

**Type material examined.** - Holotype: MNHN Sto 1419, male (TL 27 mm), New Caledonia, lagoon, 18°27.2'S, 163°02.3'E, 39-40 m, sand & *Halimeda*, coll. B. Richer de Forges.

**Other material examined.** - *Indian Ocean*: USNM 189382, 3 males (TL 16-26 mm), 1 female (TL 17 mm), Red Sea, Sinai Peninsula, Egypt, 3 km S of Sherm A Sheikh, 0-3 m, coll. Ch. Lewinsohn & R. B. Manning, 15 Oct.1979; TAU NS16766, 2 males (TL 27-28 mm), Ras Muhummad, coll. B. S. Galil, 7 Apr.1979; ZSM, 1 female (TL 18 mm), Mersa Haleib, Sudan, 'Pola' Expedition, Nov.1895; ZSM, 1 female (TL 19 mm), Habban, Saudi Arabia, 'Pola' Expedition; NHMV, 1 female (TL 39 mm), Djeddah, Saudi Arabia, 1885; MNHN Sto 365, 1 female (TL 35 mm), Abulat, Red Sea; MNHN Sto 366, 1 female (TL 21 mm), Abulat, Red Sea; MNHN Sto 364, 2 males (TL 49 mm; 1 broken, CL 7.3 mm), 3 females (TL 36-42 mm), Djibouti & Obock, coll. F. P. Jousseume, 1897; USNM 124717, 1 female (TL 39 mm), French Somalia, Djibouti & Obock, coll. F. P. Jousseume, 1897; USNM 268587, 1 male (TL 30 mm), Mozambique Channel, 16(21'S, 43(59'E, 27

m, IIOE Sta 408-F, RV "Anton Bruun", 16 Oct.1967; USNM 268582, 1 male (TL 39 mm), 3 females (16-41 mm), Comores, poison station, 12°40'23"S, 045°04'28"E, 6-18 m, stn RW88-15, coll. R. Winterbottom, 15 Nov.1988; USNM 268584, 1 female (TL 46 mm), Beacon Island, SE corner, Seychelles, 3-9 m, IIOE Sta F-5, coll. D. Dockins et al., 25 Jan.1964; USNM 268585, 1 male (TL 20 mm), Amirantes Islands, vicinity of St Joseph Island, Seychelles, SW of Ressource Island near drop-off, outside small boat passage, 24-30 m, IIOE Sta F-95, coll. J. Bohlke et al., 7 Mar.1995; USNM 268588, 1 female (TL 23 mm), vicinity of Anonyme Island, Seychelles, 2.8 m, IIOE Sta F-37, coll. J. Bohlke et al., 10 Feb.1964; USNM 268593, 1 male (TL 46 mm), Praslan Id, Seychelles, IIOE Sta F-59, coll. 22 Feb.1964.

*Pacific Ocean*: MM C81, 1 female (TL 37 mm), Moluccas, Indonesia; USNM 268589, 1 female (TL 61 mm), Philippines, 09°02'27"N, 123°07'37"E SI PHILEXP-78, Sta SP-78-9, poison stn, 6-9 m, coll. V. Springer, 12 May 1978; USNM 268590, 1 male (TL 39 mm), 1 female (TL 41 mm), Philippines, 10°52'30"N, 120°56'00"E, SI PHILEXP-78, Sta SP-78-20, poison stn, 0-14 m, coll. V. Springer, 23 May 1978; SMF 311809, 1 female (TL 37 mm), Amami Islands, Japan, coll. K. Sakai, 22 Jul.1966; NTM Cr010277, 1 male (TL 41 mm), Tab Island, Pik Island, Madang, Papua New Guinea, 05°10.6'S, 145°50.6'E, 25-30 m, coll. G. Allen, 30 Oct.1991; NTM Cr009512, 1 male (TL 32 mm), 1 female (TL 80 mm), Pik Island, Tab Islands, Madang, Papua New Guinea, 05°08.5'S, 145°49.7'E, 12-17 m, rotenone, coll. G. Allen, 31 Oct.1991; QM W22265, 1 female (TL 14 mm), West Islet lagoon, Wreck Flat, Coral Sea, Australia, 15 m, in *Tubipora musica* on large bommie, coll. J. Short, 19 May 1988; MNHN Sto 1416, 1 male (TL 52 mm), New Caledonia, lagoon, 21°58.5'S, 166°42.6'E, 34-40 m, coll. B. Richer de Forges, 6 Aug.1986; MNHN Sto 1417, 1 male (TL 60 mm), New Caledonia, 22°08.9'S, 167°00.5'E, 48 m, coral blocks and red algae, coll. B. Richer de Forges, Aug.1986; MNHN Sto 1418, 1 male (TL 69 mm), 1 female (TL 28 mm), Chesterfield Islands, lagoon, 19°09.00'S, 158°42.62'E, 62 m, with *Halimeda*, coll. B. Richer de Forges, Jul-Aug.1988; AM P19456, 1 female (TL 87 mm), Pula Iwa, New Hebrides, coll. G. Allen, 25 Jun.1973; AM P19970, 1 female (TL 73 mm), Sandfly Passage, Florida Island, Solomon Islands, 10 m, from coral crevice, coll. B. Goldman & J. Randall, Jul.1973; USNM 104699, 1 male (TL

23 mm), Kajsingamaiangi Atoll, Tiatua Is., Caroline Ids., coll. C. Hand, 13 Jul.1954; USNM 124892, 1 female (broken, CL 4.8 mm), SW side of Caroline Island, Saipan, from coral head, coll. A. H. Banner 1945; USNM 128351, 1 female (TL 34 mm), Canton Island, Phoenix Islands, 02(50'S, 171(40'W, 6-7.5 m, coral head from lagoon, coll. C. A. Ely, 2 Nov.1941; USNM 268583, 1 female (TL 36 mm), Fiji Expedition, poison stn, Marsden Square 354-4, Stn WE 83-09, 0.5-2.5 m, 20 Mar.1983; USNM 268591, 1 male (TL 29 mm), Fiji Expedition, poison stn, Marsden Square 354-4, Stn WE 83-37, 5-10 m, 2 Apr.1983; USNM 268586, 1 female (TL 25 mm), Ponape, Sta 4, coll. Marine Resources Division per Richard Croft, 1981; USNM 268592, 1 male (TL 36 mm), Ponape, Sta 2, coll. Marine Resources Division per Richard Croft, 1981; AMNH 9330, 2 females (TL 26 mm), Mataatu Harbor, Savaii Island, Samoa, 2.4 m, eastern reef, in crevices in coral, RV "Zaca", 17 Oct.1936; AMNH 9331, 2 males (TL 23-33 mm), Mataatu Harbor, Savaii Island, Samoa, 2.4 m, RV "Zaca", 18 Oct.1936; USNM 124889, 2 females (TL 20 mm; 1 broken, CL 4.6 mm), Tuamotu Archipelago, Fakaraua, Paumotu Reef, "Albatross", 13 Oct.1899; USNM 109625, 1 female (TL 48 mm), Society Islands, Tahiti, 12-18 m, sand & coral, coll. R. Watkins, 2 Mar.1962; USNM 124890, 1 female (TL 27 mm), Port du Bourayne, Huahine, Society Islands, from massive coral, stn 86c-57, coll. Smithsonian-Bredin Expedition to the Society Islands, 01 May 1957; USNM 124891, 1 male postlarva (broken, CL 2.5 mm; TL ca. 13 mm), 1 female (TL 25 mm), Arno Atoll, Marshall islands, Stn EL-291, coll. R. W. Hiatt, 1950.

**Diagnosis.** - Eye with cornea broadened anteriorly, slightly broader than stalk. Carapace dorsum with median circular patch of dark pigment, often pale in outline, occasionally obscured by transverse band of pigment. AS1-3 each lacking posterolateral spine. AS4-5 each with posterolateral spine. AS3-5 sternal keel each produced as a sharp, posteriorly directed spine. AS6 lacking accessory inner spine at base of IM spine. Telson LT carina not extending anteriorly beyond about two thirds distance to anterior margin of telson. Terminal spines of uropodal protopod lacking distinct ventral carina.

**Description.** - Eye with cornea broadened anteriorly, slightly broader than stalk; not extending beyond A1 peduncle segment 2; CI 200-474.

A1 peduncle 0.62-0.94CL. A2 scale slender, 0.42-0.60CL.

Rostral plate broader than long, cordiform to ovoid; apex angled to broadly rounded; lacking dorsal ornamentation. Carapace dorsum with median circular patch of dark pigment, often with pale outline, occasionally obscured by transverse band of pigment.

Raptorial claw propodus with 2-3 movable spines proximally. PI 060-084. PLDI 529-826.

AS1-3 each lacking posterolateral spine. AS4-5 with posterolateral spine. AS1 sternal keel angular, blunt; that of AS2 triangular. AS3-5 sternal keel each produced as a sharp, posteriorly directed spine. AS6 lacking accessory inner spine at base of intermediate spine in adults.

Telson with LT carina not extending anteriorly beyond about two thirds distance to anterior margin of telson.

Uropod exopod proximal segment outer margin with 9-12 graded movable spines, distalmost exceeding midlength and occasionally apex of distal segment.

**Colour pattern in alcohol.** - Base colour generally uniform red-brown to brown-green, grading to transverse, alternating light and dark bands. In specimens of uniform base colour, dorsum of carapace, thorax and abdomen sometimes with numerous small white spots as depicted by Kemp (1915: pl.1) (Fig. 3). Carapace with dark brown or black median circular patch, with or without pale outline, occasionally obscured by transverse band of pigment in banded morphs. Posterior margin of thoracic and abdominal somites crimson. TS6-8 sterna with dark transverse bar. Posterolateral angles of AS6 with dark brown or black 'eye' spot. Spines of AS6, telson teeth and movable outer spines of the uropod crimson. Telson margin dark brown. Raptorial claw dactylus maroon to bright pink; propodus dark on proximal half, with diffuse black spot distally; carpus with dark spot on inner surface.

**Measurements.** - male ( $n = 23$ ) TL 13-49 mm, female ( $n = 34$ ) TL 14-87 mm, male postlarva TL 13 mm.

**Remarks.** - Characters distinguishing *P. richeri* from *P. megalophthalma* are discussed under the account of the latter. As already noted, almost all published records of *P. megalophthalma* are based on *P. richeri*. The identity of the specimen reported from Mauritius by Manning (1977b) cannot be confirmed without reexamination of the specimen.

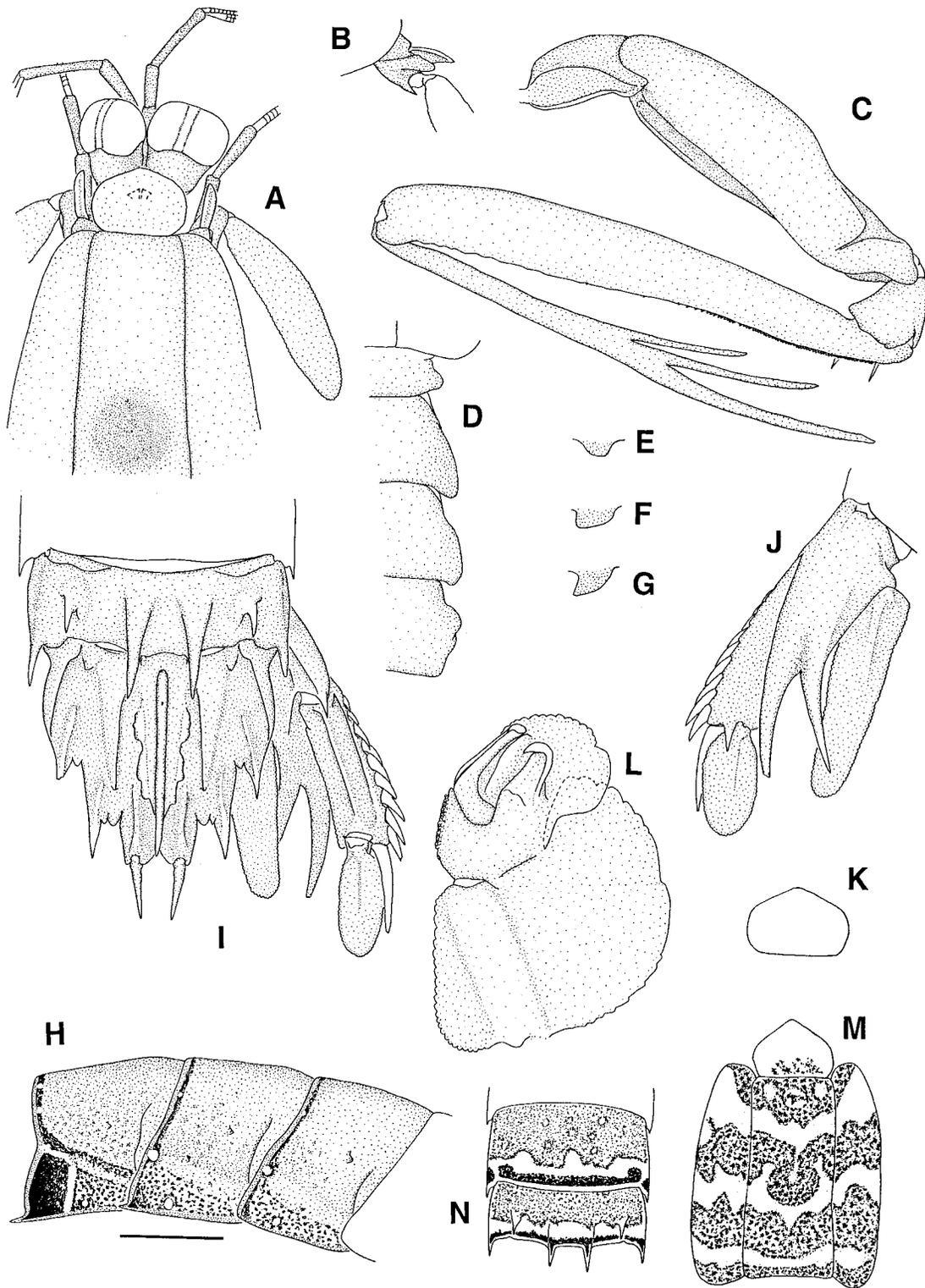


Fig. 2. *Pseudosquillana richeri* (Moosa), A-J, female (TL 87 mm), AM P19456, New Hebrides. K, male (TL 46 mm), USNM 268593, Seychelles. L, female (TL 37 mm). Moluccas. M, N, female (TL 14 mm), QM W22265, Coral Sea. A, anterior cephalon, dorsal. B, antennal protopod, right lateral. C, raptorial claw, right lateral. D, TS5-8, right dorsal. E, TS8 sternal keel, right lateral. F, AS1 sternal keel, right lateral. G, AS2 sternal keel, right lateral. H, AS3-5, right lateral showing colour pattern. I, AS6, telson & uropod, dorsal. J, uropod, right ventral. K, rostral plate, dorsal. L, pleopod 1 endopod, right anterior. M, carapace & rostral plate, dorsal showing colour pattern. N, AS5-6, dorsal, showing colour pattern. Scale: A-J = 5 mm, K = 2.5 mm, L-N = 1.2 mm.

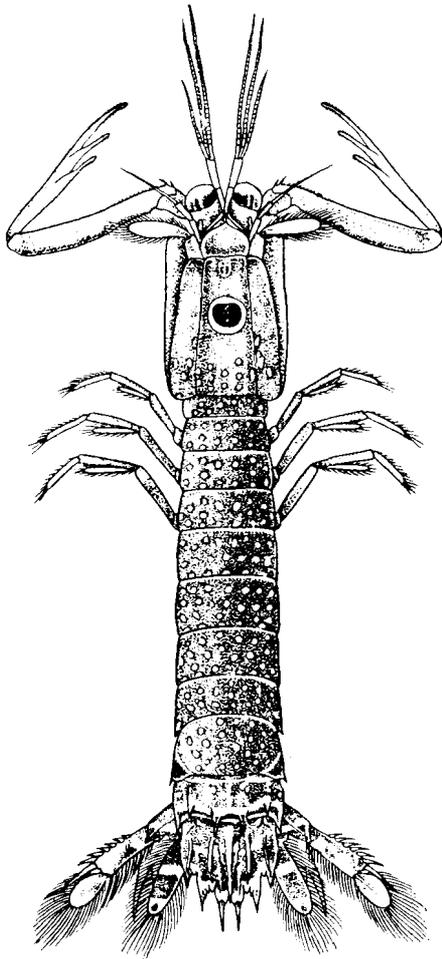


Fig. 3. *Pseudosquillana richeri* (Moosa), male (TL 38 mm), Philippines. Dorsal view (after Kemp (1915)).

Allometric variation is present in the shape of the anterior margin of the rostral plate, relative length and number of movable spines on the propodus of the raptorial claw, the relative size of the eyes and relative length of the antennular peduncle. As in other juvenile pseudosquillids, the anterior margin of the rostral plate is obtusely angled and becomes increasingly rounded with increasing size. In most specimens up to TL 30-40 mm, the propodus bears three movable spines, whereas in most specimens above this size, the proximal spine is lost. The holotype of *P. richeri* bears two movable spines on the propodus of both raptorial claws, not one as reported (Moosa, 1991). As in other stomatopods, the width of the eyes and length of the antennular peduncle relative to the carapace length decreases with increasing size.

In preserved material, the background coloration ranges from transversely banded, as in the holotype,

to more uniform brownish with varying numbers of pale spots as figured by Kemp (1913: pl.1) (Fig. 3). Regardless of background colour, however, a consistent feature of *P. richeri* is the large, circular median patch on the carapace and dark 'eye' spot on the AS5 posterolateral angle. This median 'eye spot' on the carapace may or may not be surrounded by a light ring and in some specimens, the median spot may be flanked by several small pale spots. When the general background pattern is banded, the median 'eye spot' may be somewhat obscured. In some specimens the variation in the median 'eye spot' relates to preservation. Many specimens, however, show a well preserved colour pattern as well as the aforementioned pattern variation associated with the median 'eye spot', suggesting that such variation is not an artefact of preservation. Whereas species of *Raoulserenea* and *Pseudosquillisma* show species specific colour patterns, the intergrading exhibited by the present material suggests that colour pattern in *P. richeri*, like *Pseudosquilla ciliata*, is highly variable.

*Pseudosquillana richeri* apparently settles at a considerably smaller size than other pseudosquillids - the single postlarva in the present collection, a broken male, has an approximate TL of 13 mm. Postlarval *Pseudosquilla ciliata* (Fabricius, 1787) have been reported at a TL 17.8-23.7 mm (Bigelow, 1931; Manning, 1969, 1977); *Pseudosquillisma adialta* (Manning, 1964) at TL 25 mm (Camp & Kuck, 1990); *Pseudosquillisma oculata* (Brullé, 1837) at a TL 24-33.3 mm (Bigelow, 1931; Manning, 1969, 1977); *Pseudosquillisma guttata* (Manning, 1972) at TL 25 mm (Manning, 1972); *Raoulserenea ornata* (Miers, 1880) at TL 20.5 mm (Bigelow, 1931); and *R. pygmaea* (Caldwell & Manning, 2000) at TL 18 mm (Caldwell & Manning, 2000).

One male specimen from the Philippines, (USNM 268589) was found with a male and female of the ectoparasitic parasitic gastropod, *Caledoniella montrouzieri* Soubrier, 1869, attached. Manning & Reaka-Kudla (1990) reported *C. montrouzieri* only from members of the Gonodactylidae; the present record therefore represents the first for the Pseudosquillidae.

**Distribution.** - widely distributed in the Indo-West Pacific, from the western Indian Ocean and Red Sea, Seychelles, to the Philippines, Indonesia, the Solomon Islands, New Caledonia, the Caroline Islands and now from Japan, Papua New Guinea, French Polynesia and Australia. Shore or shallow

sublittoral down to 62 m (Moosa, 1991).

## ACKNOWLEDGMENTS

Thanks are due to Dr P. Berents (AM), Mr G. Dally (NTM), Mr P. Davie (QM) and Mr S. Norrington (MM) for access to their stomatopod collections. Thanks to Drs A. Crosnier, D. Guinot, N. Ngoc-Ho and Mr R. Cleva (MNHN) for their generous hospitality during a visit to the Paris by STA. Thanks to Dr G. Wilson (AM) for reviewing a draft of the manuscript. STA's stomatopod studies were supported by a grant from the Joyce Vickery Research Fund (Linnean Society of New South Wales), an Australian Museum Postgraduate Grant and an Australian Postgraduate Award from the Australian Research Council, administered by the University of New South Wales.

## LITERATURE CITED

- Ahyong, S. T. & S. F. Norrington, 1997. Stomatopod Crustacea in the Macleay Museum, University of Sydney. *Proc. Linn. Soc. N.S.W.*, **118**: 97-110.
- Bigelow, R. P., 1893. Preliminary notes on the Stomatopoda of the Albatross collections and on other specimens in the National Museum. *Johns Hopkins Univ. Circ.*, **12**(106): 100-102.
- Bigelow, R. P., 1894. Report on the Crustacea of the Order Stomatopoda, collected by the Steamer Albatross between 1885-1891 and on other specimens in the U.S. National Museum. *Proc. U.S. Nat. Mus.*, **17**: 489-550, figs 1-28, pls. 1-3.
- Bigelow, R. P., 1931. Stomatopoda of the southern and eastern Pacific Ocean and the Hawaiian Islands. *Bull. Mus. Comp. Zool. Harv.*, **72**(4): 105-191, pls. 1,2.
- Borradaile, L. A., 1907. Stomatopoda from the western Indian Ocean. The Percy Sladen Trust Expedition to the Indian Ocean in 1905, under the leadership of J. Stanley Gardiner. *Trans. Linn. Soc. London* (2, Zool.), **12**: 209-216, pl. 22.
- Brullé, G. A., 1837-1839. Crustacés. In: P. Barker-Webb, & S. Berthelot, Histoire naturelle des Iles Canaries, Zoologie **2**(2, Entomologie): 13-18 [1839]. Atlas [1837].
- Caldwell, R. L. & R. B. Manning, 2000. A new dwarf pseudosquillid of the genus *Raoulserenea* from French Polynesia (Crustacea, Stomatopoda). *Zoosystema*, **22**(1): 101-105.
- Camp, D. K. & H. G. Kuck, 1990. Additional records of stomatopod Crustaceans from Isla del Coco and Golfo de Papagayo, East Pacific Ocean. *Proc. Biol. Soc. Washington*, **103**(4): 847-853.
- Cappola, V. & R.B. Manning, 1995 [for 1994]. Research on the coast of Somalia. Crustacea Stomatopoda. *Trop. Zool.*, **7**: 271-291.
- Dana, J. D., 1852-1855. Crustacea, Part 1. United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N., **13**: 1-685 [1852]. Atlas: 1-27, pls. 1-96 [1855]. C. Sherman, Philadelphia.
- Dollfus, R. Ph., 1938. Stomatopoda (II). Catalogue synonymique des espèces jusqu'à présent récoltées dans la Mer Rouge, y compris la partie sud du Canal de Suez et le Golfe d'Aden. In: Mission Robert Ph. Dollfus en ...Égypte, X. - *Mémoires de l'Institut d'Égypte*, **37**: 185-236.
- Dollfus, R. Ph., 1959. Stomatopoda, III. In: *Mission Robert Ph. Dollfus en Égypte*, **XXX**, *Sci. Res.*, **3**: 241-245.
- Fabricius, J. C., 1787. Mantissa insectorum sistens eorum species nuper detectas adjectis characteribus genericis, differentiis specificis, emendationibus, observationibus, **1**: xx + 348pp. Christ. Gottl. Proft, Hafniae.
- Holthuis, L. B., 1941. The Stomatopoda of the *Snellius* Expedition. Biological Results of the *Snellius* Expedition, XII. *Temminckia*, **6**: 241-294.
- Holthuis, L. B., 1967. The stomatopod Crustacea collected by the 1962 and 1965 Israel South Red Sea Expeditions. The Second Israel South Red Sea Expedition, 1965, Report No. 1. *Israel J. Zool.*, **16**: 1-45.
- Ingle, R. W., 1963. Crustacea Stomatopoda from the Red Sea and Gulf of Aden. Contributions to knowledge of the Red Sea no. 26. *Bull. Sea Fish. Res. Station (Haifa)*, **33**: 1-69.
- Kemp, S., 1913. An account of the Crustacea Stomatopoda of the Indo-Pacific region, based on the collection in the Indian Museum. *Mem. Indian Mus.*, **4**(1): 1-217.
- Kemp, S., 1915. On a collection of stomatopod Crustacea from the Philippine Islands. *Philippine J. Sci.* **10**(3D): 169-186.
- Manning, R. B., 1964. A new West American species of *Pseudosquilla* (Stomatopoda). *Crustacean*, **6**(4): 303-308.
- Manning, R. B., 1969. Stomatopod Crustacea of the western Atlantic. *Stud. Trop. Oceanography*. Miami **8**: viii + 380pp.
- Manning, R. B., 1972. Two new species of

- Pseudosquilla* (Crustacea, Stomatopoda) from the Pacific Ocean. *Am. Mus. Novitates*, **2484**: 1-11.
- Manning, R. B., 1977a. A monograph of the West African stomatopod Crustacea. *Atlantide Report*, **12**: 25-181.
- Manning, R. B., 1977b. Stomatopod Crustacea in the Muséum d'Histoire Naturelle, Geneva. *Rev. Suisse Zool.*, **84**: 279-295.
- Manning, R. B., 1995. Stomatopod Crustacea of Vietnam: the legacy of Raoul Serène. *Crust. Res. Special No. 4*: 1-339. The Carcinological Society of Japan. Shimoda Printing, Kumamoto, Japan.
- Manning, R. B. & Ch. Lewinsohn, 1986. Notes on some stomatopod Crustacea from the Sinai Peninsula, Red Sea. *Smithson. Contr. Zool.*, **433**: 1-19.
- Manning, R. B. & M. L. Reaka-Kudla, 1990. The distribution of the parasitic gastropod *Caledoniella montrouzieri* Souverbie, 1869 (Caledoniellidae), on gonodactylid stomatopod crustaceans. *Raffles Bull. Zool.*, **38**(1): 77-82.
- Miers, E. J., 1880. On the Squillidae. *Ann. Mag. Nat. Hist.*, **5**: 1-30, 108-127.
- Moosa, M. K., 1984. Notes on Stomatopod Crustacea from La Réunion and Mauritius. Résultats de campagnes océanographiques du M.S. 'Marion-Dufresne' et de prospections littorales de la Vedette 'Japonaise', C.N.F.R.A **55**: 37-40.
- Moosa, M. K., 1991. The Stomatopoda of New Caledonia and Chesterfield Islands. In: Richer de Forges (ed.). *Le benthos de fonds meubles des lagons de Nouvelle-Calédonie 1*: 149-219. Editions de l'ORSTOM, Paris.
- Nobili, G., 1906. Fauna Carcinologique de la Mer Rouge. Decapodes et Stomatopodes. *Ann. Sci. Nat., Zool.*, (9)**4**: 1-347, pls. 1-11.
- Roxas, H. A. & E. Estampador, 1930. Stomatopoda of the Philippines. *Natural and Applied Science Bulletin, University of the Philippines*, **1**(1): 93-131.
- Souverbie, S. M., 1869. Diagnoses de mollusques inédits provenant de la Nouvelle-Calédonie. *J. Conchyl.*, **17**: 416-421.
- Tattersall, W. M., 1921. Report on the Stomatopoda and Macrurous Decapoda collected by Mr Cyril Crossland in the Sudanese Red Sea. *J. Linn. Soc. Zool.*, **34**: 345-398, pls. 27-28.
- Vine, P., 1986. *Red Sea Invertebrates*. IMMEL, London, 224 pp.