

**COMPENDIUM OF MANTIS SHRIMPS
(CRUSTACEA: STOMATOPODA) OF THE
INDIAN WATERS COLLECTED DURING THE
EXPEDITIONS OF FORV SAGAR SAMPADA**

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**MINISTRY OF EARTH SCIENCES,
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PREFACE

India is one of the most biodiverse nations on the planet with diverse marine ecosystems supporting an estimated 20,000 + animal species. The climate change coupled with human-induced disturbances through fishing, mining, tourism and pollution observed to impair their sustainability, in some cases lead to extinction. Although, several studies have been undertaken to document the biodiversity of the Indian waters (presently Indian Exclusive Economic Zone), they remained as patchy in terms of geographic coverage, thereby necessitating comprehensive surveys across the region for understanding discernible changes in biodiversity. In this regard, the “Resource Exploration and Inventorization System” sponsored by the Ministry of Earth Sciences, Government of India, and executed by the Centre for Marine Living Resources & Ecology, Kochi has been at the forefront of these efforts. Comprehensive surveys of the seas in the Indian EEZ by the CMLRE-owned Fisheries Oceanographic Research Vessel (FORV) Sagar Sampada have resulted in moderately large faunal collections that have been deposited in the Referral Centre of the CMLRE. The present work on the mantis shrimps is a part of a series of e-books on various groups of marine crustaceans collected on-board the FORVSS.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, CMLRE, Kochi, India for providing an opportunity and facilities to carry out taxonomic studies on marine crustaceans. The study has been a part of the “Resource Exploration and Inventorization System” Project funded by the Ministry of Earth Sciences, Government of India. The authors are also grateful to the scientific staff and crew members of the FORV Sagar Sampada for meticulously collecting the samples. A special thanks to Dr. Venkata Ramu Cherukuri, Project Scientist B, CMLRE for plotting the maps.

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INTRODUCTION

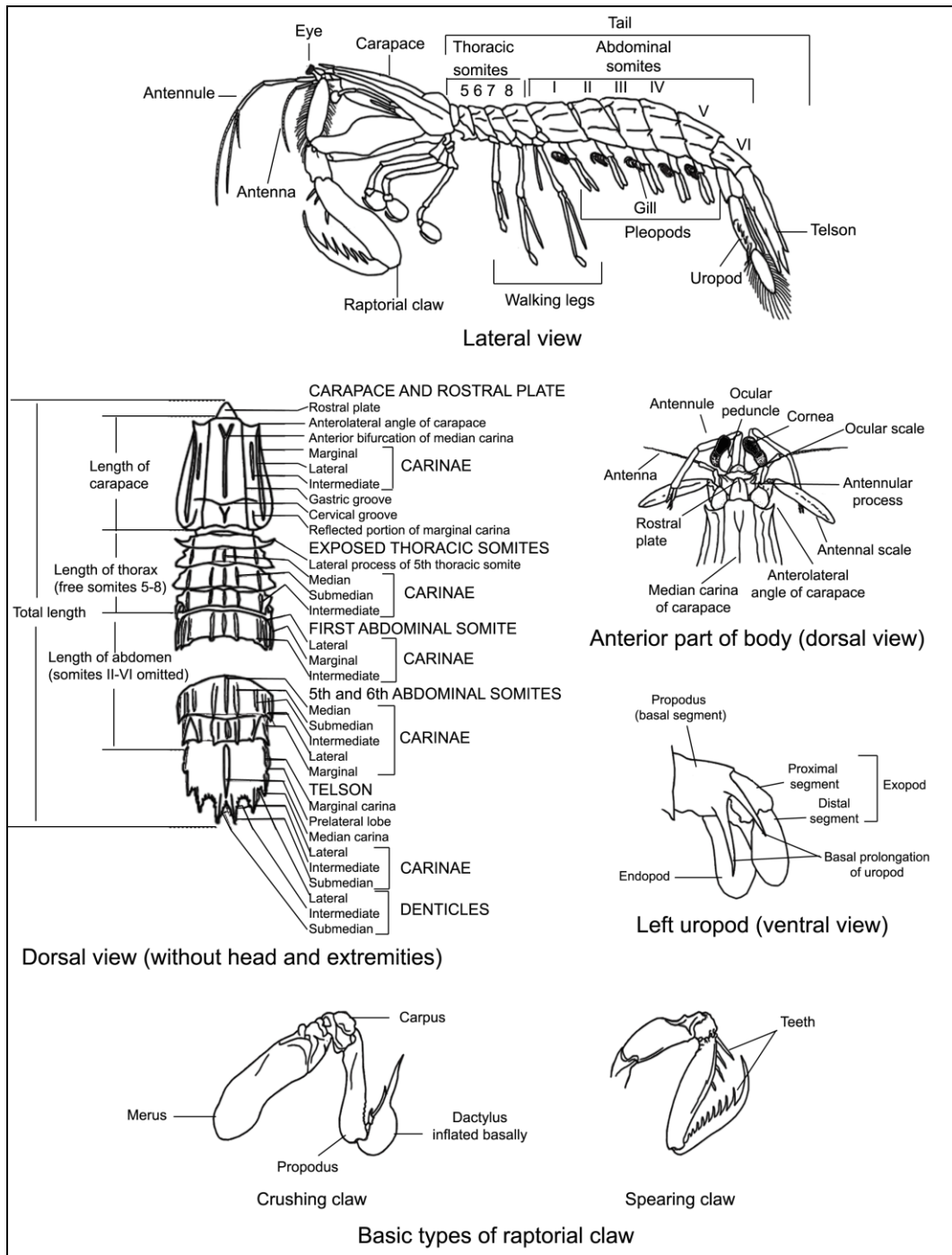


Fig. 1. Generalized diagram of a mantis shrimp (Order Stomatopoda) indicating body parts (modified from Manning, 1998).

Mantis shrimps are primitive burrowing predators (Schram, 1986) belonging to Subclass Hoplocarida Calman, 1904: Order Stomatopoda Latreille, 1817: Suborder Unipeltata Latreille, 1825. Their body is covered by chitinous exoskeleton and divided into head, thorax and abdomen. Each division contains

definite number of segments such as 6 cephalic, 8 thoracic and 6 abdominal somites. The carapace covers all cephalic and first 4 thoracic somites, and bears 1 pair of compound eyes, biramous antennules and antennae, uniramous mandibular palp and maxillipeds (mouth parts). The second pair of maxillipeds is modified into huge raptorial claws folded under the carapace. The last 4 thoracic sternites and all abdominal somites are covered by separate calcareous plates. The thoracic somites bear 3 pair of walking appendages called pereopods; abdominal somites bear 5 pairs of pleopods. The telson is expanded and bears appendages called uropods, which consist of 1 basal protopod, and 1 pair of apical segments namely the inner endopod and outer exopod (Fig. 1; Manning, 1998). These organisms are classified into 7 superfamilies namely Bathysquilloidea Manning, 1967; Erythroquilloidea Manning & Bruce, 1984; Eurysquilloidea Manning, 1977; Gonodactyloidea Giesbrecht, 1910; Lysiosquilloidea Giesbrecht, 1910; Parasquilloidea Manning, 1995; Squilloidea Latreille, 1802 based on the differences in shape of cornea, and maxilliped propodi, as well as external armature on carapace, raptorial claw, thoracic somites, abdomen, telson and uropods (Ahyong, 2001).

Mantis shrimps inhabit estuaries, coral reefs, subtidal sandflats, and waters beyond 200 m depth. They play an important ecological role in structuring marine benthic food webs (Antony *et al.*, 2010) as diet of crustaceans (Hamano & Matsuura, 1986), fishes (Navia *et al.*, 2011) and seabirds (Copello *et al.*, 2008). Their burrowing activities were found to bioturbate the sediments, thereby affecting the energy flow and nutrient cycling (Laverock *et al.*, 2011). They are good ecological indicators of pollution stress in coral reef ecosystems (Erdmann & Caldwell, 1997), and also support economically important fishery resources worldwide (Lai *et al.*, 2003).

However, despite their economic and ecological importance, taxonomy of stomatopods is least studied among the Indian crustaceans. Most published literature dates back to the British colonial period, resulting in lacunae in information on the taxonomy, habitat and geographical distribution of these organisms, thereby necessitating detailed work on this aspect. This e-book provides brief illustrated taxonomic accounts of stomatopods collected on-board FORV Sagar Sampada from several locations in the Indian EEZ.

Historical background

Studies on stomatopod taxonomy commenced with the following description of *Cancer mantis* Linnaeus, 1758 (= *Squilla mantis* (Linnaeus, 1758)) from the Mediterranean Sea: "*Thoracis testa membranacea. Pedes utrinque 3. Pollex serrato-dontatus, terminalis. Dactyli sub abdomine trium parium. Antennae trifidae: lamina ovata ad oculos.*" Subsequently, substantial volumes of literature have been published over the next 250 years.

Prof. James Wood-Mason (1875) initiated stomatopod taxonomy in India when he described *Haptosquilla glyptocercus* (Wood-Mason, 1875) from Nicobar Islands, *Clorida decorata* Wood-Mason, 1875 from Andamans, and *Alimopsis supplex* (Wood-Mason, 1875) from Mumbai. Wood-Mason & Alcock (1891) described *Squilloides tenuispinis* (Wood-Mason, 1891) from Bay of Bengal. Alcock (1894) published a new species *Kempina stridulans* (Wood-Mason, 1894) posthumously described by Prof. Wood-Mason from Bay of Bengal. Wood-Mason (1895) compiled an illustrated monograph of 9 species deposited in the Indian Museum, Kolkata, including *Acanthosquilla multifasciata* (Wood-Mason, 1895), new to science. Alcock & Anderson (1899) reported *S. leptosquilla* from Andaman Sea. Lanchester (1903) reported 7 varieties of *Gonodactylus chiragra* (Fabricius, 1781) from Lakshadweep, out of which *Gonodactylellus incipiens* (Lanchester, 1903) was new to science.

Kemp (1911) described 12 new species out of which 9 namely *Heterosquilloides insignis* (Kemp, 1911), *Lenisquilla gilesi* (Kemp, 1911) *Alima hieroglyphica* (Kemp, 1911), *Quollastria gonypetes* (Kemp, 1911) *Miyakella holoschista* (Kemp, 1911), *Oratosquillina perpensa* (Kemp, 1911), *O. interrupta* (Kemp, 1911) *Erugosquilla woodmasoni* (Kemp, 1911), and *Harpiosquilla annandalei* (Kemp, 1911) are considered valid species. Kemp (1913) published the first comprehensive monograph of 97 Indo-West Pacific species deposited in the Indian Museum, out of which *Cloridopsis immaculata* (Kemp, 1913), and *Lysiosquilla sulcirostris* (Kemp, 1913) were new discoveries from the Indian waters. Kemp (1915) reported *Cloridopsis scorpio* (Latreille, 1828), *C. immaculata*, *O. interrupta* from Chilka Lake along with larval stages of *C. immaculata*. Gravely (1927) reported *Gonodactylaceus glabrous* (Brooks, 1886) and *Gonodactylellus demanii* (Henderson, 1893) from Gulf of Mannar. Chopra (1934) provided brief descriptions of 22 species from the mouth of River Hugli including 5 new records of *Areosquilla indica* (Hansen, 1926), *C. decorata*, *L. gilesi*, *Lysiosquillina maculata* Fabricius, 1793 and *Bigelowina phalangium* Fabricius, 1798. Alikunhi (1944, 1952, 1967) reported the late pelagic larval and post-larval stages of *Alima hieroglyphica* (Kemp, 1911).

Post-independence, several studies added information on the stomatopod fauna of India. Tiwari & Biswas (1952) reported 13 species deposited in the Indian Museum, out of which *C. bengalensis* (Tiwari & Biswas, 1952) was new species. Rao *et al.* (1965) reported *S. leptosquilla* from deep-water surveys off Kerala coast. Chhapgar & Sane (1967) described 2 new species namely *Clorida bombayensis* (Chhapgar & Sane, 1967) and *C. denticauda* (Chhapgar & Sane, 1967) from Mumbai coast. Manning (1969a) described *H. indica* Manning, 1969 in his revision of the genus *Harpiosquilla* Holthuis, 1964. Shanbhogue (1971) reported new records of *Lysiosquilla tredecimdentata* Holthuis, 1941, *Alima neptuni* (Linnaeus, 1768) and *C. lirata* from Indian waters. Tiwari & Ghosh (1973) re-described *C.*

bengalensis (Tiwari & Ghosh, 1973) from India. Ghosh (1975) described *Manningia andamanensis* Ghosh, 1975 from North Andaman Island. Manning (1975) described *Chorisquilla andamanica* from Andaman Sea. Shanbhogue (1975) published a list of 115 species from the Indian Ocean region, along with identification keys to all the species. Manning (1978a) described *Oratosquillina pentadactyla* (Manning, 1978) and *Q. subtilis* (Manning, 1978) from Indian waters. Shanbhogue (1987) studied the stomatopods of the Indian region and reported 30 species. In addition to the above, the Zoological Survey of India has reported several stomatopod species in its bulletins and monographs (Ghosh, 1976, 1984, 1987, 1990, 1995a, 1995b, 1999; Ghosh & Manning, 1988). Lyla *et al.* (1997) reported the stomatopod fauna of Parangipettai coast, Tamil Nadu. Dev Roy & Gokul (2012) published a checklist of 79 species known from Indian waters based on published literature. Ahyong & Kumar (2018) reported 17 species, including 7 new records of *L. lisa* Ahyong & Randall, 2001, *Odontodactylus cultrifer* (White, 1951), *O. japonicus* (De Haan, 1844), *Faughnia formosae* Manning & Chan, 1997, *Busquilla plantei* Manning, 1978, *Carinosquilla spinosa* Ahyong & Naiyanetr, 2002, and *Q. kapala* Ahyong, 2001, from by-catch of trawlers operating off southern India.

MATERIALS AND METHODS

The present study area extended from 6°–23°N latitudes, and from 68°–94°E longitudes at 53–514 metres depths. Samples were collected on-board the FORV Sagar Sampada during cruise numbers 292, 334 (leg I), 334 (leg II), 349 (leg II), 367 (leg II), 388 (Andaman waters), 372, 378 (Arabian Sea), 391 and 392 (Bay of Bengal).

Specimens were hand-picked from the catch, washed under running tap water to remove debris, photographed using an Olympus TG-5 field camera, and preserved in 10% formalin solution and/ or 70% ethanol. These specimens were deposited as reference vouchers at the Referral Centre, Centre for Marine Living Resources & Ecology, Kochi. Taxonomic identification involved morphology, meristic counts, and morphological measurements following the identification keys provided by Ahyong (2001). Terminology used in the taxonomic descriptions of stomatopods follows Ahyong (2001).

Abbreviation used in the text is as follows: TL - Total length.

SYSTEMATICS

Odontodactylus latirostris Borradaile, 1907

Superfamily Gonodactyloidea Giesbrecht, 1910

Family Odontodactylidae Manning, 1980

Genus *Odontodactylus* Bigelow, 1893

Odontodactylus latirostris Borradaile, 1907

(Figs. 2, 3A-H)

Synonymy

Odontodactylus latirostris Borradaile, 1907: 212, Pl. 22: Figs. 3, 3a (type locality: Amirante Is, Seychelles); Debelius, 1999: 280–281; Ahyong, 2001: 79 (identification key), 83–84, Fig. 40, 313 (checklist).

Odontodactylus southwelli Kemp, 1911: 94; Kemp, 1913: 142, Pl. 9: Figs. 103–106 (type locality: Andaman Is).

Odontodactylus japonicus: Stephenson, 1962: 35 [not *O. japonicus* (de Haan, 1844)].

Odontodactylus brevirostris: Manning, 1967: 23 (part); Moosa, 1991: 161–162 [not *O. brevirostris* (Miers, 1884)].

Diagnosis (modified from Ahyong, 2001): Body sub-cylindrical, strongly convex (Fig. 2). Eye large, cornea sub-globular. Ocular scales truncated, widely separated by concavity (Fig. 3A, B); anterior margin of ophthalmic somite with concavity. Antennal protopod bearing articulated plate dorsally. Rostral plate ovoid, wider than long, apex rounded (Fig. 3A, B). Carapace smooth, corners rounded (Fig. 3A).

Raptorial claw ischio-meral articulation sub-terminal (Fig. 3C); dactylus base strongly inflated into blunt heel, inner margin bearing 8 short teeth (Fig. 3D). Maxillipeds 3–4 propodi ovate, lacking distal ribbing (Fig. 3E).

Thoracic sternites 5–8 smooth dorsally, sternites 6–8 lateral margins rounded (Fig. 3F). Abdominal somite 5 bearing postero-lateral spine; somite 6 articulating with telson, dorsal surface bearing sub-median, intermediate, lateral ridges ending in spine (Fig. 3G).

Telson bearing distinct median carina, single accessory median carina present on either side of median carina; sub-median, intermediate, lateral carinae slender, apices of sub-median carinae movable; marginal denticles including 10 sub-median, 2 intermediate, 1 lateral (Fig. 3G, H). Uropodal protopod bearing 2 primary spines, outer spine longer; exopod distal segment distinctly shorter than proximal segment, articulating terminally; proximal segment almost entirely black, bearing 11 movable spines on outer margin (Fig. 3G, H).



Fig. 2. *Odontodactylus latirostris* Borradaile, 1907 (Andaman Sea): A) 4.10 cm TL (live colouration); B) 2.55 cm TL (preserved colouration).

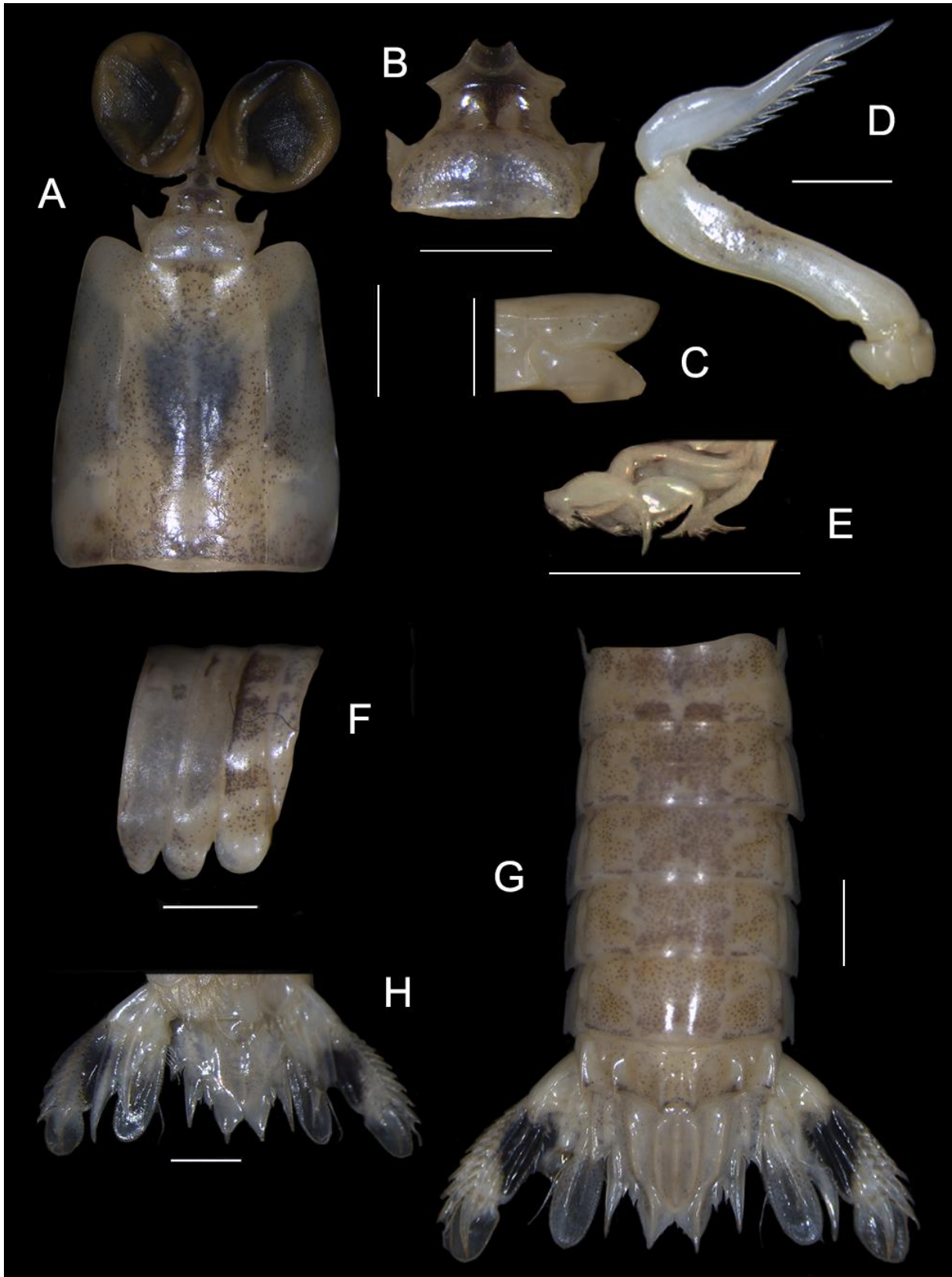


Fig. 3. *Odontodactylus latirostris* Borradaile, 1907: A) Carapace dorsal; B) Ocular and rostral plates dorsal; C) Raptorial claw ischio-meral articulation lateral; D) Raptorial claw dactylus and propodus lateral; E) Maxillipeds 3-4 propodi lateral; F) Thoracic sternites 5-8 lateral; G) Abdomen, telson and uropods dorsal; H) Telson and uropods ventral. Scale: A-D, G, H, 2 mm; E, 10 mm; F, 1 mm.

Geographical distribution and habitat: Amirante Islands to the Andaman Sea, Indonesia, New Caledonia, Australia (Ahyong, 2001), at depths of 20–30 m (Ahyong, 2001). The present specimens were collected from the Andaman Sea at depths of 53 m off Little Andaman Island, and 56 m off Great Nicobar Island (along with rocks and boulders) (Fig. 4).

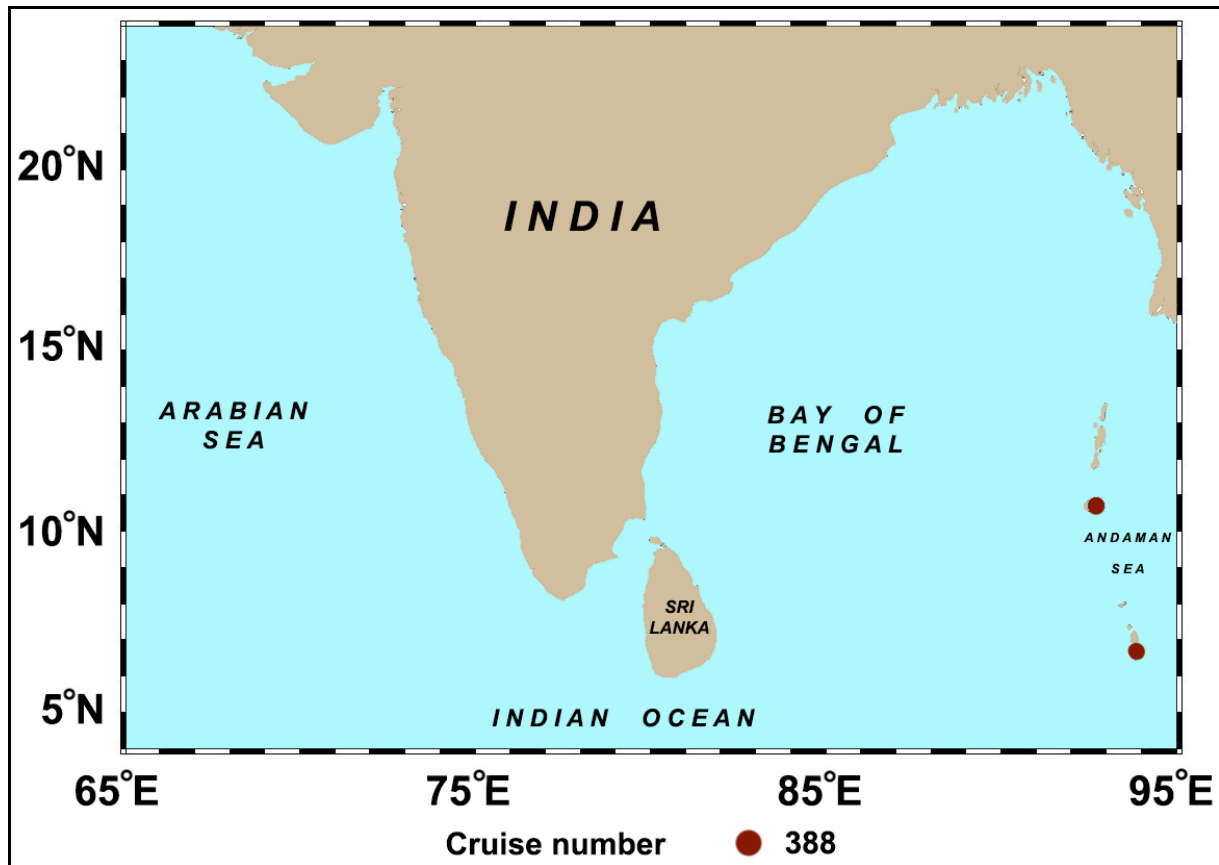


Fig. 4. Geographical locations of collection of *Odontodactylus latirostris* Borradaile, 1907.

Chorisquilla andamanica Manning, 1975

Superfamily Gonodactyloidea Giesbrecht, 1910

Family Protosquillidae Manning, 1980

Genus *Chorisquilla* Manning, 1969

Chorisquilla andamanica Manning, 1975

(Figs. 5, 6A–H)

Synonymy

Gonodactylus excavatus: Kemp, 1913: 187, Pl. 10 Figs. 122, 123; Manning, 1969b: 158 (list).

Chorisquilla lenzi: Manning, 1969b: Fig. 6 (error in figure legend).

Chorisquilla excavata: Manning, 1969b: 159 (identification key); Dev Roy & Gokul, 2012: 88 (checklist).

Chorisquilla andamanica Manning, 1975: 258–260, Fig. 3a, b (type locality: Andaman Islands, 9.5–20 fathoms (= 17–37 m) depth); Ahyong, 2001: 88 (identification key).

Diagnosis (modified from Manning, 1975): Body sub-cylindrical, convex (Fig. 5). Eye large, cornea flattened. Ocular scales oblique, fused; anterior margin of ophthalmic somite triangular, distal tip acuminate (Fig. 6A, B). Antennal protopod bearing 1 distal spine dorsally. Rostral plate trispinous, median spine longer (Fig. 6A, B). Carapace smooth, antero-lateral corner angular, postero-lateral corner rounded (Fig. 6A).

Raptorial claw ischio-meral articulation sub-terminal (Fig. 6C); propodus opposable margin bearing 9–10 teeth proximally, dactylus base strongly inflated into blunt heel, inner margin minutely serrated (Fig. 6D). Maxillipeds 3–4 propodi ovate, lacking distal ribbing (Fig. 6E).

Thoracic sternites 5–8 smooth dorsally, sternites 6–8 lateral margins rounded (Fig. 6F). Abdominal somite 5 postero-lateral angle sharp; somite 6 articulating with telson, dorsal surface bearing smooth sub-median, intermediate, lateral bosses, intermediate bosses irregular (Fig. 6G).

Telson posterior margin divided into 2 halves by U-shaped median emargination; dorsal surface bearing 5 unarmed longitudinal bosses, sub-median bosses extending posteriorly beyond apex of median emargination, not reaching to base of sub-median teeth; marginal denticles including only sub-marginal denticle under sub-median lobes (Fig. 6G, H). Uropodal protopod bearing 2 primary spines, outer spine distinctly longer; exopod distal segment shorter than proximal segment, articulating terminally; proximal segment bearing 9 movable spines on outer margin (Fig. 6G, H).

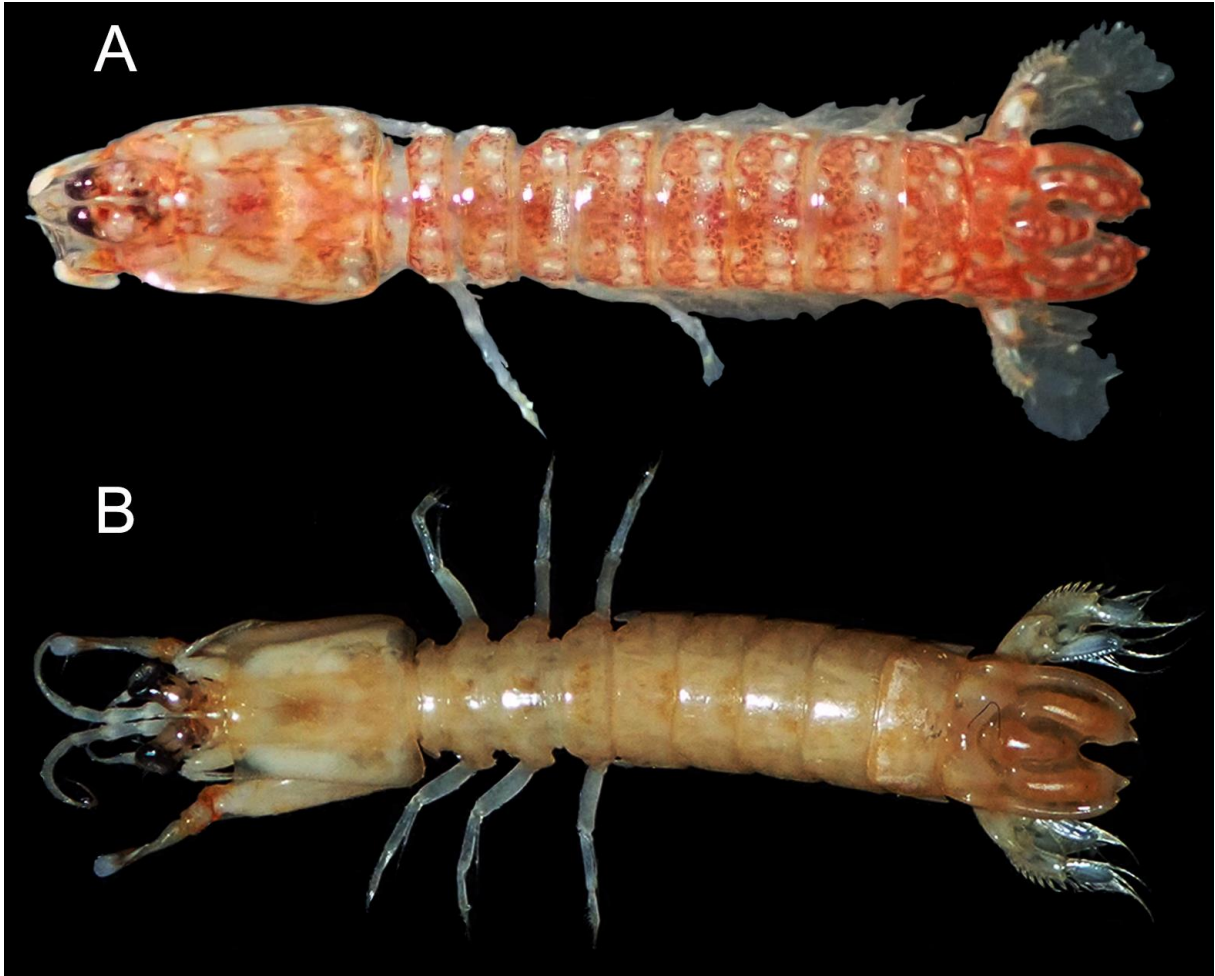


Fig. 5. *Chorisquilla andamanica* Manning, 1975 (Andaman Sea): A) 2.80 cm TL (live colouration); B) 2.80 cm TL (preserved colouration).

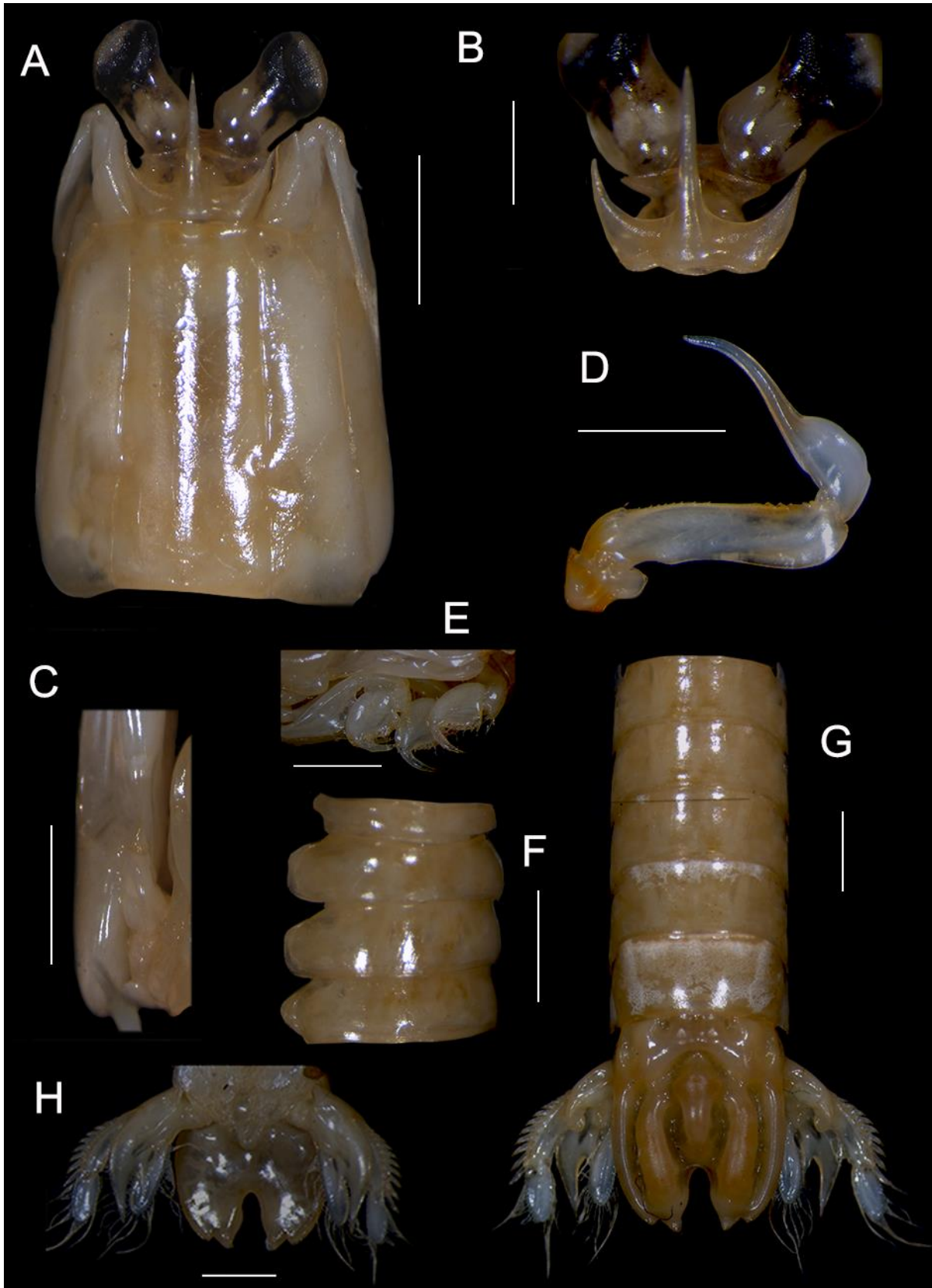


Fig. 6. *Chorisquilla andamanica* Manning, 1975: A) Carapace dorsal; B) Ocular and rostral plates dorsal; C) Raptorial claw ischio-meral articulation lateral; D) Raptorial claw dactylus and propodus lateral; E) Maxillipeds 3-4 propodi lateral; F) Thoracic sternites 5-8 lateral; G) Abdomen, telson and uropods dorsal; H) Telson and uropods ventral. Scale: A, C-H, 2 mm; B, 1 mm.

Geographical distribution and habitat: Coral reefs off Andaman Islands (Manning, 1975), at depths of 17–37 m (Manning, 1975). The present specimens were collected from 56 m depth off Great Nicobar Island (Fig. 7).

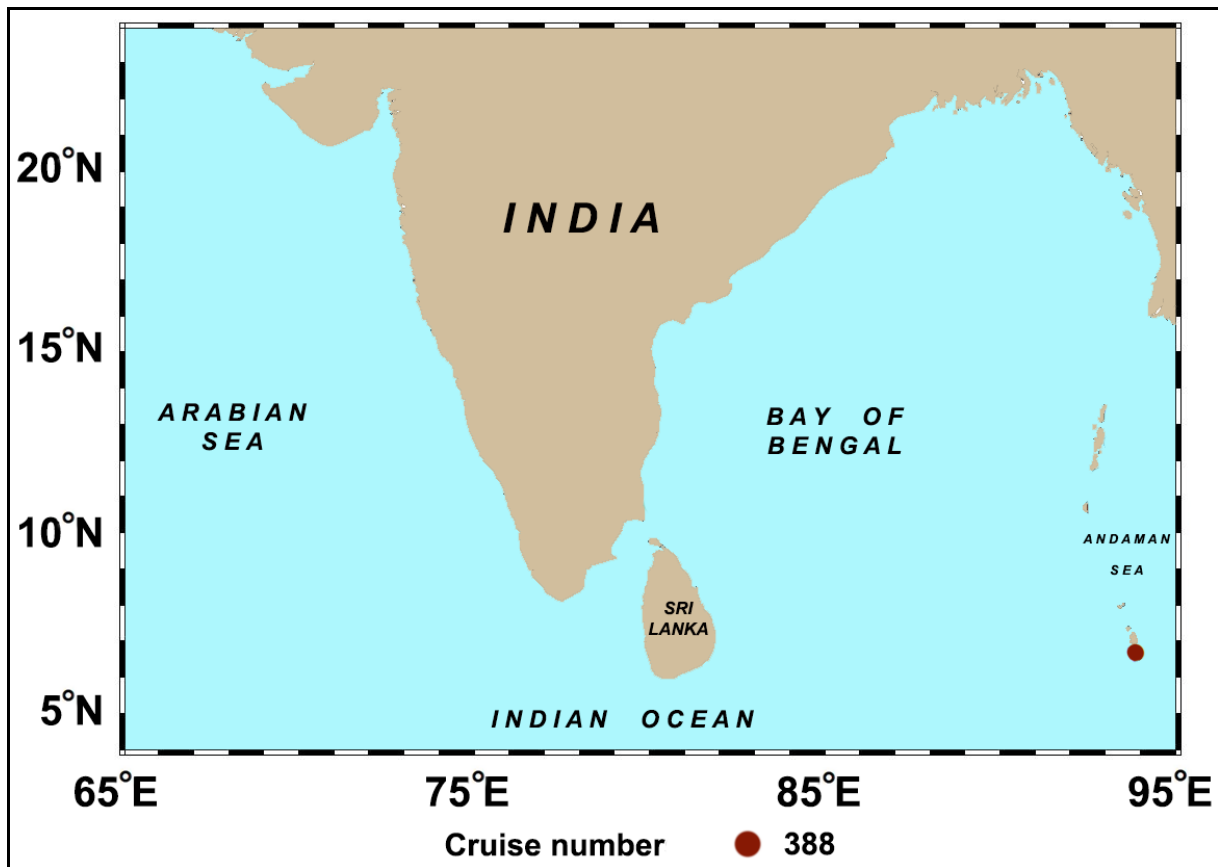


Fig. 7. Geographical locations of collection of *Chorisquilla andamanica* Manning, 1975.

Haptosquilla tuberosa (Pocock, 1893)

Superfamily Gonodactyloidea Giesbrecht, 1910

Family Protosquillidae Manning, 1980

Genus *Haptosquilla* Manning, 1969

Haptosquilla tuberosa (Pocock, 1893)

(Figs. 8, 9A–H)

Synonymy

Gonodactylus tuberosus Pocock, 1893: 476, Pl. 20B, Fig. 2 (type locality: Macclesfield Bank, South China Sea); Kemp, 1913: 5, 11, 149, 181; Kemp, 1915: 183–186.

Gonodactylus nefandus Kemp, 1911: 93 (type localities: Andaman Is., Cheduba, Straits of Malacca); Kemp, 1913: 179–180, Pl. 10: Figs. 119, 120; Kemp, 1915: 184–185;

Kemp & Chopra, 1921: 311; Hansen, 1926: 33; new synonymy; Ghosh & Manning, 1988: 654.

Haptosquilla nefanda: Manning, 1969b: 162; Moosa, 1973: 10–11; new synonymy; Manning, 1995: 21 (checklist); Dev Roy & Gokul, 2012: 88 (checklist).

Haptosquilla tuberosa: Manning, 1969b: 162; Moosa, 1973: 12; Manning, 1995: 21 (checklist), 99 (identification key), 105–106, Pl. 19, Figs. 9k, 43e, 55–58; Ahyong, 2001: 101 (identification key), 109–110, Fig. 53A–H, 313 (checklist); Ahyong & Naiyanetr, 2002: 287, 305 (list).

Diagnosis (modified from Ahyong, 2001): Body subcylindrical, convex (Fig. 8). Eye large, cornea cylindrical. Ocular scales rectangular, separate; anterior margin of ophthalmic somite triangular, distal tip acuminate (Fig. 9A, B). Antennal protopod bearing 1 distal spine dorsally. Rostral plate trispinous, median spine longer (Fig. 9A, B). Carapace smooth, corners rounded (Fig. 9A).

Raptorial claw ischio-meral articulation sub-terminal (Fig. 9C); propodus opposable margin bearing 9–10 minute spines proximally, dactylus base strongly inflated into blunt heel, inner margin minutely serrated (Fig. 9D). Maxillipeds 3–4 propodi ovate, lacking distal ribbing (Fig. 9E).

Thoracic sternites 5–8 smooth dorsally, sternites 6–8 lateral margins rounded (Fig. 9F). Abdominal somite 5 corrugated dorsally; somites 1–5 with irregular depression laterally; somite 6 articulating with telson, dorsal surface bearing sub-median, intermediate, lateral bosses (Fig. 9G).

Telson posterior margin bearing 4 pairs of primary teeth, thin median fissure dividing posterior half; dorsal surface bearing median sub-circular, 1 pair of ovate sub-median bosses, sub-median bosses slightly posterior to median boss; marginal denticles including 7 sub-median, 1 intermediate, 1 lateral (Fig. 9G, H). Uropodal protopod bearing 2 primary spines, outer spine distinctly longer; exopod distal segment shorter than proximal segment, articulating terminally; proximal segment bearing 10 movable spines on outer margin (Fig. 9G, H).



Fig. 8. *Haptosquilla tuberosa* (Pocock, 1893) (Andaman Sea): A) 2.80 cm TL (live colouration); B) 2.80 cm TL (preserved colouration).

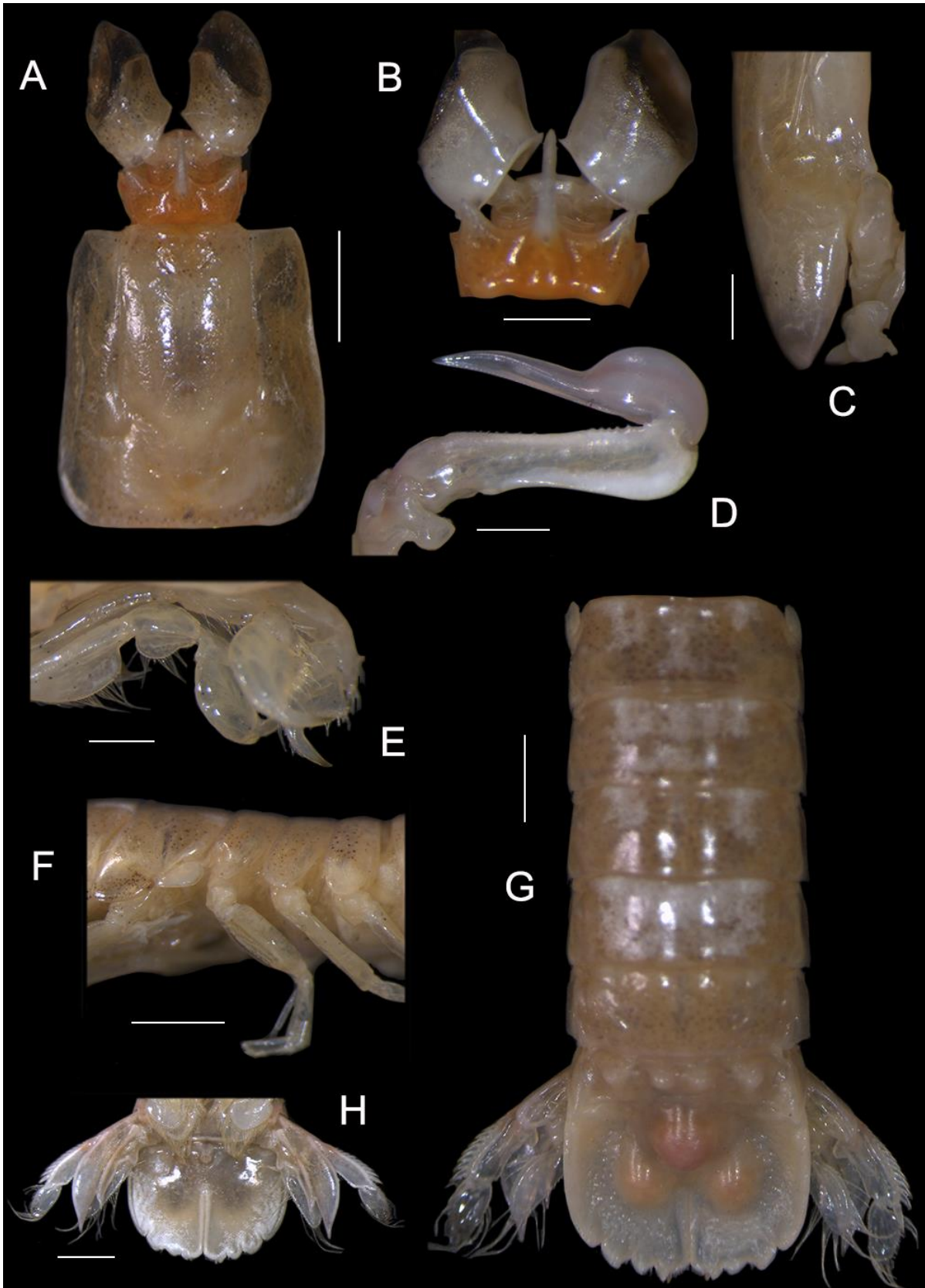


Fig. 9. *Haptosquilla tuberosa* (Pocock, 1893): A) Carapace dorsal; B) Ocular and rostral plates dorsal; C) Raptorial claw ischio-meral articulation lateral; D) Raptorial claw dactylus and propodus lateral; E) Maxillipeds 3-4 propodi lateral; F) Thoracic sternites 5-8 lateral; G) Abdomen, telson and uropods dorsal; H) Telson and uropods ventral. Scale: A, F-H, 2 mm; B-E, 1 mm.

Geographical distribution and habitat: South China Sea, Indonesia, Bay of Bengal, Andaman Sea, Australia (Ahyong, 2001), at depths of 30–82 m, on sand, rubble or coarse shell substrates (Ahyong, 2001). The present specimens were collected from 53 m depth off Little Andaman Island (Fig. 10).

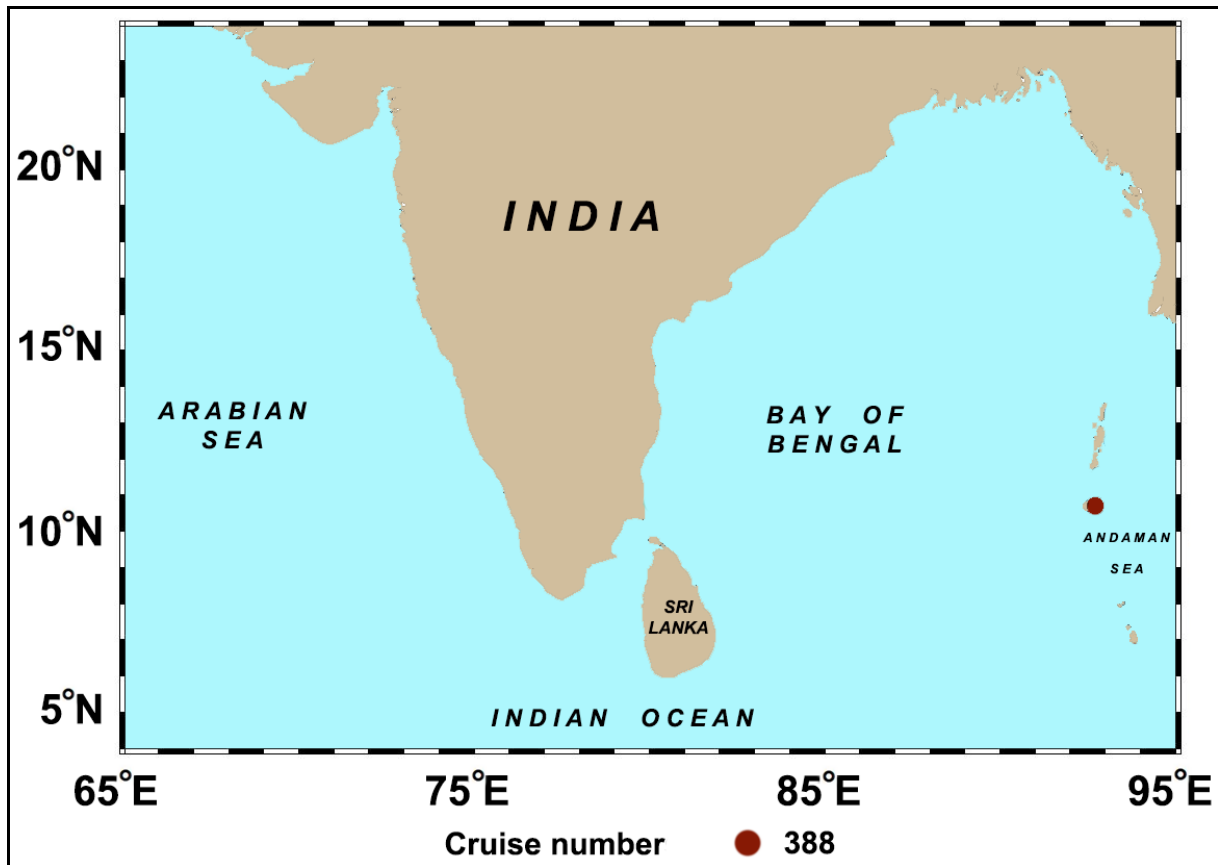


Fig. 10. Geographical locations of collection of *Haptosquilla tuberosa* (Pocock, 1893).

Pseudosquilla ciliata (Fabricius, 1787)

Superfamily Gonodactyloidea Giesbrecht, 1910

Family Pseudosquillidae Manning, 1977

Genus *Pseudosquilla* Dana, 1852

Pseudosquilla ciliata (Fabricius, 1787)

(Figs. 11, 12A–H)

Synonymy

Squilla ciliata Fabricius, 1787: 333 (type locality: Exmouth Gulf, Western Australia, restricted by neotype selection).

Squilla stylifera Lamarck, 1818: 189 (type locality: unknown).

Squilla quadrispinosa Eydoux & Souleyet, 1842: 362, Pl. 5: Fig. 1 (type locality: Sandwich Is. (= Hawaii)).

Pseudosquilla ciliata var. *occidentalis* Borradaile, 1900: 398, 402 (type locality: West Indies).

Pseudosquilla ciliata: Haswell, 1882: 209–210; Kemp, 1913: 3, 10, 96–100, 196; Hale, 1929: 34; Holthuis, 1941: 261–263; Tweedie, 1950: 140; Stephenson, 1952: 9; Stephenson, 1953: 44; Stephenson & McNeill, 1955: 245; Stephenson, 1962: 34; McNeill, 1968: 88; Moosa, 1986: 385; Moosa, 1991: 169–170; Manning, 1995: 21 (checklist), 111–116, Pl. 20, 21, Figs. 59a, 60a, b, e, 61–63; Gosliner *et al.*, 1996: 195; Ahyong & Norrington, 1997: 104; Debelius, 1999: 290; Ahyong, 2001: 112–115, Fig. 55A–I, 313 (checklist); Ahyong & Naiyanetr, 2002: 287, 305 (list); Dev Roy & Gokul, 2012: 88 (checklist).

Diagnosis (modified from Ahyong, 2001): Body sub-cylindrical, convex (Fig. 11). Eye large, cornea sub-globular. Ocular scales triangular, separate; anterior margin of ophthalmic somite triangular, distal tip acuminate (Fig. 12A, B). Antennal protopod bearing articulated plate dorsally. Rostral plate pentagonal, apex obtusely angled (Fig. 12A, B). Carapace smooth, corners rounded (Fig. 12A).

Raptorial claw ischio-meral articulation terminal (Fig. 12C); propodus opposable margin evenly pectinate proximally, sparsely pectinate distally, bearing 3 movable spines; dactylus slender, bearing 3 serrated teeth (Fig. 12D). Maxillipeds 3–4 propodi ovate, lacking distal ribbing (Fig. 12E).

Thoracic sternites 5–8 smooth dorsally, lateral margins rounded (Fig. 12F). Abdominal somites 1–5 smooth dorsally, marginal carinae indistinct, somites 4–5 bearing spinules postero-laterally; somite 6 articulating with telson, dorsal surface bearing sub-median, intermediate, lateral ridges ending in spine (Fig. 12G).

Telson bearing median carina, 1 pair each of accessory, anterior sub-median, marginal carinae; median, sub-median carinae apices ending in spine; marginal denticles including 1 intermediate, 1 lateral; sub-median denticles movable (Fig. 12G, H). Uropodal protopod bearing 2 primary spines, inner spine longer; slender spine anterior to endopod articulation; exopod distal segment shorter than proximal segment, articulating terminally, proximal segment bearing 8 movable spines on outer margin (Fig. 12G, H).



Fig. 11. *Pseudosquilla ciliata* (Fabricius, 1787) (Andaman Sea): 2.60 cm TL (preserved colouration).

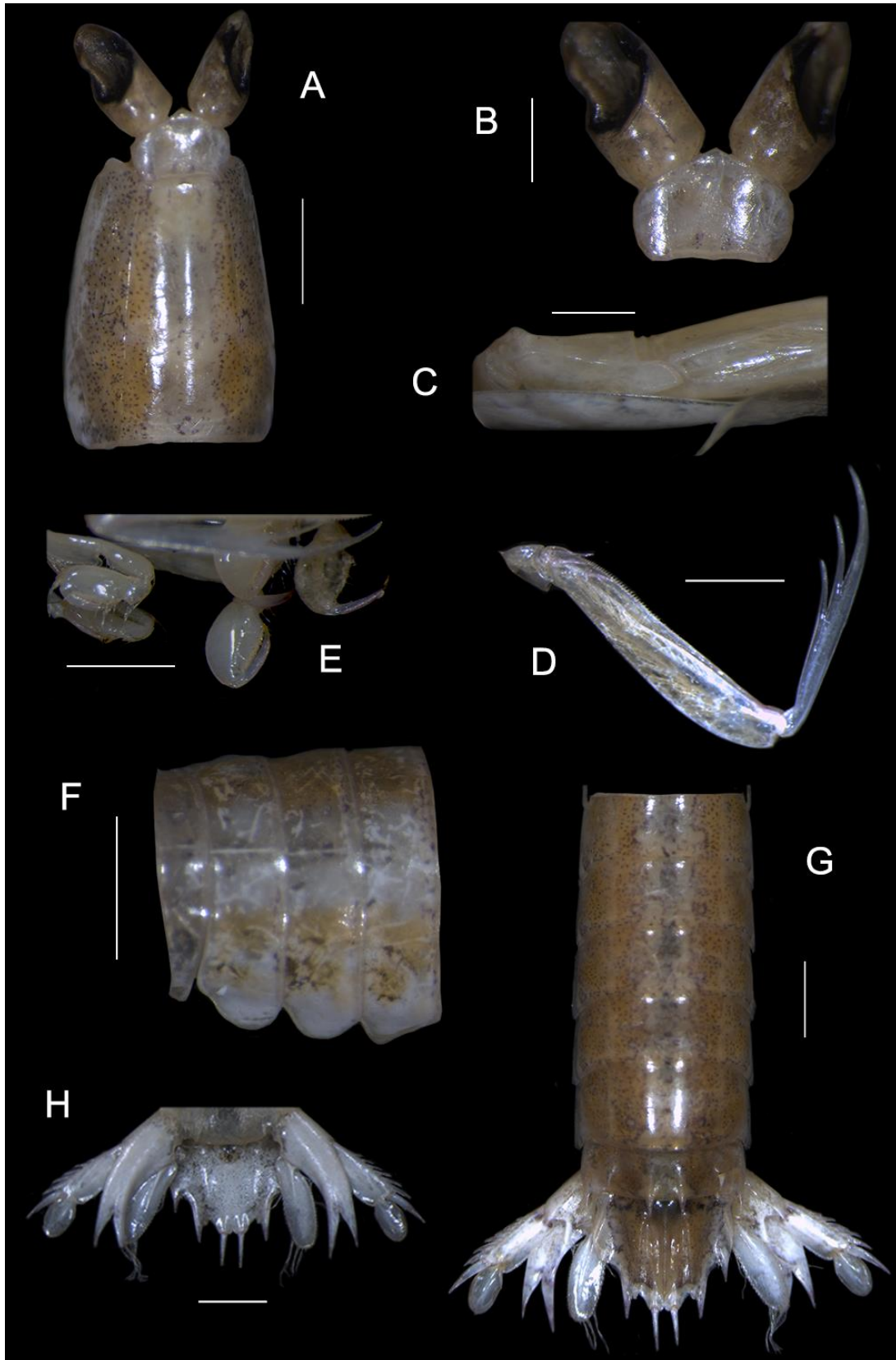


Fig. 12. *Pseudosquilla ciliata* (Fabricius, 1787): A) Carapace dorsal; B) Ocular and rostral plates dorsal; C) Raptorial claw ischio-meral articulation lateral; D) Raptorial claw dactylus and propodus lateral; E) Maxillipeds 3-4 propodi lateral; F) Thoracic sternites 5-8 sub-dorsal; G) Abdomen, telson and uropods dorsal; H) Telson and uropods ventral. Scale: A, C, E - H, 2 mm; B, D, 1 mm.

Geographical distribution and habitat: All tropical oceans except the eastern Pacific, at depths up to 86 m, under boulders, coral rubble on coral and rocky reef flats, burrows in seagrass beds, sand and mudflats (Ahyong, 2001). The present specimen was collected from 53 m depth off Little Andaman Island (Fig. 13).

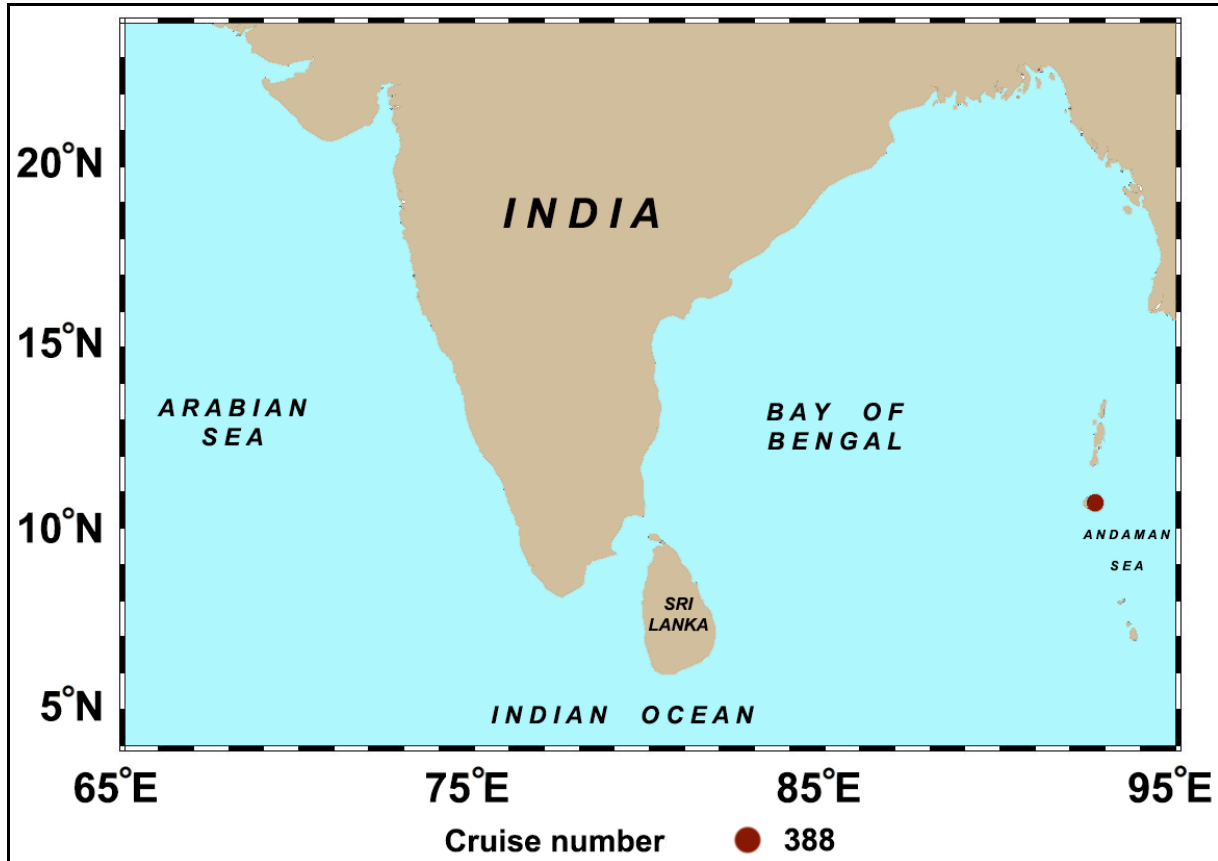


Fig. 13. Geographical locations of collection of *Pseudosquilla ciliata* (Fabricius, 1787).

Busquilla plantei Manning, 1978

Superfamily Squilloidea Latreille, 1802

Family Squillidae Latreille, 1802

Genus *Busquilla* Manning, 1978

Busquilla plantei Manning, 1978

(Figs. 14, 15A-H)

Synonymy

Busquilla plantei Manning, 1978b: 23-24, Fig. 11 (type locality: Passe Lokobe, Madagascar); Manning, 1995: 23 (checklist), 170 (identification key); Ahyong, 2001: 204 (identification key), 204-205, Fig. 99A-H, 314 (checklist); Ahyong & Kumar, 2018: 385.

Diagnosis (modified from Ahyong, 2001): Body depressed (Fig. 14). Eye long, cornea bilobed. Ocular scales separate, sub-quadrangle distally; anterior margin of ophthalmic somite triangular bearing distal spine (Fig. 15A, B). Antennal protopod unarmed. Rostral plate bluntly triangular, wider than long (Fig. 15A, B). Carapace bearing antero-lateral spine, postero-lateral corner rounded; dorsal surface bearing intermediate, lateral, marginal, reflected marginal carinae (Fig. 15A).

Raptorial claw ischio-meral articulation terminal (Fig. 15C); propodus opposable margin closely pectinate, bearing 3 movable spines proximally; dactylus slender, bearing 5 teeth (Fig. 15D). Maxillipeds 3–4 propodi ovate, lacking distal ribbing (Fig. 15E).

Thoracic sternite 5 smooth dorsally, bearing pair of acuminate spines laterally, anterior spine longer, obliquely directed; sternites 6–8 bearing intermediate carinae, bilobed laterally, anterior lobe smaller than posterior (Fig. 15F). Abdominal somites 1–5 bearing sub-median, intermediate, lateral, marginal carinae, somite 6 lacking marginal carinae; sub-medians of somites 5–6, intermediates of 4–6, all laterals, marginals bearing posterior spine; somite 5 with triangular spot between lateral and marginal carinae, somite 6 with small dark patch between intermediate and lateral carinae (Fig. 15G).

Telson bearing median carina; sub-median, intermediate, lateral carinae slender; sub-median carinae apices fixed; marginal denticles including 4 sub-median, 9 intermediate, 1 lateral; post-anal carina present (Fig. 15G, H). Uropodal protopod bearing 2 primary spines, inner spine longer, bearing large lobe on outer margin; slender spine anterior to endopodal articulation, inner margin crenulate; exopod distal segment subequal to proximal, articulating terminally, inner half of distal segment, distal half of proximal segment black; proximal segment bearing 8 movable spines on outer margin (Fig. 15G, H).

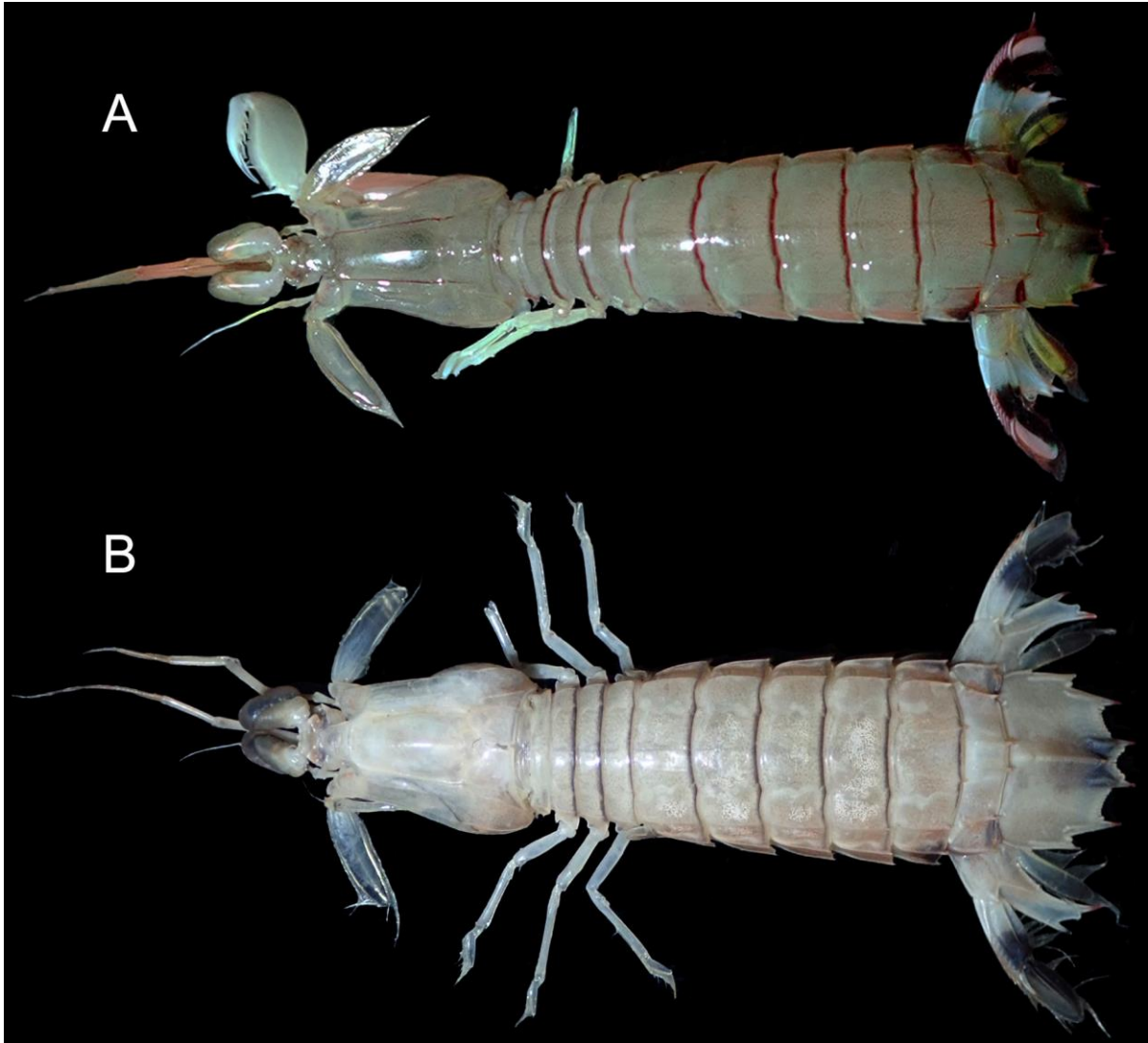


Fig. 14. *Busquilla plantei* Manning, 1978 (Bay of Bengal): A) 6.20 cm TL (live colouration); B) 6.20 cm TL (preserved colouration).

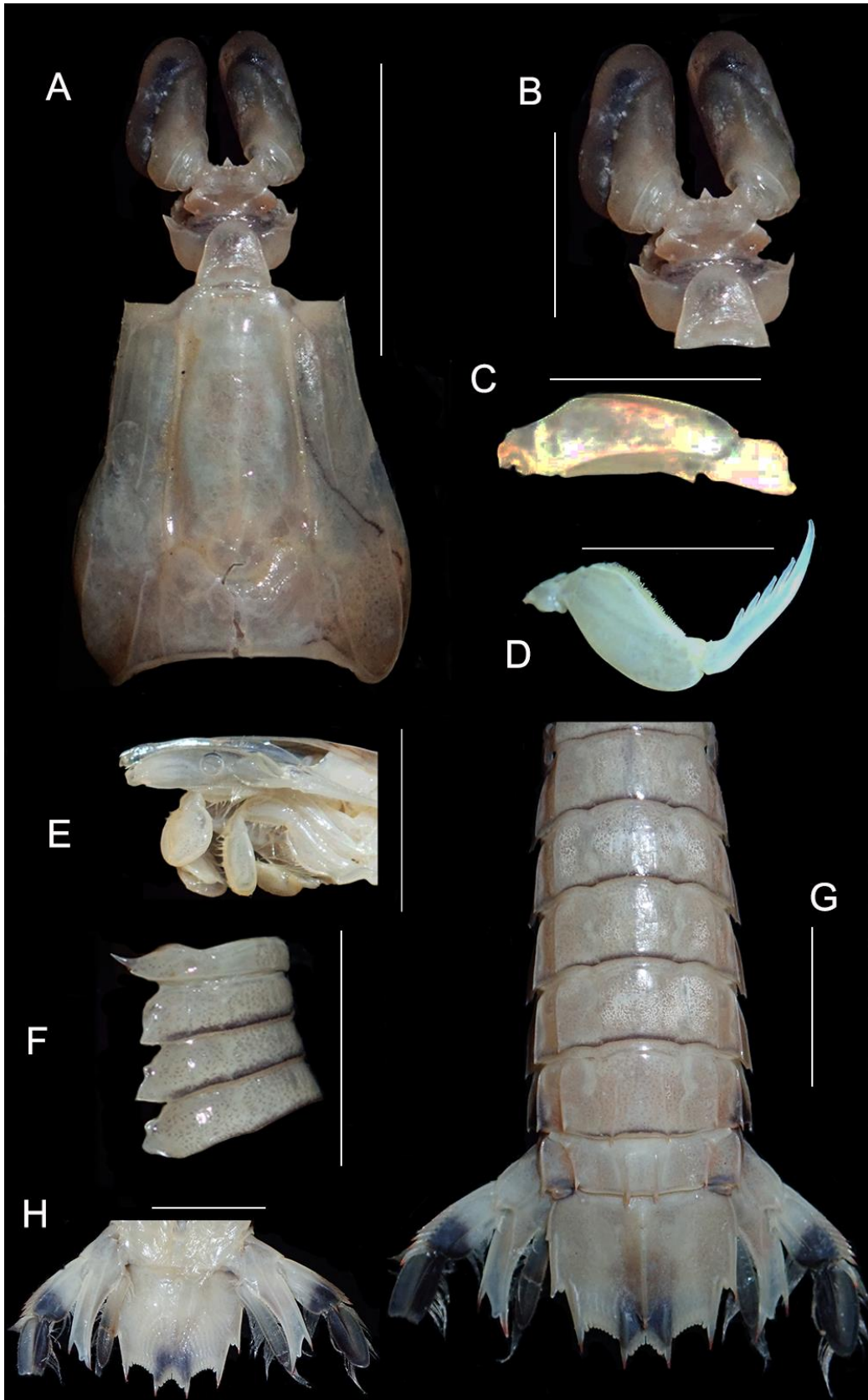


Fig. 15. *Busquilla plantei* Manning, 1978: A) Carapace dorsal; B) Ocular and rostral plates dorsal; C) Raptorial claw ischio-meral articulation lateral; D) Raptorial claw dactylus and propodus lateral; E) Maxillipeds 3-4 propodi lateral; F) Thoracic sternites 5-8 lateral; G) Abdomen, telson and uropods dorsal; H) Telson and uropods ventral. Scale: A, C-H, 10 mm; B, 5 mm.

Geographical distribution and habitat: Madagascar, India, Australia, Hawaii (Ahyong & Kumar, 2018), at 17–221 m depths, on soft, sandy substrates (Ahyong, 2001, 2002). The present specimen was collected from 56 m depth in the southwestern Bay of Bengal off Tamil Nadu coast (Fig. 16).

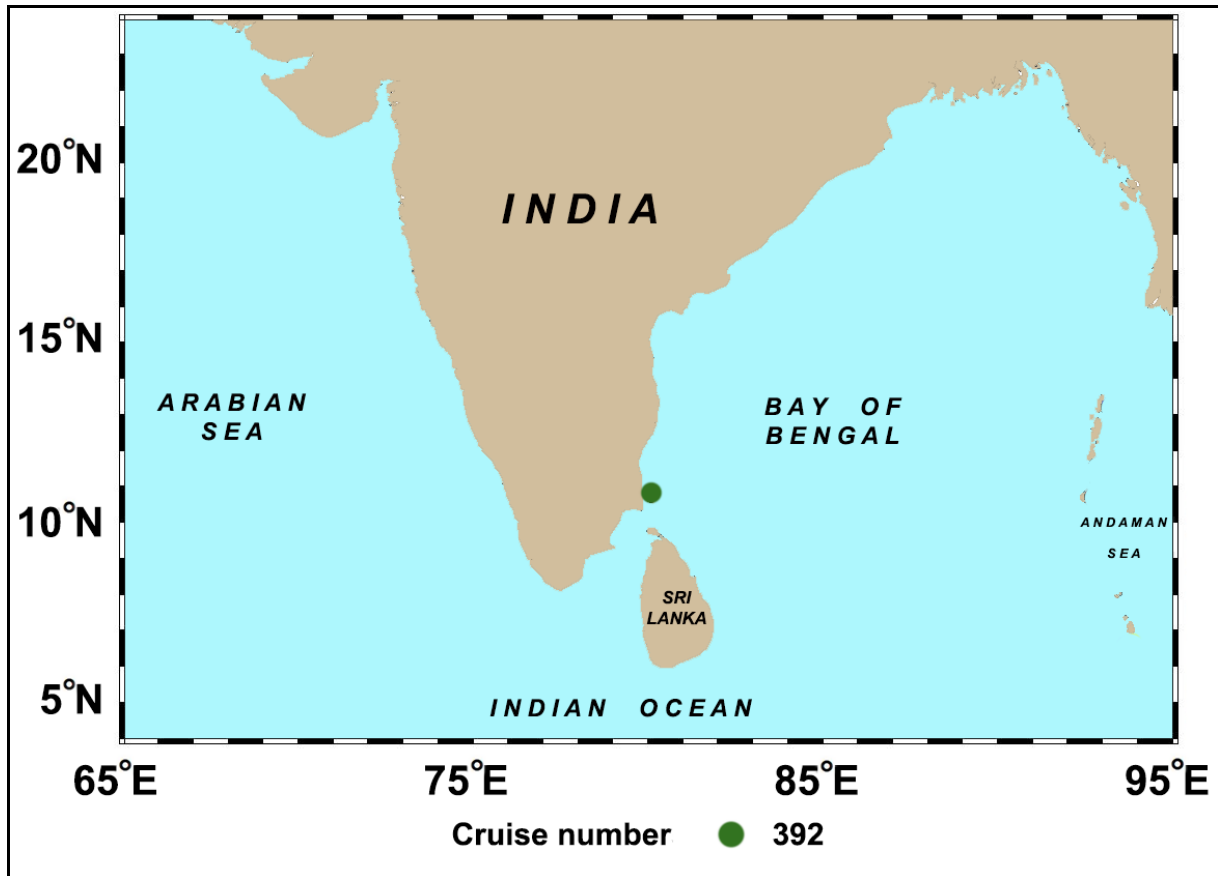


Fig. 16. Geographical locations of collection of *Busquilla plantei* Manning, 1978.

Harpiosquilla harpax (de Haan, 1844)

Superfamily Squilloidea Latreille, 1802

Family Squillidae Latreille, 1802

Genus *Harpiosquilla* Holthuis, 1964

Harpiosquilla harpax (de Haan, 1844)

(Figs. 17, 18A–G)

Synonymy

Squilla harpax de Haan, 1844 (atlas): Pl. 51, Fig. 1 (type locality: Japan); de Haan, 1849: 222 (text); Tiwari & Biswas, 1952: 358, Figs. 3b, d, f.

Squilla raphidea: Stephenson, 1952: 4, 5; Stephenson, 1953: 43; Stephenson & McNeill, 1955: 239–240 (part, not *Squilla raphidea* Fabricius, 1787).

Harpiosquilla harpax: Manning, 1968: 15–18, Fig. 4; Manning, 1969a: 6, 25–33, Figs. 28–38; Manning, 1991: 8; Manning, 1995: 23 (checklist), 148 (identification key), 153–158, Pl. 28, Figs. 90a, 92b, 93, 95, 96; Yamaguchi & Baba, 1993: 179–180, Fig. 11; Ah Yong & Norrington, 1997: 106; Ah Yong *et al.*, 1999: 38, 41, Fig. 2a–d; Ah Yong & Ebach, 1999: 227–228; Ah Yong, 2001: 256 (identification key), 257–260, Fig. 126A–L, 314 (checklist); Ah Yong & Naiyanetr, 2002: 307 (list); Dev Roy & Gokul, 2012: 89 (checklist).

Harpiosquilla japonica Manning, 1969a: 15–17, Figs. 10–11 (type locality: Wakanoura, Kii, Japan); Garcia, 1978: 236; Garcia, 1981: 14–16; Manning, 1995: 23 (checklist), 149 (identification key), 158–160, Figs. 87b, d, 88b, 91b, 92a, e, 94b; new synonymy.

Harpiosquilla intermedia Manning & Michel, 1973: 113–116, Figs. 1, 2b (type locality: Baie de Ducos, New Caledonia); Garcia, 1978: 236; Garcia, 1981: 13–14; new synonymy; Manning, 1995: 23 (checklist), 149 (identification key).

Harpiosquilla malagasiensis Manning, 1978b: 30, Fig. 15 (type locality: Tamatave, Madagascar); new synonymy; Manning, 1995: 23 (checklist), 149 (identification key).

Harpiosquilla paradipa Ghosh, 1987: 306–308, Fig. 1 (type locality: Paradip, India); new synonymy; Manning, 1995: 23 (checklist), 148 (identification key).

Diagnosis (modified from Ah Yong, 2001): Body depressed (Fig. 17). Eye large, cornea bilobed. Ocular scale separate, truncate distally; anterior margin of ophthalmic somite rounded (Fig. 18A). Antennal protopod unarmed. Rostral plate longer than wide, median projection slender (Fig. 18A). Carapace bearing antero-lateral spine, postero-lateral corner excavated; dorsal surface bearing median, intermediate, lateral, marginal, reflected marginal carinae (Fig. 18A).

Raptorial claw ischio-meral articulation terminal (Fig. 18B); propodus opposable margin bearing 8 long, 8–10 medium-sized, 12–14 short erect spines, 3 movable spines proximally; dactylus bearing 8 teeth, outer margin angular (Fig. 18C). Maxillipeds 3–4 propodi ovate, lacking distal ribbing (Fig. 18D).

Thoracic sternites 6–8 bearing sub-median carinae, sternites 5–8 bearing intermediate carinae; sternite 5 ventral process triangular; sternites 6–7 bilobed laterally, anterior lobe shorter than posterior (Fig. 18E). Abdominal somites 1–5 bearing sub-median, intermediate, lateral, marginal carinae, somite 6 lacking marginal carina; sub-medians of somite 6, intermediates of somites 2–6, all laterals, marginals bearing posterior spine (Fig. 18F).

Telson bearing median carina; sub-median, intermediate, lateral carinae slender; carinae apices fixed; marginal denticles including 4–5 sub-median, 8–10 intermediate, 1 lateral; post-anal carina present (Fig. 18F, G). Uropodal protopod bearing 2 primary spines, inner spine longer, bearing lobe on outer margin;

slender spine anterior to endopodal articulation, inner margin crenulate; endopod distal half black; exopod distal segment shorter than proximal segment, articulating terminally, inner half black; proximal segment bearing 9 movable spines on outer margin (Fig. 18F, G).



Fig. 17. *Harpiosquilla harpax* (de Haan, 1844) (north-eastern Arabian Sea): A) 17.00 cm TL (live colouration); B) 15.25 cm TL (preserved specimen).

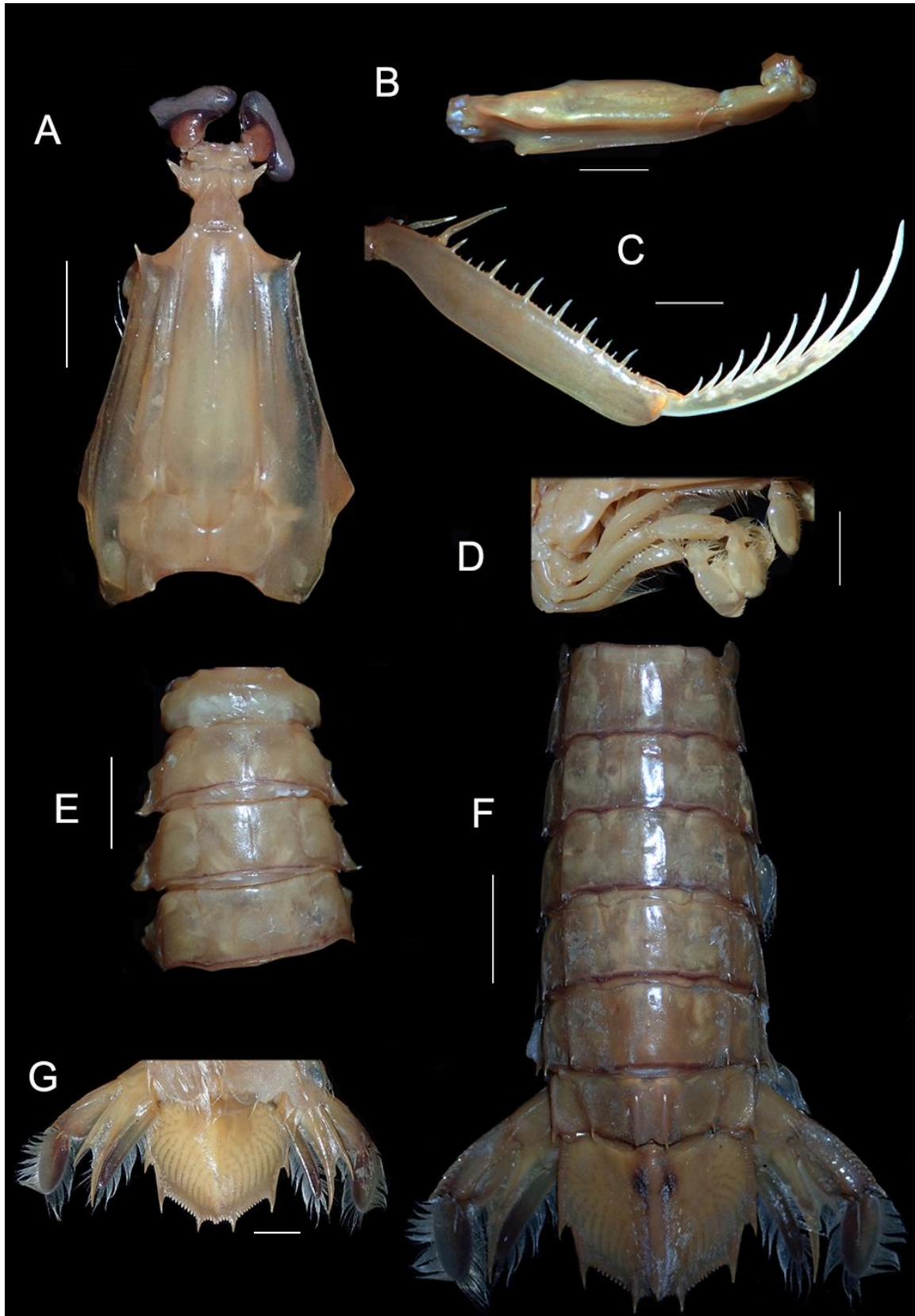


Fig. 18. *Harpiosquilla harpax* (de Haan, 1844): A) Carapace, ocular and rostral plates dorsal; B) Raptorial claw ischio-meral articulation lateral; C) Raptorial claw dactylus and propodus lateral; D) Maxillipeds 3-4 propodi lateral; E) Thoracic sternites 5-8 dorsal; F) Abdomen, telson and uropods dorsal; G) Telson and uropods ventral. Scale: A-G, 10 mm.

Geographical distribution and habitat: Red Sea, western Indian Ocean to Taiwan, Philippines, Vietnam, Japan, New Caledonia, Australia, on sandy mud substrates in intertidal zone, shallow coastal waters, estuaries and embayments up to 93 m depth (Ahyong, 2001). The present specimens were collected from 72 m depth in the north-eastern Arabian Sea off Gujarat coast (Fig. 19).

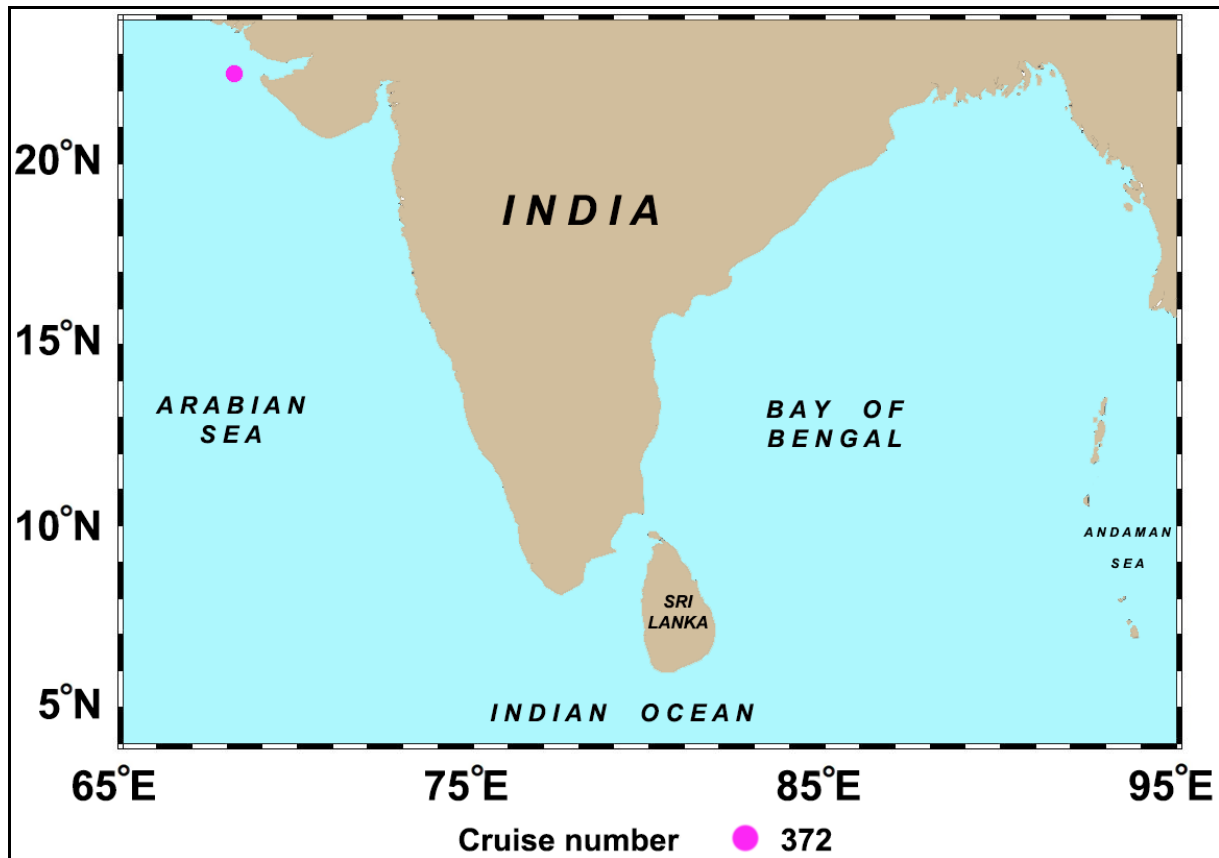


Fig. 19. Geographical locations of collection of *Harpiosquilla harpax* (de Haan, 1844).

Lenisquilla gilesi (Kemp, 1911)

Superfamily Squilloidea Latreille, 1802

Family Squillidae Latreille, 1802

Genus *Lenisquilla* Manning, 1977

Lenisquilla gilesi (Kemp, 1911)

(Figs. 20, 21A-I)

Synonymy

Squilla gilesi Kemp, 1911: 95 (type locality: Bay of Bengal, 80–110 fathoms (= 146–202 m); Kemp, 1913: 39, Pl. 2, Figs. 25–27; Ghosh & Manning, 1988: 657.

Lenisquilla gilesi: Manning, 1995: 24 (checklist), 208 (identification key); Ahyong, 2001: 269 (identification key); Dev Roy & Gokul, 2012: 90 (checklist).

Diagnosis (modified from Kemp, 1911): Body depressed (Fig. 20). Eye long, cornea bilobed. Ocular scale separate, blunt distally; anterior margin of ophthalmic somite rounded (Fig. 21A). Antennal protopod unarmed. Rostral plate triangular, longer than broad (Fig. 21A). Carapace bearing antero-lateral spine, postero-lateral corner rounded; dorsal surface bearing intermediate, lateral, marginal, reflected marginal carinae (Fig. 21A).

Raptorial claw ischio-meral articulation terminal (Fig. 21B); propodus opposable margin closely pectinate, bearing 3 movable spines proximally; dactylus basally inflated in male (Fig. 21C), slender in female (Fig. 21D), bearing 6 teeth (Fig. 21C, D). Maxillipeds 3-4 propodi ovate, lacking distal ribbing (Fig. 21E).

Thoracic sternites 7-8 bearing sub-median carinae, sternites 5-8 bearing intermediate carinae; sternite 5 bearing obliquely directed acuminate lateral process, ventral process acuminate; sternites 6-7 single lobed laterally (Fig. 21F). Abdominal somites 1-5 bearing sub-median, intermediate, lateral, marginal carinae, somite 6 lacking marginal carina; sub-medians of somite 6, intermediate of somites 3-6, laterals of somites 2-6, all marginals bearing posterior spine (Fig. 21G, H).

Telson bearing median carina inflated at both ends in males (Fig. 21G), slender in females (Fig. 21H); sub-median, intermediate, lateral carinae slender; submedian carinae apices movable; marginal denticles including 2 sub-median, 7 intermediate, 1 lateral; postanal carina present (Fig. 21G-J). Uropodal protopod bearing 2 primary spines, inner spine longer, bearing lobe on outer margin; slender spine anterior to endopodal articulation, inner margin crenulate, bearing 2 spines at the end of crenulation in male (Fig. 21I), 1 spine in female (Fig. 21J); endopod distal half black; exopod distal segment shorter than proximal segment, articulating terminally; proximal segment bearing 8 movable spines on outer margin (Fig. 21G-J).



Fig. 20. *Lenisquilla gilesi* (Kemp, 1911) (north-eastern Arabian Sea): A) 9.10 cm TL (live colouration); B) 8.50 cm TL (preserved colouration).

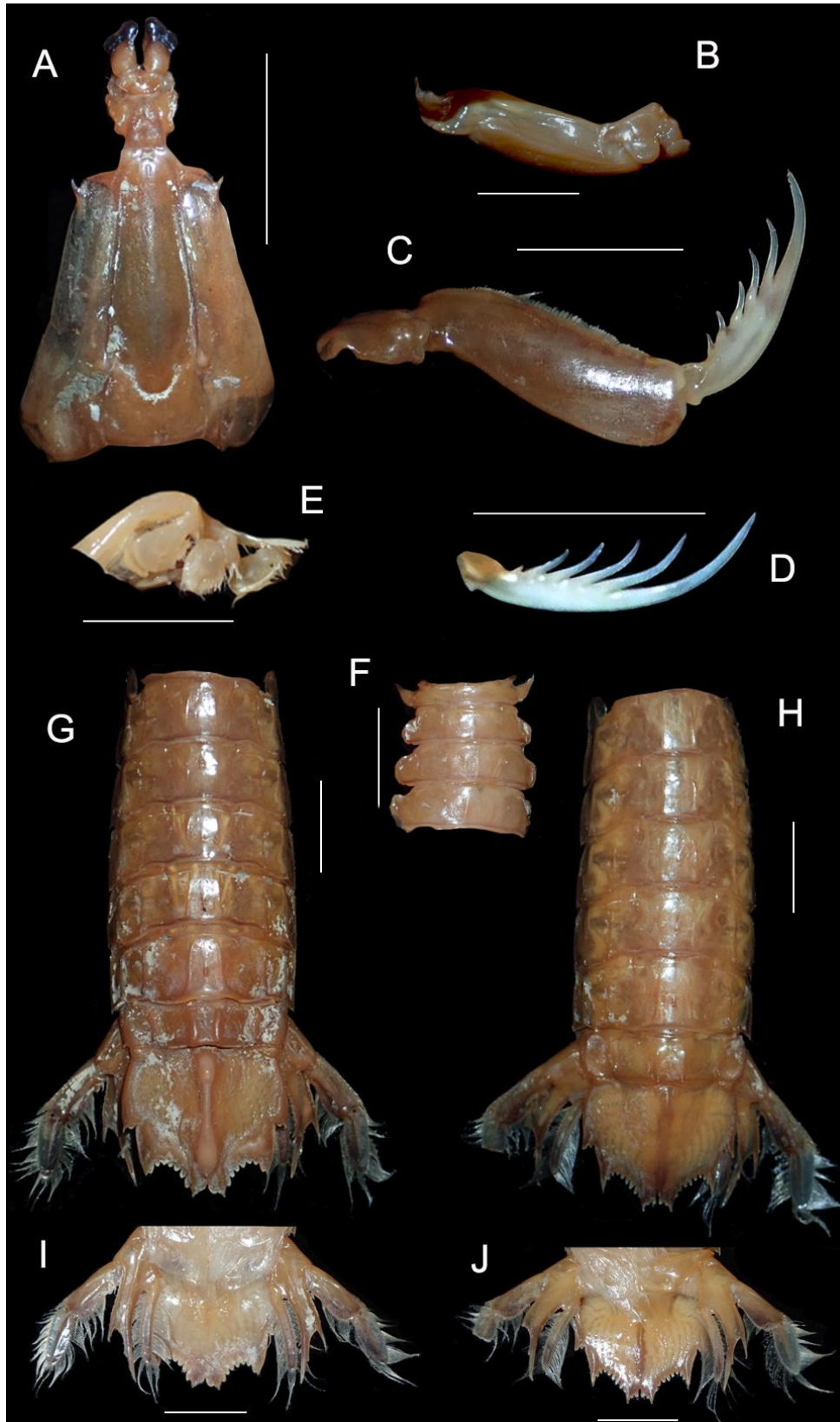


Fig. 21. *Lenisquilla gilesi* (Kemp, 1911): A) Carapace, ocular and rostral plates dorsal; B) Raptorial claw ischio-meral articulation lateral; C) Male raptorial claw dactylus and propodus lateral; D) Female raptorial claw dactylus; E) Maxillipeds 3-4 propodi lateral; F) Thoracic sternites 5-8 dorsal; G) Male abdomen, telson and uropods dorsal; H) Female abdomen, telson and uropods dorsal; I) Male telson and uropods ventral; J) Female telson and uropods ventral. Scale: A-J, 10 mm.

Geographical distribution and habitat: Persian Gulf to Bay of Bengal, at depths of 64–202 m (Kemp, 1913). The present specimens were collected from 72 m depth in the north-eastern Arabian Sea off Gujarat coast (Fig. 22).

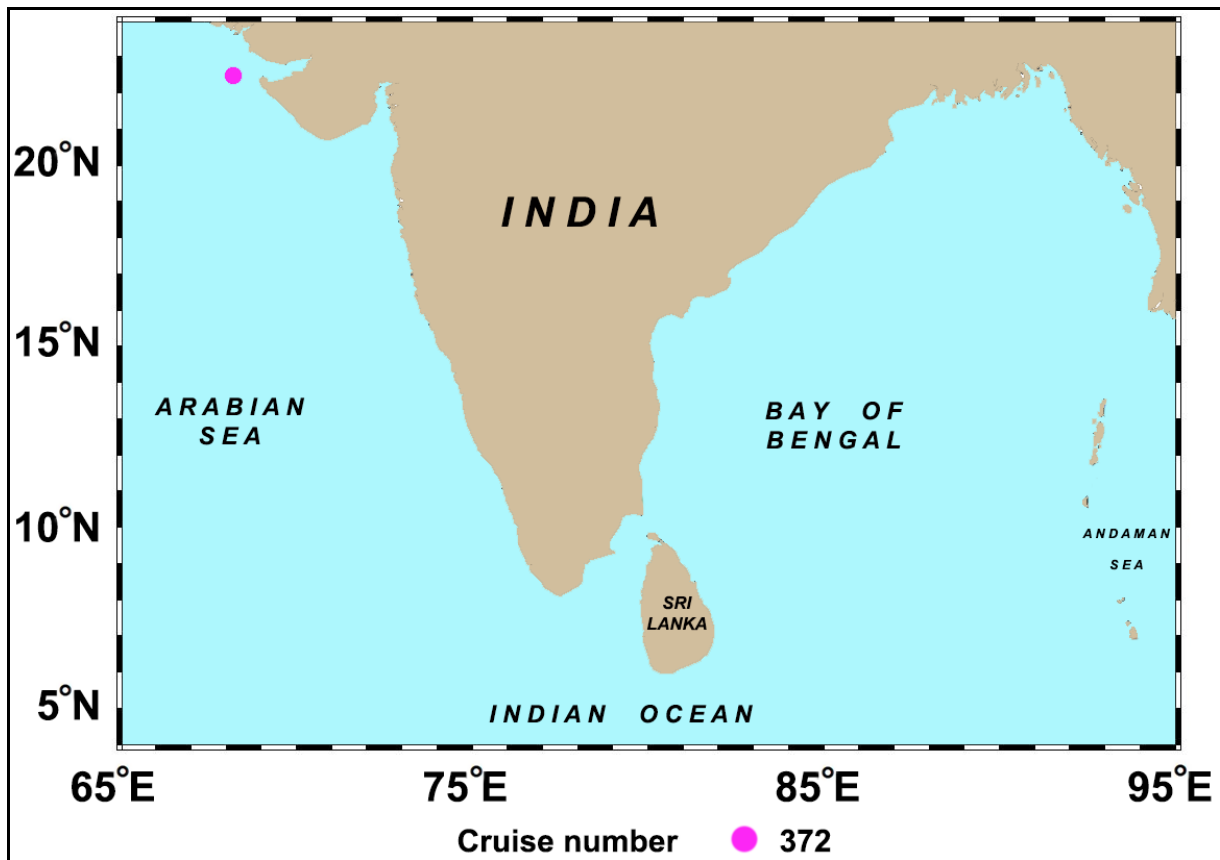


Fig. 22. Geographical locations of collection of *Lenisquilla gilesi* (Kemp, 1911)

Quollastria gonypetes (Kemp, 1911)

Superfamily Squilloidea Latreille, 1802

Family Squillidae Latreille, 1802

Genus *Quollastria* Ahyong, 2001

Quollastria gonypetes (Kemp, 1911)

(Figs. 23, 24A–H)

Synonymy

Squilla gonypetes Kemp, 1911: 96 (type locality: restricted to vicinity of Cheduba I., Myanmar, 13 m, by lectotype selection; Kemp, 1913: 3, 10, 22, 54, Pl. 4, Figs. 42–44 (part); Stephenson, 1962: 35; Manning, 1965: 250–253, Pl. 11 Fig. b; Ghosh & Manning, 1988: 657.

Oratosquilla gonypetes: Manning, 1971: 14; Manning, 1978a: 7, 12-14, Fig. 5; Graham *et al.*, 1993: 24, 64; Dev Roy & Gokul, 2012: 90 (checklist).

Oratosquillina gonypetes: Manning, 1995: 25 (checklist), 226 (identification key), 228; Ah Yong & Naiyanetr, 2002: 306 (list).

Quollastria gonypetes: Ah Yong, 2001: 301 (identification key), 304-306, Fig. 147A-L, 314 (checklist); Ah Yong & Kumar, 2018: 390, Fig. 3A.

Diagnosis (modified from Ah Yong, 2001): Body depressed (Fig. 23). Eye long, cornea bilobed. Ocular scales separate, sub-quadrangle distally; anterior margin of ophthalmic somite rounded (Fig. 24A, B). Antennal protopod unarmed. Rostral plate bluntly triangular, longer than broad (Fig. 24A, B). Carapace bearing antero-lateral spine, postero-lateral corner rounded; dorsal surface bearing median, intermediate, lateral, marginal, reflected marginal carinae, branches of anterior bifurcation of median carina separated from the median carina, dorsal pit present (Fig. 24A).

Raptorial claw ischio-meral articulation terminal (Fig. 24C); propodus opposable margin closely pectinate, bearing 3 movable spines proximally; dactylus slender, bearing 5 teeth (Fig. 24D). Maxillipeds 3-4 propodi ovate, lacking distal ribbing (Fig. 24E).

Thoracic sternites 5-8 bearing sub-median, intermediate carinae; sternite 5 bearing pair of acuminate spines laterally, anterior spine longer, obliquely directed; sternites 6-8 bilobed laterally, anterior lobe smaller than posterior (Fig. 24F). Abdominal somites 1-5 bearing sub-median, intermediate, lateral, marginal carinae, somite 6 lacking marginal carina; sub-medians of somites 5-6, intermediate of somites 3-6, all laterals, marginals bearing posterior spine; somites 2, 5 with 1 pair each of dark squares on either side of sub-median carinae (Fig. 24G).

Telson bearing median carina; sub-median, intermediate, lateral carinae slender, apices fixed; marginal denticles including 3-4 sub-median, 7 intermediate, 1 lateral; post-anal carina medially interrupted (Fig. 24G, H). Uropodal protopod bearing 2 primary spines, inner spine longer, bearing lobe on outer margin; long slender spine anterior to endopodal articulation, inner margin crenulate; exopod distal segment slightly shorter than proximal segment, articulating terminally; proximal segment bearing 8 movable spines on outer margin (Fig. 24G, H).



Fig. 23. *Quollastria gonypetes* (Kemp, 1911) (north-eastern Arabian Sea): A) 7.90 cm TL (live colouration); B) 7.90 cm TL (preserved colouration).

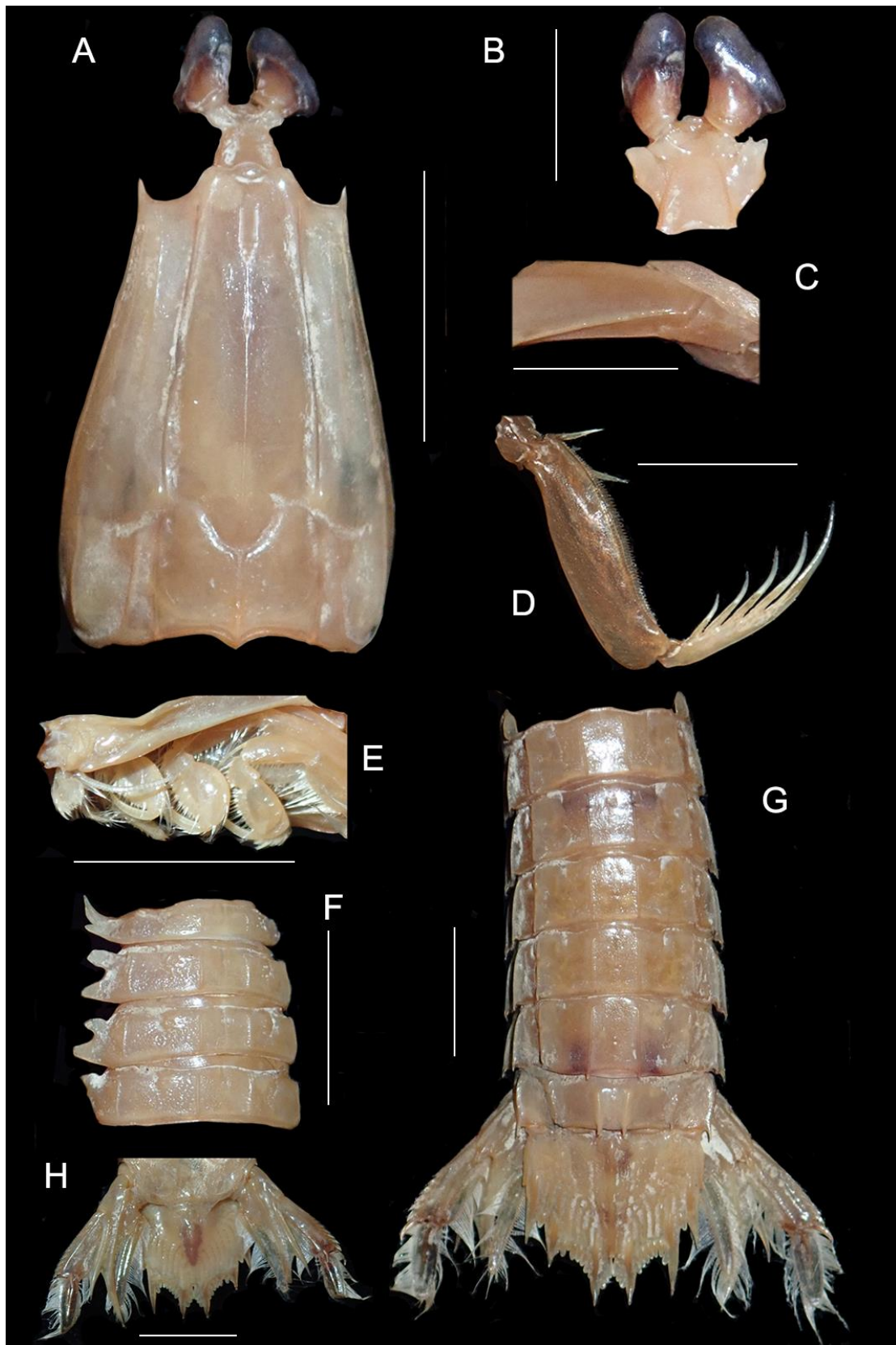


Fig. 24. *Quollastria gonypetes* (Kemp, 1911): A) Carapace dorsal; B) Ocular and rostral plates dorsal; C) Raptorial claw ischio-meral articulation lateral; D) Raptorial claw dactylus and propodus lateral; E) Maxillipeds 3-4 propodi lateral; F) Thoracic sternites 5-8 sub-dorsal; G) Abdomen, telson and uropods dorsal; H) Telson and uropods ventral. Scale: A, C-H, 10 mm; B, 5 mm.

Geographical distribution and habitat: Western Indian Ocean, India, Australia, Indonesia, Philippines, Vietnam to Japan (Ahyong & Kumar, 2018), on sandy mud substrates at depths of 13–110 m (Ahyong, 2001). The present specimens were collected from 72 m depth in the north-eastern Arabian Sea off Gujarat, 106 m off Goa, 110 m off Mangalore, and 56 m in the southwestern Bay of Bengal off Tamil Nadu coast (Fig. 25).

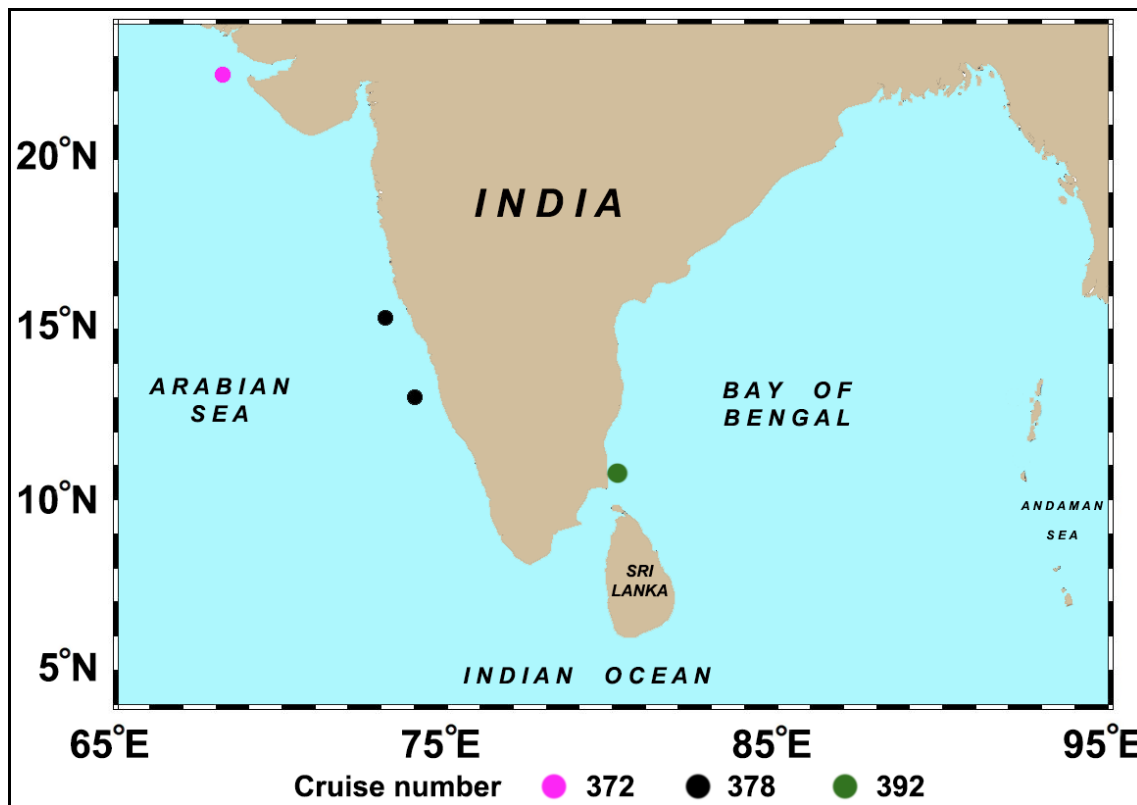


Fig. 25. Geographical locations of collection of *Quollastria gonypetes* (Kemp, 1911)

Squilloides leptosquilla (Brooks, 1886)

Superfamily Squilloidea Latreille, 1802

Family Squillidae Latreille, 1802

Genus *Squilloides* Manning, 1968

Squilloides leptosquilla (Brooks, 1886)

(Figs. 26, 27A–G)

Synonymy

Squilla leptosquilla Brooks, 1886: 30–34, Pl. 1: Figs. 1–2 (type locality: Celebes Sea, Philippines); Kemp, 1913: 46–48; Jurich, 1904: 370–372, Pl. 25(I): Fig. 1.

Squilla leptosquilla var. *dentata* Jurich, 1904: 372, Pl. 25(I): Fig. 2.

Squilloides leptosquilla: Moosa & Cleva, 1984: 80; Moosa, 1986: 410–411, Pl. I: Figs. D, E; Manning, 1991: 15; Manning, 1995: 26 (checklist); Ahyong, 2001: 310 (identification key), 310–312, Fig. 150A–K, 314 (checklist); Ahyong & Naiyanetr, 2002: 307 (list); Dev Roy & Gokul, 2012: 91 (checklist); Ahyong & Kumar, 2018: 391, Fig. 3C.

Diagnosis (modified from Ahyong, 2001): Body depressed (Fig. 26). Eye long, cornea bilobed. Ocular scales separate, rounded distally; anterior margin of ophthalmic somite rounded (Fig. 27A). Antennal protopod unarmed. Rostral plate triangular, longer than wide (Fig. 27A). Carapace bearing antero-lateral spine, postero-lateral corner rounded; dorsal surface bearing median, intermediate, lateral, marginal, reflected marginal carinae (Fig. 27A).

Raptorial claw ischio-meral articulation terminal (Fig. 27B); propodus opposable margin closely pectinate, bearing 3 movable spines proximally; dactylus slender, bearing 4 teeth (Fig. 27C). Maxillipeds 3–4 propodi ovate, lacking distal ribbing (Fig. 27D).

Thoracic sternites 5–8 bearing sub-median, intermediate carinae; sternite 5 bearing long straight lobe laterally, ventral process acuminate; sternites 6–7 bearing single lobe laterally (Fig. 27E). Abdominal somites 1–5 bearing sub-median, intermediate, lateral, marginal carinae, somite 6 lacking marginal carina; sub-medians of somite 6, intermediates of somites 2–6, laterals of 1–6, all marginals, bearing posterior spine (Fig. 27F).

Telson bearing sharp median carina; sub-median carina slender, intermediate, lateral carinae thick tapering, carinae apices fixed; marginal denticles including 13–14 sub-medians, 11–12 intermediate, 1 lateral; post-anal carina present (Fig. 27F, G). Uropodal protopod bearing 2 primary spines, inner spine longer; slender spine anterior to endopodal articulation, inner margin crenulate; exopod distal segment shorter than proximal segment, articulating terminally; proximal segment bearing 8 movable spines on outer margin (Fig. 27F, G).



Fig. 26. *Squilloides leptosquilla* (Brooks, 1886) (south-eastern Arabian Sea): A) 12.70 cm TL (live colouration); B) 11.30 cm TL (preserved colouration).

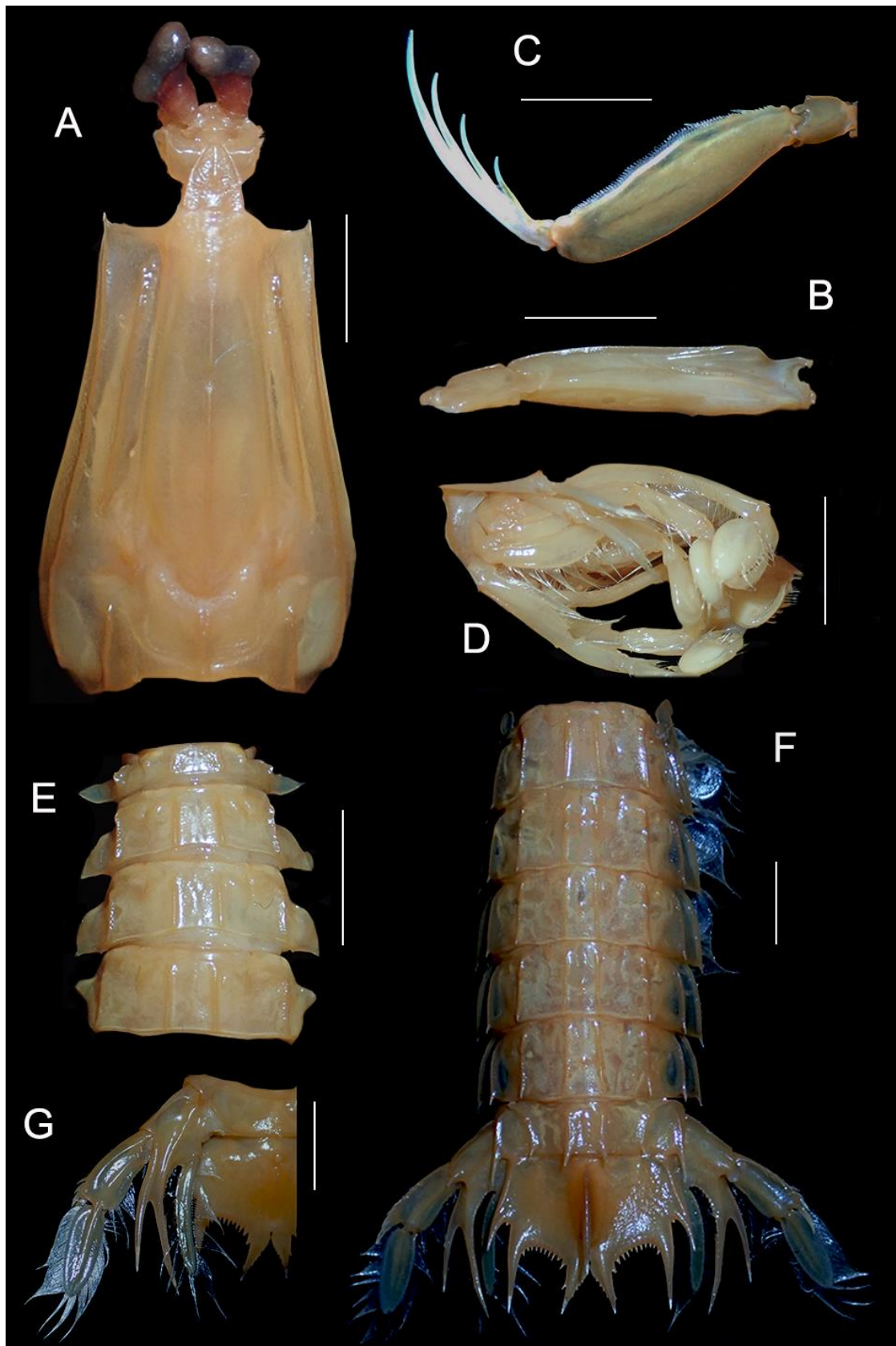


Fig. 27. *Squilloides leptosquilla* (Brooks, 1886): A) Carapace, ocular and rostral plates dorsal; B) Raptorial claw ischio-meral articulation lateral; C) Raptorial claw dactylus and propodus lateral; D) Maxillipeds 3-4 propodi lateral; E) Thoracic sternites 5-8 dorsal; F) Abdomen, telson and uropods dorsal; G) Telson and uropods ventral. Scale: 10 mm.

Geographical distribution and habitat: Arabian Sea to Andaman Islands, Philippines, Indonesia, Australia, South China Sea, Taiwan, Japan and Korea (Ahyong, 2001) at depths of 170–754 m (Moosa, 1986). The present specimens were collected from 327 m in the south-eastern Arabian Sea off Kerala coast, 173 and 238 m in the southwestern Bay of Bengal off Tamil Nadu coast, and 299–514 m in the Andaman Sea (Fig. 28).

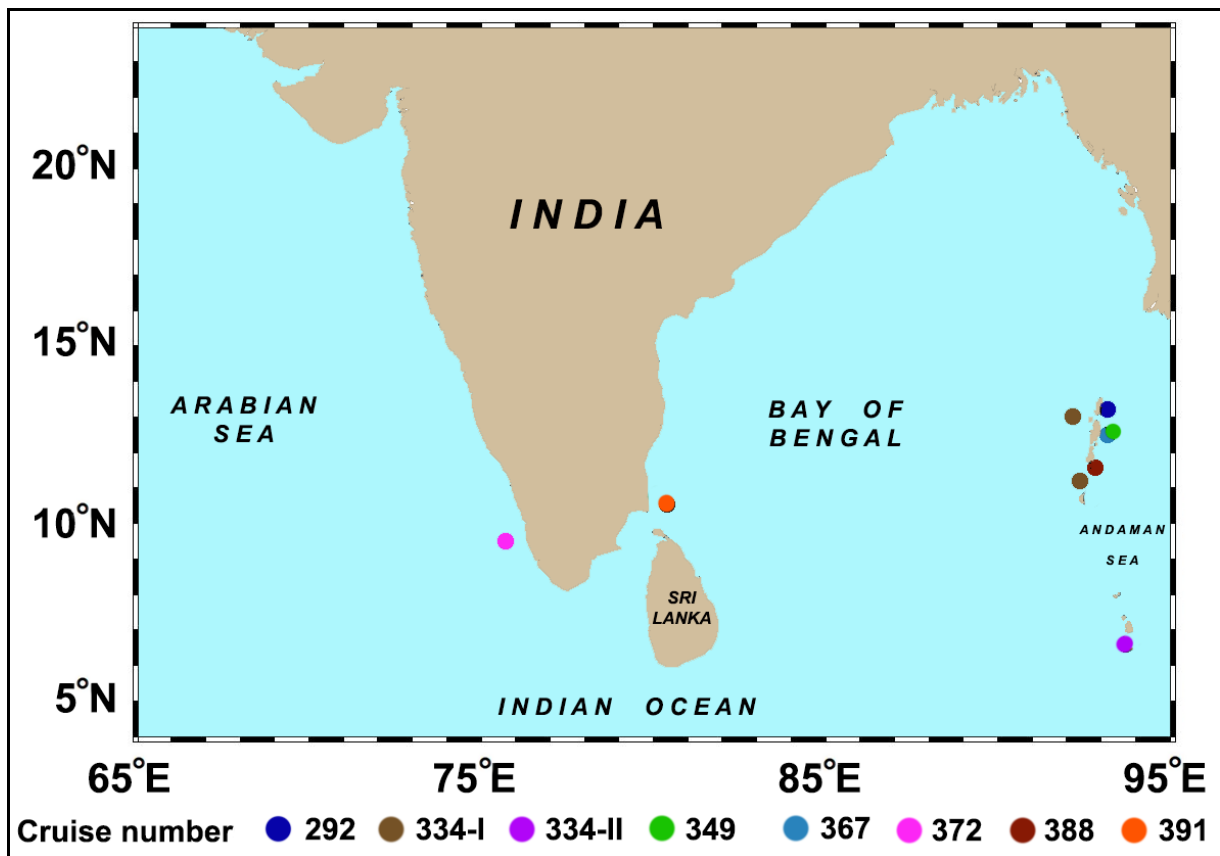


Fig. 28. Geographical locations of collection of *Squilloides leptosquilla* (Brooks, 1886).

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