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First records of dendrobranchiate prawns (Decapoda: Dendrobranchiata) from the Andaman Sea, India

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ABSTRACT

The Andaman Sea adjoining the Indian Territory is biologically rich in terms of marine diversity. However, inadequate surveys during the post-independence era have resulted in large lacunae in data on the species composition in these waters. In this paper, we report the first observation of two species of dendrobranchiate prawns, *Metapenaeopsis difficilis* Crosnier, 1991 and *Haliporus taprobanensis* Alcock and Anderson, 1899, in the Indian seas, supplemented with notes on their morphological diagnoses, comparison with closely related species and zoogeographical distribution. Crustacean specimens were collected using trawl nets and a naturalists' dredge on board the Fisheries Oceanography Research Vessel *Sagar Sampada* in the deeper offshore region between 124 and 850 m depth in the Andaman Sea during the period 2015–2017. *Metapenaeopsis difficilis* is distinguished by an oval-shaped thelycal plate and a low, unarmed bead-like plate on the thoracic sternum between the third pereopods. *Metapenaeopsis difficilis* is previously reported from the Philippines, Indonesia, Coral Sea, New Caledonia, Marquesas Islands, and Wallis and Futuna Islands at depths between 21 and 440 m, thereby indicating its westward range extension. *Haliporus taprobanensis* is distinguished by a tough integument, presence of a postero-dorsal spine on the fourth pleonal somite, and smooth dorsum of the first four pleonal somites. *Haliporus taprobanensis* is previously reported from South Africa, Madagascar, off Sri Lanka, Indonesia, Philippines and northern Australia at depths between 300 and 1650 m.

ARTICLE HISTORY

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KEYWORDS

Decapoda; prawns; new records; Andaman Sea; India

Introduction

The Andaman Sea is known to support a diverse deepwater dendrobranchiate shrimp fauna (Alcock 1901). Most taxonomic studies on deepwater dendrobranchiate prawns from the Andaman Sea were limited to the colonial era (Wood-Mason and Alcock 1891; Alcock and Anderson 1899a; Alcock 1901, 1905, 1906; Kemp 1910; Calman 1925). There were very few taxonomic studies of dendrobranchiate prawns in the Andaman Sea during the last eight decades (Silas and Muthu 1974, 1976; Thomas 1977). However, these studies dealt only with shallow-water species. Recently, a study on the deepwater shrimp

diversity in the Indian waters dealt only with material obtained from fish landing centres along the shores of the Arabian Sea and Bay of Bengal (Purushothaman et al. 2019). Moreover, most of the bathymetric features in the Andaman Sea remain unexplored with respect to invertebrate fauna including deepwater crustaceans (Van Dover et al. 2002). The dearth of faunal surveys in the continental slope regions of the Andaman Sea has resulted in large lacunae in the data on dendrobranchiate shrimp diversity. This has necessitated a comprehensive re-assessment of the taxonomy of this group from the Andaman Sea.

Based on this need, the Centre for Marine Living Resources and Ecology, Kochi (India), conducted fishing operations off the Andaman and Nicobar archipelagoes to collect spatially and taxonomically resolved records of marine crustaceans from the Indian Exclusive Economic Zone.

The cosmopolitan penaeid genus *Metapenaeopsis* Bouvier, 1905 includes 72 species and seven subspecies (De Grave and Fransen 2011), of which 43 species and seven subspecies are characterised by the lack of a stridulating organ on the carapace (Crosnier 1987, 1991, 1994a). The deepwater solenocerid genus *Haliporus* Spence Bate, 1881, includes only three valid species and is characterised by the presence of an accessory branchio-cardiac carina on the carapace, a shallow depression mid-dorsally in the cervical sulcus region, a podobranch on thoracic somites II and III, and three pairs of movable spines on the telson. The present study reports the first record of two species of dendrobranchiate prawns, *Metapenaeopsis difficilis* Crosnier, 1991 and *Haliporus taprobanensis* Alcock and Anderson, 1899, in the Indian seas, supplemented with information on their morphological diagnoses, comparison with closely related species and notes on zoogeographical distribution. This paper is a part of a larger study aimed to collect spatially and taxonomically resolved records of marine crustaceans in the Indian Exclusive Economic Zone.

Material and methods

Study area

The Andaman and Nicobar archipelagoes (6–14.000°N, 92–94.000°E) are situated along the southeastern margin of the Bay of Bengal, and overlie the Andaman–Nicobar Ridge. This ridge slopes eastwards at a gradient of 2.5° into the Andaman Sea (Rodolfo 1969). Alcock (1902, table I) reported various muddy substrates including ‘soft green mud’, ‘blue mud’ and ‘grey mud’ in the continental slope region.

The present study area, located between 6.60°N and 14.32°N latitude and between 92.09°E and 93.70°E longitude, includes the continental slope region (124–850 m depths) off the Andaman and Nicobar archipelagoes (Figure 1).

Sample collection and processing

Three cruises were conducted on board the Fishery Oceanographic Research Vessel *Sagar Sampada* (cruise numbers 334, 349 and 367) during 2015–2017, wherein 16 out of the 28 sampling stations were located in the Andaman Sea. Samples were collected using a high-opening trawl (HOT) model net with 30-mm codend mesh

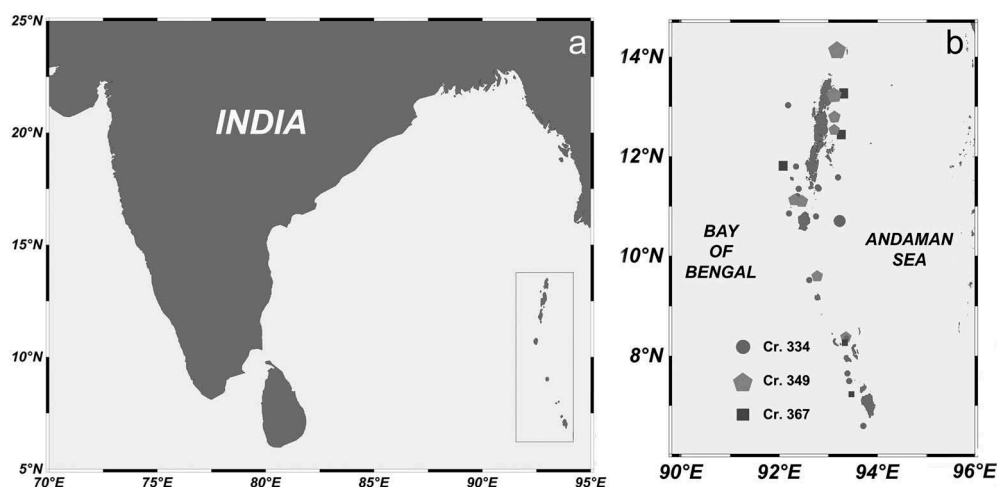


Figure 1. (a) Geographical location of the study area; (b) map of the study area indicating the location of sampling stations in the Indo-Pacific oceans.

size, the indigenously developed High Speed Demersal trawl II (Crustacean Version) net with 30-mm codend mesh size and the Naturalists' dredge with 10 mm mesh size at depths of 124–850 m (Figure 1). The specimens were preserved in 5% formalin and transported to the laboratory for detailed examination. Taxonomic identification of specimens followed relevant published literature (Alcock 1901; Crosnier 1988, 1991). Morphometric characters were measured using vernier callipers with an accuracy of 0.01 mm, and ratios derived following the above literature. Species identification was corroborated following the descriptions and illustrations provided by Crosnier (1988, 1991). Material examined during this study was deposited as reference vouchers at the Referral Centre of the Centre for Marine Living Resources and Ecology, Kochi (India).

Terminology used in the taxonomic descriptions follows Crosnier (1988, 1991). Numbers of body somites and appendages are denoted in Roman numerals. The list of synonyms provided in the taxonomic accounts follows the relevant taxonomic literature and the World Register of Marine Species (Horton et al. 2018).

Abbreviations

The abbreviations used for morphological and other terms used in the text are, in alphabetical order: AL, abdominal length; CL, carapace length; FORVSS, Fisheries Oceanography Research Vessel *Sagar Sampada*; HOT, high-opening trawl; HSDT (CV), high-speed demersal trawl (crustacean version); MUSORSTOM, joint expeditions of the Muséum national d'Histoire naturelle, Paris, and the Office de la Recherche scientifique et technique d'Outre-Mer; P, pereopod; PDL, pereopod dactylar length; PPL, pereopod propodal length; RIMSS, Royal Indian Marine Survey Ship; RL, rostrum length; stn., station; TeL, telson length; TL, total length; TPL, total pereopod length; UexL, uropodal exopod length.

Taxonomy

Order **DECAPODA** Latreille, 1802

Suborder **DENDROBRANCHIATA** Spence Bate, 1888

Superfamily **PENAEOIDEA** Rafinesque, 1815

Family **PENAEIDAE**, 1815

Genus ***Metapenaeopsis*** Bouvier, 1905

Metapenaeopsis difficilis Crosnier, 1991

(Figures 2, 3)

Metapenaeopsis difficilis Crosnier, 1991, p. 167 (key), p. 170 (key), p. 255, figs 65–67 – Crosnier 1994a, p. 340–, Crosnier 1994b, p. 370–, Crosnier 2007, p. 302 (list).

Material examined

1 ♀, Andaman Sea, FORVSS stn. 33402B, 10°42'23"N, 93°13'29"E, 124 m depth, CL (15.0 mm) (IO/SS/DEN/00055).

Geographic and bathymetric distributions

Western Pacific: 21–200 m depth from the Philippines, Indonesia, Coral Sea, New Caledonia, Marquesas Islands (French Polynesia) (Crosnier 1991), and 105–440 m depth off the Wallis and Futuna Islands (Crosnier 1994a, 1994b). Indian Ocean: 124 m depth in the Andaman Sea, India (present study).

Diagnosis

(modified from Crosnier 1991)

Rostrum short, reaching middle of second segment of antennule (CL:RL 1.00:0.53), distal end directed slightly upwards, dorsal margin with seven teeth, ventral margin nearly straight, edentulate, bearing long setae.

Carapace short (TL:CL 1.00:0.28), covered with short setae; epigastric tooth at anterior one-fourths of CL; antennal spine small; hepatic spine slightly larger, pterygostomial spine prominent; stridulating ridge absent (Figure 2(a)).

Eyes large, pigmentation prominent, eyestalk without tubercle on inner margin.

Inner antennular flagellum 0.5 times as long as peduncle, prosartema well developed. Antennal scaphocerite long, with prominent spine.

Maxillipeds II–III with long exopods.

All pereopods with exopods and epipods; PI–III missing; PIV–V long (CL:TPL_{IV} 1.00:1.20; CL:TPL_V 1.00:1.47), dactyli shorter than propodi (PPL_{IV}:PDL_{IV} 1.00:0.50; PPL_V:PDL_V 1.00:0.40).

Abdomen long (TL:AL 1.00:0.43), covered with short setae, somites I–II rounded dorsally, somite III–VI not rounded, and with prominent broad, mid-dorsal carina, flattened dorsally, with split ends posteriorly; carina on somite 4 splitting widely with median deep notch (Figure 2(b)); somite VI long, (AL:somite VI length 1.00:0.27; somite V length:somite VI length 1.00:1.86). Uropodal exopod with disto-lateral spine.

Telson slender, reaching distal end of spine on uropodal exopod, with one pair of large sub-apical fixed spines and three pairs of movable spines laterally.

Thelycum with a low lobe between bases of PIII; thelycal plate between bases of PIV transversely oval, bearing minute median spine anteriorly, flanked by convex margins;

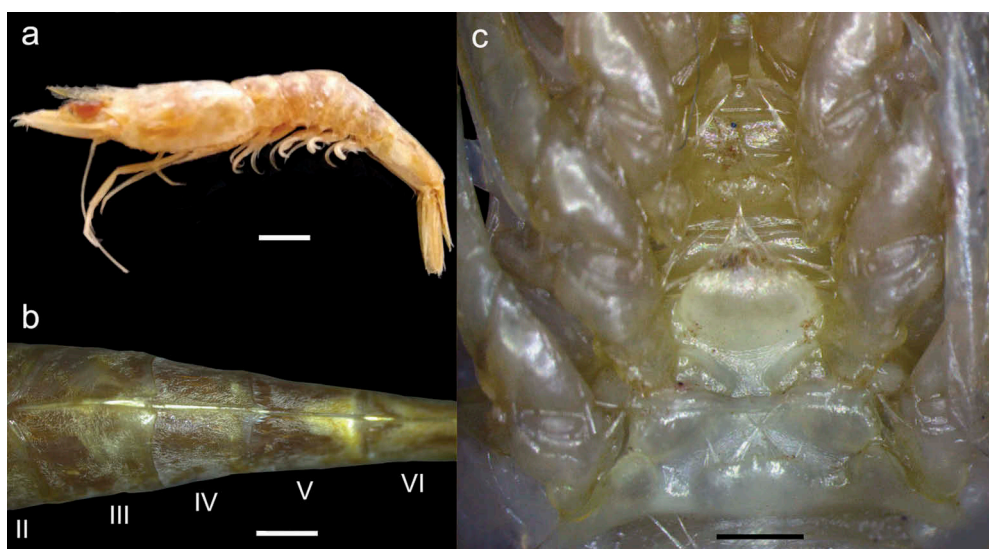


Figure 2. *Metapenaeopsis difficilis* [Crosnier, 1991](#): (a) female, lateral view; (b) pleon, dorsal view; (c) thelycum, ventral view. Scale bars: a = 10 mm; b, c = 500 μ m.

intermediate zone comprising a median ramp flanked by a pair of apertures of seminal receptacles; transverse plate between bases of PV sinuous, with straight ends; posterior plate divided into one broad, low central lobe with median denticle, and two high lateral lobes ([Figure 2\(c\)](#)).

Remarks

Metapenaeopsis difficilis is a small-sized species [CL 4.8–17.2 mm ([Crosnier 1991](#)); CL 8.0 mm ([Crosnier 1994a, 1994b](#)); CL 15.0 mm (present study)], widely distributed in the Western Pacific region ([Crosnier 1991, 1994a](#)) ([Figure 3](#)). This species was described from a female specimen (MNHN-Na 12577) collected from depths of 92–95 m in the Sibuyan Sea, Philippines, during the *MUSORSTOM 3* expedition ([Crosnier 1991](#)). The present observation is the first record from Indian waters, indicating westward extension of its geographical range ([Figure 3](#)).

This species is defined by a combination of the following morphological characters (following [Crosnier 1991](#)): rostrum bearing 7 or 8 dorsal teeth, except epigastric tooth; outgrowth on the sternum, between PIII, low, unarmed; thelycal plate anterior margin slightly convex; petasma with left valve lacking terminal tip, distoventral element reduced, spiral element with distal part of last turn with wing bearing large rib ventrally; left distodorsal element of petasma with quadrangular distal portion visible in ventral view, distal lobule well developed, slightly curved dorsally; thoracic somite VII completely lacking, or bearing weakly developed posterior-thoracic arthrobranch, lower arthrobranch rudimentary, pleurobranch variable. The present confirmation of the species was on the basis of morphological characters (thelycum and accessory structures), and herein agrees with the original description and illustrations of the holotype female of *M. difficilis* (voucher number MNHN-Na 12577) as emphasised by [Crosnier \(1991, p. 255, figs 65–66\)](#). The specimen is characterised by an upper rostrum with 6 teeth [vs 8 dorsal

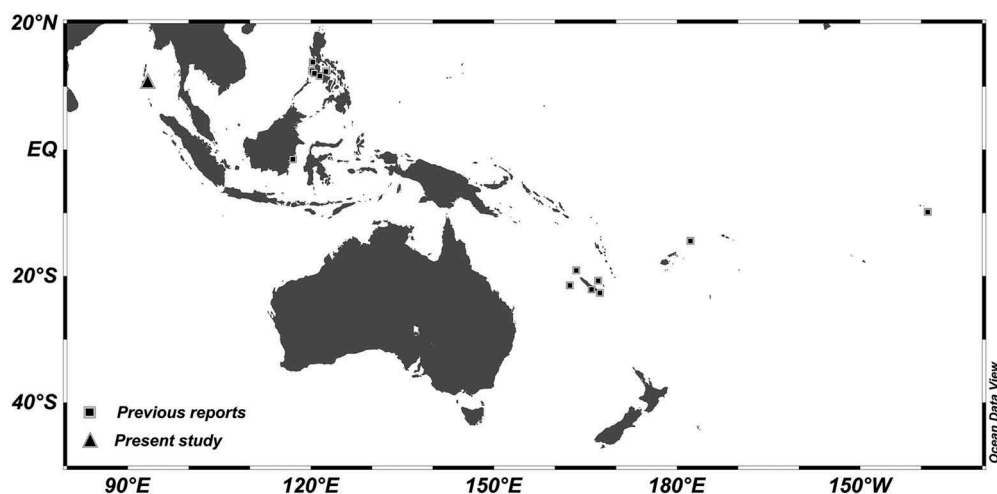


Figure 3. Map indicating the geographical distribution of *Metapenaeopsis difficilis* Crosnier, 1991 in the Indo-Pacific oceans.

teeth in the holotype (Crosnier 1991, fig. 65a)], third pleonal somite with flattened mid-dorsal carina having split wider posteriorly (vs third pleonal somite with mid-dorsal carina slightly split posteriorly in the holotype (Crosnier 1991, fig. 65b–c), and an oval-shaped thelycal plate with convex margins flanked by a pair of wide apertures of the seminal receptacle (vs thelycal plate flanked by a pair of small apertures of the seminal receptacle in the holotype (Crosnier 1991, fig. 66).

The present specimen also shows affinity with *M. quinquedentata* (De Man, 1907) in the number of dorsal rostral teeth, and the presence of a wide notch separating the split ends of the dorsal carina on pleonal somite III (Crosnier 1991).

Metapenaeopsis difficilis is very similar to *M. quinquedentata* (De Man, 1907) in the posterior splitting of the dorsal carina of the third pleonal somite with a notch separating the split ends, and the presence of a protuberance on the sternum between the bases of pereopods III. However, *M. difficilis* differs from *M. quinquedentata* in having 8 rostral teeth [vs 6 rostral teeth in *M. quinquedentata* (Crosnier 1991, fig. 62a)]. Secondly, *M. difficilis* lacks a well-developed outgrowth on the sternum between the third pair of pereopods (vs the presence of a well-developed outgrowth, with an apical spine, on the sternum between the third pair of pereopods in *M. quinquedentata* (Crosnier 1991, fig. 63a). It is noteworthy that the above species groupings are relevant only with respect to female genital morphology (Crosnier 1991).

Family **SOLENOCERIDAE** Wood-Mason in Wood-Mason and Alcock, 1891

Genus *Haliporus* Spence Bate, 1881

Haliporus taprobanensis Alcock and Anderson, 1899a

(Figures 4, 5)

Haliporus taprobanensis Alcock and Anderson, 1899a, p. 280 – Alcock and Anderson 1899b, pl. XLI, fig. 3 – Alcock 1901: p. 25 – Bouvier 1906: p. 4, 5, 6 – Bouvier 1908:

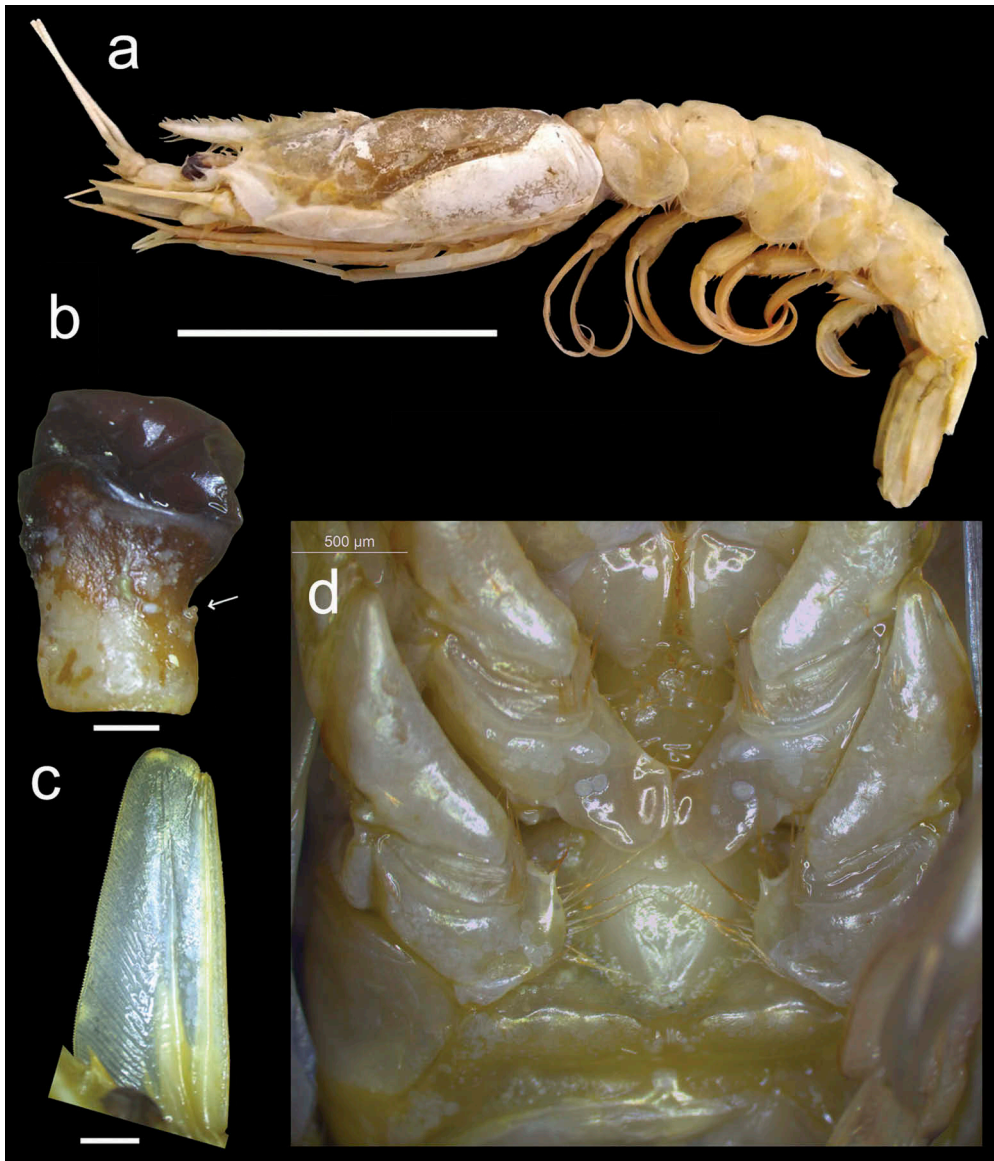


Figure 4. *Haliporus taprobanensis* Alcock and Anderson, 1899: (a) female, lateral view; (b) eye and eyestalk (arrow indicating the position of tubercle), dorsal view; (c) scaphocerite, dorsal view; (d) thelycum, ventral view. Scale bars: a = 50 mm; b–d = 500 µm.

p. 80, 81, 82 – De Man 1911: p. 7, 31 (list) – Pérez Farfante 1977: p. 263 – Crosnier 1978: p. 97, figs 34, 35, 39a, 40a, 42a –, Crosnier 1984: p. 23 –, Crosnier 1986: p. 865 (discussion) – Crosnier 1988: p. 576, figs 1c, 2b, 2g, 3b, 6d–f, 7, 8, 9c, 10c–d, 11 d–f – Dall 1999: p. 564, fig. 7.

Hymenopenaeus taprobanensis: Burkenroad 1936: p. 104 – Anderson and Lindner 1945: p. 290 (key) – Burukovsky 1974: p. 45 (key) – Burukovsky 1983: p. 60 (key).

Hymenopenaeus kannemeyeri Kensley, 1977, p. 27, fig. 7.

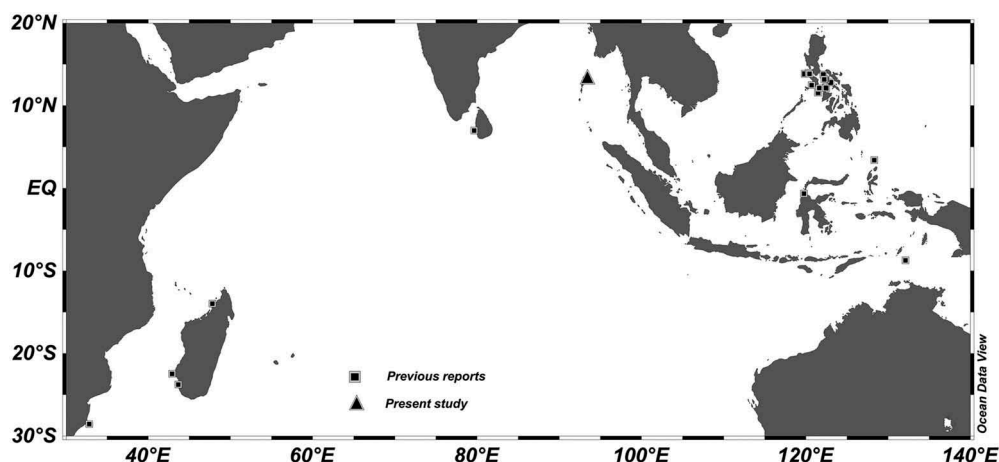


Figure 5. Map indicating the geographical distribution of *Haliporus taprobanensis* Alcock and Anderson, 1899 in the Indo-Pacific oceans.

Material examined

2 ♀, Andaman Sea, FORVSS stn. 36708, 13°15'54"N, 93°15'50"E, 635 m depth, CL (46.0 mm) (IO/SS/DEN/00076), CL (51.0 mm) (IO/SS/DEN/00077).

Geographic and bathymetric distributions

Indian Ocean: 1006 m depth off Sri Lanka (Alcock and Anderson 1899a), 775–825 m off South Africa (Kensley 1977), 528–582 m and 675 m off Indonesia (Crosnier 1984), 700–1200 m off Madagascar, 520–550 m and 1650 m off the Philippines (Crosnier 1988), and northern Australia (Dall 1999). The present study reports this species from a depth of 635 m in the Andaman Sea.

Diagnosis (modified from Crosnier 1988)

Rostrum moderately long (CL:RL 1.00:0.34), reaching as far as the distal end of second segment of antennular peduncle, dorsal margin nearly straight with 7 dorsal teeth, of which 3 are on carapace, ventral margin convex in nature.

Carapace short (TL:CL 1.00:0.30), post-rostral carina elevated, extending to posterior margin, epigastric tooth on anterior half, adrostral carina prominent, cervical groove deep, continuous across dorsal margin and terminating above hepatic groove (Figure 4(a)). Antennal, hepatic, pterygostomian spines present; hepatic groove commencing at base of orbital region and extending to its junction with branchio-cardiac groove. Branchio-cardiac carina and groove curve towards dorsal surface. A feeble post-hepatic carina commences behind hepatic spine and extends parallel to branchio-cardiac groove (Figure 4(a)).

Eyes moderately long, almost reaching distal end of basal segment of antennular peduncle, cornea wider than eyestalk; eyestalk with prominent tubercle characteristic of the species on inner margin (Figure 4(b)).

Upper and lower antennular flagellae sub-cylindrical, about as long as the entire body, first antennular segment with antero-median spine, prosartema well developed. Scaphocerite long, distally rounded, maximum width at base, median ridges usual (Figure 4(c)).

Maxilliped II–III with long filamentous exopods.

Pereiopods I–IV bear exopods and epipods, exopod in PV reduced, epipod absent. PI–III chelate, PI–II short (CL:TPL_I 1.00:0.71; CL:TPL_{II} 1.00:1.06), PIII long (CL:TPL_{III} 1.00:1.46). PI ischium and merus with 1 distal spine each; meri of PII–IV with 1 distal meral spine. PIV simple, long (CL:TPL_{IV} 1.00:1.35), dactylus more than half as long as propodus (PPL_{IV}:PDL_{IV} 1.00:0.57). PV missing.

Abdomen long (TL:AL 1.00:0.46), all somites with mid-dorsal carina but without pits dorsally, somite I with low carina on posterior half, somites IV–VI with postero-dorsal spines (Figure 4(a)), somite V with depressed lateral carina; uropodal exopod with disto-lateral spine.

Telson with 1 pair of sub-apical fixed spines and 3 pairs of movable lateral spines.

Thelycum comprising small-sized tubercle between the bases of PIII and PIV, and a larger ovate tubercle between the bases of PV (Figure 4(d)).

Remarks

Haliporus taprobanensis is a large-sized species [maximum CL + RL 64 mm (Alcock 1901); CL + RL 39.8–43.5 mm (Kensley 1977); CL 34.2–57.5 mm (Crosnier 1984); CL 15.3–49.5 mm (Crosnier 1988); 41.5–56.0 mm (Dall 1999); CL 46.0–51.0 mm (present study)] distributed across the Indo-West Pacific regions (Dall 1999) (Figure 5). This species was described from a female specimen (Indian Museum voucher number 3805/10) collected from 1006 m depth in the Gulf of Mannar off Sri Lanka during the deep-sea expedition of the RIMSS *Investigator* (Alcock and Anderson 1899a). The present observation is the first record from the Andaman Sea (Figure 5).

This species is defined by a combination of the following morphological characters (following Crosnier 1988): integument firm; eye almost reaching the distal end of segment I of the antennal peduncle, cornea distinctly wider than the base of ocular peduncle, darkly pigmented; mid-dorsal ridge of abdominal somite I extending over half the space between transverse groove and posterior edge of somite; somite IV with tooth at the distal end of mid-dorsal ridge. The present confirmation of the species was on the basis of morphological characters such as dimensions of the eye, pleonal armature and shape of the thelycum following Crosnier (1988). The present specimens are characterised by: an elevated rostrum with 5 dorsal teeth; a distinct pterygostomian spine; the mid-dorsal ridge on pleonal somite I extending only half the distance between the transverse groove and posterior edge; the lack of pits and longitudinal grooves on the pleonal somites; pleonal somite IV with distinct tooth distally on the mid-dorsal ridge; and a relatively shorter somite VI. The morphology of the present specimens agrees with the original description of the holotype female, described by Alcock and Anderson (1899a) and depicted in pl. XVI, fig. 3 (Alcock and Anderson 1899b).

The present specimens also show affinity with *H. thetis* Faxon, 1893 in having a firm integument, and a longer eye almost reaching segment I of the antennal peduncle with the cornea distinctly wider than the ocular peduncle.

According to Crosnier (1988), *H. taprobanensis* differs from *H. curvirostris* Spence Bate, 1881 in having a firm integument (vs soft integument in *H. curvirostris*); secondly, *H. taprobanensis* possesses a longer eye almost reaching segment I of the antennal peduncle with cornea distinctly wider than the basal part of the ocular peduncle [vs shorter eye

reaching only up to half the length of segment I of the antennal peduncle with cornea as wide as the ocular peduncle in *H. curvirostris* (Crosnier 1988, fig. 1a)].

On the other hand, *H. taprobanensis* differs from *H. thetis* in lacking a pitted surface on pleonal somites I–IV [vs presence of pitted surface on pleonal somites I–IV in *H. thetis* (Crosnier 1988, fig. 6g)]; secondly, in *H. taprobanensis*, the mid-dorsal ridge on pleonal somite I is restricted to the posterior half [vs the mid-dorsal ridge extending along the entire distance between the transverse groove and posterior edge in *H. thetis* (Crosnier 1988, fig. 6g)]; thirdly, *H. taprobanensis* possesses a distinct distal tooth on the mid-dorsal ridge of pleonal somite IV [vs absent in *H. thetis* (Crosnier 1988, fig. 6g)].

Discussion

Deepwater habitats, previously considered to be predominantly oligotrophic in nature (Druffel and Robison 1999), are now known to receive massive amounts of detritus from the surface waters through physical processes such as topographic modification of currents and enhanced detrital transport (Ramirez-Llodra et al. 2010). These processes consequentially support the trophic requirements of diverse benthic communities of chemoautotrophs and heterotrophic animals (Levin and Sibuet 2012). Dendrobranchiate prawns [including the families Penaeidae, Aristeidae Wood-Mason and Alcock 1891 (in Wood-Mason and Alcock 1891) and Solenoceridae] are among the most abundant deepwater invertebrates along the continental shelf and slope regions. The present surveys carried out at a depth range of 124–850 m revealed the highest abundance of prawns at 300–400 m. Published literature from the Mediterranean Sea indicates a high abundance of prawns at depths of 500–750 m (Koukouras et al. 2000), whereas they were reported from deeper bathyal waters off the Australian coasts (Farrelly and Ahyong 2019). These organisms prey upon a wide array of benthic invertebrates, protozoans, small fishes and detritus (Sobrinho et al. 2005; Li et al. 2016; Paturi and Myla 2017). At this level of ocean benthic dynamics, the seafloor supports substantial populations of decapod crustaceans, especially prawns. Stock assessment studies of these organisms (Tursi et al. 1993; Fiorentino et al. 1998) have revealed that fishable stocks of two aristeids, namely *Aristaeomorpha foliacea* (Risso, 1827 in [Risso 1826–1827]) and *Aristeus antennatus* (Risso, 1816), in the Mediterranean Sea were already overexploited by the mid-1980s.

During the present study, two new records of dendrobranchiate prawns have been reported from the Andaman Sea. This study assumes significance in generating new information on the crustaceans with the possibility of finding more rare species. Solenocerid prawns are known to prefer soft-bottom habitats (Chan 1998); however, only two specimens of *H. taprobanensis* were obtained during the present study using 30-mm codend mesh size. This is attributed to the use of the HSDT (CV) net with smaller mesh size, which is effective in crustacean sampling. On the other hand, the Naturalists' dredge is suitable for collecting macrobenthic epifauna (Ganesh and Raman 2007), which includes small-sized crustaceans such as *M. difficilis*.

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Disclosure statement

The authors have no potential conflict of interest or financial ties to disclose.

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