



## Occurrence of the feather star associated symbiotic brachyuran crab- *Permanotus purpureus* (Gordon, 1934) from the Andaman Sea, India

N K Nigam\*, C Sivaperuman & K K Bineesh

Zoological Survey of India, Andaman and Nicobar Regional Centre, Port Blair, Andaman and Nicobar Islands – 744 102, India

\*[E-mail: naveennigam88@gmail.com]

Received 01 September 2020; revised 04 August 2022

The present paper reports the first occurrence of *Permanotus purpureus* (Gordon, 1934), a crinoid associated symbiotic brachyuran crab from Andaman Sea. In the Indo-Pacific region, this species is very widespread. The Andaman Islands coral reef habitats were the source of five specimens that were procured during the surveys through scuba diving. We have also documented this species is association with three crinoid species as obligate symbionts.

[**Keywords:** Association, Brachyura, Crinoids, Distribution, New record]

### Introduction

The brachyuran crabs are widely distributed in coral reef environment and they are associated with many other invertebrates. Some brachyuran crabs are closely associated with Crinoidea (feather stars), Echinoidea (sea urchins) and Holothuroidea (sea cucumbers)<sup>1</sup>. The most varied symbionts were revealed in association with feather stars among the echinoderms. Crinoids have complex morphologies that shield their associated symbionts from predators and provide a variety of microhabitats, allowing multiple symbiotic species to coexist<sup>2</sup>. The feather stars have a variety of symbionts are amphipods, brittle stars, copepods, crabs, myzostomids, polychaetes and shrimps<sup>1,3-5</sup>.

Potts<sup>6</sup> documented the symbiotic associations between feather stars and brachyuran crabs; and their ecology. In Indo-West Pacific region, 33 species in 12 genera of the family Pilumnidae are obligatory symbionts of echinoderms, among 5 genera namely *Ceratocarcinus*, *Harrovia*, *Permanotus*, *Rhabdonotus* and *Tiaramedon* are associated with comatulids (feather stars) species<sup>7</sup>. In India, seven symbiotic crab species were recorded on echinoderms, of which five species were reported on feather star<sup>8-10</sup>. Presently, a total 4 feather stars associated crabs known from Andaman and Nicobar Islands<sup>11-13</sup>. This paper records *Permanotus purpureus* (Gordon, 1934) on three feather star species (*Comaster schlegelii*, *Comanthus parvicirrus* and *Anneissia bennetti*) from the Andaman Sea.

### Materials and Methods

Five specimens (3 males and 2 females) were collected by SCUBA diving from Andaman Islands (Fig. 1), between 10-15 m depth on feather star species. Collected specimens were brought in laboratory; symbionts separated gently and identified hosts and symbionts using appropriate taxonomic literature<sup>14-15</sup>. The specimens were examined under the stereo zoom microscope - Leica M 205A, measured carapace length (CL) and carapace width (CW) by using a digital Vernier calliper (Table 1) and preserved in 70% ethanol. The specimens were deposited to the National Zoological Collections of Zoological Survey of India, Andaman and Nicobar Regional Centre (ZSI/ANRC), Port Blair.

### Results

#### Systematics

Order: Decapoda Latreille, 1802

Family: Pilumnidae Samouelle, 1819

Genus: *Permanotus* Chia and Ng, 1998

*Permanotus purpureus* (Gordon, 1934)<sup>9-11,15</sup> (Fig. 2a – e)

#### Synonymy

*Harrovia bituberculata* Dai & Chen in Shen, Dai & Chen, 1982

*Harrovia purpurea* Gordon, 1934

#### Material examined

India: Andaman Islands- 1 male (CL 4.15mm and CW 5.18 mm) and 1 female (CL 6.25 mm, and CW 7.92 mm), Neil Island (11°50.807'N, 93°01.280'E), 21

March 2018, (Reg. No. ZSI/ANRC/24890); 1 male (CL 5.43 mm and CW 7.70 mm) and 1 female (CL 7.17 mm and CW 9.84 mm), Sound Island (12°56.469' N, 92°57.660' E), 21 February 2018, (Reg. No. ZSI/ANRC/24891); 1 male (CL 6.36 mm and CW 8.15 mm) Tree Island (13°25.948'N, 93°04.644'E), 20 February 2018, (Reg. No. ZSI/ANRC/24892).

**Diagnosis**

Carapace is wider than long; rostrum short; clearly deflexed downward; well-defined regions; distinct gastric and protogastric regions; mildly swollen cardiac region; depressed hepatic regions; relatively plane to covered with disseminated small granules; dorsal surface typically covered with very thin pubescence. The anterolateral and posterolateral margins are well defined; the anterolateral margin is rounded; the first three lobes are truncate, bordered with tiny granules, and separated from one another by narrow fissures. Antenna-free, antennal basal segment rectangular; the eyes are well developed and fill the

orbit; the third maxilliped is quadrate; the ischium is rectangular; the median oblique sulcus is deep; and the merus is squarish. Abdomen seven segmented, Chelipeds slightly granular, carpus spine or tubercle absent on the inner angle; chelae elongated and slender, fingers not carinate, pollex not distinctly bent downwards, dactylus elongated. Commonly, the colours of carapaces were dark brown and light bands, and a dirty white margin. Males are distinguished from females by having larger chelipeds, and larger females have inflated, bulbous carapaces<sup>9-11,15</sup>.

Table 1 — Morphometric data of Male and Female – *Permanotus purpureus* (Gordon, 1934)

Variable	Male	Female
Carapace Length (CL) mm	4.15 – 6.36 mm	6.25 – 7.17 mm
Carapace Width (CW) mm	5.18 – 8.15 mm	7.92 – 9.84 mm
Chelipeds	Larger	Small
Abdomen	Narrow and triangular	Broad and round

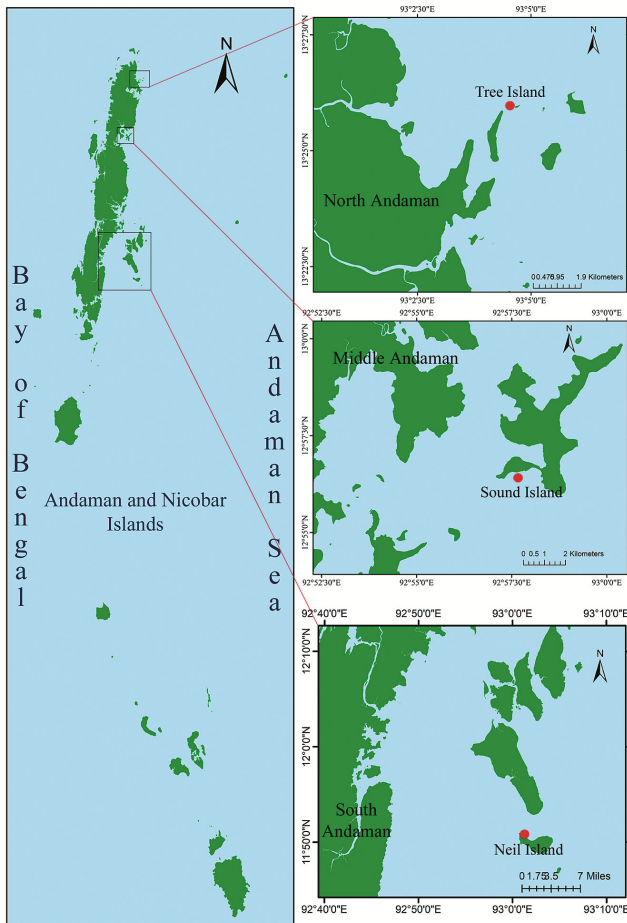


Fig.1 — Map of study areas of Andaman Islands

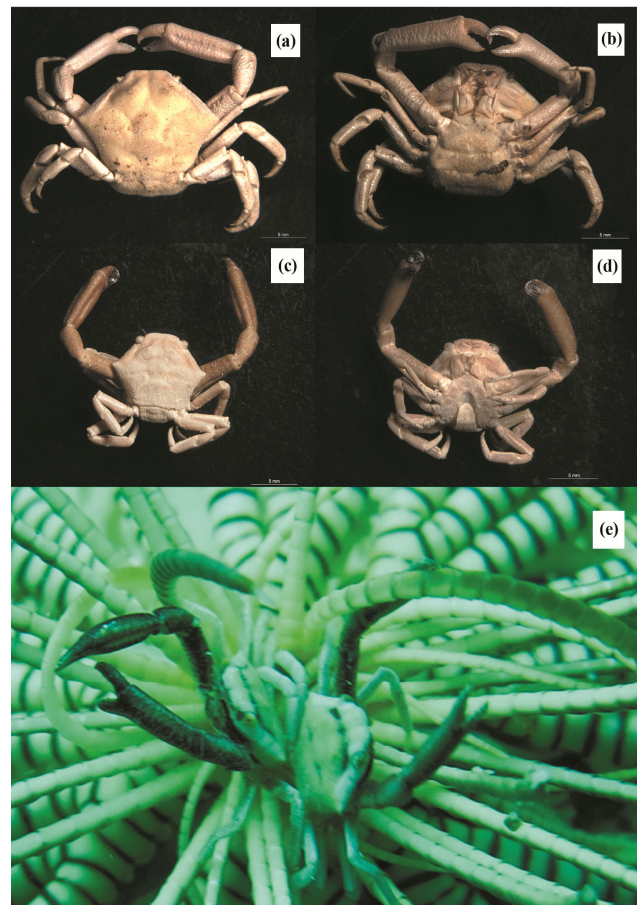


Fig. 2 — *Permanotus purpureus* (Gordon, 1934): a) dorsal view, b) ventral view of female, c) dorsal side, d) ventral side of male, e) *In-situ* image of associated crabs

### Distribution

The Indo-Pacific area has a vast distribution of this species<sup>7,15</sup>.

### Ecology

The symbionts were recorded from a depth between 10 – 15 m and associated with three Crinoids (feather stars) species, e.g. *Anneissia bennetti*, *Comaster schlegelii* and *Comanthus parvicirrus* in coral reef habitat.

### Discussion

Both in India and the Andaman & Nicobar Islands, there hasn't been much research done on the symbiotic organisms that live on feather stars. A variety of macrosymbionts linked with feather stars were found, which revealed the region's high diversity of crinoids that are symbionts. *P. purpureus* is a distinct species and associated with crinoids<sup>15</sup>. *P. purpureus* species (2 females and 1 male sample) were recently found on *Comaster schlegelii* and *Phanogenia gracilis* feather stars from the Lakshadweep Islands at depths of 13 to 18 m, respectively<sup>9-10</sup>. The feather star species *Anneissia bennetti*, *Comaster schlegelii*, and *Comanthus parvicirrus* were shown to have a symbiotic connection with the brachyuran crab *P. purpureus* in the current study. There are three distinct colour morphs of *Permanotus purpureus*: the first is a dark orange colour with transverse bands of cream; the second is a light cream band with a dark transverse orange band; and the third morph is in between the first two<sup>9-10,15</sup>. The first morph among the three appears to be the most widespread, whilst the second morph appears to be the least common<sup>15</sup>. The colour scheme of the current specimen resembles that of the original morph. A remarkable record for the Andaman and Nicobar Islands is the presence of *P. purpureus* on the crinoids *Anneissia bennetti* and *Comanthus parvicirrus*. This information is added to the database of brachyuran crabs found in the Andaman and Nicobar Islands. To fully understand the variety of feather star associated micro and macro symbionts from the Andaman and Nicobar Islands as well as other reef ecosystems in India, more in-depth research is needed.

### Acknowledgements

The authors are grateful to the Director, Zoological Survey of India, Ministry of Environment, Forest and Climate Change, Government of India for providing facilities. We are very thankful to Dr. Peter K. L. Ng, Department of Biological Science, National

University of Singapore for confirming the species identification.

### Conflict of Interest

Authors declare that they have no competing or conflict of interest.

### Author Contributions

NKN collected specimens, identified, photographed and drafted the manuscript. KKB & CS reviewed & edited the manuscript.

### References

- 1 Ng P K L & Jeng M S, The brachyuran crabs (Crustacea: Decapoda: Eumedonidae and Portunidae) symbiotic with echinoderms in Taiwan, *Zoo Stud*, 38 (3) (1999) 268-274.
- 2 Deheyn D, Lyskin S A & Eeckhaut I, Assemblages of symbionts in tropical shallow-water crinoids and assessment of symbionts' host-specificity, *Symbiosis*, 42 (2006) 161-168.
- 3 Britayev T A & Mekhova E S, Assessment of hidden diversity of crinoids and their symbionts in the bay of Nhatrang, Vietnam, *Org Divers Evol*, 11 (4) (2011) 275-285.
- 4 Fishelson L, Ecology of the Northern Red Sea Crinoids and Their Epi- and Endozoic Fauna, *Mar Biol*, 26 (1974) 183-192.
- 5 Mekhova E S, Martynov A V & Britayev T A, Host selection and host switching in *Gymnolophus obscura* - a symbiotic ophiuroid associated with feather stars (Crinoidea: Comatulida), *Symbiosis*, 76 (3) (2018) 313-320.
- 6 Potts F A, The fauna associated with the crinoids of a tropical coral reef; with special reference to its colour variations, *Papers from the Department of Marine Biology, Carnegie Institution of Washington*, 8 (1915) 73-96.
- 7 Castro P, Symbiotic Brachyura, In: *Decapoda: Brachyura, Treatise on Zoology – Anatomy, Taxonomy, Biology. The Crustacea, Complementary to the volumes translated from the French of the Traité de Zoologie [founded by Grassé (†), P. P.]*, edited by P Castro, P J F Davie, D Guinot, F R Schram & J C Von Vaupel Klein, (Brill, Leiden and Boston), 2015, pp. 543-581.
- 8 Trivedi J N, Trivedi J D, Kauresh D, Vachhrajani & Ng P K L, An annotated checklist of the marine brachyuran crabs (Crustacea: Decapoda: Brachyura) of India, *Zootaxa*, 4502 (1) (2018) 1-83.
- 9 Mariyambi P C, Mohammednoushad B, Idreesbabu K K & Sureshkumar S, First Record of Two Crinoid-Associated Brachyuran Crabs (Crustacea: Decapoda: Pilumnidae) from the Arabian Sea, Western Indian Ocean, *Thalassas*, (2020). <https://doi.org/10.1007/s41208-020-00197-w>
- 10 Prakash S & Marimuthu N, Notes on some crinoid associated decapod crustaceans (Crustacea: Decapoda) of Lakshadweep Archipelago, Central Indian Ocean, *Zootaxa*, 4766 (1) (2020) 86-100.
- 11 Castro P, Chia D G B & Ng P K L, On the taxonomic status of *Ceratocarcinus longimanus* White, 1847 (Crustacea: Decapoda: Brachyura: Eumedonidae), a crab symbiotic with comatulid crinoids, *Raffles Bull Zool*, 43 (1) (1995) 239-250.

- 12 Dev R M K & Nandi N C, Brachyuran crabs (Crustacea), In: *State Fauna Series, 19: Fauna of Andaman and Nicobar Islands*, edited by Director Zoological Survey of India, (Director ZSI, Kolkata), 2012, pp. 185-236.
- 13 Kumaralingam S, Raghunathan C, Ajithkumar T T & Chandra K, Reef associated common crustaceans of Andaman and Nicobar Islands, Lakshadweep and Gulf of Mannar, *Rec Zool Surv India*, 380 (2017) 1-249.
- 14 Clark A M & Rowe F W E, *Monograph of shallow-water Indo-west Pacific echinoderms*, (British Museum of Natural History), 1971, pp. 238.
- 15 Chia D G B & Ng P K L, A revision of *Ceratocarcinus* White, 1847, and *Harrovia* Adams and White, 1849 (Crustacea: Decapoda: Brachyura: Eumedonidae), two genera of crabs symbiotic with crinoids, *Raffles Bull Zool*, 46 (1998) 493-563.