Indian Journal of Geo Marine Sciences
Vol. 53 (04), April 2024, pp. 234-238
DOI: 10.56042/ijms.v53i04.10122

Short Communication

A new host record of pea crab, *Arcotheres placunae* (Hornell & Southwell, 1909) (Brachyura: Pinnotheridae), in *Placuna quadrangula* (Philipsson, 1788) (Bivalvia: Placunidae), from the southeastern coast of India

R B Chryso[a], S Ragul*[,a] & J N Trivedi[b]

[a]Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai, Tamil Nadu – 608 502, India

[b]Department of Life Sciences, Hemchandracharya North Gujarat University, Patan, Gujarat – 384 265, India

*[E-mail: nivinragulsiva@gmail.com]

Received 3 January 2024; revised 19 April 2024

Previously, the pea crab *Arcotheres placunae* (Hornell & Southwell, 1909) was only recorded from the known host bivalve species, *Placuna placenta* (Linnaeus, 1758). This study presents the first report on the host association between *A. placunae* and *Placuna quadrangula* (Philipsson, 1788) based on specimens found in the Vellar estuary, southeastern coast of India. During regular fishing survey along the Vellar estuary, observed a single male and female specimen of *A. placunae* in the mantle cavity of a live windowpane oyster, *P. quadrangula*. The association observed here remarks that the pea crab has a commensal relationship with the host, *P. quadrangula*. The present study provides the details of morphological features and association of new host of the species herein.

[**Keywords**: Estuary, Host association, Pinnotherids, Windowpane oyster]

Introduction

The genus *Arcotheres* Manning, 1993 is presently acknowledged by twenty-three species in the family Pinnotheridae. Pinnotherids are widely distributed in the Indo-West Pacific region, which all are mostly associated with bivalves[1]. Nauck[2] proposed the name *Arcotheres* to a number of pinnotherid crab species that bear a resemblance to *Pinnotheres* sp. After diagnosing the genus, Manning[3] re-erected *Arcotheres* from the *Pinnotheres* synonymy[4].

Members of the family Pinnotheridae are known for their obligatory endo or ectosymbiontism with a number of invertebrate hosts, which includes bivalves, gastropods, holothurians, echinoids/sea urchins, polychaetes and ascidians[5]. However, the pinnotherid crab genus *Arcotheres* is only known for their parasitic associations with bivalves, owing to their cryptic lifestyle, sexual dimorphism, and different female morphotypes[5]. Among all the species belonging to the genus *Arcotheres*, only *Arcotheres placunae* is known to be an obligate symbiont with windowpane oysters from the genus *Placuna*[1,6,7]. Previously, *A. placunae* was only reported from *Placuna placenta*[7–10]. The present study reveals a new host, *P. quadrangula* (Figs. 1a & 2).

During survey, both a male and female specimen of the pinnotherid crab *A. placunae* were collected, examined, and their species identity were confirmed. The present paper discusses the very first report on the association between *A. placunae* and *P. quadrangula* from the southeastern coast of India. In addition, a list of known associations of the pea crab species *A. placunae from various hosts* is presented based on previously published literature (Table 1). This study can be regarded as a baseline for further ecological and infestation studies pertaining to oysters and other bivalve species.

Materials and Methods

During September 2023, a regular survey was conducted along the intertidal region of the Vellar estuary (11°29'30" N; 79°46'05" E), Tamil Nadu, southeastern India, to explore the biodiversity in that location. Live windowpane oyster, *Placuna quadrangula*, were collected manually (randomly) from the Vellar estuary by hand-picking method during low tide when the intertidal region was partially exposed and checked visually for the presence of pea crabs. This windowpane oysters lodged in the oyster bed were found exposed on the sandy shore of the estuary.

Two live specimens of Pea crab belonging to the family Pinnotheridae were collected from the mantel cavity of the live windowpane oyster. The collected specimens were brought to the laboratory, after which they were photographed live along with the bivalve host (Fig. 1a). The species was identified by its diagnostic characters and confirmed as *Arcotheres placunae*. The species-level identification is done using a previously published taxonomic key by Trivedi *et al.*[7], and the host bivalve species, *P. quadrangula* is identified by the taxonomic key

given by Das *et al.*[11]. After the examination, both specimens were preserved in 95 % ethanol for further studies. The specimens are deposited in the Zoological Reference Collection (LFSC.ZRC-216), Department of Life Sciences, Hemachandracharya North Gujarat University.

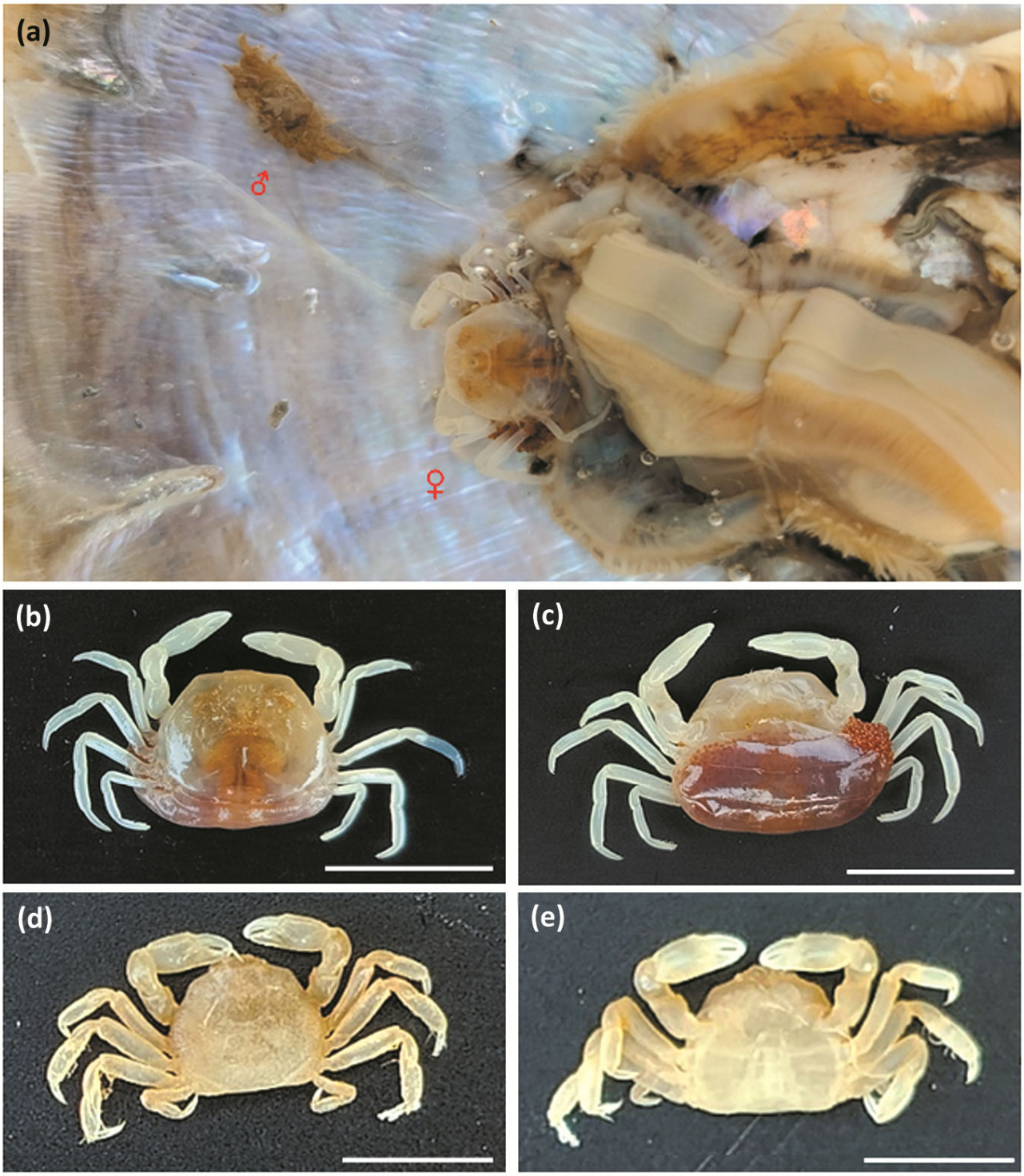

Fig. 1 — *Arcotheres placunae* (Hornell & Southwell, 1909): (a – e) Colour in life and in situ presence in *Placuna quadrangula*; (b & d) Overall dorsal & (c & e) Ventral view; (b & c) Ovigerous female (10×9.5 mm); and (d & e) Male (5×4.5 mm). Scale bars: b, c = 10 mm; d, e = 5 mm

Results and Discussion

Material examined

Arcotheres placunae (Hornell & Southwell, 1909), LFSC.ZRC-216, One male ♂ (5×4.5 mm), one ovigerous female ♀ (10×9.5 mm), specimen from the mantle cavity of the bivalve host *Placuna quadrangula*, 02 September 2023, by hand picking, from oyster beds: *Crassostrea madrasensis* (Preston, 1916) and *Saccostrea cucullata* (Born, 1778), exposed during low tide, adjacent to the Marine Biological Research station, Vellar Estuary (11°29'30" N; 79°46'05" E), Tamil Nadu, India.

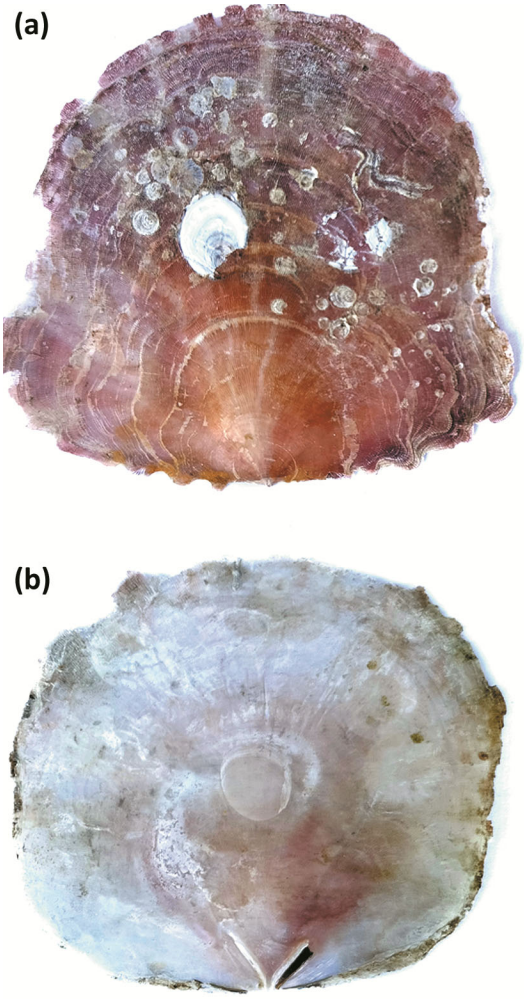

Fig. 2 — (a) Right valve, outer view; and (b) Left valve, inner view of host, *Placuna quadrangula*

Description of pea crab

Ovigerous female (10×9.5 mm): Posterior region, Abdomen wider than the carapace. Carapace length is three-quarter of its width. Middle of the anterior carapace has a concave protrusion. The pollex and moveable dactylus are slightly setose. Fourth walking leg pair/ ambulatory pereiopod pair, dactylus highly setose and ended with 12–14 spinules. Translucent pale orange colour (Fig. 1a, b) with irregular black spots; cheliped and pereiopods with bright white colour. Brownish-orange eggs (Fig. 1c). Male (5×4.5 mm): Relatively smaller than female. Front of carapace triangular. Abdomen narrowing posteriorly, not apparent from the top pale brownish green (Fig. 1a, d); cheliped dactylus translucent pale white.

Arcotheres placunae can be easily differentiated from other species by dactylus of cheliped is smaller than the propodus; eyes present but not visible from dorsal view; dactylus of fifth pereiopod has short setae on the dorsal, ventral and lateral margins. The studied specimens of both male and female agree with the previous description and figures given by Trivedi *et al.*[7].

Description of pea crab-windowpane oyster association

The two pea crabs were collected from shallow waters with muddy bottoms inside an oyster bed in the intertidal zone. An ovigerous female of *A. placunae* was found clinging underneath the mantle cavity of *Placuna quadrangula* (Fig. 2), which closely attached to the ctenidium, while the male was found at the oral surface of the shell (Fig. 1a).

The crabs remained firmly clung to the mantle cavity of the bivalve, mainly around the gills, even after the hosts were removed from the water. The carapace and appendices of the female crab have slightly variable colour tones, somewhat similar to the mantle of the hosts, but the male was much darker

Table 1 — List of association records between bivalves and the pea crab *Arcotheres placunae* (Hornell & Southwell, 1909)

Bivalve (host)	Localities	References
Placuna placenta (Linnaeus, 1758)	Okhamandal, Gulf of Kutch	Hornell & Southwell[12]
	Bombay, India	Chhapgar[9]
	Kakinada Bay, Andhra Pradesh, India	Devi & Rao[16]; Devi[17]
	Gulf of Kachchh, Gujarat, India and Balapur Bay, Gulf of Kachchh, Pakistan	Trivedi *et al.*[7]
	Korangi Creek, Pakistan	Kazmi *et al.*[8]
Placuna quadrangula (Philipsson, 1788)	Vellar estuary, Tamil Nadu, India	Present study

brown in colour (Fig. 1a, d). The reason for the occurrence of both sexes in the same host might be for copulation; male or female, entered the oyster in search of an un-associated host.

The host windowpane oyster, *P. quadrangula* can be easily distinguished from its other two Indian *Placunae* species, namely, *P. placenta* and *P. ephippium* by its morphological characteristics (Fig. 2b), such as thin quadrangular shape (vs. circular in *P. placenta*; vs. circular with curved dorsal margin in *P. ephippium*) and by the presence of irregular radial lines originating from umbones (vs. absent in *P. placenta* and *P. ephippium*). Das *et al.*[11] reviewed the genus *Placuna* and reported the occurrence of *P. quadrangula* in the Indian sub-continent, based on only five valves collected from Chennai and Pondicherry coast.

According to Das *et al.*[11], *P. quadrangula* is sparsely distributed in the southeastern coast of India. During the sampling along the Vellar estuary, a total of eighteen windowpane oysters, *P. quadrangula* were collected and dissected, which revealed only one oyster associated with a male, and an ovigerous female pea crab, *A. placunae* (frequency of occurrence, 5.5 %). Chhapgar[9] observed the frequency of occurrence of *A. placunae* (as *P. placunae*) in *P. placenta* from Bombay Coast was about 90 %. Additionally, Devi[17] observed the frequency of occurrence of *A. placunae* (as *P. placunae*), less in May (28 %) and high in September (93 %) in the host, *P. placenta*.

Hornell & Southwell (1909) described that healthy matured pea-crabs from the species *A. placunae* (as *Pinnotheres placunae*) were most frequent in less grown or immature *Placuna placenta* hosts[12] (Table 1). Jose & Deepthi[13] recorded a mass number of the pinnotherid crab, *A. placunae*, in association with the green mussel, *Perna viridis* and classified the relationship as parasitism. They stated that *A. placunae* infested mussels have relatively less growth in size and weight than the healthy mussels in the same localities. Later, Ng & Kumar[14] concluded that the identity of *A. placunae* (as *Pinnotheres placunae*) by Jose & Deepthi[13] is still ascertain, which needed re-examination[15].

Finding the present association of *A. placunae* in *P. quadrangula* may be due to environmental factors such as water flow, tide, sediment texture, bivalve biology (length of shell and age of mussel), abundance of bivalves in the area or number of windowpane oysters examined by researchers. This new record extends the host range for *A. placunae* from just one species of *Placuna* to two. *Arcotheres placunae* is, therefore, less specialistic than some other species of *Arcotheres*, which can only be found in one host[5] but still seems to be a windowpane oyster specialist. The present findings support the hypothesis that the ecological understanding of pea crabs on the Indian coast remains unsatisfactory and open to further research.

Acknowledgements

The authors are thankful to the Director and Dean of the Faculty of Marine Sciences, Annamalai University, for providing the necessary facilities.

Conflict of Interest

Authors declare no competing or conflict of interest.

Author Contributions

RBC & SR wrote the first version of the manuscript, carried out field sampling and collected the specimens. JNT confirmed the identity of the crab species. All authors contributed to the draft, provided critical feedback and helped shape the research. All authors read and approved the final manuscript.

References

1 Ng P K L, *Arcotheres placunicola*, a new species of pea crab (Crustacea: Brachyura: Pinnotheridae) from the window-pane shell, *Placuna ephippium* Philipsson, 1788 (Placunidae) in Singapore, *Raffles B Zool*, 66 (2018) 474–485. https://doi.org/10.5281/zenodo.5359479

2 Nauck E, Das Kaugerüst der Brachyuren, *Zeits Für Wisse Zool*, 34 (1880) 11–69, pl. 1.

3 Manning R B, Three genera removed from the synonymy of *Pinnotheres* Bosc, 1802 (Brachyura: Pinnotheridae), *Proc Biol Soc Wash*, 106 (3) (1993) 523–531.

4 Campos E, Authorship and diagnosis of the genus *Arcotheres* Manning, 1993 (Crustacea: Brachyura: Pinnotheridae), *Raffles B Zool*, 49 (1) (2001) 167–168.

5 de Gier W & Becker C, A review of the ecomorphology of pinnotherine pea crabs (Brachyura: Pinnotheridae), with an updated list of symbiont-host associations, *Diversity*, 12 (11) (2020) p. 431. https://doi.org/10.3390/d12110431

6 DecaNet (eds), *Arcotheres* Manning, 1993. Accessed through: World Register of Marine Species at: https://www.marinespecies.org/aphia.php?p=taxdetails&id=439639; Accessed on March 2024.

7 Trivedi J N, Vachhrajani K D & Ng P K L, Redescription of *Arcotheres placunae* (Hornell & Southwell, 1909) (Crustacea: Decapoda: Brachyura: Pinnotheridae) from India and Pakistan, *Zootaxa*, 4433 (1) (2018) 50–68. https://doi.org/10.11646/zootaxa.4433.1.2

8 Kazmi Q B, Sultana R & Ghory F S, Redescription of *Arcotheres placunae* and three new records, *A. aff. alcocki*, *A. casta* and *Pinnotheres quadratus* from Pakistan with a note on previously recorded Pakistani Pinnotherid crabs, *Pak J Mar Sci*, 25 (1&2) (2016) 131–143.

9 Chhapgar B F, On the marine crabs (Decapoda: Brachyura) of Bombay State, Part 2, *J Bombay Natl Hist Soc*, 54 (3) (1957) 503–549.
10 Chhapgar B F, *Marine crabs of Bombay State. Contribution No. 1 of the Taraporevala Marine Biological Station*, (Department of Fisheries, Bombay), 1957, pp. 89.
11 Das R R, Samuel V K D, Sampath G, Krishnan P, Ramachandran P, *et al.*, The windowpane oyster family Placunidae Rafinesque, 1815 with additional description of *Placuna quadrangula* (Philipsson, 1788) from India, *J Threat Taxa*, 11 (15) (2019) 5061–5067. https://doi.org/10.11609/jott. 5049.11.15.15061-15067
12 Hornell J & Southwell T, Description of a new species of *Pinnotheres* from *Placuna placenta*, with a note on the genus, In: *A Report to the Government of Baroda on the Marine Zoology of Okhamandal in Kattiawar, Part 1*, edited by Hornell J, (Richard Clay & Sons Ltd., Bungay, Suffolk), 1909, pp. 99–103.
13 Jose B & Deepthi T R, Green mussel *Perna viridis*, a new host for the pea crab *Pinnotheres placunae* along the Malabar coast, Kerala, *Curr Sci*, 89 (7) (2005) 1090–1091.
14 Ng P K L & Kumar A B, A new species of *Afropinnotheres* Manning, 1993 (Crustacea, Brachyura, Pinnotheridae) from southwestern India, the first record of the genus from the Indian Ocean, with a review of the Pinnotheridae of India and adjacent seas, *Zootaxa*, 3947 (2) (2015) 264–274. https://doi.org/10.11646/zootaxa.3947.2.8
15 Trivedi J N, Trivedi D J, Vachhrajani K D & Ng P K L, An annotated checklist of the marine brachyuran crabs (Crustacea: Decapoda: Brachyura) of India, *Zootaxa*, 4502 (1) (2018) 1–83. https://doi.org/10.11646/zootaxa.4502.1.1
16 Devi S L & Rao K H, Some aspects of biology of the pea crab *Pinnotheres placunae* Hornell & Southwell, *Proc Indian Natl Sci Acad*, Part B, 52 (4) (1986) 455–459.
17 Devi S L, Some aspects of biology and effect of infestation of *Pinnotheres placunae* Hornell and Southwell of Kakinada Bay, *J Mar Biol Assoc India*, 28 (1986) 113–123.