

Short Communication

Occurrence of deep-water spider crab *Paramaya mulli* Ng, Prema & Ravichandran, 2018 from the Southwest coast of India

R D Chakraborty*, P Laxmilatha, P V Vidhya, V U
Unnimaya Udayan, S Sreelakshmy, M Aghana, A P
Gayathri, K T S Sunil & T Rethesh

Shellfish Fisheries Division, Central Marine Fisheries
Research Institute, Ernakulam North P.O., P.B. No. 1603,
Cochin, Kerala – 682 018, India

*[E-mail: rekhadevi7674@gmail.com]

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This study documents the occurrence of deep-water spider crab, *Paramaya mulli*, along the Southwest coast of India. Initially described in 2018 from Tamil Nadu on the east coast, this species was subsequently noted in 2020 in Gujarat on the west coast. The specimen was retrieved from by-catch discarded by commercial fishing trawlers at Sakthikulangara fishing harbour off Kollam, Kerala. Identification as *Paramaya mulli* was established through a combination of morphological and molecular data. Both 16S ribosomal RNA (16S rRNA) and cytochrome c oxidase I (COI) sequences from the current specimen were compared with the NCBI sequences of previously identified specimens. Phylogenetic analysis, using mitochondrial gene sequences (16S: OQ456467, OQ456468) from the present specimen and sequences obtained from NCBI GenBank, was conducted to elucidate the relationships of genus *Paramaya*.

[**Keywords:** Deep-water, Majoidea, Southwest coast, Spider crab, Systematics]

Introduction

Kerala, situated on the Southwest coast of India, boasts a 590 km coastline, contributing to 10 % of the country's total coastal expanse. The state has a thriving marine fisheries sector, serving as a crucial source of livelihood for its coastal population. The rich marine ecosystem along Kerala's coastline harbours a diverse array of marine organisms¹. Notably, the infraorder Brachyura, belonging to the subphylum Crustacea, demonstrates substantial diversity in the marine environment, with extensive research on their variations along the Indian coastline²⁻⁸.

Globally, there are 7620 brachyuran species across 104 genera. In India, 910 marine brachyuran crabs, representing 361 genera and 62 families, have been

documented⁸⁻⁹. Many of these crab species are commonly caught as by-catch in trawls¹⁰. Spider crabs, classified under the genus *Maja* Lamarck, 1801, fall within the family Majoidea: Majidae Samouelle, 1819. They are prevalent in the eastern Atlantic, Mediterranean, and Indo-West Pacific regions, inhabiting both shallow and deep waters¹⁰. While most species are small to medium-sized and lack commercial value, the revision of the *Maja* genus in 2015 led to the recognition of *Paramaya* De Haan, 1837, as a distinct genus. Other genera, such as *Neomaja*, *Paramaja*, *Alcomaja*, *Holthuija*, *Sakaija*, *Planaja*, *Ovimaja*, and *Rathbunaja*, were also identified⁹.

Currently, four species of genus *Paramaya* are known, namely *Paramaya coccinea* Ng & Richer de Forges, 2015, *Paramaya ouch* Ng & Richer de Forges, 2015, *Paramaya spinigera* (De Haan, 1837), and *Paramaya mulli* Ng, Prema & Ravichandran, 2018^(ref. 9). Of these, only *Paramaya mulli* has been recorded in India⁸⁻¹¹. Members of the *Paramaya* genus can be easily distinguished from other genera by their distinctive features, including very long carapace spines, elongated epistome, and spinose ambulatory meri⁹.

This study marks the first recorded occurrence of the spider crab *Paramaya mulli* Ng, Prema & Ravichandran, 2018, belonging to the family Majidae, along the Southwest coast of India.

Materials and Methods

The specimen of *P. mulli* was collected from the deep-sea by-catch discarded by commercial fishing trawlers at Sakthikulangara fishing harbour off Kollam, Kerala, along the Arabian Sea, Southwest coast of India in December 2022. The sample was preserved in 95 % ethanol, and the voucher specimen (ED.2.2.3.7) was deposited in the referral museum of the Central Marine Fisheries Research Institute (CMFRI) in Cochin, India. Identification of the specimen confirmed the species as *Paramaya mulli* Ng, Prema & Ravichandran, 2018, based on the descriptions and illustrations provided by Ng, Prema & Ravichandran, 2018^(ref. 11). The Post-pseudorostral Carapace Length (PCL) and maximum Carapace Width (CW) of the specimen were measured in millimeters. Total genomic DNA was extracted using the DNeasy® Blood & Tissue Kit. The mitochondrial

region's 16S and COI sequences were amplified using universal primers^{12,13}, and the PCR-purified products were sequenced using the dideoxy chain termination method with the ABI Prism 3770 automated sequencer from GeneSpec, India¹⁴.

Results and Discussion

Systematics

Order: Decapoda Latreille, 1802

Suborder: Pleocyemata Burkenroad, 1963

Superfamily: Majoidea Samouelle, 1819

Family: Majidae Samouelle, 1819

Genus: *Paramaya* De Haan, 1837

Paramaya mulli Ng, Prema & Ravichandran, 2018

Material examined

One male specimen (CW: 46 mm, PCL: 56 mm), deposited as ED.2.2.3.7, was collected at the Sakthikulangara fish landing center (located off Kollam at 8°56'60.78" N; 76°32'34.27" E) in Kerala, India, on December 22, 2022.

Diagnosis

The carapace exhibits an oval shape (Fig. 1A), with a relatively long eyestalk (Fig. 1Ca) and a broad intercalated tooth on the carapace (Fig. 1Cb). The dorsal surface is convex and granular, featuring relatively short pseudorostral spines. The hepatic, lateral, and branchial spines are notably long, and a median row consists of 5 spines - 3 gastric, 1 cardiac, and 1 intestinal; with

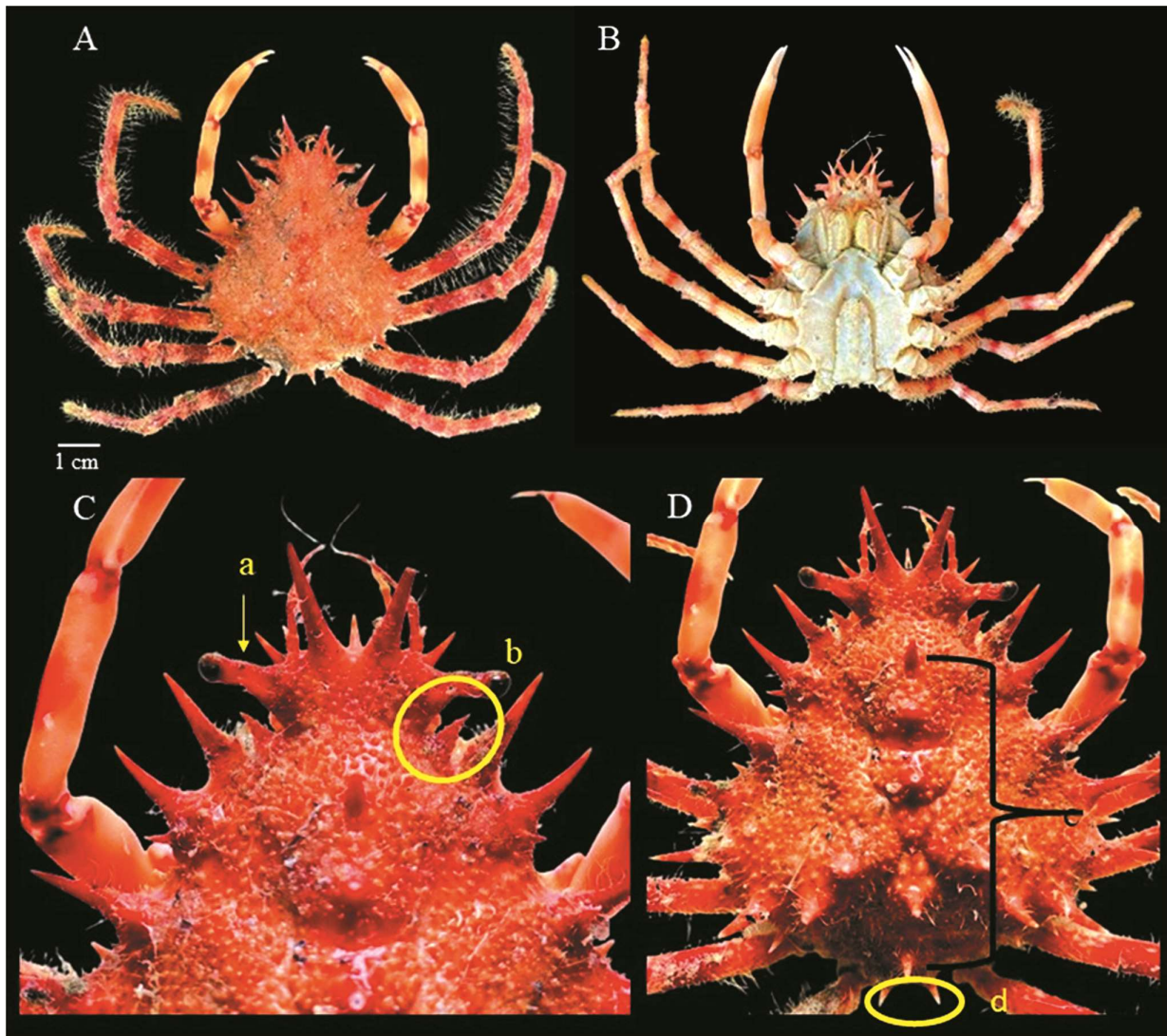


Fig. 1 — *Paramaya mulli* Ng, Prema & Ravichandran, 2018, CW 46 mm, PCL 56 mm, Male, (ED.2.2.3.7), Sakthikulangara (off Kollam 8°56'60.78" N; 76°32'34.27" E) fish landing center. A: Dorsal view, B: Ventral view, C: Upper carapace, D: Carapace, a: Eyestalk, b: Intercalated tooth, c: median row with 5 spines, and d: Two spines on posterior carapace margin

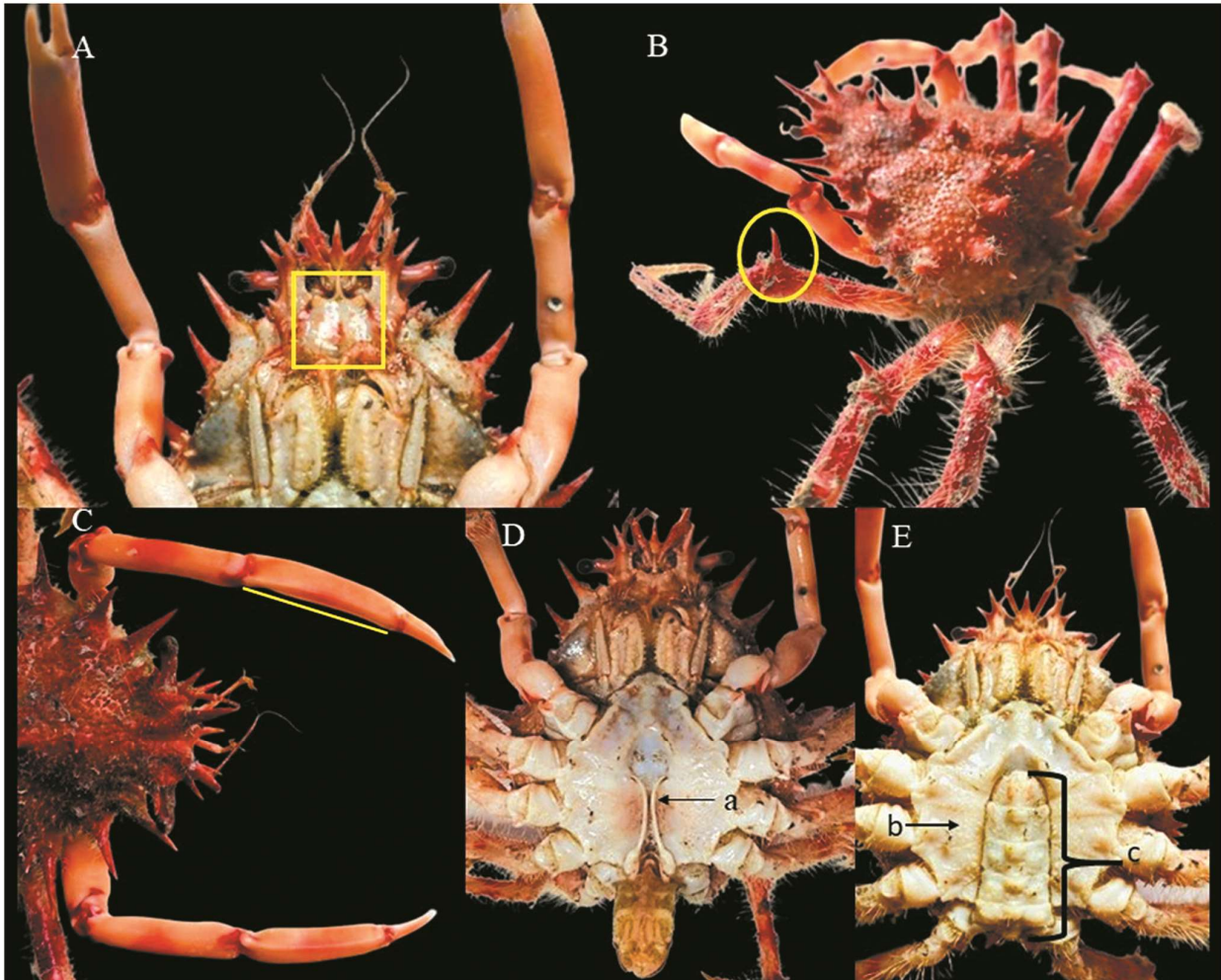


Fig. 2 — *Paramaya mulli* Ng, Prema & Ravichandran, 2018, CW 46 mm, PCL 56 mm, Male, (ED.2.2.3.7), Sakthikulangara (off Kollam 8°56'60.78" N; 76°32'34.27" E) fish landing center. A: Quadrate epistome, B: Merus of the ambulatory legs with subdistal dorsal spine, C: Chela with distinct carina, D: Slightly curved G1 with rounded tip, E: Enlarged ventral view, a: Gonopod; b: Surface of thoracic marked with numerous prominent rounded granules, and c: abdomen with six somites & telson

2 spines on the posterior carapace margin. Distinct grooves separate the gastric, branchial, and cardiac regions. The adult branchial region appears swollen (Fig. 1D), and the epistome is quadrate (Fig. 2A). The thorax surface is marked with numerous prominent rounded granules and is less setaceous (Fig. 2Eb). The dorsal and ventral margins of the chela feature distinct carina (Fig. 2C). The ambulatory meri are relatively long and slender, covered with long setae, while the merus of the ambulatory legs contain a subdistal dorsal spine (Fig. 2B). The male abdomen comprises 6 somites and a telson (Fig. 1B and Fig. 2Ec), and the gonopod (G1) is slightly curved with a rounded tip (Fig. 2Da).

Coloration

The specimen displays an orangish-red hue on its dorsal surfaces, featuring red and white bands on the

ambulatory legs. The chelipeds are of a yellowish-orange color, and the tips of the fingers exhibit a white shade. The ventral surfaces are predominantly white, adorned with patches of orange and red on the chelipeds and ambulatory legs.

Distribution

In India, the species *Paramaya mulli* was previously documented at the Pazhayar fish landing centre, situated along the Bay of Bengal in Tamil Nadu¹¹, and at Sutrapada in the state of Gujarat⁸.

Remarks

Paramaya mulli do not exhibit much difference from descriptions and figures provided by Ng *et al.*¹¹ and Trivedi *et al.*⁸. The present specimen is smaller than the one described by Ng *et al.*¹¹ (CW - 64.4 mm,

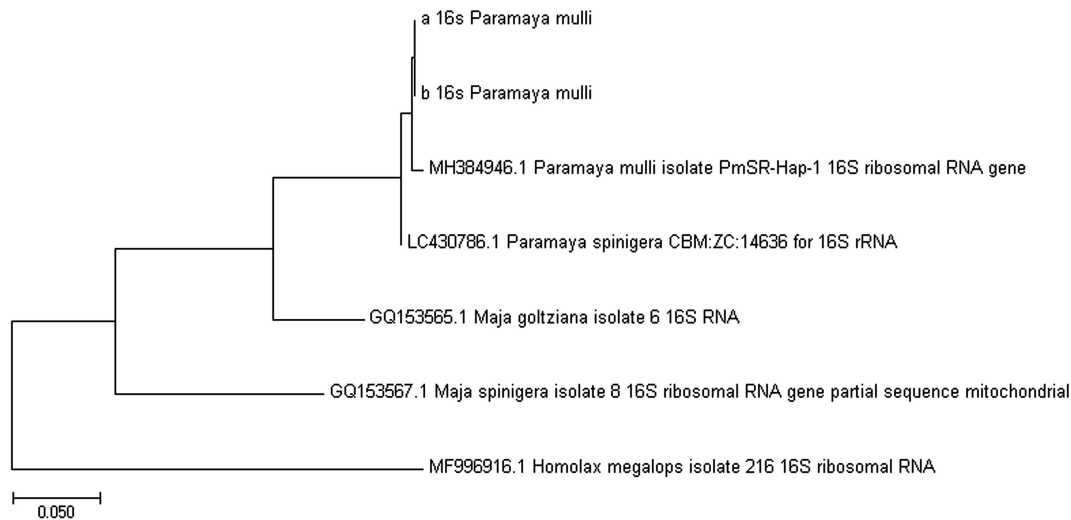


Fig. 3 — Phylogenetic tree of *Paramaya mulli* using maximum likelihood based on the Tamura-Nei model inferred from DNA sequences of 16S mitochondrial gene

PCL - 70.4 mm) and larger than the one described by Trivedi *et al.*⁸ (CW – 21 mm, PCL - 29 mm). *Paramaya mulli* superficially resembles *P. spinigera* (De Haan, 1837) which is known only from Japan, Taiwan, and Korea. Though superficially similar to *P. spinigera*, it nevertheless differs from all congeners by its more swollen branchial regions, relatively shorter pseudorostral and carapace spines, and distinctly granulated male thoracic sternum.

Mitochondrial gene sequencing

The 16S ribosomal RNA sequences of the present specimen were submitted to GenBank with accession numbers OQ456467 and OQ456468. These sequences have lengths of 478 bp and 415 bp, respectively. Comparative analysis was conducted by aligning the present specimen's sequences with those of *Paramaya mulli* isolate PmSR-Hap-1, *Paramaya spinigera*, *Maja goltziana*, *Homolax megalops*, and *Maja spinigera* obtained from NCBI GenBank to construct the phylogenetic tree (Fig. 3). The analysis revealed that *P. mulli* is more closely related to *P. spinigera*. Notably, among *Maja goltziana* and *M. spinigera*, *M. goltziana* exhibited a closer relationship with the sequenced specimen.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

Data will be made available on request.

Ethical Statement

This article does not contain any experimental studies with live animals by any of the authors.

Author Contributions

RDC: Conceptualization, supervision, investigation, methodology, writing – original draft; PL: Supervision and editing; PVV: Sample collection, original draft writing, data curation and laboratory analysis; VUUU: Sample collection and laboratory assistance; SS: Draft editing; MA: Draft editing and figures; APG: Software; KTSS: Sample collection and laboratory analysis; and TR: Laboratory assistance and data entry.

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