International Journal of Biology Research
www.biologyjournal.in
E-ISSN: 2455-6548
Received: 10-10-2026, Accepted: 09-11-2026, Published: 24-11-2026
Volume 11, Issue 4, 2026, Page No. 45-47

Morphological characterization and comparative morphometric analysis of male and female *Macrobrachium rosenbergii* (De Man, 1879)

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DOI: https://doi.org/10.66856/ijbr.2026.11.4.11059

Abstract
The freshwater prawn *Macrobrachium rosenbergii* (De Man, 1879) is an economically important palaemonid crustacean exhibiting distinct external sexual characteristics and variation in body proportions. The present study aimed to document selected external morphological features and compare morphometric measurements between male and female specimens collected from the Nanded region of Maharashtra, India. A total of 13 specimens, comprising six males and seven females, were examined. Sex was determined based on the position of genital openings and external secondary sexual characteristics. Nine morphometric parameters, namely body weight, total body length, carapace length, carapace height, rostrum length, second pleon segment height, sixth pleon segment length, telson length and telson width, were recorded. The measurements were summarized as mean ± standard deviation. Males exhibited higher mean values for total body length (26.22 ± 1.58 cm), carapace length (6.37 ± 1.01 cm), carapace height (4.98 ± 0.61 cm) and rostrum length (8.18 ± 1.02 cm). Females showed higher mean values for body weight (176.86 ± 106.71 g), second pleon segment height (4.30 ± 1.50 cm), sixth pleon segment length (1.67 ± 0.27 cm) and telson length (2.47 ± 0.44 cm). Mean telson width was identical in both sexes (0.70 ± 0.13 cm). The observations provide baseline descriptive information on external morphology and morphometric variation in the examined specimens of *M. rosenbergii* from the Nanded region.

Keywords: *Macrobrachium rosenbergii*, freshwater prawn, external morphology, morphometric variation, sexual dimorphism, Nanded

Introduction
Freshwater prawns are important components of aquatic ecosystems and valuable resources for inland fisheries and aquaculture. Among commercially important palaemonid crustaceans, *Macrobrachium rosenbergii* (De Man, 1879), commonly known as the giant freshwater prawn, is notable for its large body size, growth potential and suitability for freshwater aquaculture (Jayachandran, 2001; New, 2002) [3, 4].

The species possesses a well-developed cephalothorax covered by a carapace, an elongated rostrum, a segmented abdomen and five pairs of thoracic pereiopods. The second pair of pereiopods develops into prominent chelipeds, particularly in mature males. Sexual differences are also evident in the development of appendages and abdominal morphology (Holthuis, 1950; New, 2002) [1, 4].

Sex identification is facilitated by the position of the genital openings, which occur at the bases of the fifth pair of pereiopods in males and the third pair in females. Mature males generally possess well-developed second chelipeds, whereas females characteristically exhibit a relatively broader abdomen associated with egg incubation (New, 2002) [4]. Male morphotypes and body proportions also contribute to morphological variation in this species (Ibrahim *et al.*, 2023) [2].

Morphometric measurements provide useful information on body proportions and morphological variation in crustaceans. Measurements of body weight, body length, carapace, rostrum, abdominal segments and telson are useful in documenting morphological characteristics and comparing specimens (Pillai *et al.*, 2017) [5].

Although *M. rosenbergii* is an important freshwater aquaculture species, descriptive information on its morphometric characteristics in the Nanded region of Maharashtra is limited. Therefore, the present study was undertaken to document selected external morphological features and describe nine morphometric parameters in male and female specimens obtained from this region.

Materials and Methods
1. Study Area and Specimen Collection
The investigation was conducted in the Nanded region of Maharashtra, India. Specimens identified as *Macrobrachium rosenbergii* were obtained from local fish markets and available freshwater sources. The specimens were transported to the laboratory of the Department of Zoology, Yeshwant Mahavidyalaya, Nanded, for morphological examination and morphometric measurements.

A total of 13 specimens, comprising six males and seven females, were examined.

2. Species Identification and Sex Determination
Specimens were identified based on their external morphological characteristics, following established taxonomic descriptions (Holthuis, 1950; New, 2002) [1, 4]. Sex determination was based primarily on the position of the genital openings. In males, the genital openings are situated at the bases of the fifth pair of pereiopods, whereas in females they occur at the bases of the third pair. Secondary sexual characteristics, particularly the development of the second chelipeds and abdominal morphology, were also considered.

3. Morphometric Measurements

Nine morphometric parameters were recorded using a measuring scale, vernier caliper and digital weighing balance. The parameters included body weight (BW), total body length (TBL), carapace length (CL), carapace height (CH), rostrum length (RL), second pleon segment height (SPH), sixth pleon segment length (SPL), telson length (TL) and telson width (TW).

Body weight was expressed in grams (g), while all linear measurements were expressed in centimetres (cm). Measurements were recorded separately for male and female specimens.

4. Data Presentation

The specimens were grouped according to sex, and the morphometric measurements were summarized using arithmetic means and standard deviations (mean ± SD).

Results

1. External Morphological Characteristics

The examined specimens exhibited the characteristic body organization of palaemonid prawns. The body was differentiated into an anterior cephalothorax covered by a carapace and a posterior abdomen consisting of six pleonal segments, followed by the telson. The rostrum projected anteriorly, and the thoracic appendages and abdominal pleopods were externally distinguishable.

Male specimens possessed comparatively developed second chelipeds, whereas female specimens exhibited relatively broader abdominal morphology. The position of the genital openings provided the principal external character for distinguishing the sexes.

2. Comparative Morphometric Measurements

The morphometric measurements recorded in male and female *M. rosenbergii* are presented in Table 1.

Table 1: Comparative morphometric measurements of male and female *Macrobrachium rosenbergii*.

Morphometric Parameter	Male (n = 6)	Female (n = 7)
Body weight (g)	171.83 ± 39.00	176.86 ± 106.71
Total body length (cm)	26.22 ± 1.58	25.07 ± 5.29
Carapace length (cm)	6.37 ± 1.01	6.19 ± 2.04
Carapace height (cm)	4.98 ± 0.61	4.67 ± 1.35
Rostrum length (cm)	8.18 ± 1.02	7.94 ± 2.06
Second pleon segment height (cm)	3.68 ± 0.82	4.30 ± 1.50
Sixth pleon segment length (cm)	1.52 ± 0.28	1.67 ± 0.27
Telson length (cm)	2.35 ± 0.32	2.47 ± 0.44
Telson width (cm)	0.70 ± 0.13	0.70 ± 0.13

Note: *Values are expressed as mean ± standard deviation (SD).*

Male specimens showed higher mean values for total body length, carapace length, carapace height and rostrum length. Female specimens exhibited higher mean values for body weight, second pleon segment height, sixth pleon segment length and telson length. The mean telson width was identical in both sexes. Female body weight showed greater variation, as indicated by its comparatively higher standard deviation.

Discussion

The present study documents selected external morphological characteristics and morphometric measurements of male and female *Macrobrachium rosenbergii* from the Nanded region of Maharashtra. The observed external characteristics, particularly the position of the genital openings and the development of the second chelipeds, are consistent with the established morphological descriptions of this species (Holthuis, 1950; New, 2002) [1, 4].

Male specimens exhibited higher mean values for total body length and the measured cephalothoracic dimensions, including carapace length, carapace height and rostrum length. Male *M. rosenbergii* exhibit considerable variation in body size and cheliped development, and different male morphotypes are recognized in the species (Ibrahim *et al.*, 2023) [2]. Such morphological variation is an important characteristic of the species.

Female specimens showed higher mean values for second pleon segment height, sixth pleon segment length and telson length. The relatively broader abdominal morphology of females is associated with egg incubation, as the abdomen provides a brood chamber for carrying eggs (New, 2002) [4]. However, the present study was restricted to selected morphometric measurements and did not include detailed observations of reproductive condition.

Female specimens also exhibited a slightly higher mean body weight than males, accompanied by greater variation in body weight. Body weight and other morphometric characteristics in *M. rosenbergii* may vary with body size, developmental stage and individual biological condition. Pillai *et al.* (2017) [5] documented variation in body weight and other body traits in an Indian population of this species, highlighting the importance of morphometric characteristics in its biological and aquaculture studies.

The present observations provide a descriptive account of selected morphological and morphometric characteristics of *M. rosenbergii* from the Nanded region. The measurements contribute baseline information for further investigations of this economically important freshwater prawn.

Conclusion

The present study documented selected external morphological characteristics and nine morphometric parameters of male and female *Macrobrachium rosenbergii* from the Nanded region of Maharashtra. Male specimens exhibited higher mean values for total body length, carapace length, carapace height and rostrum length, whereas female specimens showed higher mean values for body weight, second pleon segment height, sixth pleon segment length and telson length. Mean telson width was identical in both sexes. The findings provide baseline descriptive information on the morphology and morphometric characteristics of *M. rosenbergii* in the Nanded region.

Acknowledgements

The authors express their sincere thanks to the Principal, Yeshwant Mahavidyalaya, Nanded, and the Head, Department of Zoology, Yeshwant Mahavidyalaya, Nanded, for providing institutional support and necessary facilities during the course of this investigation.

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