Taxonomic study and identification character of freshwater prawn *Macrobrachium assamense peninsulare* (Tiwari, 1958) in Garhwal region of Central Himalaya, India

Koshal Kumar[1*], Anita Rawat Rana[2] and Chandra Bhanu Kotnala[1]

[1]Department of Zoology, H.N.B Garhwal University (A Central University) BGR Campus Pauri Garhwal-246001, Uttarakhand, India

[2]Department of Zoology, Govt. P.G. (Autonomous) College Rishikesh-249202, Dehradun, Uttarakhand, India

*Email id: koshalbagelu@gmail.com

Abstract: The freshwater prawn *Macrobrachium assamense peninsulare* was studied in the Central Himalayan region of Uttarakhand, India in a Rawasan stream. The morphometric and meristic characters of prawn body including the shape and structure of rostrum (ventral and dorsal teeth) were used for the identification of specimens. A total of 403 individuals were collected and morphologically analyzed to assess the taxonomical status of each animal. The total length was observed in the range of 20-70 mm having 0.16 to 5.8 g body weight in both sexes. The animal was characterized by the small rostrum with 5 to 10 dorsal teeth and 0 to 3 ventral ($5-10/0-3$), which is a species specific character for taxonomical study. From the morphological data it has been concluded that different body parts show a similar pattern of relationship in shape and size, which indicate that it is in fact a single prawn species, proved taxonomically as *M. assamense peninsulare.* A modified Key for the identification of *M. assamense peninsulare* was alos prepared, after detail morphological analysis. This hypothesis also need a valid verification by study the mitochondrial DNA (mt DNA) and microsatellite work which reveal that they have been genetically valid species.

Key Words: *Taxonomy, Morphometric, Meristic Character, Freshwater prawn, Rawasan stream*

Introduction

Crustacean exhibits a range of morphological characteristic for taxonomical identification. Shrimps, prawns, lobster and crab are invertebrates belonging to the same group called decapods crustacean. *Macrobrachium* is a member of crustacean fishery distributed worldwide across the tropical and sub-tropical regions on all continents except Europe and Antarctica and comprises over 200 described species (Jayachandran, 2001), majority of them are freshwater. These freshwater prawns were divided into major and minor prawn depending upon their body size. Majority of major prawn species are marine and few of them are freshwater, such as *Macrobrachium rosenbergii* and *Macrobrachium malcolmsoni*. These are fairly well known and have been studied more vigorously and attracted more scientific attention. On the other hand all freshwater species which have widespread distribution from the river system to the peninsular India to the mountain regions in the Northern part of India were categorized as minor prawn species. In India the research work on minor prawn is in its infancy due to their small size and little trade value, yet they are quite popular as a source of protein and vitamin rich food among the local peoples. Hence an effort has been made to survey and study the prawn diversity in hill stream river of Uttarakhand. One species of freshwater prawn i.e., *Macrobrachium assamense peninsulare* has been reported till date and detailed taxonomical monograph has been discussed in this paper. Description was based on adult individuals collected during the study and their morphological and meristic character studies. Extensive studies on the taxonomy and biodiversity of Palaemonid prawn of the world have been carried out by several workers (Henderson, 1893; Henderson and Matthai,1910; Kemp, 1917 & 1925; Tiwari 1947, 1955 & 1963; Holthuis, 1950, 1952 & 1995; George, 1969; Dutt and Ravindranath1974; Ravindranath1979; Jayachandran, 2005; Jalihal and Sankolli, 1988; Jayachandran and Raji, 2004 and Cai et. al., 2004). In addition to this few studies on morphometric characteristics of prawns/lobster was carried out by Kuris et. al., 1987; Jayachandran and Joseph, 1988 & 1989; Mariappan and Balasundaram, 2004; Dineshbabu, 2006; Koshal et al., 2014b.

Materials and Methods

In order to identify the prawn either in the field or in the laboratory the knowledge of certain morphological characters is essential. For this study the prawns were collected monthly from all the five selected sites viz., Narikatal, Jarpani, Seela, Pupaldanga and Madhan in Rawasan stream during August 2013 to July 2015. The stream is bounded by 29º55'33.82"N and 78º26'42.41"E having an elevation of 2,664.04 feet and an eye altitude 13,320.21 feet. Randomly collected specimens from selected sites were placed in polythene bags and brought to the laboratory in an ice box and morphologically analyzed. Collected prawn were examined using hand lenses and under a binocular stereo microscope. Photographs of different body parts and intact prawns were taken in the laboratory and use for morphologically evidence. Identification was confirmed with the help work cited (Cai et. al., 2004; Wowor and Ng, 2007).

a. Morphometric measurement

Prawn body measurements were taken by using sharp pointed needle like divider and Digital caliper (0.01mm) and different measurements of the body parts had been carried out in the laboratory. Morphologically defined characters for each individual were determined by study the detail morphometric characters of each individual. The following distinguishing characters were recorded: Sex, Total length, Abdomen length, Carapace length, 2nd Pleura length, Rostrum length, Dactylus length of the 2nd Pereipod, Palm length of 2nd Pereipod, Length of 2nd chilipeds parts i.e., Propods, Carpus, Merus, Ischium. These variables were studied in relation to the each other as per the taxonomical requirements.

b. Meristic characters

Meristic characters like rostrum teeth count, Rostrum Formula (RF), Type and the presence or absence of spines on the 2nd pereiopod, body colouration were studied with the help of hand lens. Stereomicroscope was also used for micro-observation. The meristic characters and some micro-observation i.e., spine count, propodus, carpus length measurement, rostrum teeth count, carapace spines, carinae and sulcii, carination of the abdomen, telson, appendages and secondary sexual characters like petasma and appendix masculine in male and thelycum in female were made with the help fine forceps, hand lens and Stereomicroscope

Observations

A total of 403 individuals including 192 male and 211 female were used for morphometric and meristic characters to assess the taxonomic status of prawn in both sexes separately. In this study only one species of freshwater prawn *Macrobrachium assamense peninsulare* were identified after critically observing different body parts of each animal in different size group. Range and mean±SE of descriptive statistics of morphometric characters of male and female are summarized in table 1 respectively. From the data obtained it has been observed that male individual were heavier than a female in Rawasan stream. The morphological data obtained was unique being an exceptional data to be produced in terms of the species morphometric in the Garhwal region during this study. This information is useful for future prawn study and would facilitate to understanding the impact of changing ecological conditions on the morphology of *Macrobrachium* in future or to study the species diversity in the region. After scrutinize the different body prates and their relationships of *Macrobrachium assamense peninsulare* the taxonomically monograph were prepared and described below.

Table 1 Range and mean ±SE of descriptive statistics (morphometric data) of the raw measurements (mm) of *Macrobrachium assamense peninsulare* during August 2013 to July 2015

S. No.	Character	Male		Female	
		Range (mm)	Mean ± SE	Range (mm)	Mean ± SE
1	Total Weight (g)	0.16–5.8	1.446±0.076	0.23–2.86	1.181±0.056
2	Total Volume (ml)	0.15–4.0	2.905±1.344	0.25–3.5	2.163±0.492
3	Total length (L1)	24.0–70.0	42.421±0.918	25.0–55.0	40.663±0.830
4	Standard Length (L2)	20.0–60.0	36.018±1.000	22.0–47.0	35.148±0.863
5	Carapace length (CC)	5.0–20.0	11.704±0.455	6.0–18.0	10.923±0.198
6	Abdomen length (CA)	11.0–32.0	19.082±0.494	12.5–25.0	19.230±0.380
7	Telson length (TL)	3.5–9.0	6.056±0.117	3.5–8.0	5.759±0.097
8	Rostrum length (RL)	3.0–10.0	6.054±0.152	4.0–7.5	5.754±0.117
9	2nd Pleura length (CPL)	2.5–7.5	4.817±0.106	2.8–9.5	5.550±0.168
10	Highest propodus length (CPR)	1.0–22.0	10.902±0.387	4.5–14.5	9.237±0.251
11	Highest of propodus height (APR)	1.0–5.0	2.901±0.347	0.5–3.5	2.077±0.088
12	Palm length of 2nd pereipod (PL)	1.5–12.0	5.897±0.248	1.5–8.0	4.816±0.102
13	Length of Carpus (CRL)	1.0–9.0	4.896±0.173	2.5–6.5	5.465±0.740
14	Length of Merus (MRL)	1.0–10.0	5.630±0.204	0.5–7.0	4.890±0.076
15	Length of Ischium (ISH)	1.0–9.0	4.967±0.210	2.5–6.5	4.395±0.113

Taxonomy

***Macrobrachium assamense peninsulare* (Fig 1-3)**

Material Examined: Specimens from all sites of the Rawasan stream, Pauri Garhwal district Uttarakhand (29º45' to 30º15' N and 78º24' to 79º23' E.), altitude <1000m asl, Augusts 2103 to July 2015, Coll. Koshal.

Local Name: "Jhinga machi"

Habitat: The present species was found in some foothill stream and small rivers in the Garhwal and Kumaon region of Uttarakhand.

Economic Importance: Used as food by the local people.

Geographical Distribution: As the distribution of the taxon was not fully understood and the potential threats to it was unknown, and hence considered to be 'Data Deficient' and poorly known taxa (by IUCN). It was observed during 1958 from several areas i.e., Vindya and Stapura ranges, along the left bank of the Narmada River, up to Pachmarshi in the Mahadeo Hills (Madhya Pradesh, India). In the Northern part of India, it was reported from an unspecified site in Uttar Pradesh by Jayachandran, 2004 and in Uttarakhand reported from foot hill streams and rivers (Bisht et. al., 2002; Koshal et. al., 2014a).

Ecological Note: The species commonly found in the stream having low water velocity. They are generally bottom feeder and present in stagnant water under the crevices of the stones, logs, dead leaves, grassy vegetation. It plays an important role as a scavenger in the aquatic ecosystem. Adult animal were seen throughout the year and juveniles were observed only in the rainy season. The population of the species in the area appears to be quite tiny in size.

Description of *Macrobrachium assamense peninsulare*

Body is elongated, more or less spindle-shape and bilaterally symmetrical. Size of the animal varies from a range of 20 mm to75 mm in total body length. *Macrobrachium assamense peninsulare* is a minor freshwater prawn on the basis of body size. Maximum total length recorded during the collection of prawn was 75 mm in male and 60 mm in female prawn in total body length. *M. assamense peninsulare* is distinctly divided into 19 segments or somites, all bearing jointed appendages. Different body parameters were described in Figure 1 and shown in Figure 2 to 3. Hepatic spine present on anterior carapace fringe. The body segments are arranged into two main regions: anterior

cephalothorax (fused head-thorax) and posterior abdomen. Cephalothorax is large, rigid, un-jointed and more or less cylindrical in shape and consists of 13 segments (Fig. 1). Cephalothorax is formed by union of two region (i) head and (ii) abdomen. Head consist of 5 segments while the rare portion of head (thorax) includes 8 segments: 3 sets of maxillipeds and 5 sets of legs (pereiopods). Five pairs of peraepods or true legs present in cephalothorax region. The slit like month opens mid-ventrally at the anterior end of cephalothorax. Rostrum was slightly slender reaching to the distal end of scaphocerite, rostral tip slightly upturned, rostral teeth placed more widely in posterior region of rostrum than anterior region, hair present in between the teeth, carapace smooth. Rostrum formula: It is characterized by the small rostrum with 5 to 10 dorsal teeth and 0 to 3 ventral teeth ($5-10/0-3$) (Fig 2). The first and second pairs of legs end in claws and are used for capturing and holding food items and others (third, fourth and fifth) are used for walking. A well-developed abdomen consists of 6 movable segments. The first five have a pair of pleopods each and used for swimming and sixth segments has a pair of pleopods called uropods and a terminal conical piece telson. Each abdominal segment carries a pairs of jointed ventral appendages, called pleopods or swimmerets. The tail plate or telson is shown with two pairs of dorsal spines, ending in a small acute median point. The prawn move or jerks backwards using the telson and uropods. Abdominal segments are dorsally rounded, latterly compressed and normally bent under the cephalothorax, so that animal looks more or less like a comma (,) in shape and looks almost circular in a cross section.

The 2nd pleura (Fig. 3) overlap on first and third pleura, Spines on 2nd pereiopods in male and absent in female, hair present on pereiopods, segments of 2nd pereiopods are unequal in mature adult animal and equal in size in young.

There was a well marked sexual dimorphism and morphological difference in male and female individuals. The remarkable character of sexual dimorphism was noticed in *Macrobrachium assamense peninsulare*, confirmed by the presence of appendix masculine in the second pleopods of the males. *Macrobrachium assamense peninsulare*, male can be easily recognized by their longer and stronger chelipeds with spines as compared to female. Cephalothorax is bigger in male as compared to the female, while abdomen was narrower in the female. The presence of appendix masculine in the 2nd pleopods was the key character for the identification of male individuals. The genital pore of the male was present in between the base of the 5th walking leg and in females the genital pore is at the base of the 3rd walking leg, having a broader gap in between 5th walking legs. The first, second and third abdominal pleura of the female are elongated and broad and forms a brood chamber for incubating eggs. Anus is a longitudinal aperture lying ventrally at the base of the telson.

The berried female carries very numerous eggs after egg lying under the abdomen attached with swimmerets. In female, the ovary is located dorsal to the stomach and hepatopancreas in the carapace cavity. When the female is in ripe condition the orange colour ovary are visible through carapace and mature female can easily be identified by observing the orange colour of ovaries during the breeding season, that occupy a large portion of Cephalothorax. In breeding season female was seen loaded with eggs and mature gonads were clearly show through carapace. It was temporary character which was seen only during May-September (breeding season) of the prawn. Ovigerous female was found from May to September in the study periods.

Like all crustaceans, *Macrobrachium assamense peninsulare* regularly cast off their exoskeleton in order to grow, a process known as moulting. There are four distinct phases in the *Macrobrachium assamense peninsulare* life cycle: egg, larva (zoea), post larva (PL) and adult. The time spent in each phase and its growth rate is affected by the environmental factor.

Colour of *Macrobrachium assamense peninsulare*: *Macrobrachium assamense peninsulare* was light straw in colour in first stage of life and become brown or sometime creamish in colour with pink spot on the body and tips of walking legs are red in fully mature animal. Carapace as well as abdomen region are transversely banded with red and white lines. The antennae are grayish brown in colour. Pereiopods and pleopods are brown and having fringing setae of red colour. Colour changing in the animals during the life span depends upon the surrounding substratum.

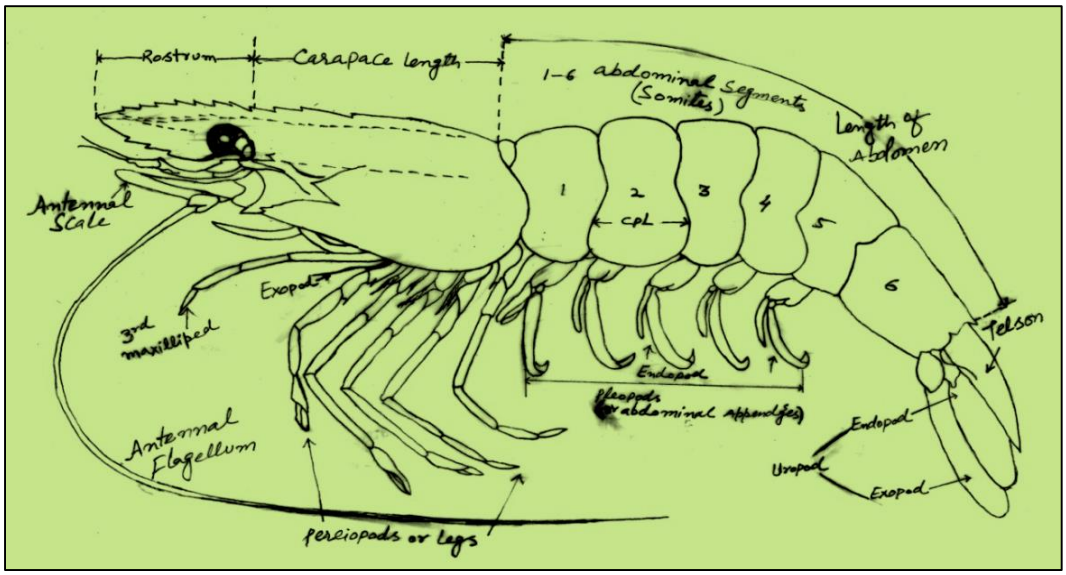

Figure 1 Diagrammatic representation of morphometric characters considered for study

Figure 2 Different body parts of prawns (Dorsal, Ventral, and Lateral View)

Figure 3 *Macrobrachium assamense peninsulare* **(a)** 2nd pleura **(b)** telson

Key Characters for the identification of *Macrobrachium assamense peninsulare*

A review of the species of freshwater prawns belonging to the genus *Macrobrachium* in central Himalaya region of India is presented.

According to the study, the genus *Macrobrachium assamense peninsulare* (Tiwari, 1958) is a sub-species present in the Garhwal region of Uttarakhand. Geographical species are distributions in other parts of the country and abroad. After critically analysis of the different body parts of all size group animals and keys for the identification this species was generated which is help in further study.

1. Branchiostegal spine absent; hepatic spine present on anterior carapace fringe; Dactylus of last 3 legs simple.
2. Rostrum smaller slightly slender reaching to the distal end of scaphocerite, rostral tip slightly upturned.
3. Rostrum with ventral teeth, Rostrum with 5–10 teeth dorsally, 3 of which generally placed behind the orbit, 0–3 teeth in ventrally with hair in between (species specific character).
4. Rostrum smaller in female as compared to the male.
5. 2nd pleura broader then longer and overlap in first and third, shorter in male then female.
6. Carapace generally broader and longer in female then male.
7. Palm of 2nd leg swollen fingers shorter than palm.
8. Telson with two pairs of dorsal spines and two pairs of posterior spines, ending in a small acute median point.
9. Carpus of 2nd leg in adult male larger than chela.
10. Length of carpus always shorter then palm and merus, equal in adult animal.
11. Spines on 2nd pereiopods in male and absent in female, hair present on pereiopods,
12. Segments of 2nd pereiopods are unequal in mature animal and equal in length in young, all joints of 2nd leg in adult male pubescent.
13. Large chela of 2nd leg of adult male with tubercles at both sides of the cutting edges.
14. Fingers of 2nd leg of adult male with 3–4 teeth placed at regular intervals, sometimes restricted to the proximal part. Teeth are generally of equal size, but one of the proximal teeth may sometimes be larger.
15. Movable finger of the 2nd chelipeds in the adult male is covered by a dense velvet-like fur (except the extreme tip), while such fur is absent from the fixed finger and the rest of the cheliped.
16. Male has large then female and 2nd chelipeds in which all segments are developed and provided with spines.

Conclusion

It has been concluded form this study that a single species of freshwater prawn were conformed and validated as *Macrobrachium assamense peninsulare* and identification key of this species was generated which help in further study**.**

Acknowledgement

Authors are also gratefully acknowledge the financial assistance rend by UGC New Delhi for providing National Fellowship for Higher Education (NFHE) to Koshal Kumar for conducting this research work.

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