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DIVERSITY, ABUNDANCE AND COMPOSITION OF LARGE FRESHWATER PRAWN SPECIES IN THE GANGA RIVER SYSTEM

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ABSTRACT

The composition and temporal distribution of large freshwater prawn species in the Ganga river around Patna were studied during January 2000 - December 2001 and two larger *Macrobrachium* species were recorded. The species composed of *Macrobrachium malcolmsonii, M. gangeticum* and *M. lamarrei*; among them, the small species *M. lamarrei* was the dominant one throughout the year followed by larger ones *M. gangeticum* and *M. malcolmsonii*. The catch of *M. gangeticum* and *M. malcolmsonii* was restricted and their availability was found to be during May to October in middle stretch of the river Ganga around Patna in both the years. The species *M. gangeticum* possess prominently curved rostrum with highly convex elevated dorsal crest, whereas in *M. malcolmsonii*, the rostrum is slightly elevated and projecting upto antennular peduncles. The catch composition was recorded maximum 70.89 % during monsoon and rest 29.11 % in summer during first year. During second year maximum 72.22% recorded in monsoon and minimum 27.78% in summer. The percentage composition of two larger species *M. gangeticum* and *M. malcolmsonii* ranged from 75 to 90 % and 6.1-18.0 % respectively during two years in different months and season.

INTRODUCTION

Freshwater prawns are present in all biogeographically regions, with the exception of Antarctica. However, the Oriental region harbours the majority of species (Grave *et al.,* 2008). Population parameters are necessary in order to understand the health of any fishery to determine appropriate management measures. Five decades ago, the distribution and availability of the Ganga river prawns was reported for four species up to Kanpur with adequate quantity and year around availability (Jhingran, 1956). But now, two major *Macrobrachium* species *i.e. M. gangeticum* and *M. malcolmsonii* are distributed and available in limited months at middle stretch of the river Ganga. Jhingran and Ghosh, (1978) reported the declining trends in fishery of the river Ganga including its main tributaries. 125 freshwater prawn species under genus *Macrobrachium* are distributed in inland water throughout the world, which belong to the family Palaemonidae (Holthuis, 1980). Over 60 species of this genus have been recorded from the freshwaters of Indian subcontinent and distributed in different open water bodies (Jayachandran and Indira, 2010). Among them, *Macrobrachium rosenbergii, M. malcolmsonii* and *M. gangeticum* are recorded as first, second and third largest freshwater prawns respectively in India. These species are considered as suitable candidates from aquaculture point of view (Kurian and Sebastian, 2001; Kanaujia *et al.,* 2000; Prasad, 2011). The species *M. malcolmsonii* and *M. gangeticum* are available from May to October in the middle stretch of the river Ganga around Patna (Prasad and Kanaujia, 2006). The taxonomy, distribution and occurrence of freshwater prawns in the river Ganga has been studied with record of a number of freshwater prawn species by Tiwari and Holthuis, (1996). The information about the two large sized Gangetic river prawns is scanty, unsystematic and very little data available on *M. malcolmsonii* and *M. gangeticum*.

Thus the aim of the present study is to document the structure, distribution and biology of two large *Macrobrachium* species of the middle stretch in the river Ganga around Patna especially as regards management and biodiversity.

MATERIALS AND METHODS

Survey and sampling site: Investigation on freshwater prawn distribution and biology in the river Ganga at selected sites viz. Gandhisetu, Alamgange and Basghat around Patna (Bihar) (25º37'N L 85º21' E L) were carried out and data was collected for a period of two years. Personal communication was made with the local fishermen, fish dealers and fish merchants for the collection of data on prawn landings during the course of study. While collecting the data on prawn landings, species-wise segregation was done keeping the prawn specimens under three main groups *i.e. M. gangeticum, M. malcolmsonii* and other small-sized prawn species (*M. lamareii, M. lamareii lamareii*, etc) to record the individual composition of total catch.

Segregation and species composition: The sex-wise segregation of two larger prawn species *M. gangeticum* and

M. malcolmsonii was recorded for the study of composition of males and females in different months and seasons. The appendix masculina was clearly visible only in the male specimens of 50mm size and above which formed the base for identification of sexes in the commercial catches. The total length of individual specimens of all the groups was recorded from the tip of rostrum to the tip of telson to the nearest accuracy. Breeding in both the prawn species was recorded from May to October as is evident from the occurrence of berried females in the catch. Further studies on the biology, taxonomy and allied aspects of the collected prawn specimens were carried out at Central Institute of Freshwater Aquaculture (CIFA) Bhubaneswar, Orissa.

Data analysis: The primary data recorded and simple tabular percentage analysis was done. Statistical analysis was done by using Student[s] T-test and Microsoft Excel 2007 software.

RESULTS

Taxonomy and Abundance: In the present study rostrum of *M. gangeticum* was found short extending upto antennal peduncle, which is highly convex and slightly upturned. It has an elevated dorsal rostral crest, rostral formula usually found with 9 - 11 + 1- 3/ 4 - 6. The dorsal rostral teeth on elevated crest usually found closely set up with each other. The number of ventral teeth was recorded as 4-6 numbers, which are separated from each other. However, in *M. malcolmsonii* the elevation of rostrum was observed to be less than *M. gangeticum*. The dorsal rostral formula usually recorded as 8 - 11 + 0 - 3 and ventral rostral as 2 - 8. Data on morphometric features and percentage composition of *M. malcolmsonii* adult males and females recorded. The size ranged from 65 - 225mm, the adult prawns below 65 mm in length were not recorded in this stretch while those above 65mm were recorded from May to October in both years in the catches. The adult and berried females were recorded from May and continued till the end of October. The number of berried females was increased and recorded to be maximum during the middle of the monsoon in August. These species *M. malcolmsonii* was observed to be comparatively much lower in number than that of *M. gangeticum* in total catch. The catch of Gangetic prawn *M. gangeticum* recorded in present survey/ study in this stretch is found much less in comparison to that recorded five decades earlier indicated in (Table 1 & Fig 1a,b).

Fishery composition: During two years study, total prawn catch recorded was in kg. 5871.5kg. The year and month-wise prawn catches recorded at three sites Gandhisetu, Alamgange and Basghat around Patna (Bihar) of the river Ganga. The total prawn catch recorded during the first year was 2943.8kg comprising of 1085.7kg (Gandhisetu), 941.6kg (Alamganj) and 916.5kg (Basghat). During the second year, the total prawn catch recorded was 2927.7kg. The catch composition of *M. gangeticum* was pre-dominated during all the months and seasons throughout the study period. The composition of *M. malcolmsonii* was recorded lower in the upper and middle zones of middle stretch of Ganga namely Basghat and Alamganj; however it was found more in the lower zone, *i.e.* Gandhisetu. As per prawn availability, the catch data was only found for six month *i.e.* May, June, July, August, September and October with the two major *M.*

Table 1: Set up of dorsal, ventral serrations and rostral formula of two large *Macrobrachium* species

Macrobrachium gangeticum						*Macrobrachium malcolmsonii*					
Total	No. of males	No. of females	No. of dorsal serrations	No. of ventral serrations	Rostral formula	Total	No. of males	No. of females	No. of dorsal serrations	No. of ventral serrations	Rostral formula
8	-	8	9	3-5	9 / 3-5	30	-	30	9	3-5	9 / 3-5
30	10	20	10	2-8	10 / 2-8	50	20	30	10	2-8	10 / 2-8
42	18	22	11	2-6	11 / 2-6	50	20	30	11	2-6	11 / 2-6
26	10	19	12	3-7	12 / 3-7	25	10	15	12	3-7	12 / 3-7
5	3	2	13	5-6	13 / 5-6	14	5	9	13	5-6	13 / 5-6
1	1	-	14	8	14 / 8	4	4	-	14	8	14 / 8

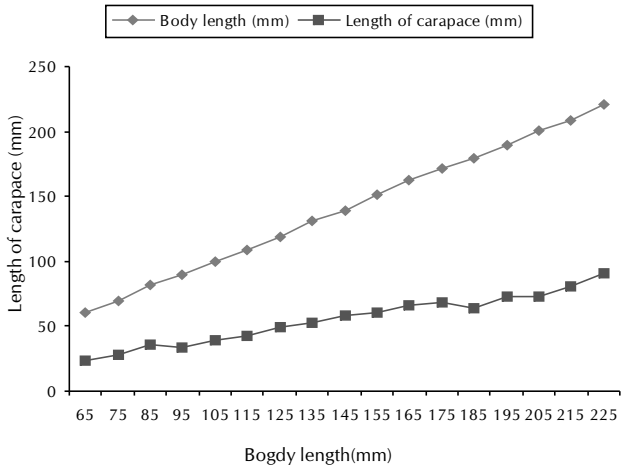

Figure 1a: Body length of *Macrobrachium malcolmsonii* in relation to length of carapace

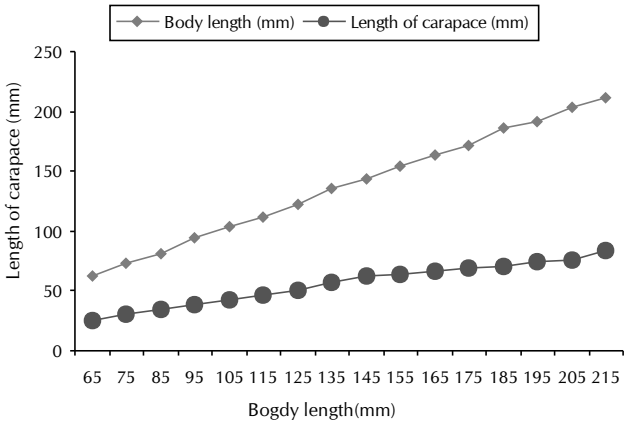

Figure 1b: Body length of *Macrobrachium gangeticum in* relation to length of carapace

Table 2: Catches composition (%) of major species in the river Ganga at three sites near Patna during 2000 and 2001

Species	Centre	First year Catch (kg)	%	Second year Catch (kg)	%	Mean
M. gangeticum	Gandhisetu	894.45	82.38	919.98	84.47	907.215
	Alamganj	773.08	82.10	761.7	82.04	767.390
	Bashghat	764.06	83.36	750.38	81.62	757.220
M. malcolmsonii	Gandhisetu	95.71	8.81	88.36	8.21	92.035
	Alamganj	95.49	10.14	93.1	8.99	94.295
	Bashghat	72.08	7.86	113.75	12.33	92.915
Others smaller prawn species	Gandhisetu	86.76	7.99	77.79	7.23	82.275
	Alamganj	88.64	8.41	72.92	7.85	80.780
	Bashghat	80.48	8.82	50.59	5.48	65.535

malcolmsonii and *M. gangeticum*. However, they have been recorded nil from November to April both the years (Table 2).

Percentage composition: The percentage composition of *M. malcolmsonii* and *M. gangeticum* during two years in different months indicated marked variations. In the first year, during May - October average percentage composition of *M. gangeticum* was observed to be 82.6 %, *M. malcolmsonii* 9.13% and others 7.6% at Gandhisetu. In the same year, during May-October average percentage composition of *M. gangeticum* was 81.5 %, *M. malcolsonii* 9.33% and others 9.3% at Alamganj. In the same year, during May - October, percentage composition of *M. gangeticum* was 89.0 %, *M. malcomsonii* 9.3% and others 15.4% at Basghat. In the second year, during May - October average percentage composition of *M. gangeticum* was observed to be 89.0%, *M. malcolmsonii* 9.6% and others 8.1 % at Gandhisetu. In the same year, during May - October average percentage composition of *M. gangeticum* was 90.0 %, *M. malcolmsonii* 18.0% and others 16.0% at Alamganj. In the same year, during May - October, percentage composition of *M. gangeticum* 87.1 %, *M. malcolmsonii* 18.0% and others 8.0 at Basghat. The species *M. gangeticum* recorded a minimum 78.0% in total catch in September and maximum 86.9% in total catch in May at Gandhisetu during first year whereas, at Alamganj, it was minimum 75.3% in June and maximum 90.0% in September. The percentage of *M. gangeticum* at Bashghat ranged from 71.2% in October to 89% in July. During second year, the composition of *M. gangeticum* varied between 78.4% (in June) to 89.0% (in July) at Gandhisetu. This range was found slightly higher i.e., 75 % (in May) to 90 % (in October) at Alamganj whereas at Bashghat, the percentage composition of this species during second year ranged from 73% in June to 87.1 % in September (Table 3).

As indicated in catch composition of different prawns, the percentage composition of *M. malcolmsonii* ranged from 6.1 - 18.0 % during two years in different months and season. The similar trend was found in percentage composition of other species, which ranged from minimum 3% to maximum 16 %. Prawn fishery and catch of *M. malcolmsonii* was comparatively much lower than that of *M. gangeticum*. The percentage composition of males and females in *M. malcomsonii* indicated significant fluctuations in various size groups. In size groups 65-160mm, females dominated the males whereas in size group 166-200mm males were dominate. But the size group 201-225 mm only males were observed. But in case of *M. gangeticum* more or less similar observation was found with the maximum size group of male being 215mm (Tables 3 & Fig 1a,b).

DISCUSSION

Freshwater Carideans shrimps are present in the entire main biogeographically regions. The Oriental region harbours three times as many species as the next most species rich provinces,

Table 3: Monthly percentage composition of freshwater prawn species in total catch at three sites near Patna

Months	Species	2000 Gandhisetu (%)	Alamganj (%)	Bashghat (%)	2001 Gandhisetu (%)	Alamganj (%)	Bashghat (%)
May	*M. gangeticum*	86.9	78.0	78.0	83.2	75.0	76.0
	M. malcolmsonii	08.1	07.0	07.0	09.6	18.0	18.0
	Others	05.0	15.0	15.0	08.2	07.0	06.0
June	*M. gangeticum*	85.3	75.3	88.8	78.4	83.0	84.3
	M. malcolmsonii	08.2	09.4	08.1	08.5	12.0	08.4
	Others	06.5	15.3	06.1	16.1	05.0	07.3
July	*M. gangeticum*	79.4	80.0	89.0	89.0	85.0	82.0
	M. malcolmsonii	15.3	12.0	06.0	06.0	09.0	15.0
	Others	05.3	08.0	05.0	05.0	06.0	03.0
Aug.	*M. gangeticum*	85.2	85.2	77.4	87.1	84.3	75.0
	M. malcolmsonii	06.0	08.4	07.2	07.3	07.6	17.0
	Others	8.8	06.6	15.4	05.6	08.1	08.0
Sept.	*M. gangeticum*	78.0	90.0	89.0	89.0	76.0	87.1
	M. malcolmsonii	05.0	06.0	06.0	06.0	08.0	05.1
	Others	13.0	04.0	05.0	05.0	16.0	03.8
Oct.	*M. gangeticum*	80.7	80.3	71.2	81.8	90.0	79.3
	M. malcolmsonii	12.2	13.6	9.3	10.1	06.1	13.6
	Others	07.1	07.0	10.2	08.1	03.0	07.1

Neotropical, Afrotropical and Australian. The Nearctic region harbours the lowest number of taxa. Although the Palaearctic region 47 taxa (Grave *et al.,* 2008). India has immense inland resources of rivers with considerable freshwater prawn diversity. Almost all the major river system of India from north to south and backwaters of Kerala have been recorded with considerable amount of varieties of freshwater prawns. The Gangetic ecosystem reported with predominance of prawn fishery at places like Allahabad, Varanasi, Gajipur, Buxure, Ballia Arah, Patna, Bhagalpur and Farakka. Singh and Shrivastava (1989) reported *M. gangeticum* found in this river mainly from Varanasi down to terminal part of the river. Prakash and Agrawal (1986) reported a gradual and significant increases in the abundance of juveniles as that proceeded from Varanasi to Patna down the Ganga river. Jayachandran and Indira (2010) described complete picture on the diversity of freshwater prawns of India. They grouped under six broad categories of freshwater prawn on the basis of habitat preferences. They also reported other feasible areas of the diversity, utilization, namely introduction of new potential candidate species for aquaculture, ornamental purpose as forage organism, etc. *M. gangeticum* and *M. malcolmsonii* are two large indigenous species found in the middle stretches of river Ganga and Brahmaputra (Tiwari and Holthuis, 1996; Prasad and Kanaujia, 2006; Prasad, 2005; Prasad and Kaushal, 2012). They are migratory in nature and inhabitant of freshwater but their larval development and metamorphosis require brackishwater to complete all eleven larval stages, which occur in nature under estuarine environment (Kanaujia *et al.,* 2000; Prasad and Kaushal, 2012). Since recent past, due to overfishing of juveniles and berried prawns in particular, construction of dam, use of nylon nets, contamination of river waters by insecticide and pesticides residues through run- off and discharge of effluents from industries, their population has declined drastically (Rajyalakhmi and Randhir, 1969; Jhingran and Ghosh, 1978; George *et al.,* 1998; Jhingran, 2003; Prasad *et al.,* 2010).

In the present study, it has been observed that the catch in middle stretch of the river Ganga constitutes mainly two major species of prawns that include *Macrobrachium gangeticum* and *Macrobrachium malcolmsonii,* their production prolong for six months *i.*e. during May to October and thereafter, its production is found negligible in the rest of the months. Prawn fishery in the middle stretch of the river Ganga around Patna composed with *M. gangeticum* with higher population. The species *M. malcolmsonii* observed comparatively much lower than that of *M. gangeticum*. The percentage composition of freshwater prawns during different season at three sites indicated maximum 68.26 - 74.87% during monsoon and 25.13 - 31.74% in summer and recorded nil during winter in the both years. The percentage catch of *M. gangeticum* in total prawn landing has been recorded to be much higher *i.e.,* over 80% than those of *M. malcolmsonii* and other smaller species. It was found that the present catch of *M. gangeticum* in this stretch was much lesser than the catch recorded about 5 decades ago. Mariappan *et al*. (2002) reported six *Macrobrachium* species such *M. malcolmsonii, M. rude, M. nobili. M. lamarrei, M. scabriculum* and *M. australe* at lower Anicut in the river Cauvery. The relationship with length of rostrum, carapace and body of *M. gangeticum* and *M. malcolmsonii* has shown a ratio of 1:2:4 in 65 - 150mm, 1:4:5 in 151 - 195mm and 1:2:6 in 196mm and above. In every sample the carapace length was observed to be more than length of rostrum predicted in Table 1& Fig 1a,b. The little variations in body coloration, size and external morphological characters between both the species created confusion in the identification under field condition. Ganga river prawn *M. gangeticum* may be only recognized with the highly elevation of the dorsal crest (Kanaujia, 1989; Prasad, 2007; Prakash, 2002; Prasad and Kaushal 2012; Prasad, 2010). The rostrum of *M. gangeticum* found short extending up to antennal peduncle. This is highly convex and slightly upturned. It has been found with an elevated dorsal, rostral crest usually found closely setup with each other; the ventral teeth were separated from each other. However, the elevation of rostrum in *M. malcolmsonii* found less than *M. gangeticum*. Rostral formula usually found with 9-11+1-3/4-6. The Gangetic ecosystem was earlier reported of the presence of four freshwater prawn species between 1950 - 1954 and a predominant fishery of Ganga river prawn at many places with contribution to 85 % of the total prawn population (Jhingran, 1956; Rao, 1986). While comparing the present catch of *M. gangeticum* in this stretch with those of catch recorded 5 decades earlier, it is found much less. The availability of Five prawn species was recorded in middle stretch of river Ganga; among them *M. gangeticum* was one of the major prawn species reported with predominance (Tiwari and Holthuis, 1996; Jhingran, 1956; Prasad and Kanaujia, 2006; Prasad *et al.,* 2011). In this study the percentage composition of the two large prawns during two years in different months indicated marked variations, it was observed maximum 86.9% of *M. gangeticum* and minimum 8.1 % of *M. malcolmsonii* and 5.0% other in May during first year at Gandhisetu. Similar trend with little variations to this percentage catch composition in different months at different centres was found during two years. In present study maximum size of *M. gangeticum* was recorded 215 mm and *M. malcolmsonii* 225mm recorded. Whereas the maximum size of 327mm of *M. malcolmsonii* was in the river Godavary Rajyalakhmi, (1980). The total length and weight of *M. gangeticum* recorded ranged between 200-250mm and 50-100gm in male and 150-200mm and 35-25gms in females respectively (Tiwari and Holthius, 1996). During the present study, secondary sexual characters in males of both species were recorded with the presence of appendix masculina observed on the indopods of the second pleopods at 60mm size, whereas, testicular maturity in *M. gangeticum* and *M. malcolmsonii* are attained at 75mm, the berried females of both the species were found in last week of May indicated breeding season of the prawn, which continued till the end of October. The number of berried females was found to be higher during the months of August to September, which indicated peak period of their breeding in this stretch. However, for *M. malcolmsonii*, prolonged breeding period of nine months from April to December with peak during August to November was observed in Kolleru lake (Rao, 1986). The result clearly indicated the restricted distribution and declining trend of prawn fishery in this region as well as stretch. Some of the conservation measures need to be undertaken to allow them to migrate to upper stretches and natural population of these prawn species. Further, biology and related aspects

under the natural riverine system indicated it breeds only in restricted periods from May to October.

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