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Physico-chemical studies of river Pumba and distribution of prawn, *Macrobrachium rosenbergii*

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Abstract: *Physico-chemical factors of river Pumba, Kerala has been analyzed to understand its relationship with the distribution of Giant river prawn, Macrobrachium rosenbergii in the water body. Water samples were taken from two sites on the basis of presence and absence of juveniles. Analysis of temperature, pH, turbidity, dissolved oxygen, dissolved carbondioxide and salinity of the water samples revealed that except salinity all the other parameters were identical in both the regions. Salinity was high i.e., 5 - 8‰ in lower Kuttanad region, where juveniles were seen. In upper Kuttanad region, where only adults were located, the salinity was of freshwater pattern i.e., 2.1-2.9‰. The gut content analysis of M. rosenbergii in both the regions showed similar food pattern. The study reveals the significance of a water body with high saline region for breeding purpose and low saline region i.e., freshwater pattern for adult prawns in the life cycle of M. rosenbergii.*

Key words: *Giant river prawn, Macrobrachium rosenbergii, Physico -chemical parameters, Pumba river, Gut content analysis*
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Introduction

Fresh water prawns of the genus *Macrobrachium rosenbergii* commonly known as Giant river prawn or "Attu Konchu" is the largest prawn. In Kerala, it is seen in the backwaters of Travancore and especially in river Pumba. It migrates from the region of lower salinity to higher during its breeding season. *Macrobrachium* species have many favourable characters for artificial prawn culture. The fecundity rate of *M. rosenbergii* vary from 1,00,000 to 5,00,000 in different regions. In Kerala, it breeds during post-monsoon (August to October) period. In river Pumba, during post-monsoon period, ecological factors are favourable for breeding and they migrate from upper to lower Kuttanad of Allapuzha district.

Growth of prawns depends on the ability to moult and the quality of the available food and water (Hartnoll, 1982; Kriengkrai, 2006). The survival/ mortality could be affected by environmental factors such as low temperature (Nelson *et al*., 1977; Sarver *et al*., 1982; Chappie and Burton, 1997; Zimmermann, 1998; New and Valenti, 2000; Kriengkrai, 2006 ; Prasad and Kanaujia, 2006), low pH (Strauss *et al*., 1991; Castro *et al*., 2004; Kriengkrai, 2006 ; Prasad and Kanaujia, 2006) and low dissolved oxygen (Rogers and Fast, 1988; New and Valenti, 2000; Burton *et al*., 2005; Kriengkrai, 2006).

The larvae and adults of *M. rosenbergii* are euryhaline to a considerable degree (Goodwin and Hanson, 1975) and tolerated salinities upto 21‰ (Fujimura, 1974; Goodwin and Hanson, 1975). *M. rosenbergii* is a tropical freshwater species that requires brackish water environment during its larval stage (New and Valenti, 2000) as the larvae die within a few days in either fresh water or high salinities (Sandifer and Theodore, 1985). Wild adult *M. rosenbergii* lives in freshwater (Kriengkrai, 2006). The migration of fresh water prawn *M. idae* into brackish water for spawning and the return of its juveniles upstream to freshwater have been investigated by Visco (1920), Nataraj (1947), Panikkar (1967), George (1969). Such studies pertaining to *M. rosenbergii* in upper and lower Kuttanad regions needs consideration. In this context the present study is aimed to report the physico-chemical aspects of the water and distribution of *M. rosenbergii* in upper and lower Kuttanad regions of river Pumba, Kerala.

The objective of the present study is to find out the reasons for the occurrence of *M. rosenbergii* in the Kuttanad region of river Pumba on the basis of physico-chemical parameters and food availability.

Materials and Methods

Collection of freshwater prawn: *M. rosenbergii* were collected from the local landings in the early morning from Kuttanad region of Pumba river, Kerala during August 2006 to January 2007. Two pairs of prawns were examined every month(total 12 pairs). Juveni were collected in the month of October. Each prawn was packed in separate polythene bag and brought to the laboratory. The date of collection, sex, weight, total length (from claw to telson), standard length and gut content analysis were recorded.

The gut contents of the prawns were examined for studying the type of food in the gut on the day of collection itself. Intestine from the thoracic region was removed and gut contents of each individual were carefully excised and preserved in 10% buffered formalin. During the analysis, gut contents were carefully washed with distilled water in a petridish. The contents were determined visually, by placing under a compound microscope and noted.

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Physico-chemical parameters of the river water: Water samples were taken from upper (UK) and lower Kuttanad (LK) regions of river Pumba, where adult and juveniles are seen. The physico-chemical aspects of water namely pH, temperature, turbidity, dissolved oxygen, dissolved carbondioxide and salinity were studied. The studies were conducted twice in a month from August 2006 to January 2007 every at fort night. During this period breeding and migration of prawns takes place. For the water analysis APHA (2005) Standards were followed.

Statistical analysis: To evaluate the statistical significance of the water parameters, one-way Analysis of Variance (ANOVA) (Kothari, 1990) was applied. The data were analyzed at 5% significance level.

Results and Discussion

Prawns feed plant and animal materials. The gut content analysis showed that all the specimens are uniform detritivores, irrespective of season and place *i.e.*, the food available in both the areas are the same. The gut of the selected specimen contained plants, crustaceans, molluscs, worms and fish parts. Juveniles were collected from lower Kuttanad in the month of October. The gut content analysis of the entire juveniles contained plankton, fish and plants. Both post larval and adult prawns seemed to be omnivorous nature of feeding and this has been in confirmation with the similar reports made by Ismael and New (2000), Kriengkrai (2006). Body weight of adult males was higher than adult females. Weight of males ranged between 105-330 g and females 80-280 g. The total length of male *M. rosenbergii* ranged 20-67cm, whereas in female it was 19-59 cm. The standard length of male prawns ranged 12-29 cm, whereas in females it was 12-26 cm. In all the sample collections, males were more in number compared to females (an average of 14 males and 8 females). Similarly the report on sex ratio indicated that *Palaemon pancidens* showed a higher proportion of males than that of females (Jong *et al*., 2008). All the adult females collected in the month of August and September were moulted. The weight of juveniles ranged 5-7 g. Their total length ranged 9-13 cm and standard length ranged 5-6 cm (Table 1). Average weight indicated that adult males weighed more than females. Similarly total length and standard length of males was slightly higher when compared to females.

Physico-chemical studies of water in river Pumba: Physico-chemical factors namely pH, temperature, turbidity, dissolved oxygen, dissolved carbondioxide and salinity are related to the growth, feeding and migration activity of prawns (Zimmermann, 1998; New and Valenti, 2000; Kriengkrai, 2006).

Water pH in upper Kuttanad was neutral throughout the study (except in one sample, pH-8) whereas in lower Kuttanad it was slightly alkaline (pH-8) and it was due to increase in salinity. river Pumba has a pH between 7 and 8, which is tolerable for *M. rosenbergii* (Table 2,3). Further, Castro *et al*. (2004), Kriengkrai (2006) have suggested that *M. rosenbergii* is very sensitive to acidic and basic conditions and mass mortality may occur at pH levels 9.5 or greater. pH changes adversely affect some biological processes resulting in deterioration of whole water chemistry (Ayse *et al*., 2008). Temperature recordings revealed that Pumba river basin provided most favourable temperature for *M. rosenbergii*. Temperature in lower Kuttanad was slightly higher than upper Kuttanad. A minimum temperature of 22.6°C in August, 2006 and a maximum of 24.7°C in January, 2007 (Table 3) was redorded in

Table - 1: Measurements in adults and juveniles of *Macrobrachium rosenbergii*

Macrobrachium rosenbergii	Weight range (g)	Total length (cm)	Standard length (cm)
Males	105 - 330	20 - 67	12 - 29
Females	80 - 280	19 - 59	12 - 26
Juveni	5 - 7	9 - 13	5 - 6

Table - 2: Physico – chemical characteristics of water samples from upper Kuttanad during August–January(2006 – 2007)

Sample No.	Spot study			Sample study		
	pH	Temperature (°C)	Turbidity	Dissolved O_2 (mg l^{-1})	Dissolved CO_2 (mg l^{-1})	Salinity (‰)
1	7	22.6	Clear	11.2	1.3	2.5
2	7	21.9	Clear	11.2	0.4	2.1
3	7	20.8	Turbid	10.4	1.3	2.2
4	7	21.3	Turbid	12.0	0.9	2.9
5	7	23.3	Clear	11.2	1.3	2.5
6	7	23.0	Clear	9.6	1.8	2.5
7	7	24.0	Clear	11.2	1.8	2.1
8	8	23.8	Clear	8.8	1.8	2.7
9	7	22.0	Clear	11.2	1.3	2.6
10	7	21.8	Clear	10.4	1.8	2.6
11	7	23.0	Clear	11.2	1.8	2.6
12	7	23.8	Clear	10.4	1.3	2.6
Range	7 - 8	20.8 - 24.0	- -	8.8 - 11.2	0.4 - 1.8	2.1 - 2.9

O_2 = Oxygen, CO_2 = Carbondioxide

Table - 3: Physico-chemical characteristics of water samples from lower Kuttanad during August - January (2006-2007)

Sample No.	Spot study			Sample study		
	pH	Temperature (°C)	Turbidity	Dissolved O_2 (mg l^{-1})	Dissolved CO_2 (mg l^{-1})	Salinity (‰)
1	8	22.8	Turbid	8.8	1.3	5.6
2	8	22.6	Turbid	10.4	0.9	5.2
3	7	22.7	Clear	11.2	1.8	5.2
4	8	22.8	Clear	10.4	1.3	5.5
5	7	23.1	Clear	11.2	0.9	8.5
6	7	22.9	Clear	9.6	1.8	8.5
7	7	24.3	Clear	11.2	1.3	8.7
8	8	23.6	Clear	10.4	1.7	8.6
9	7	22.8	Clear	11.2	0.9	5.8
10	7	23.0	Clear	11.3	1.3	8.6
11	7	23.9	Clear	11.5	1.8	8.5
12	7	24.7	Clear	11.2	1.8	8.5
Range	7 - 8	22.6 - 24.7	- -	8.8 - 11.5	0.9 - 1.8	5.2 - 8.7

O_2 = Oxygen, CO_2 = Carbondioxide

Table - 4: Sources of variance – upper Kuttanad (UK) versus lower Kuttanad (LK) regions of Pumba river

Parameters	Mean square		F-value
	Between samples	Within samples	
Temperature (°C)	1.3	0.796	1.63(1)
pH	0.19	0.104	1.83(2)
DO (mg l^{-1})	0.01	0.313	0.03(3)
DC (mg l^{-1})	0.0	0.098	0.0(4)
Salinity (‰)	68.4	1.218	56.16(5)

1 - 4 = Not significant, 5 = Significant at 5% level, DO = Dissolved oxygen, DC = Dissolved carbondioxide

lower Kuttanad. Temperature recordings in upper Kuttanad showed a minimum 20.8°C in September, 2006 and a maximum of 24°C in November, 2006 (Table 2). In this context, Zimmermann (1998) suggested that post-larvae are more tolerant of lower temperature (*i.e.* 20°C - 25°C) and beyond 32°C it affected their survival and breeding.

Turbidity study indicated that the water was clear throughout the study, except during monsoon period (Table 2,3). Light penetration enhances chlorophyll production in phytoplankton, which forms the major food item for both adult and juveniles. Growth of prawns depends on the availability of food and water quality (Kriengkrai, 2006). Oxygen and carbondioxide are two important ecological factors controlling the floral and faunal distribution of lentic as well as lotic fresh water bodies. Oxygen content during the study period ranged from 8.8 to 11.5 mg l^{-1} (Table 2,3) in both the regions. Since oxygen is the most important factor for aquatic organism and for self purification processes (Said *et al*., 2004), recording of monthly and stational variations of dissolved oxygen is of high importance (Ayse *et al*., 2008). Carbondioxide content in both the regions ranged from 0.4 to 1.8 mg l^{-1} (Table 2,3). In the present study Pumba river holds good amount of oxygen and low carbondioxide which provided a favourable condition for the growth and survival of prawns, which was supported by Burton *et al*. (2005), Kriengkrai (2006).

Upper Kuttanad region, from where the adult prawns were collected, showed a salinity of fresh water pattern *i.e.* 2.1 to 2.9‰ (Table 2). New and Valenti (2000), Kriengkrai (2006) reported that wild adult *M. rosenbergii* preferred to live in fresh water. Salinity in lower Kuttanad during monsoon period was low (5.2 to 5.6‰) when compared to post monsoon period, October to January (8.5 to 8.7‰) (Table 3). During monsoon period there was a mixing of sea water in the river which raises salinity of river water in lower Kuttanad. Towards the post monsoon period, the water level in the river lowers due to evaporation and percolation resulting in further increase of salinity. Hence high salinity was recorded during that period, which provided a suitable environment for breeding of prawns. It was further supported by Kriengkrai (2006) that female *M. rosenbergii* migrated to brackish water for the purpose of hatching of eggs hatch into free-swimming larvae. Later on, larvae moulted and migrated upstream seeking fresh water environment. Based on the present findings salinity was noted to be a crucial factor for the breeding of *M. rosenbergii* and it was further confirmed with statistical analysis of the data.

This study on *M. rosenbergii* explains that, the gut content analysis of all the specimens showed similar detritivorous food pattern, irrespective of season and place. High salinity in lower Kuttanad region of river Pumba provides a good breeding ground for *M. rosenbergii*. lower Kuttanad is slightly alkaline than upper Kuttanad. Pumba river holds good amount of oxygen which provided favourable condition for the growth and survival of prawns. This species had a wide scope for aquaculture. In view of its economic value, commercial cultivation of *M. rosenbergii* can be implemented in the Kuttanad regions of river Pumba.

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