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Influence of photoperiod and rainfall on body length of male and female freshwater prawn "*Macrobrachium rosenbergii*"

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Abstract
The speculation that climate change may impact on sustainable prawn growth suggests a need to understand how these effects influence body length of prawn. It is well known that growth in crustaceans is influenced by abiotic factors like photoperiod and rainfall. These factors were studied on the body length of freshwater prawn *Macrobrachium rosenbergii* under natural environmental conditions from June to March. The results revealed that the minimum and maximum photoperiod is found to be 4.3 h to 8.5 h respectively. The rainfall highly recorded is 545.8 mm in November. The body growth of prawn is dependent only in monsoon and post monsoon periods. However, the present study deals with the study of influence of abiotic factors such as photoperiod and rainfall on increase in body length in male and female prawns that can be implemented in aquaculture practices for the better yield of production.

Keywords: *Macrobrachium rosenbergii*, growth parameters, photoperiod, rainfall

1. Introduction
The study of length-weight relationship in aquatic animals shows many applications in delineating the growth pattern [1]. *Macrobrachium rosenbergii* is commonly called as 'scampi' and it is known to be the largest freshwater prawn. It is most important for mass hatchery production and land-based aquaculture system in India and various countries of Asia. Photoperiod and rainfall are the abiotic factors affecting the growth and survival of aquatic organisms [2].
The effect of photoperiod in crustaceans was contradictory. The cycle of light and dark and seasonal changes are important in crustaceans and play a significant role in controlling various physiological processes of aquatic animals. Intensity variations, spectral composition, light polarization and photophase duration also affect the growth in Crustaceans. It has shown to affect behavior [3, 4] and physiology [5, 6, 7]. In addition, the study on the effect of light intensity (750 and 75 lx) and photoperiod 12L/12D and 7L/5D on *Penaeus merguiensis* and found that light intensity and photoperiod significantly influence the percentage weight gain [8]. The light intensity affected the growth of shrimp (*Fenneropenaeus chinensis*) by influencing mainly the food conversion value [9]. On the other hand, longer light hours promoted smooth and regular metamorphosis, against delayed metamorphosis from phyllosoma larva to puerulus postlarvae stage caused by longer dark hours in *Panulirus japonicus* [10]. Contrary to our findings there was a significant increase in body length of freshwater prawn juveniles under total darkness (L0:D24) [11].
Rainfall is also one of the important abiotic factor that affect the distribution of aquatic animals. It indirectly contributes to the food supply of all life-history stages of penaeid prawns. The effects of rainfall on prawn population behavior and abundance remains inadequate [12]. No studies are available on effect of rainfall on growth of crustaceans and aquatic organisms. The influence of rainfall on non-estuary dependent species Mackerel and tuna has been reported respectively [13, 14]. It has been revealed that growth and weight of juvenile banana prawn was significantly greater during high flow conditions compared to low flow conditions by major increases in biomass [15]. The present study has been conducted to determine the impact of rainfall on the growth of *Macrobrachium rosenbergii.*

2. Materials and Methods
The data was collected from the natural aquaculture ponds situated at Kovur, Nellore, Andhra Pradesh, India. The total land area under culture was 8 acres. The pond was stocked with post-larvae stage <15 days in the month of February. They were fed four times a day (06:00, 11:00, 18:00, 22:00 h) on a pelletized shrimp feed (40% crude protein) in the beginning and after one month the feed was gradually reduced to three times a day (06:00, 11:00, 18:00 h). Every month at the time of catching the data regarding growth parameters (length) of twelve individuals sex-wise were recorded and there average was taken.

The length is measured from the tip of rostrum to the end of telson using a 30 cm ruler scale and its weight was recorded using electronic weighing balance (Shimadzu, model no and simultaneously the weather data on the catching day was also recorded from the Agriculture Research Station, Meteorological Department, Nellore. The data were statistically analyzed using Two-way Analysis of Variance (ANOVA) followed by F test using SPSS 16.0. The data were expressed as mean ± S.D. and 'p' value <0.05 was considered a significant.

3. Results

It is observed that the body length of freshwater prawn *Macrobrachium rosenbergii* was influenced by photoperiod and rainfall and the results from June to March were shown in Table 1. The body length was increased (19.46 ± 1.27 and 15.45 ± 0.54) in males and females at photoperiod 8.5 h in March month during 10 months of study, shown in table 1and Fig.1. Similarly, table 1 and Figure 1 are shown a significant increase (19.46 ± 1.27 and 15.45 ± 0.54) in body length of male and female prawns after the rains in post-monsoon months (January-March). However, there is no correlation between photoperiod and rainfall on the growth of freshwater prawn.

Table 1: Effect of natural environmental conditions on body length in *Macrobrachium rosenbergii*.

Month	Photoperiod(hr)	Rainfall(mm)	Body length(cm)	
			Male	Female
June	7.7	24.2	$11.67^{a} \pm 0.735$	$11.79^{a} \pm 0.956$
July	4.3	22.6	$12.19^{ab} \pm 0.599$	$12.06^{a} \pm 1.022$
Aug	5.6	110.2	$13.61^{b} \pm 1.128$	$13.29^{b} \pm 0.744$
Sept	5.7	99.2	$14.21^{bc} \pm 1.667$	$13.99^{bc} \pm 0.326$
Oct	7.6	33.4	$14.86^{bc} \pm 1.013$	$13.51^{b} \pm 1.006$
Nov	5.7	545.8	$15.49^{c} \pm 1.221$	$14.10^{b} \pm 0.701$
Dec	5.0	179.0	$16.50^{c} \pm 1.263$	$14.89^{c} \pm 0.585$
Jan	7.2	2.2	$18.71^{d} \pm 1.034$	$15.10^{c} \pm 0.897$
Feb	8.3	Nil	$18.60^{d} \pm 0.823$	$14.56^{c} \pm 0.372$
Mar	8.5	Nil	$19.46^{d} \pm 1.277$	$15.45^{c} \pm 0.540$

Values are mean ± standard deviation of twelve individuals.
Values with different superscripts differ significantly at $p<0.05$.

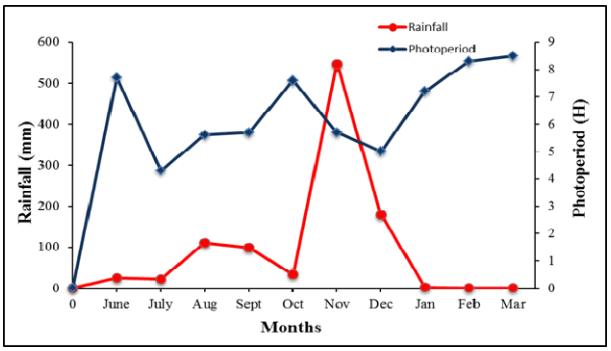

Fig 1: Rainfall versus photoperiod from June to March in Kovur.

4. Discussion

Among the abiotic factors the effect of photoperiod and rainfall on the body length of male and female prawns is observed in the present study. The effect of photoperiod on growth has been studied in several species of crustacean and the results varied with species. Our results revealed that the maximum body length of male and female prawn (19.46 and 15.45 cm) was attained when photoperiod is increased to 8.5 h. Our results are supported by, the increase in photoperiod responsible for increase in molting frequency in Australian giant crab *Pseudocarcinus gigas* [16]. In addition, reports show that the growth of freshwater prawn larvae increased with increasing photoperiods [17]. Further, photoperiod had a significant effect on the growth of banana prawn, *Penaeus merguiensis* juveniles [8]. In contrast to our results, photoperiod does not show any significant increase in growth of shrimp *Litopenaeus vannamei* [18]. A significant increase was observed in molting frequency in darkness in pink shrimp, *Penaeus duorarum* [19]. Moreover, it has been stated that increase in growth of juveniles of freshwater prawn under total darkness than light-dark periods [11].

Rainfall is another important environmental factor that shows its impact on the growth of the animal. Our results have been showed that a significant increase in body length in post monsoon months. The study supports our results that increasing salinity caused to decrease in growth of freshwater crayfish, *Pacifastacus leniusculus* [20]. It is believed that low salinity leads to food scarcity in aquatic species. Though, rainfall also indirectly contributes to the food supply of all life-history stages of crustacean species. In addition, the effects of rainfall on prawn population behaviour and abundance remains inadequate [12]. It was determined that lower salinity may be caused to increase in weight of female prawns, increased body growth might be due to increase in ecdysis [21]. The catching of maximum number of prawns were recorded in North-east in post monsoon periods [22]. However, there can be positive effects of rainfall (availability of food) or negative effects (higher mortality of juveniles, reduction of usable nursery habitat) due to changes in salinity depending on genetic adaptation [23, 24].

The correct interpretation of the abiotic parameters from length-weight relationship will disclose information that is useful for fisheries management. To conclude the study shows that photoperiod affected the feeding activity of the *Macrobrachium rosenbergii*, where they depend more on eyes to search for food. The male and female prawns grow up to 19.46 and 15.45 cm during 8.5 hours photoperiod and in post monsoon months. Hence, from the above results we can conclude that the ambient conditions of natural environmental factors that show maximum growth (body length) in prawn are photoperiod 8.5 h and post monsoon months.

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