

## **OBSERVATIONS ON GROWTH, SURVIVAL, MATURATION AND BREEDING OF *MACROBRACHIUM DAYANUM* (HENDERSON, 1893) UNDER LABORATORY CONDITIONS**

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*Macrobrachium dayanum* is a small freshwater prawn species that completes its lifecycle in freshwater. It shows abbreviated larval development. The egg bearing females were reared individually till egg hatching in 10 l glass jars. The hatchlings were collected and reared in freshwater for 190 days under laboratory conditions. Hatchlings were fed initially (up to seven days after hatching) with mixed zooplankton collected from ponds and subsequently with formulated pellet diet. The hatchlings grew from an initial weight of 1.11 mg to 1029 mg in 190 days. The survival rate was 65.3%. Sexual maturation was observed after 120 days of rearing when the female was 37 mm total length and 670 mg weight. Breeding occurred in the rearing tanks and the embryonic period was found to be 29 days at 28-31°C. A new generation of hatchlings was found after 150 days of rearing.

### **INTRODUCTION**

The research attention in freshwater prawn in India has been primarily focused on two larger species *viz.*, *Macrobrachium rosenbergii* and *M. malcolmsonii*. However, species diversification in aquaculture has become one of the thrust areas for aquaculture research in recent years. *Macrobrachium dayanum* (Henderson, 1893), a small species distributed in India, Bangladesh and Indo-west Pacific, is completely adapted to freshwater environment and shows extremely abbreviated larval development (Jayachandran, 2001). As we look for alternate species for culture, smaller species such as *M. dayanum* offers certain advantages such as abridged larval development and completion of lifecycle in freshwater. For developing culture technology, knowledge of important biological aspects of the candidate species such as reproduction, life history, food and feeding habits, growth and survival is essential.

Few reports are available on different aspects of its biology such as sexual dimorphism, larval development, clutch size and fecundity (Koshy, 1971, 1973; Koshy and Tiwari, 1976; Bhattacharjee and Dasgupta, 1989; Biswas and Qureshi, 1993). The present work was undertaken to study the growth, maturation and survival of *M. dayanum* under laboratory conditions.

## MATERIAL AND METHODS

Live specimens of *M. dayanum* (adult females and males) were collected from the farm of Central Institute of Freshwater Aquaculture, Bhubaneswar, India. The prawns were brought to the laboratory and sampled for measurement of length and weight and stocked in a 1000 l tank containing filtered and well-aerated freshwater. The specimens were identified using the description presented by Jayachandran (2001). The prawns were fed daily with formulated diet (in crumble form) @5% of the biomass. Cleaning was done daily to remove the fecal materials using a siphon tube and water was exchanged @ 50% every alternate day. Some of the females carried eggs in their brood chamber and some eggs were detached from the female for measurement of egg size. The size of eggs was measured using an ocular micrometer calibrated with a stage micrometer. Total egg mass was also removed from some of the berried females for estimation of fecundity.

Five sets of brooders (one adult male and adult female with maturing ovary) were stocked in five separate 10 l glass jars for breeding and to find out the embryonic period. Once the female became berried, the male was removed and the female was reared in the jar till egg hatching. The tanks were provided with continuous aeration from a blower. The tanks were cleaned and water was exchanged @ 50% daily. The tanks were observed daily for appearance of larval stages. The hatchlings were collected, counted and released into a 450 l FRP tank containing freshwater for further rearing. Mussel shell strings and floating weeds (*Eichhornia* sp.) were provided as shelter to the prawns. The hatchlings were found to take shelter in the dense root system of the floating weeds. Initially the hatchlings were fed *ad libitum* with mixed zooplankton collected from culture ponds. The smallest plankton group sieved through 60-mesh sieve was provided to the post-larvae. Seven days after hatching, the post-larvae were provided with pellet diet (protein-32%; lipid-5%) in crumble form. After one month of rearing the post-larvae were transferred to a 3600 l tank and reared for next 160 days. Growth (mg/day) of post-larvae was monitored on a monthly basis.

## RESULTS AND DISCUSSION

The live adult specimens of *M. dayanum* when collected were brownish grey in colour with distinct stripes on pereopods and antennae. Male (Plate 1) was larger than the female (Plate 2) with strong and robust second pair of cheliped. The total length of adult females ranged 41-64 mm and that of males ranged 48-69 mm. The mean weight of berried female was 1.46 g and that of male was 2.10 g. The largest female in our collection measured 64.0 mm total length. Koshi (1971) reported sexual dimorphism in this species and reported that males are larger than the females with stouter second chelipeds. Jayachandran (2001) also reported that males are larger than females in this species and reported 70.0 mm as maximum size for male and 59.0 mm for female. In a study on

fecundity of this species, Bhattacharjee and Dasgupta (1989) have reported that body length of berried females ranged from 45.0-68.0 mm. This report and our observation indicate that we need to revise the largest female size from 59.0 to 68.0 mm.

Rostrum in adult prawn was without dorsal crest, long and slightly curved upwards distally. Rostrum was longer than antennal scale and the adult rostral formula was found to be 8-9/4-5. Two rostral teeth are situated behind the eye orbit. The adults lost their brown colour after molting under laboratory conditions and became pale probably due to the lack of natural food and plankton cover in the tanks. The rostral formula of *M. dayanum* was reported to be 5-11 teeth (usually 8-9) on the dorsal margin and 4-7 teeth (usually 5-6) on the ventral margin (Jayachandran, 2001).

In the laboratory, the prawns were found to breed naturally as more and more berried females (Plate 3) could be found in the stocked population. The peak breeding activity was observed during monsoon season, i.e. from June to September. Our observation is similar to that of Biswas and Qureshi (1994) who studied the annual reproductive cycle of *M. dayanum* and reported continuous breeding in this species with two peaks, one in March and another extending from June to September. Fecundity (post-spawn) values are presented in Table 1 and it ranged from 71-141 (51-64 mm total length). Manna and Raut (1991) studied the clutch size in this species and reported that it varied between 30-130 numbers in specimens collected from Midnapur in West Bengal where as Bhattacharjee and Dasgupta (1989) reported fecundity of 37 to 111 in prawns collected from ponds and swamps of Kamrup in Assam.

The mean length of newly spawned egg was  $2.28 \pm 0.05$  mm and the mean width was  $1.57 \pm 0.07$  mm. The shape of the egg was elliptical and the colour of the newly spawned egg was dark green. Embryonic period was found to be  $29 \pm 1$  days at  $28 \pm 2^\circ\text{C}$ . Jayachandran (2001) reported that the egg size of *M. dayanum* to be 1.45-1.70 mm x 1.80-2.40 mm. Hatchlings were benthic in habit and found to cling to the sides of the containers. The hatchlings resembled adults in all respects except the shape of the telson, which was triangular, and are referred to as post-larvae in the present communication. Post-larvae were found to emerge from the eggs upon hatching indicating direct development. Freshly hatched out post-larvae has a mean total length of  $6.2 \pm 0.44$  mm and a mean weight of  $1.11 \pm 0.05$  mg. The distinguishing characters of the hatchlings were stalked eyes, smooth carapace, translucent body, short rostrum armed on both sides with rostral teeth and abdomen with six distinct somites. Telson was triangular in shape with plumose setae on posterior region. Uropods were present. Pereiopods were normal, five pairs, and all functional. First and second pair of pereiopods were with claws. Pleopods were biramous and functional.

Table 1. Fecundity (post spawn) of *Macrobrachium dayanum*

Length (mm)	Weight (g)	Fecundity (number of eggs per female)
51	2.10	141
53	1.91	71
55	2.17	86
56	2.45	115
59	2.68	82
64	2.98	129

Biswas and Qureshi (1993) reported the presence of one larval stage, which resembles post-larvae in all aspects except the shape of telson that is triangular. Jalihal *et al.* (1993) made a comparative study of the developmental pattern of various species of genus *Macrobrachium* and broadly classified the larval stages into three: 1) prolonged normal type, 2) partially abbreviated type, and 3) completely abbreviated. Jayachandran (2001) slightly modified the earlier classification of Jalihal and subdivided the earlier divisions, and *M. dayanum* and *M. hendersodayanum* are grouped under completely abbreviated category. Our observation on the morphology of hatchling agrees with those of Biswas and Qureshi (1993) and Jayachandran (2001). However, we have reservations in calling the hatchlings as larvae. Since the hatchlings resemble post-larvae in its morphology except the shape of telson (having full complements of pereopods and pleopods), habits and feeding behavior, it should be called a post-larva than larva. All the larval stages are therefore embryonized and the post-larvae emerge from the embryo.

Growth of *M. dayanum* under controlled conditions in the laboratory is provided in Table 2. The post-larvae readily accepted mixed zooplankton initially for 7 days and subsequently accepted formulated pellet diets in crumble form. The hatchlings grew from an initial weight of 1.11mg to 1029 mg in 190 days. Average daily growth increased from

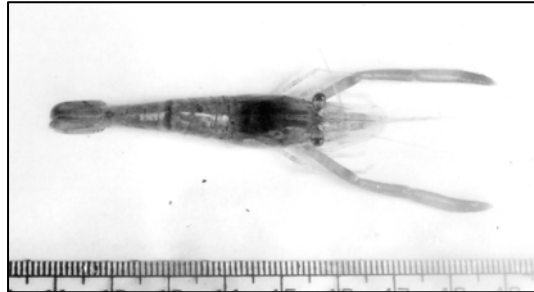


Plate 1: Adult male *Macrobrachium dayanum*

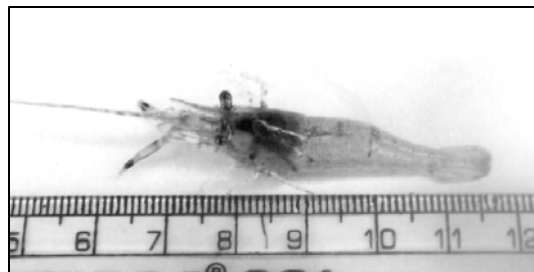


Plate 2: Adult female *Macrobrachium dayanum*



Plate 3: Egg bearing (berried) female *Macrobrachium dayanum*

Growth of *M. dayanum* under controlled conditions in the laboratory is provided in Table 2. The post-larvae readily accepted mixed zooplankton initially for 7 days and subsequently accepted formulated pellet diets in crumble form. The hatchlings grew from an initial weight of 1.11mg to 1029 mg in 190 days. Average daily growth increased from

0.48 mg/day in the first month to a maximum of 11.9 mg/day in the fifth month, subsequently it decreased to 2.35 mg/day. Increased breeding activity might have been responsible for the reduction in growth rate observed after five months. There are few reports on the growth rate of smaller species of the genus *Macrobrachium*. Chandrasekharan *et al.* (2005) reported that *Macrobrachium lamarrei lamarroides* grew from an initial weight of 167-194 mg to 310-355 mg in 30 days with the average daily growth ranging from 4.96 to 5.30 mg/day, which is similar to the growth observed by similar sized *M. dayanum* in the present study. Mariappan and Balasundaram (2004) studied the growth of three weight groups (337, 542 and 732 mg) of *Macrobrachium nobilii*, another small species, at three densities of 22, 38 and 77/m<sup>2</sup> for 60 days and recorded average daily growth of 21.9, 18.2 and 15.2 mg/day, respectively for the small, medium and large size groups.

Table 2. Growth of *Macrobrachium dayanum* under controlled conditions

Days of rearing	Length (mm)	Weight (mg)	Growth (mg/day)
0	6.10±0.2	1.10±0.06	-
30	11.4±0.3	15.5±0.96	0.48
60	18.0±0.4	66.0±4.3	1.68
90	28.0±0.3	253±16.5	6.23
120	34.0± 0.9	579±58.7	10.9
150	39.0± 0.6	935±43.2	11.9
190	42.6± 0.5	1029±47.0	2.35

Values expressed as mean ± SD (n=30)

Sexual maturation was observed after about 120 days of rearing when the female was 37 mm total length and weighed 670 mg. Breeding occurred in the rearing tanks and the embryonic period was found to be 29±1 days at 28-31°C. A new generation of hatchlings was found after 150 days of rearing. The survival rate of parent stock after 190 days of rearing was 65.3%.

The present study revealed that *M. dayanum* grows and breeds well under controlled conditions and readily accepts formulated feeds. Due to its complete adaptation to freshwater and abridged larval development its culture techniques can be very simple without a hatchery phase. This provides possibility of the species to be promoted as a candidate for aquaculture, especially in the rural areas where it can cater to the local market.

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