CHAPTER 5
5. Photoperiod Related Growth

5.1. INTRODUCTION

Growth must be a coordinated event with moult in crustacea, since they have rigid exoskeleton. Growth and moulting are prominent usually synchronized periodic phenomena in the life of arthropods.

Continuous darkness has often been examined in studies to underscore the effects of photoperiod on decapod larvae, as a mean to improve rearing techniques or to analyze larval dynamics. (Templeman, 1936; Sandoz and Rogers, 1944; Reeve, 1969; Dawirs, 1982; Wienberg, 1982, Eagles et al., 1986; Nakanishi, 1987). In Macrobrachium rosenbergii the effects of continuous light have been examined by Withyachumnarnkul et al. (1990).

Photoperiod has found to effect the moulting frequency in crustaceans. Cray fish moult more frequently in long - day than in short -day periods (Aiken, 1969). Though moulting is an obligatory process preceding body growth, it may also precede change in reproductive stage.
(Adiyodi, and Adiyodi, 1970). The present experiment is aimed at to study the growth of *M. malcolmsonii* in response to different photoperiodic conditions.

The present study was carried out to test if photoperiod would modulate growth of *M. malcolmsonii* in terms of changing their body size and weight. The possibility that the results of this study might be of benefit on commercial scale culture adds another advantage.

5.2. MATERIALS AND METHODS

The freshwater prawn *Macrobrachium malcolmsonii* were collected from the Grand Anicut (regulating shutters) of the river Cauvery. The juvenile prawns of uniform size (length 22.2 ± 0.1 mm and weight 116.5 ± 5 mg) were sorted and divided into 4 groups, consisting of 10 animals each. Each group was reared separately in a 10 litre plastic trough containing 5 litre of water. Each group of prawns were exposed to one of the predetermined, following light: dark conditions 0.30 hr. light : 23.30 hr. dark (L 0.30 : 23.30) 4hr. light : 20 hr. dark (L 4 : D 20) 6 hr. light : 18 hr. dark (L6 : D 18), 8 hr. light : 16 hr. dark (L 8 : D 16). For carrying out each experiment, two replicates were run simultaneously with same number of juveniles. A control was also maintained parallely.
with normal light and dark conditions (12 hr. light & 12 hr. dark) for all the groups.

Length and weight of the prawns were determined on the first day of the experiment and subsequently at every 15 days interval. The experiment lasted for 60 days. Length of the each animal was measured from the tip of the rostrum to the end of the telson as total length. The weight of the animal was taken using digital balance. The experimental group of prawns were fed equal quantity of pellet feed once a day. The growing medium was also replenished every day, while removing the uneaten feed, faeces and exuvia (moulted exoskeleton). The light intensity was measured using a Radiometer (INS Lux meter-Dx 100). The light intensity of the open area (direct sun light) and inside the laboratory were measured at different phases of the day to assess the percentage of light diffusion into the lab.

5.3. RESULTS

The laboratory receives only to 15 - 20% of diffused sunlight, the light intensity of the direct sunlight was found to be higher at 2.00 P.M and lower at 4.00 P.M. The intensity of the experimental room was also found to be in the same trend. The temperature was 27° + 2° C.
The experimental prawns were almost equal in size (22.2 ± 0.1 mm long and 116.5 ± 5 mg weight) at the beginning of the experiment. The 15 days growth revealed a significant increase in length and weight in the animals exposed to L 0.30 : D 23.30 and L 4 : D 20 (Fig 1). The size increment was found to follow the same trend on 30th day, 45th day and 60th day also (i.e. the prawns exposed to L 0.30 : D 23.30 and L 4 : D 20). A very high degree of positive correlation (P < 0.01) were observed between length and weight of the animal. The length increase was comparatively not significant in the prawns exposed to other photoperiodic conditions L 6 : D 18 and L 8 : D 16. The same trend was found in the control animal also. At the end of 60th day the animals exposed to L 0.30; D 23.30 and L 4 : D 20 had an equal average length of 27.9 mm, an increment of 5.7 mm from the initial length. An increase of 4.9 mm and 4.5 mm, 4.0 mm length was found in the prawns exposed to L 6 : D 18, L 8 : D 16 and control respectively.

Prawns maintained in L 4 : D 20 had a significant increase in the weight than the prawns exposed to other photoperiodic conditions. They showed a weight increase of 34.00 mg, the final average weight being 153 mg. The increase in weight was also found to be not significant.
in the prawn exposed to L 6 : D 18 and L 8 : D 16. (Fig. 2). The increased growth was the ultimate result of increased moult frequency at higher percentage in L 4 : D 20 when compared to the other photo periodic conditions. No mortality of experimental as well as control prawns were encountered during the study period.

5.4. DISCUSSION

Visible spectrum of light falls on water are most readily penetrated through water. The ability to respond to light (or) other wave length of electromagnetic radiation is based on the ability of molecules to absorb quanta of energy, thereby attaining their own energy levels (McElroy and Glass 1961). Wave length below 300 nm contain enough energy to break covalent bonds in molecules that absorb them, quanta with wave length above 1000 nm are not energetic enough to create much change in the energy of a molecule that absorbs them.

Ecdysone appears to act by inducing the synthesis of messenger RNA (Giese, 1964). Clever and Karlson (1960) reported that ecdysone acted at the level of the gene and caused the formation of chromosomal puffs. Such activity can be used to regulate the synthesis of protein upon which the development of the animals depends.
Present study revealed that a longer darkness (D 23.30 and D 20 hrs.) on this nocturnal animal *M. malcolmsonii* juvenile enhances the body growth. But at the same time the weight increment was higher in D 20 than D 23.30. It could be attributed to the requirement of minimum light condition (more than 30 minutes and less than 4 hr.). Identical observation was reported on juvenile *M. rosenbergii* exposed to continuous light (L 24 : D 0) had no effect on growth (Withyachumarnnukul *et al.*., 1990). Under continuous darkness advantageous effects on larval survival duration and growth have been described in *Bernhardus* and *Homarus americanus* (Templeman, 1936; Dawirs, 1982; Eagles *et al.*, 1986). In an investigation on the effects of photoperiod on the reproductive cycle of *Gammarus setosus*, Steele *et al.* (1977) suggested that “exposure to decreased photoperiod will cause accelerated development and exposure to lengthened photoperiod will cause inhibition”. In the present study also, the increased photoperiod did not show any positive effect on growth of the juvenile prawns. The mechanism by which photoperiod modulates growth in this species is yet unknown. In sheep and cattle the gonad stimulated by photoperiods had an increased concentration of serum prolactin an anabolic hormone (Schanbacher and Crouse, 1980, Tucker, *et al.* 1984 and Petitclerc *et al.* 1983). In Syrian hamster the pineal
gland is not involved in the photoperiod induced growth, which is evidenced by even the removal of pineal gland does not suppress the short day induced growth of this animal.

The function of crustacean endocrine system is still not fully known. The moult in crustacea is induced by the periodic rise of ecdysteroids at the pre-moult stage which is essential for the growth of crustaceans. (Aiken, 1969, Kleinholr and Keller, 1979, Graf and Delbecque, 1987). The Y - organs produce ecdysteroids in the form of ecdysone, which is then metabolized into other active ecdysteroids in target tissues (Kleinholr and Keller, 1979). Moulting inhibiting hormone (MIH) produced by the optic lobe suppresses the production of ecdysone. The 'X' organs situated in the optic lobe produce MIH which is responsible for the suppression of ecdysone.

The reason for increased growth of M. malcolmsonii in L 4 : D 20 condition is that prolonged darkness may suppress the production of MIH, which in turn enhance the production of ecdysone from the ‘Y’ organ. It would cause an increased moulting frequency and growth (Withyachumarnkuls et al., 1990). In amphibians and reptiles, the pineal gland is a photoreceptor organ (Reiter 1988). Though the pineal gland has never been described in
crustaceans, the organ of Bellonci in the eyestalk shows a remarkable resemblance to the pineal gland of higher species (Elofsson and Lake 1971, Bellon-Humbert and Van Herb, 1988). The organ is composed of ciliated neuron like cells, which indicates its sensory function. The organ also contains a very high concentration of 5-hydroxy tryptamine (5HT). The indole is found abundantly in the mammalian pineal gland (Reiter, 1988). Thus the activity of the organ of Bellonci, may be modified by the darkness, which may suppress the production of MIH resulting in an increased moulting frequency and growth.