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MOULTING CYCLE AND GROWTH IN THE AFRICAN RIVER PRAWN *acrobrachium vollenhovenii* (Herklots 1857) (Decapoda, Palaemonidae)

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ABSTRACT

The moult cycle in adults and juveniles of *Macrobrachium vollenhovenii* was investigated. Increase in length at moult calculated as growth factor (% increment in length) was 1.06 (21%) and 0.86 (12%) for juveniles and adults respectively. Limb regeneration was found to accelerate the moulting process in the species. The aquacultural implications of these results are discussed.

Key Words: Moulting, Growth, *Macrobrachium vollenhovenii.*

INTRODUCTION

Many factors such as eye stalk ablation (Marian *et al.* 1986) social structure (Hulata *et al.* 1988), photoperiod, humidity, temperature (Passano, 1960) and nearest neighbour effect (NNE) (Hedgecock and Nelson, 1978) are known forces that influence the inter-related processes of growth and development in crustaceans. At ecdysis, an increase in length and weight usually occurs (Teissier, 1960). This increase in length and weight is quantified as the growth factor. Growth factors have been determined in some crustaceans including *Austropomobius pallipes* (Pratten, 1980), stomapod larvae (1.25 or 17.8%) (Teissier, 1960), *Penaeus californiensis* (1.43) and *P. stylirostris* (Huner and Bernard Colvin, 1979).

The intermoult period (IP) of some crustanceans has also been determined. For example, 12 to 19 days are reported for most *Macrobrachium* species (Miyajima, 1971), while 11,8 ± 0.7 and 9.1 ± 0.6 days are giver for *Penaeus califormiensis* and *P. styloristris* (Huner & Bernard-Colvin, 1979) respectively.

In this study, the intermoult cycle or period as well as the growth factor was investigated in normal and limb regenerating adults and juveniles of *Macrobrachium vollenhovenii* (Herklots). Stage specific growth factors and the influence of lost limbs on duration of the moult cycle were also studied. *M. vollenhovenii* is a fresh water shrimp of economic importance in West Africa, both for commercial fisheries and as a candidate for aquaculture in Nigeria.

MATERIALS AND METHODS

Specimens used for this study were collected from the Kwa falls (36 km from Calabar), Cross River State, Nigeria. They were acclimated to laboratory conditions for one week before commencement of study. Nineteen adults (total carapace length between 24mm to 32mm) and 10 juveniles (5 to 16mm carapace length) at moult stage D^3 (Pebbles 1978, 1979) were used to examine moult cycle duration and growth between successive moults. Specimens were individually held in aerated aquaria to prevent mutilation, cannibalism and nearest neighbour effect (NNE) (Hedgecock and Nelson, 1978, Pratten, 1980).

The specimens were fed daily with trash fish and *Egaria radiata* in excess. Uneaten foods were removed every 48 hours during which time aquaria were cleaned and complete water exchange undertaken. Photoperiod was maintained at 12:12 hours; water temperature was within 28 ± 2.0°C. Experiment was conducted in two stages:

In the first experiment, aquaria were inspected twice daily for presence of moult exuviae, and carapace lengths of all exuviae measured. The carapace length was considered to be the distance between the tip of the rostrum and the mid-dorsal posterior end of the cephalothorax. A growth factor was calculated for each moult as the percentage increase in carapace length per moult. The growth factor was related to carapace length using the following regression:

$$\text{Log. GF} = \text{Log.a} - X \text{ Log. CL}$$

Where "GF" is the growth factor, X is the pre-moult carapace length "a" is constant equivalent to the mean growth factor with increasing pre-moult carapace length, and "X" the slope of the regression. The mean of all the moulting periods (time in days between 2 successive moults) was calculated and considered as the intermoult duration for all juveniles and adults. The experiment ran for 356 days.

To determine the effect of limb regeneration on the intermoult duration, a limb was amputated from each of 6 newly moulted adults. They were left in aquaria and fed at 48 hourly interval until the limb regenerated. Water was changed every 48 hours before feeding. Water temperature and photo-period were maintained at 28 ± 2.0C and 12:12 hours respectively. The intermoult period was considered as the length of time in days between day of amputation (immediately after moulting) to day of moulting. The experiment ran for 170 days.

RESULTS

Adults specimens exhibited longer intermoult cycles than the juveniles giving 34 ± 3.60 days and 19.8 ± 6.04 days respectively. Duration of intermoult

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periods varied with increasing size of juveniles. Larger (adult) specimens regenerating limbs exhibited shorter moulting cycles than the non-limbs regenerating specimens (Table 1) at P > 0.01 significant level.

Table 1: Moulting cycles of adults and juveniles of M. vollenhovenii Temperature 28 ± 2.0oC.

Size	Size range (mm)	n	Duration of study (days)	No.of moult	Intermoult cycle (days) mean ± SD	Range of moult cycles	Mean Growth factor
Juve-nile.	5-16	10	356	36	19.8±6.05	9-26	1.06
Adults	20-32	9	256	12	34.0±3.06	29-38	0.86
*Adults	24-31	6	170	20	24.3±2.89	21-26	0.86

* Adult specimens whose limbs were extirpated

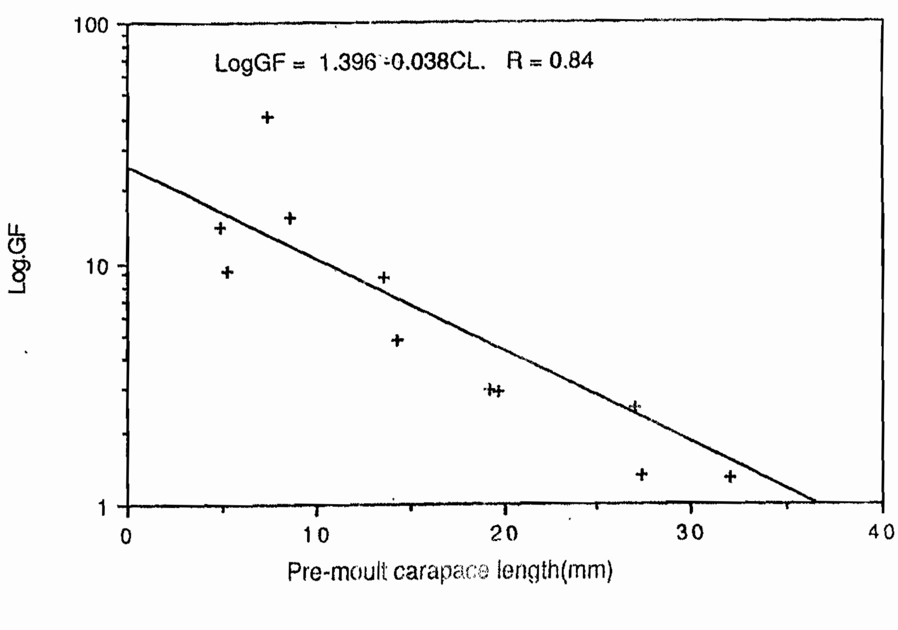
The mean growth factor determined for the juveniles and adults (non-limb regenerating/limb regenerating) were 12% (1.06) and 8.5% (0.86) respectively. Larger specimens exhibited lower growth factors than the smaller (Juveniles) individuals (Fig. 1).

DISCUSSION

The intermoult cycle in crustaceans varies with health, age (Teissier, 1960; Marian *et al* 1986) and social structure (Hulata *et al* 1988). The healthier and younger the individual, the shorter the cycle. In mixed populations of juveniles and adults of *Macrobrachium rosenbergii*, moulting is not affected but in populations of males and females, the females exhibit shorter intermoult periods than in female only population; while male growth were inhibited by the presence of females (Hulata *et al* 1988). The implication of these results is that specimens which showed fast growth rates had shorter moult cycles while those whose growth were suppressed could not moult easily. Growth rates are known to increase in *Macrobrachium* species whose eye-stalk have been ablated (Marian *et al* 1986); in this case eye stalk ablation is considered to cause similar effect on *Macrobrachium* species as limb amputation. In this study, limb regeneration has also been associated with growth in crustaceans; juveniles and adults of *Macrobrachium vollenhovenii* exhibited different intermoult cycles. Adults regenerating lost limbs moulted faster than normal adults of the same size within the same environments (Table 1) even though their growth factors are the same. The growth factors in the juveniles exposed to the different experimental conditions were not similar.

The calculated growth increases at moult (GF) in adult *M. vollenhovenii* (normal and limb regenerating) were similar (Fig. 1; Table 1). This is an indication of similarity in growth rates of these two categories of specimens. The younger the juvenile, the faster it rate of growth when limbs were amputated. This shows that the amputated juveniles soon turn into adults at shorter intervals than their non-amputated counterparts. Although, the physiological consequences of amputation on development of reproductive stages were not investigated, the juveniles can be assumed will become matured earlier when limbs are amputated after every moult than in non-amputated individuals. Experience gained from related studies points favourable to this conclusion. However, the adults specimens were not inspected for gonadal maturation as limbs were regenerated, but there were indictions positively indicating that amputated adult females tend to mature faster than females not amputated, considering the speed in growth of these amputees. This result may find application in hatcheries.

Growth factors decreased as specimen size increased (Fig. 1) and become nearly constant when adults of approximately the same size moult under the different experimental conditions (extirpated and non extirpated and adults (Table 1). The mean growth factor for the juveniles was 21% (1.06) and that of the adults was 12% (0.86). Huner and Bernard-Colvin



(1979) gave 46%(2.46) and 29%(1.43) for the juveniles and adult specimens respectively, of *Penaeus californiensis* and 27% (1.82 juveniles) for *P. stylirostris* and stated that growth in juveniles was twice that measured in adult of the same species. This study has shown that the growth of *Macrobrachium vollenhovenii* matches the findings already given for the two peneaids mentioned above. It also demonstrate that juveniles grow faster than adults under culture. Most *Macrobrachium* species, including the species of this study, are cannibalistic, attacking and maiming each other even when fed. These attacks usually result in loss of limbs. This natural process may as well contribute to speeded moulting and growth which is beneficial in hatcheries.

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