

EFFECTS OF EARLY STARVATION ON THE DEVELOPMENT AND SURVIVAL OF *Macrobrachium vollenhovenii* (Herklots, 1857) LARVAE REARED IN THE LABORATORY

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ABSTRACT

Macrobrachium vollenhovenii (Herklots) has been identified as a crustacean species with great culture potential. The effects of starvation on development and survival of early larval stages of the African river prawn *M. vollenhovenii* were investigated.

As an aspect of the ongoing effort to determine the culturability of the species, the time of first need for exogenous food by the larvae was examined in relation to larval development and survival.

Larvae required external food 2 to 3 days from hatching. This time corresponded with the period of transformation of the first larval stage into stage II larvae. Larvae starved at this stage of development cannot moult into subsequent instars and soon die.

Key words: Starvation, larvae, *Macrobrachium vollenhovenii*.

INTRODUCTION

Starvation is a major factor which drastically influences development and survival of aquatic species. Its effect includes, cessation in or delayed larval development, mortality, physiological as well as biochemical changes (Holland, 1978). Naturally, most pelagic larvae are starved in their environments (Thorson, 1950; Angers and Dawirs, 1981). The impact of starvation is dependent on the starvation period and the crustaceans species involved. Studies show that some crustaceans must positively seek food during development while others can complete part of their pelagic phase without food (Broad, 1957; Dobklyn, 1979). Wears, 1967; Angers and Nairs (1976) stated that only a small part of crustacean larval development could be accomplished without exogenous food, since food reserves in most crustaceans are never sufficient for development, except in Brachyurans larvae etc. The effects of starvation on larvae vary, depending on the stage of development. For example, starvation which commences after hatching exerts stronger influence on animal development than those that start later (Anger *et al.*, 1981, Monto, *et al.*, 1988).

The influence of starvation as an ecological factor has not been investigated in *Macrobrachium vollenhovenii* (Herklots) as compared to physiological studies on the species (Udo, 1991). *M.*

vollenhovenii is a shrimp species of great economic value to the existing local fishery; (Powell, 1983, Udo, 1991) and has also been identified as culturable in Nigeria in particular (Udo and Taeye, 1989, 1991; Udo, 1991, Udo and Ekpe, 1991) and in West Africa in general (Miller, 1971; Gordon, 1989). The present report provides information on the feeding of larval *M. vollenhovenii* as related to the time of first need for exogenous food. Knowledge of this nature is valuable in shrimp hatcheries in identifying the appropriate time and stage to provide larvae with external food for the first time and in taxonomic studies in natural marine environment.

MATERIALS AND METHODS

Ovigerous females of *Macrobrachium vollenhovenii* with new eggs were caught from the great Kwa River. The great Kwa River which opens into the Cross River Estuary is located within Latitudes 4°50'N and 5°50'N and Longitudes 8°15'E and 8°25'E. The new eggs for the species and *M. rosenbergii* are described by New and Singholka, 1982, and Willfuhr Nast *et al.* (1993). In the laboratory, specimens were gradually adjusted to water with the salinity of 19 ppt in which the larvae which hatched were collected for the test.

The newly hatched larvae were transferred individu-

ally into 250 experimental containers measuring 50ml each (containers were open cylindrical 50ml polystyrol transparent vessels), while the mother was reacquainted to freshwater. The culture salinity of 19 ppt is within the salinity range already recommended for the culture of the species larvae (Willfuhr Nast *et al.*, 1983). The experimental set up was divided into 10 sub-groups as illustrated (Fig. 1&2), each sub-group represented a feeding programme. Larvae except those in sub-group vi (Fig. 1) were fed with newly - hatched *Artemia salina nauplii* after every-daily water exchange and vial cleaning. Prior to this, containers were thoroughly inspected for moult exuviae and dead specimens. Specimens were confirmed dead after they have been found to be motionless under the binocula. Studies ended when 50% of the larvae had moulted into the fourth larval instar. Larval developments were viewed in relation to the number of larval stages in the sub-groups, while survival was calculated in percentage following the number of survivors compared to the initial number of specimen at the beginning of the study.

RESULTS

Survival of Larvae

Higher survival rates were accompanied by unsynchronized moulting in all sub-groups. All larvae survived 4 days exposure to melieu after which drastic changes occurred. Fifty six percent of all larvae in the fed control survived for 10 days while 100% mortality was recorded in the starved control (Fig. 2). Forty five percent of the specimens exposed to starvation for 1 to 4 days (sub-groups ii -v) survived the first 7 days of the experiment

Study also revealed that the greatest chance for over 50% survival were in sub-groups 1, iv, vii and ix (Fig. 2). Only specimens starved initially for 1 to 3 days before continuous feeding survived the duration of study.

Development of Larvae

Moulting which started in all sub-groups from the 2nd day of hatching were completed on the 3rd day during which time 90% of the larvae had transformed into second larval stage. Moulting into other instars were accompanied by high mortalities. Greatest success in moulting into higher larval stages were recorded in sub-groups i, iv, vii, viii and ix. Those larvae unable to moult into other stges died after the fourth day.

DISCUSSION

Newly hatched crustacean larvae depend on, firstly, endogenous yolk food which when exhausted must be supplemented from external sources. This condition must be met for early larvae of *M. vollenhovenii* which must be supplied with exogenous food 2 to 3 days from hatching. At this time, larvae has moulted from Zoea I into Zoea II which is accompanied with a drastic change in behaviour distinct from that of the first Zoea (Willfuhr-Nast *et al.*, 1993).

Survival of Larvae

We observe that all larvae survived the first four days of larval life. This 100% survival rate is attributed to their dependence on yolk food supply. A moult (from Zoea 1 to II) the solitary behaviour of larvae is changed into active pelagic behaviour; there are also changes in morphological features. This

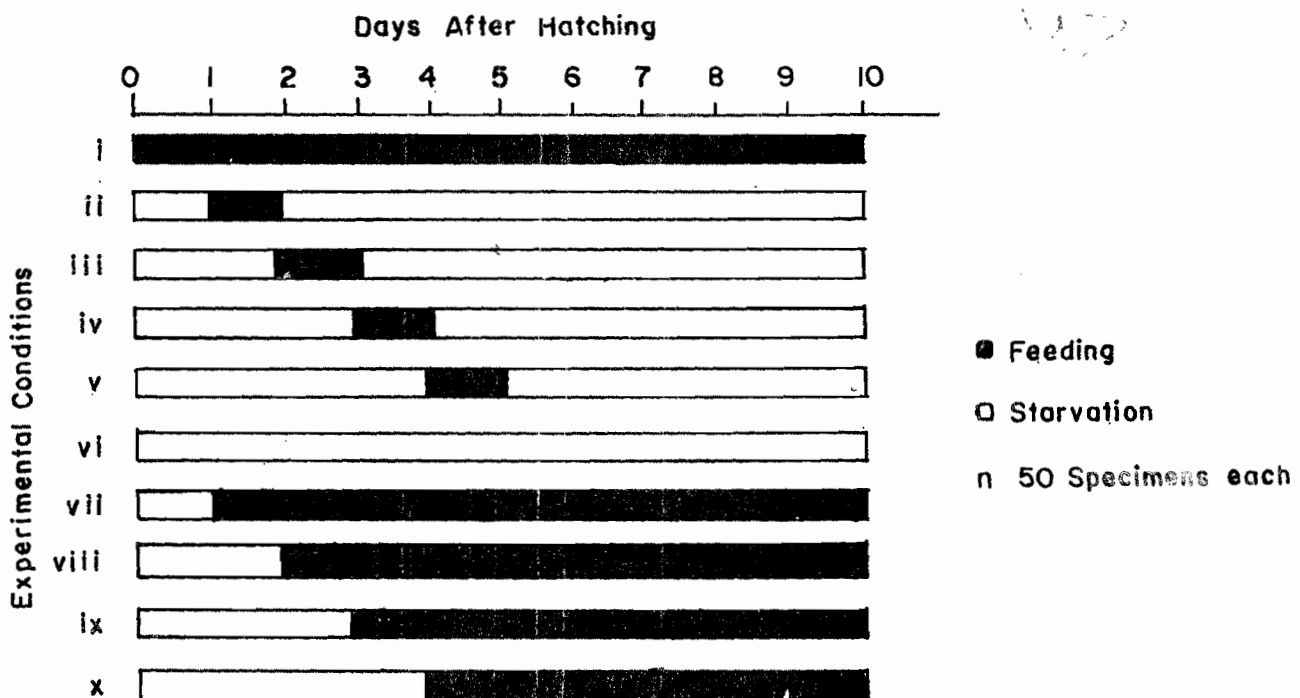


Fig. 1: Experimental Conditions Showing the ten Feeding options for the larvae of *Macrobrachium vollenhovenii*.

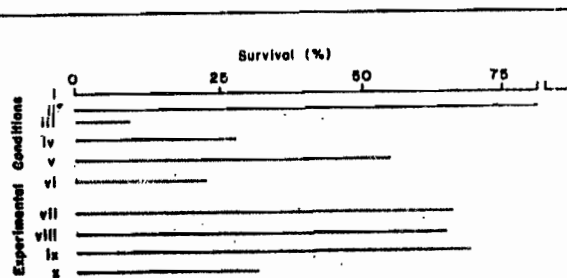


Fig. 2: Survival of *Macrobrachium vollenhovenii* larvae in relation to experimental Conditions.

changes are probably associated with high energy demand which has to be compensated through intake of food from outside the animal. survival decreased drastically in the starved group (Fig. 2) as compared to those in the fed control and those fed continuously after 1 to 3 days. Those which survived upto the 7th day became pale coloured and sluggish. Anger *et al.* (1981) reported that *Hyas araneus* (L.) behaved in a similar manner when exposed to experimental conditions resembling that of this study. This study as well as that reported for *H. araneus* (Anger *et al.*, 1981) show that continuous feeding after short exposure to hunger produced high survival rates in some crustaceans.

Development of Larvae

Udo (1991) and Willfuhr-Nast *et al.*, (1993) reported that the larvae of *Macrobrachium vollenhovenii* fed *Artemia salina* requires 2-3 days to moult into Zoea II from first instar. *M. rosenbergii* (De Man) needs 3 days for the same activity to take place (Malecha, 1983). In this study, 90% of all the specimens moulted from Zoea I to Zoea II within 3 days, those which could not moult were found dead soon after. From microscopic examination all the dead specimens were seen carrying parts of their exoskeleton. The implication of this is that death may have resulted from difficulty in moulting or the inability to shed the exoskeleton must have led to the death of the organism.

for the high mortality in the sub-groups starved and fed discontinuously.

Macrobrachium vollenhovenii must be supplied with external food immediately after moulting into Zoea II. This stage is characterised by intense activity which probably include the search for food after the exhaustion of yolk material. However, those specimens fed 72 hours after hatching still have a chance of survival. Generally, for best results, feeding of larvae should commenced 24 hours from hatching to provide food for the "jumper" (fast growing) larvae. In nature, the recruit of next year classes of post larval stocks would probably be influenced if larvae drift into unfavourable environment where larval food is lacking.

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