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Behavioral and Growth Characteristics of the Crustacean Species *Macrobrachium macrobrachion* (Herklots 1851) (Decapoda: Palaemonidae) with Special Reference to Cannibalism

Opeh, Patience Bassey[1], Inyang-Etoh, Aniema Paul[2*] and Udo, Paul Jimmy[1]

[1]Fisheries and Aquaculture Unit, Institute of Oceanography, University of Calabar, Calabar, P.M.B. 1115, Calabar, Cross River State, Nigeria.
[2]Department of Maiculture and Marine Fishery Resources, Faculty of Oceanography, University of Calabar, P.M.B. 1115, Calabar, Cross River State, Nigeria.

Authors' contributions

This work was carried out in collaboration by three expert authors. Author OPB managed literature review searches. Author IEAP wrote the protocol and first draft of the manuscript; while author UPJ designed the study, performed statistical analysis, produced the final copy of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

This study investigates the behavioral characteristics of the crustacean *Macrobrachium macrobrachion* in view of their cannibalistic tendencies and growth rates. Seventy (70) prawns comprising of individual groups representing adult / post larvae groups of prawns were stocked in hapas in the following categories: adult males/females (5/5), 10 -adult females only, 10- adult males only, mixed males and females post (5/5), 10- adult females / 10 post larvae, 10- adult males/ 10 post larvae and 10 post larvae only. These animals were stocked in their triplicates and studied for fifty six (56) days. *M. macrobrachion* is nocturnal, and diurnally, they hide in shelters sneaking out to eat when food is available. Cannibalism was high in all the groups resulting in survival rates of 40%. Growth rates of 0.03 mgd^{-1} were not significant (P> 0.001) in adult

**Corresponding author: Email: udopaul2001@yahoo.com;*

male/female, adult male, adult female and adult male /post larvae categories respectively. Growth rates of 0.07 gmd^{-1}, 0.05 gmd^{-1} were calculated from the groups that hosted adult female and the post-larval. Prawns in the mixed adults/the post larvae group exhibited the least growth rate of 0.02 gmd^{-1}. Exuviate were found in the hapas indicating that animals were eaten during molting or that they were eaten up during the process of molting. This observation suggests that cannibalism was most prevalent among the latter categories than the former probably associated with nocturnal activities .Most individuals were found with single pleopods or none at all indicating situations associated with fight or aggression. The paper concludes with management strategies for the culture of crustaceans in captivity.

Keywords: Cannibalism; M. macrobrachion; adult males/females; post larvae; mixed adults; management strategies.

1. INTRODUCTION

Freshwater prawns of the genus *Macrobrachium* are ecologically and economically important to support artisanal fisheries in many developing countries, especially in Africa [1]. Udo [2] in a study showed that *Macrobrachium vollenhovenii* is cannibalistic in behavior and as such contribute to the low production of the species in the culture system. Ling and Costello [3] had reported that members of the genus *Macrobrachium* are cannibalistic. Arazu and Udo [4] in a study reported that *Macrobrachium macrobrachion* which is known to be a detrital feeder in food habit appeared to be non-cannibalistic in behavior. The chelae of *M. macrobrachion* are equipped with furs and not pincers [5,6] a situation which tend to exonerated the species from being classified cannibalistic as against species such as *M. vollenhovenii* that displays cannibalistic behavior facilitated by the presence of pincers in the chela. However it was reported that detritus forms the major food component of the *M. vollenhovenii* species *of* the Cross River estuary [7]. Prakish [8] in a study recorded phytoplankton in *M. choprai*, whereas [9] in his conclusion from the stomach content analysis of *M. vollenhovenii* and *M. macrobrachion* in the Lagos lagoon, stated that both species are essentially detritus feeders, although *M. vollenhovenii* showed preferences for algae. Marioghae [9] classified the species as an omnivore because of its acceptance of baits and food types such as fish bones, scales, small animals, algae, fibre, sand and detritus. Udo and Ekpe [10] in a study showed that prolonged starvation of *M. vollenhovenii* during pond culture should be discouraged to prevent animals from resorting to stored food and cannibalism for survival and growth. This study was conducted to investigate the behavioral and growth characteristics of the crustaceans *M. macrobrachion* with special reference to cannibalism.

2. MATERIALS AND METHODS

2.1 Preparation and Description of Experimental Materials

Seven hapas were used in the experiment. Each hapa was made of netting materials, and measured 1 m^2 with a depth of 1.5 m.

2.2 Location and Sitting of Experiment

The experiment was sited at pond section of the institute of oceanography fish farm complex located in the city of Calabar (approx. 4°8' N; 8°20' E) within the serene rain forest and mangrove environment of South East Nigeria.

2.3 Installation of Hapas

The seven hapas were fixed with the help of four bamboo anchor poles of about 4 ft. long, attached to the four side of the hapa and anchored to the bottom of the pond.

2.4 Water Parameters Analysis

Some basic limnological studies of pH, temperature and dissolved oxygen were determine at the beginning and end of study with Lurton pH meter, Lurton OXI meter and thermometer respectively.

2.5 Stocking and Feeding

The shrimp specimen (adult and post larvae) were collected from Obufa Esuk beach. This beach is located behind University of Calabar staff quarters. The samples which were collected

Table 1. Distribution of specimen in experimental Hapa

Population structure	Male/female	Female only	Male only	Mixed adult/post larvae	Male/post larvae	Female/post larvae	Post larvae only
Hapa 1	*						
Hapa 2		*					
Hapa 3			*				
Hapa 4				*			
Hapa 5					*		
Hapa 6						*	
Hapa 7							*

in the morning or late evening were transferred quickly to acclimatized in an aquaria at the hatchery building of institute of oceanography fish farm. The specimen, were allowed to acclimatized for some days before commencement of stocking and study period. Specimen were stocked in the hapas in the ponds. The initial weights of the shrimp were measured before stocking. They were fed with tiny piece of fish flesh throughout the study period. Particles of uneaten food were removed every morning for easy flow of water. Feeding was done by direct introduction of fish flesh (pieces) into each hapa.

2.6 Cleaning and Maintenance of HAPA

Each hapa was cleaned daily to remove plant growth on the sides of the hapa, and other unclean foods. This cleaning prevents net clogging and encourages water circulation.

2.7 Statistical Analysis

ANOVA was used to determine the significant differences between the growth and survival rates of organisms in the systems with the help of the predictive analytical software (PASW) version 18. Duncan's Multiple Range test (DMRT) was used to measure specific differences between pairs of means**.**

2.8 Experimental Procedure

The experimental period lasted for 56 days. Each hapa was labeled as follows H_1 H_2 H_3, H_4, H_5, H_6, H_7, respectively. Ten (10) animals were distributed in each hapa as shown in Table 1.

3. RESULTS

Table 2 shows the general pattern of change in the animals during the 56-days of experiments. The number of individuals in the different population structures decreased with time. However, the mean weight of animals at the end of the study showed that the specimen increased in sizes in the different population structures with an increase in time giving a growth rate that ran between 0.02-0.07 gd^{-1}.

There were no significant differences in the growth rates of specimen ($P>0.001$) in male/female, female, male and male post larvae groups of this study (Table 2). However the female/post larvae and the mixed adult/ post larvae and the post larvae only groups (Table 2). Only hard parts (remain) of the body (hard parts)

Table 2. Pattern of changes in specimen during the experimental period

HAPA	Population structure	No. of individual	No. of survival			Mean weight (g) initial	Final	Growth rate (gd-1)	Survival rate (%)
			M	F	P.L.				
1	Male/female	10	2	2	-	7.00	8.80	0.03	40%
2	Female adult	10	-	4	-	6.00	7.50	0.03	40%
3	Male adult	10	4	-	-	8.00	10.00	0.04	40%
4	Mixed adult/ post larvae	10	2	1	1	4.00	5.00	0.02	40%
5	Male/post larvae	10	3	-	1	4.00	6.25	0.04	40%
6	Female/post larvae	10	-	2	2	5.00	8.75	0.07	40%
7	Post larvae	10	-	-	4	1.00	3.80	0.05	40%

of dead specimens were found in the hapa during the daily rounds of inspection (Whenever a specimen was eaten up), survival rates were similar in all study groups when these structures were mixed with post larvae only; about 1% of all stocked larvae survived. The growth rates measured in the female/post larvae population and post larvae only structure were high giving 0.07 gd^{-1} and 0.05 gd^{-1} respectively (Table 2). The population structure of adult, (male/female)/post larvae gave the least growth rate of 0.02 gd^{-1} (Table 2).

When the population of the entire animal involved in the study were compared to find out the group with highest survival rates, the data showed 39.3% survival rates.

4. DISCUSSION

During the experiment, it was observed that the color of the body of *Macrobrachium macrobrachion* was blue grey with few dark spots as reported by Miller [11]. This body shares assisted in the correct identification of the specie. *M. macrobrachion* is probably cannibalistic. This behavior is virtually eliminated when the shrimp are adequately fed [12]. It was observed that even when *M. macrobrachion* are fed on algae, flesh of fishes etc. similar result was obtained in terms of growth and survival rates as reported by [7,9,12]. From the experimental results, the male showed the highest survival rate, than other sexes (Fig. 1). This is so because there are more aggressive than others. Accordingly, [4] reported that the males are capable of eating up the female and the post larvae, when they are stocked together. The population of individuals in different population structures decreased with time. However, the mean weight of animal at the end of study showed that the specimen sizes of different population structure increased with time giving a growth rate that ranged between 0.02-0.07 gd^{-1}. Although the final numbers of individuals in different population structure were less, final weights were higher than the initial weight. (Table 2). The growth rate attained by these individual (Table 2) are similar to what was reported for *M. vollenhovenii* by [13], when a growth rate of 0.02gd-1 was given for specimen grown on a compounded feed (55% crude protein). The 40% survival rate obtained in this study is similar to that obtained by [13]. When *M. vollenhovenii* was reared in density of 54 ind' m^2. However, the stocking density of the experimental animals in the Hapa was 10ind m^2.These density, is comparable to the stocking density of *M. rosenbergii* which gave a survival rate of 70%. The difference in the growth rate and survival rate of organism in the study media is probably related to the environment and stocking densities of the individuals in these studies. It is known that higher stocking densities of individual in any culture system can affect growth rate of species [14,15,16]. These result however, shows that in all population structures involving post larvae, only about 1% of stock post larvae survived in the experiment. The larger and stronger animals probably ate up the young and week post larvae (Table 2). The disappearance of all post larvae in the study (except the post larvae group) hapas is probably

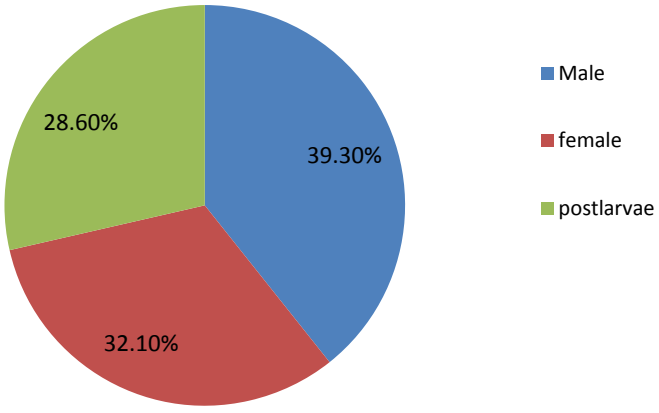

Fig. 1. A pie chart showing percentage, survivors at the end of experiment with same number of individual in different population structures

related to cannibalism where the strong eats up the weak. The population of male and females (held separately) showed equal number of survivors at the end (Table 2) implying that the males and females can be implicated as being more specialized in eating one another. It can therefore be asserted that if both are stock together, consumption to each other is possible. But what could not be confirmed is if the male are cannibalizing on themselves or on the female or vice-versa. Also, [12] stated that *M. macrobrachion* behavior of cannibalism can be eliminated if they are fed probably.

5. CONCLUSION

This observation suggests that cannibalism is most prevalent among the latter categories than the former. The paper concludes with management strategies for the culture of crustaceans in captivity. From this study, it is not possible to confirm that *M. macrobrachion* species are cannibalistic. It could not also be asserted that either the male and female is probably cannibalistic. But if the percentage (%) survival rate of all animal in the study was conducted, seeing that the male species has the highest survival rate, it could be concluded that, they are not cannibalistic in nature.

ETHICAL APPROVAL

As per international standard or university standard written ethical permission has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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