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The culture potential of the brackish river prawn *Macrobrachium macrobrachion* (Herklots, 1851) reared under three management strategies.

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ABSTRACT
The culture of shrimps is an alternative to the farming of fin fishes. In this study, post larvae of *Macrobrachium macrobrachion* were reared in earthen ponds for nine months under three feeding strategies. The first strategy was intensive feeding with Coppens (commercial feed), the other two feeding plans were semi-intensive and extensive (Commercial /natural foods). Each feeding plan was replicated thrice. Animals grew from the initial weight of 0.29 gm to 10.10 gm in 270 days under semi-intensive conditions. Significant differences were not determined in the growth rates of animals grown under extensive and intensive conditions (P>0.05). However, individuals maintained under semi-intensive conditions exhibited higher growth rates than those under intensive and extensive conditions. But, the Production Efficiency (PE) calculated for the three strategies were similar (P>0.05) giving 0.031, 0.029 and 0.026 for intensive, semi-intensive and extensive situations respectively. Specific growth rates were significantly different in individuals reared under semi-intensive conditions when compared to those from the other feeding plans (P>0.001). Growth rates were also two times higher in individuals grown semi-intensively than in those grown in the other culture strategies. Survival rates were high giving 92.8%, 89.2% and 89.8% in semi-intensive, extensive and intensive strategies. The FCR for semi-intensive, and intensive systems were.0.7 and 0.4 respectively. These results are compared with existing data on the species and results from other cultured shrimp world over.

Keywords: Cultivation, *Macrobrachium macrobrachion*, feeding strategies, ponds

1. Introduction
Macrobrachium macrobrachion is a brackish river prawn found commonly in freshwater areas including ponds, lakes, rivers and even in irrigation ditches as well as in estuaries. Report by [2] is that *Macrobrachium macrobrachion* is the dominant shrimp species in the Cross-river estuary and it tributaries. It is reported to be found in all rivers and estuaries along the West Coast of Africa from Senegal to Northern Angola [1].

The rearing of shrimp has generated great enthusiasm in Africa in recent times, especially as regards the development of indigenous species for cultivation [16, 17]. A few indigenous species has potential for culture including *Macrobrachium vollenhovenii, Macrobrachium macrobrachion, Macrobrachium equidens, Macrobrachium felicinum* among others. The total final lengths of these category of shrimps in the wild is reported to range from 80 mm in *Macrobrachium felicinum* to 190 mm in *Macrobrachium vollenhovenii* [10, 5, 6, 17]. The rate of expansion of shrimp farming in Africa is difficult to be measured because of the non-availability of statistics and data on current production of fresh water prawns [3], a few data are only available as published research results [17, 23].

However, literature reports are abundant on the rearing of non-indigenous *Macrobrachium* species, such as the giant Malaysian freshwater shrimp *Macrobrachium rosenbergii* and others [8, 13, 15, 7], provided data on the growth rates of cultured *Macrobrachium rosenbergii*. Data reported on the growth rates of *Macrobrachium macrobrachion* that feed on three types of meals were provided [17, 19]. Data also exist on survival rates, FCR and production efficiencies of indigenous and exotic *Macrobrachium* species [21, 22, 20, 13, 14, 23, 17, 18]. We have comparative data on *Macrobrachium macrobrachion*, indicating it suitability as a cultivable species in West Africa. Therefore, this paper presents data on the culture of *Macrobrachium macrobrachion* in Nigeria, with data on the growth of the species in earthen ponds under three managements

strategies.

2. Materials and Methods

Post larvae of *M. macrobrachion* measuring 29.0 mm /0.29 gm in size were stocked in earthen ponds (36 m^2 each) at a density of 12 $ind.m^{-2}$ and managed under three feeding strategies of intensive, semi-intensive and extensive conditions. Each strategy was replicated thrice and fed respectively with Coppens (commercial feed) (intensive) in fertilized ponds supplemented with known quantity of the commercial Coppens (semi-intensive), and in heavily fertilized ponds in the extensive management strategies. These extensive ponds were fertilized regularly with 25 kg rich chicken manure at bi-weekly interval ensuring that the water color does not show much phyto-plankton. Water qualities of dissolved oxygen, temperature and pH were read weekly.

The ponds were sampled once in every thirty days (30 days) by taking the weight and length of 50 individual shrimps per replicate making 9 replicates for the three strategies to monitor their monthly growth rates (Daily weight increase (DW and instantaneous weight increases (SGR%). The condition factor of the initial individuals stocked and that at harvest were calculated using the formula below:

$$C = {}^{W}/_{L3} \times 100$$

Where, C= condition factor, W and L= mean weight and length of species (at stocking/harvest).

One-way classification analysis of variance (ANOVA) was employed in determining the significant differences between the growth performances of the animals in the three feeding strategies [11]. The least significant range test was applied to determine the minute's differences between the growth performances in the strategies. T-test was applied to determine differences in condition factor of the post larvae (initial stock) and the adults at harvest.

3. Results

The results show that animals grew from the initial stocking size of 0.29 gm/29 mm to 6.17 gm/74.91 mm (or 4.1%/47% increase in weight /length) under intensive condition to the mean weight/length of 6.025 gm/80.20 mm (or 4.8%/36.2% increase in weight /length) and 7.06 gm/79.82 mm (or 4.1%/ 36.33% increase in weight /length) under semi-intensive and extensive culture situations respectively.

Table 1: Production data on *Macrobrachium macrobrachion* reared for 270 days under three management strategies in earthen ponds.

Management strategy	Stocking Density ($ind.m^{-2}$)	Length(mm)		Weight (gm)		Growth rates		Specific growth (%)		FCR	PE	Survival (%)
		Initial	Final	Initial	Final	mmd^{-1}	gmd^{-1}	length	weight			
Extensive	12	28.9	110	.29	23.0	.30	.08	.37	1.18	-	**.08**	92.9
Semi-Intensive	12	28.9	100.2	.29	21.6	.26	.08	.90	1.02	.65	.21	89.2
Intensive	12	28.9	116.0	.29	22.0	.32	.08	.47	0.46	.70	**.10**	89.8

At harvest, the size range of species were between 2 gm and 22 gm (4 – 116 mm), 2 gm and 23 gm (or 53 mm to 115 mm) and 2 - 23 gm (or 38.4 mm – 115 mm) under intensive, semi-intensive and extensive culture strategies. Survival rates, growth rates and FCR were not significantly different in the culture strategies (P>0.05). The production efficiency (PE) of animals reared under semi-intensive strategy was significantly different (P>0.05) from others (Table 1). Also different was the survival rates obtained from the extensive feeding strategy compared with those of semi-intensive and intensive (P> 0.05) (Table 1).

Water quality of the culture systems were: Dissolved oxygen was within the range of 4 mg/l to 6.8 mg/l, Temperature averaged 28±2 ºC while water pH fluctuated between 4.70 to 6.85 throughout the 270 days.

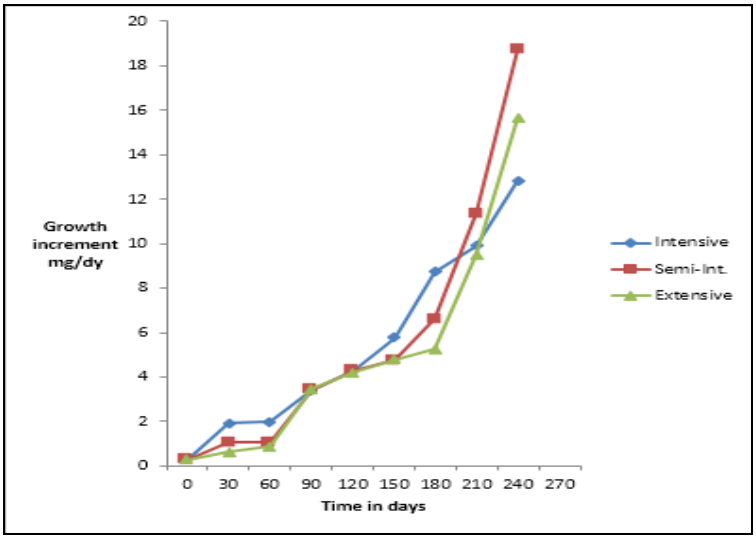

Fig 1a: Growth increment of *Macrobrachium macrobrachion* from post larvae to adulthood in 3 management strategies (mg/dy.)

Growth of *M. macrobrachion* increased with time indicating that specimens reared under semi-intensive conditions achieved faster and higher weights gains than the others (Fig 1a and b) from the other systems. Animals grown under intensive conditions increased in mean weight steadily to 12 gm in 270 days.

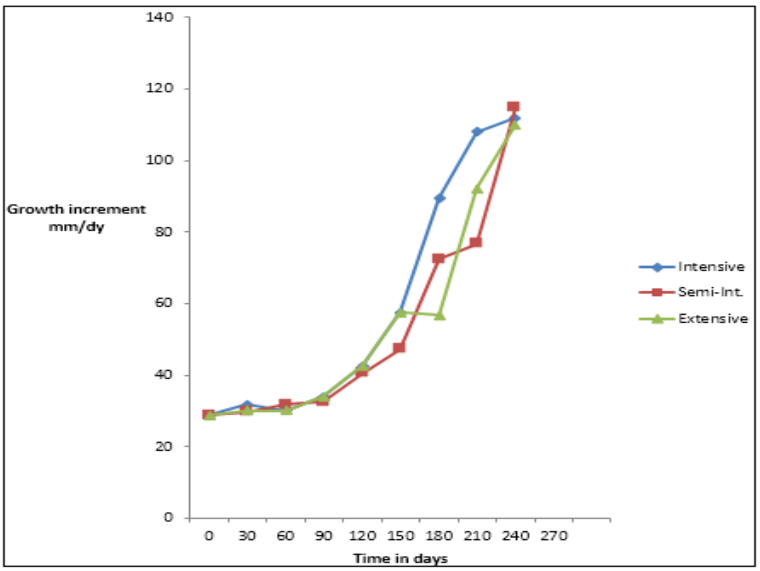

Fig 1b: *Macrobrachium macrobrachion*: Increase in total length with time under 3 management strategies (mm/dy.)

The rate of growth of organisms reared under extensive and semi-intensive situations were similar but different from those animals that grew under intensive conditions in terms of body weights (Fig.2a) (P>0.05).This situation is reversed when growth rates are compared in terms of length increments (Fig.2b).

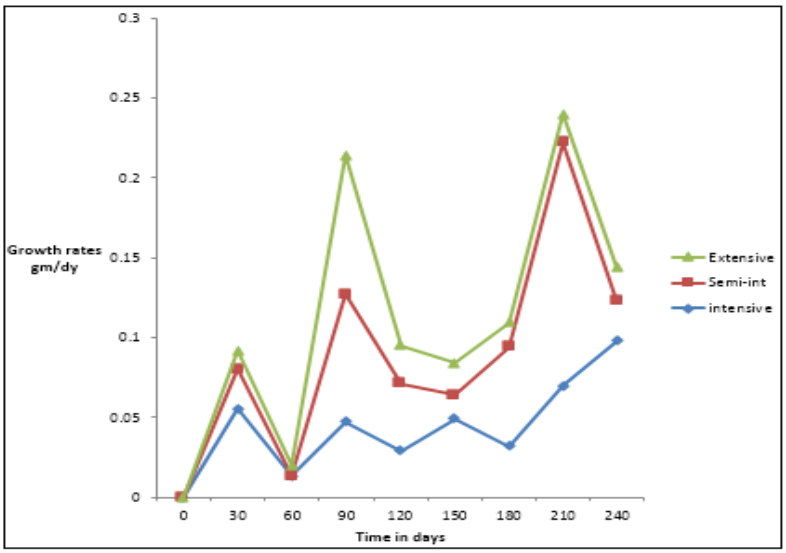

Fig 2a: Growth rates of *Macrobrachium macrobrachion* in three management strategies (gm/dy.)

When the growth rates of organisms in terms of weight and lengths are compared with each other it could be observed that there was a steady increase in growth in length from the beginning while the weight growth fluctuated (Figs. 2a and b).

Condition factor calculated for all the species in the different strategies at stocking and harvest averaged 1 x 10^{-3} and 1 x 10^{-3} respectively. T- Statistic showed that these factors were significantly similar (P>0.05).

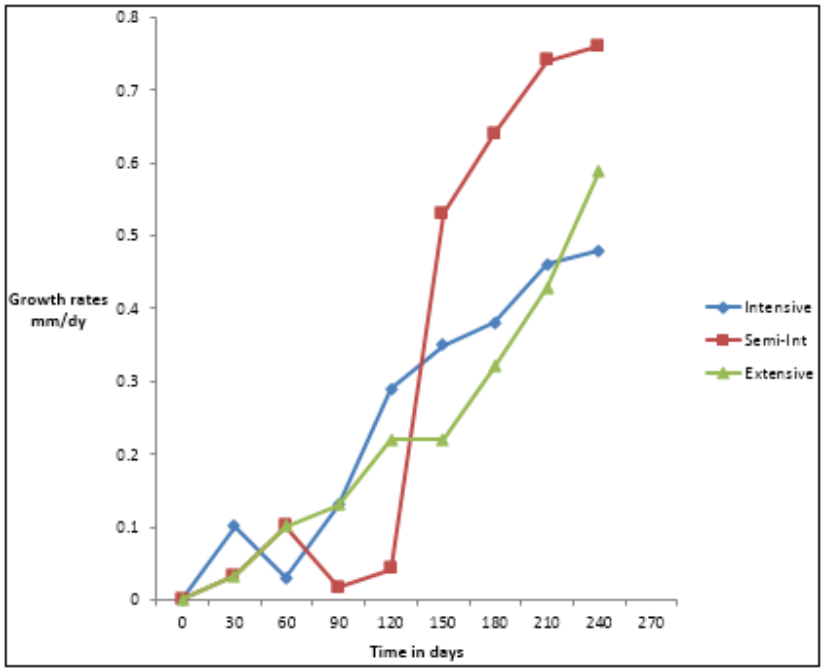

Fig 2b: Growth rates of *Macrobrachium macrobrachion* reared in three management strategies (mm/dy.)

4. Discussion

Several studies have been conducted on the growth rates of exotic shrimps and prawns .But these parameters for indigenous species in relation to several environmental factors including feeding are still scarce on cultivable indigenous species like *Macrobrachium macrobrachion* and *Macrobrachium vollenhovenii* among others. Available data are mostly those generated from the laboratory. Therefore, the data presented here on *Macrobrachium macrobrachion* reared in earthen ponds might be among the first such data. We have been able to establish a comparative base for our species of interest in this paper bearing in mind that animals reared in several but similar environmental situations seem to produce contradictory results. However, results on *Macrobrachium macrobrachion* and its cultivable congener under laboratory conditions are available and can form a very strong foundation to rely on in our comparisons.

Macrobrachium macrobrachion reared under the three culture strategies tested for this study grew at a rate of 0.08 gmd^{-1} (0.30 mmd^{-1}), under intensive situations and at the growth rates of 0.08 gmd^{-1} (0.26 mmd^{-1}) and 0.08 gmd^{-1} (0.32 mmd^{-1}) in semi-intensive and extensive conditions. The maximum total length attained in the animals at harvest in all the strategies of culture was 115 mm or 23 gm; this total length is more than the mean total length reported for wild species [5, 10]. The growth rates especially those measured from animals that grew under semi-intensive conditions are within the range of data reported on growth rates of 0.1 mmd^{-1} to 0.66 mmd^{-1} (0.022 mgd^{-1} to 0.022 gmd^{-1}) at various stock as reported for other cultured *Macrobrachium rosenbergii* [8, 13, 9, 157]. *Macrobrachium macrobrachion* reared in the laboratory and fed with three types of compounded feeds and at a stocking rate of 54 $ind.m^{-2}$ gave the growth rates of 0.015 gmd^{-1}, 0.020 gmd^{-1} and 0.05 gmd^{-1} [19, 17] reported 0.011 gmd-^{1}, 0.09 gmd^{-1} and 0.018 gmd^{-1} for specimens of *Macrobrachium vollenhovenii* that fed on the same food in similar condition of environment with the former. The growth rates of 0.08 gmd-^{1} obtained for *Macrobrachium macrobrachion* of this study (Table I) is not different from that reported in literature for *Macrobrachium rosenbergii* and other species.

We are not sure if the stocking density had any influence on the growth rates of the species; however, other *Macrobrachium* species grown at high stock densities showed good growth rates [8]. The animals of this study were cultured at a density of 12 $ind.m^{-2}$ showing it growth rate as 0.08 gmd^{-1} while *Macrobrachium carcinus* and *Macrobrachium acanthurus* stocked at 1 – 6 $ind.m^{-2}$ showed growth rate of between 0.09 mmd^{-1} to 0.27 mmd^{-1} and 0.35 mmd^{-1} to 0.42 mmd^{-1} at 8.3 $ind.m^{-2}$ to 10.7 $ind.m^{-2}$ [8]. The growth rates reported for *Macrobrachium vollenhovenii* stocked at 54 $ind.m^{-2}$ and 27.0 $ind.m^{-2}$ 0.083 mmd-^{1} and 0.12 mmd-^{1} [17], but [6] had earlier given 0.26 mmd^{-1} for the same *Macrobrachium* species without stating the culture conditions.

The production efficiencies of the different systems were tested with the shrimp production from the semi-intensive system giving 0.21 to the turnover of a biomass of 1132 gm made up of large individuals. Although the former gave such good PE (Table I), it did not produce 3430 gm and 1115 gm of intensive and extensive structures. The reason for these discrepancies is probably related to the quality of food available to shrimps cultured semi-intensively; shrimps are known to be detritivores and a lot of detritus must have been generated from the decomposed uneaten artificial food and the chicken waste that were probably available to them in the pond bottom.

The survival rates were very encouraging giving 92.9%, 89.25% and 89.8% in intensive, semi-intensive and extensive conditions respectively. Nevertheless, it could be observed that the survival in semi-intensive ponds were significantly different from the others giving a slightly lower survival rate. Survival rates of organisms in held in captivity sometimes relates to the condition in the environments [8, 1, 15]. Survival rates is sometimes linked to stocking density of organisms; at the stock density of 1.2 $indm^{-2}$, 2.5 $indm^{-2}$ survival rates of 71%, 58% and 62% were measured in *Macrobrachium rosenbergii* ponds [20]. Determine a survival rate of 92%, 70% and 38% in *Macrobrachium rosenbergii* ponds at density of 5,

10, 20 indm^{-2} while ponds stock at the density of 2 indm^{-2} and 3,7 indm-^{2} by [4] resulted equally at good survival rates [18, 19]. Obtained 100%, 100% and 60% survival in *Macrobrachium vollenhovenii* tanks stocked at the density of 16, 27 and 54 indm^{-2} respectively.

5. Conclusion

With the above data generated on the brackish river prawn, *Macrobrachium macrobrachion* reared in earthen pond environments and the comparability of these data with data from other *Macrobrachium* species (indigenous and exotic) already reared worldwide, it could be argued that its cultivability in ponds is feasible.

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