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Research Article

Effect of Stocking Density on Survival and Growth of *Potamon ebonyicum* (Freshwater Crab)

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Abstract: This work investigated survival and growth performance of male and female Potamon ebonyicum, at different Stocking Densities (SD) with 38% crude protein fish feed, in intensive culture system for six weeks. Experimental treatments were three in number viz., TI, TII and TIII. The TI contained only female, TII contained equal number of male and female, and TIII contained more females than male. The SD ranged from 1 crabT-1 to 3 CrabsT-1. All the male and female crabs survived first half (3 weeks) of the experimental period. Survival period of more than four weeks was recorded in the treatments with more than one female. Growth rates were insignificant and unevenly distributed. Yield was higher in the treatment with equal number of male and female than in the other ones. There was insignificant change in the growth rates as compared to records of previous investigations with the crab species. The narrow gap in the size of small ones, weight differential and their growth rates might assist aqua culturists to adapt SD and forecast yield in the freshwater crab. It could be suggested however that increment in the number of females during high density culture might enhance yield.

Keywords: Stocking density; *Potamon ebonyicum* (Freshwater Crab); Crab; Aquaculture

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Introduction

Crabs are active carnivorous crustacean that prefer live organisms leading to very high cost during cultivation. Wild seed supply is another limiting factor which hinders the aquaculture business to a greater extent (Saha et al. 2000). Compared to other types of aquaculture, crab aquaculture still has a large number of variants including culture systems, which range from extensive to intensive monoculture to polyculture. Aquaculture sites vary from mangrove forest to well-constructed ponds or cages, and seed stock are collected from the wild (Shelley and Lovatelli, 2011). Cannibalism is common in the culture system and juveniles are most vulnerable (Marshall et al. 2005). Mortality rate could increase with density during the cultivation of some freshwater crab species, especially the juveniles (Sant'Anna et al. 2015). An investigation on the use of SD to determine the influence of cannibalism on survival and yield was suggested by Marshall et al. (2005). Rearing of the crabs and other crustaceans in containers could add extra dimension to the running cost, and already technically intense recirculating system (Paterson and Mann, 2011). The freshwater crabs are very important shell fish resource in West Africa and method of mass producing them are yet to be explored (Pers. Obs.). The suitability of SD for aquaculture reasons could be ascertained by studying their effects on growth performance (Shengmin et al. 2016). Data on density and survival rates in freshwater-crab aquaculture especially for local species such as *P. ebonyicum* were relatively scarce. There was no published research on density, survival and growth of juveniles of the crab species. This work is therefore a preliminary study of the effects of SD on the survival and growth of the *P. ebonyicum.*

Materials and Methods

The research was carried out in the Biological Science Laboratory of Evangel University Akaeze, Ebonyi State Nigeria for a period of six weeks. Crab specimens were collected from Ugbona-Ishieke in Ivo Local Government of the State. The state is one of the five states making up the South-east geopolitical zone of Nigeria with Abakaliki as the capital. The location is latitude 6o15'18''N, Longitude 8o05'55''E. The specimens were caught by methods of Akpaniteaku and Emmanuel (2017). They were collected with the help of crab hunters crabbing in the locality. Holding was by the pincers, which were carefully held to the body to avoid detachment of appendages. They were transported dry in plastic receptacles to the research laboratory. Morphometrics of the specimens were in the following range: weight 31.10 – 64.70g, length of carapace 1.10 – 1.70cm and width of carapace 1.80 – 2.60cm. The experiments started with acclimatization of the specimens in 13 litres calibrated plastic containers with water depth of 5 cm. The pH and temperature of water for the acclimatisation was 6.92 and 31.30^{o}C respectively. They were acclimatized for 72 hours.

The crab specimens were measured with plastic tape to the nearest 0.1 cm, and their weights taken with Golden-metler USA electronic scale to the nearest 0.01 g. Three treatments were replicated 3 times as follow:

TI=1 female (1 No)

TII=1 female: 1male (2 No)

TIII=2 females: 1 male (3 No)

Pelleted fish feed (**Table 1**) produced by Grand Cereal Nigeria with fish meal as the major source of protein was fed at 2.00%–5.00% body weight. They were fed once daily at 17:00 hours. Feeding was done by dropping the pellets into the water to attract the crabs.

Water temperature and pH were measured *in situ*.

Pearson's correlation coefficient was used to determine any relationships between treatment and yield. Analysis of Variance (ANOVA) was conducted to determine at 5% probability whether variation in the relationship reflected male or female

Results and Discussion

All the male and female crabs survived three weeks after stocking. The survival records (**Table 2**) showed that a male died in the TI in the fourth week. The treatment with more than one female thrived for more than four weeks. Of all the treatments, insignificant ($p>0.05$) variation was recorded in the survival rate of the males, probably because of the very low density used in the present study. Survival rate of 57% with stocking density of 1 m^{2-1} was reported by Chaiyakam et al. (1977). The experimental containers used for the investigation seem to be smaller than those of Chaiyakam et al. (1977). Contrarily, less rearing space was utilized than in the former investigation. Saha et al. (2000)

Table 1: Nutrient content of the pelleted fish feed. (**Source:** Vital fish feed: Grand Cereal Nigeria (undated))

Nutrient	Percentage	Remarks
Protein	38.00	Maximum
Moisture	8.00	Maximum
Fat	12.00	Maximum
Crude fiber	5.00	Maximum
Calcium	1.80	Maximum
Ash	10.00	Maximum

Table 2: Biweekly survival value of male and female *P. ebonyicum* reared at various densities on 2%-5% feed rate for six weeks.

Period	Week II						Week IV						Week VI					
Treatment	T_I		T_{II}		T_{III}		T_I		T_{II}		T_{III}		T_I		T_{II}		T_{III}	
Sex	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Density (No)	–	1	1	1	1	2	–	1	1	1	1	2	–	1	1	1	1	2
Survival rate (%)	–	√	√	√	√	√	–	√	√	√	√	√	–	√	√	√	–	–
T: Treatment; M: Male; F: Female; No: Number; √: 100%																		

Table 3: Biweekly growth value of male and female *P. ebonyicum* reared at various densities on 2%-5% feed rate for six weeks.

Period	Week II						Week IV						Week VI					
Treatment	T_I		T_{II}		T_{III}		T_I		T_{II}		T_{III}		T_I		T_{II}		T_{III}	
Sex	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Density (No)	–	1	1	1	1	2	–	1	1	1	1	2	–	1	1	1	1	2
Initial CW (cm)	–	4.36	5.40	5.06	5.80	5.40	–	4.36	5.40	5.06	5.80	5.40	–	4.36	5.40	5.06	5.80	5.40
CW gain (cm)	–	0.10	0.00	0.00	0.00	0.00	–	0.20	0.20	0.10	–	0.10	–	0.10	0.00	0.10	–	–
Standard Deviation	–	0.04	0.00	0.00	0.00	0.00	–	0.08	0.09	0.04	–	0.04	–	0.04	0.00	0.04	–	–
T: Treatment; M: Male; F: Female; No: Number; CW: Carapace Width; cm: Centimeter																		

Table 4: Biweekly yield of male and female *P. ebonyicum* reared at various densities on 2%-5% feed rate for six weeks.

Period	Week II						Week IV						Week VI					
Treatment	T_I		T_{II}		T_{III}		T_I		T_{II}		T_{III}		T_I		T_{II}		T_{III}	
Sex	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Density (No)	–	1	1	1	1	2	–	1	1	1	1	2	–	1	1	1	1	2
Initial Weight (g)	–	43.43	43.06	40.00	48.00	46.15	–	43.43	43.06	40.00	48.00	46.15	–	44.43	43.06	40.00	48.00	46.15
Weight gain (g)	–	0.10	0.20	0.30	0.10	0.20	–	0.17	0.13	0.16	–	0.10	–	0.20	0.20	0.15	–	–
Standard Deviation	–	0.05	0.09	0.42	0.08	0.00	–	0.12	0.18	0.86	–	0.00	–	0.04	0.15	0.75	–	–
T: Treatment; M: Male, F: Female; No: Number; g: Gram																		

reported that survival in female crabs was found to decrease with gradual increase in SD. Although SD for the female was fixed in the present study, water quality problem may have arisen leading to condition of stress. Variation in the relationship coefficient between treatments and rates of survival (r=0.00 to r=0.05) may seem to confirm that the stress has residual effect.

Shengmin et al. (2016) reported that increased SD could cause water quality deterioration, uneven distribution of individuals and cannibalism. In the juveniles of *Dilocarcimus pagei* (freshwater crab) mortality increased accordingly with the increase in density of the culture (Sant'Anna et al. 2015). Comparatively, density and size are not the same as in the present study with *P. ebonyicum*. According to Paterson et al. (2011), rearing of individual crab was an obvious solution to the mortality rate and injury that occurred when crabs were reared in group. Contrarily, almost zero mortality was recorded by rearing them in properly maintained system, though with slower growth rate than the rates achieved in ponds (Paterson and Mann, 2011). According to Saha et al. (1997), the relationship between highest carapace size and percentage survival was of positive impact on low SD.

Growth rates were generally low (**Table 3**) during the investigation. Carapace Width (CW) increment in the male and female irrespective of size was significantly ($p>0.05$) lower at early period than midway. The CW increment was relatively low towards the end of the period. Sant'Anna et al. (2015) reported that 3 crabs L^{-1} was the most suitable SD for aquaculture due to its highest specific rate of growth. Despite the container size and sex differential in the present study, the SD was also not more than 3 crabs. Barcellos et al. (1999) observed in fin fish that competition for food and living space between individuals could be increased by high SD, which would lead to growth variation and establishment of size hierarchy. The correlation between treatment and yield for the *P. ebonyicum* was negative (r=0.00). Shelley and Lovatelli (2011) reported that each crab species (shell fish) has different biology, which equates to variation in optimal production.

Standard deviation of the weight from the yield (**Table 4**) may seem to confirm in the replicates, that some of the male and female did not gain any weights. Akpaniteaku (2013) reported that the *P. ebonyicum* was cultivable but for insignificant growth rate, which could be compared with results of the present study. Weight reduction in some of the crabs may have affected the estimated yield. Perhaps some of the females lost weight due to handling and relative effect of the density.

The undulated biweekly yield may seem to emanate from the residual effects of stress. Sant'Anna et al. (2015) observed in natural population that female crabs show faster growth rate than the males in relationship to their reproductive strategy.

Sudden growth was recorded in the males during the second week of the investigation, which dropped on the third week. Perhaps their attitude to feed in captivity was responsible for the growth pattern. According to Akpaniteaku and Onyemara (2016) food conversion is more efficient in smaller crabs than the big ones. Considering the narrow gap in size and growth differential of the smaller crabs in the present study, it could be inferred that size at stocking would be helpful in the yield assessment of the freshwater crab.

Conclusion

The study of effects of density on survival and growth of *P. ebonyicum* revealed that the crab survival and growth variables did not fluctuate positively in tandem. Lack of relationship between treatment and yield values has indicated that sex ratio, could be of positive influence on the stocking density. Equity in

the population of male and female crab might result to optimal yield in high density aquaculture. The growth differential and narrow gap in the size of the smaller crabs revealed that size at stocking could be very useful in forecasting yield in freshwater-crab aquaculture. Acclimatising of the *P. ebonyicum* in fish pond, might create conducive ambience for feeding, high rate of survival and good yield.

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