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Assessment of the Effects of Fish Density on Growth Rate of African Catfish (*Clarias gariepinus*)

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Abstract- The effects of fish density on growth rate of African catfish (*Clarias gariepinus*) in two (2) different tanks with different stocking density shows that there was a general increase in weight and length in all fish during the experimental period. Fish were fed with coppens commercial feed containing 45 % crude protein at 5 % body weight. The mean weight of fish in tank one was 5.13 ± 0.23 g and tank two 5.09 ± 0.19 g and specific growth rate (SGR) for tank one (1.92 ± 0.01 %.day^{-1}) was lower than that of tank 2 (3.62±0.01 %day^{-1}). Condition factor of 12.21 ± 0.37 and 14.14 ± 0.84 were observed for tank one and tank two respectively. However, fish survival varied between 64.0 ± 0.0 to 80.0 ± 0.0 % for tank two and tank one respectively while the percentage mortality in tank two (36.0±0.01 %) was higher than tank one (20.0±0.01 %). Feed conversion ratio was fairly the same for fish in both tank one (0.39±0.01) and tank two (0.39±0.03). Percentage weight gain was higher in tank one than values obtained for fish in the tank two. The water qualities parameter for all the experimental tanks are as follows temperature 25.05±0.07 ^{0}C each, dissolved oxygen 6.00 ± 0.14 mg/l each, pH 8.20 ± 0.17 each, ammonia 0.40 ± 0.04 each and total hardness of 60.00±0.92 mg/l. These water quality parameters probably enhanced the observed good growth and condition of the test fish throughout the experimental period. The assessment of the effect of fish density on growth rate of African catfish (*Clarias gariepinus*) was tested using Analysis of Variance (ANOVA) at p = 0.05 level of significant.

Index Terms- Fish, Growth, Tank

I. Introduction

The African catfish (*Clarias gariepinus*) is one of the most important cultured fish in the Nigeria and known for its ability to be cultured at high densities up to 500 kg/m3 (Miller and Atanda, 2004). Fish farming in Nigeria has progressed steadily over the years and the culture of fish in concrete tanks is now a common practice in Nigeria. Homestead fish farmers operate in concrete tanks whose sizes and shapes vary from location to location depending on individual taste, availability of space and financial resources (Omitoyin, 2007). Intensive tank culture can produce very high yields on small parcels of land. Species like Tilapia that grow well in high densities in confinement of tanks are preferred. Ponds are the most widely used structures for aquaculture production. In Africa, especially in Nigeria, the species mostly cultured are *Clarias gariepinus, Heterobranchus sp.* and their hybrids (Adewolu *et al*., 2008). The reasons for their culture are based on their fast growth rate, disease resistance, high stocking density, aerial respiration, high feed conversion efficiency among others. This fish is ideal for culture because of its tolerance to low dissolved oxygen, rapid growth rate and acceptability of a variety of food items, resistance to handling stress and is well appreciated in a wide number of African countries.

Recent investments in Agriculture in Nigeria have been targeted on Catfish farming (Abdullah, 2007). Currently about 90% of farmed fish in Nigeria is Catfish which is now a major attraction to private sector investors. Atanda, (2007) reported that live catfish attracted premium price in Nigeria with a high return on investment ranging between 40-60% in some successful enterprises. Investment in catfish is still growing especially with the renewed awareness being created by the government of Nigeria through the Presidential Initiative on Fisheries and Aquaculture. Fish farmers are keen to rear fish at such high densities, because operating at higher stocking densities can reduce production costs. However, densities used in commercial fish production have been highlighted as an area of welfare concern. Stocking density has been demonstrated to affect various aspects of the welfare of farmed fish, although differences between species are distinct. High densities may impair the welfare of some fish species (e.g. trout, seabream and salmon) (Ellis *et al*., 2002; Ewing and Ewing, 1995; Montero *et al*., 1999), but for other species positive effects of high densities have been shown (e.g. Arctic char and African catfish). The aim of the study was to assess the density and growth rate of fish in tanks: African catfish (*Clarias gariepinus*).

II. Material and Methods

2.1 Study Area

This research work was carried out at the Laboratory of the department of Biology School of Sciences Federal Capital Territory College of Education, Zuba-Gwagwalada, Abuja, Nigeria.

2.2 Experimental Tanks

Two circular container tanks with diameters of 7.5 × 2.30 × 0.8m each were used in this study. The two experimental tanks (containers) with screen sheets have fine mesh size with diameters of 1.75 × 2.25 × 0.7m and water volume of about 3m^3 for each division. During the experimental period, tanks water was being exchanged with fresh water at the rate of 20% of the water volume daily to keep the water quality suitable for the experimental fish. Tanks water were drained completely every 4 days and cleaned, fish wastes were removed and tanks were filled with fresh water (Adebayo and Adesoji, 2008).

2.2.1 Source of Water for the Experiment

Water source of the present study was ground water pumped into the tanks through electrical pump and pipelines connected to the experimental tanks. All ponds were supplied with air through a central lobe blower and plastic pipes laid 50 cm below the water level. Water quality parameter including water temperature (°C), dissolved oxygen (DO) concentration (mg / l), water transparency (cm), pH (degrees), ammonia (NH_3) (mg / l) and total dissolved salts (T.D.S) (mg / l) were determined. Water quality parameters were measured every four days.

2.3 Experimental fish and stocking density

A total of 100 African catfish *(Clarias gariepinus*) fingerlings, were obtained from a commercial hatchery Fish Farm in Gwagwalada Area Council of the Federal Capital Territory (FCT), Abuja-Nigeria. They were held in two tanks for acclimatization at Biology garden of Biology Department, School of Sciences Federal Capital Territory College of Education, Zuba-Gwagwalada, Abuja, Nigeria and maintained with a commercial feed with known dietary compositions for 7days prior to use for the experiment. Thereafter, the remaining fish after acclimatization were randomly stocked in circular tanks, the experimental fish were divided into two treatment groups the densely populated tank containing 25 fingerlings per tank while the second tanks containing 15 fingerlings per tank. All the experiments were carried out in duplicates. The stocked fish were fed at 5% body weight. Daily rations were divided into two halves and fed at 8 am and 4 pm West Africa time. At bi-weekly intervals, the fish in each tank were weighed and the amount of feed adjusted accordingly. Water quality parameters were determined on four (4) days interval basis during the experimental period. Water pH and temperature records was taken daily with a pH metre and laboratory mercury thermometer (0-100 ^{0}C) respectively. Length and weight measurements of the fingerlings were made at the start of experiment and weekly intervals using a metal metre rule and triple beam balance. Daily mortalities of fish in the tanks were also recorded (Ellis and Ewing, 1995).

2.4 Growth parameter

Growth rate of test fish were evaluated as follows: mean weight gain (MWG) = W2-W1 (Okoye *et al*., 2001) where W1 and W2 are initial and final body weights of fish (g). Percentage weight gain (PWG), % = Wt-Wox100/Wo (Adewolu *et al*., 2008) where Wt = final weight (g) at end of experiment, Wo = fish weight (g) at start of experiment. Specific growth rate (SGR), %day^{-1} = lnw2-lnw1x100/t_2 –t_1 (Brown, 1957) where w_2 = final weight of fish, w1 = initial weight of fish (g), t_2 and t_1 = mean of end of growth period and at time 0 in days and ln = natural logarithm. Condition factor (K) = 100w/l3 where w and l are the observed total weight (g) and total length (cm) of a fish. Feed conversion ratio (FCR) = Feed intake (g)/weight gain (g), and Survival of fish (S) = Ni x 100/No (Alatise and Otubusin, 2006) where No and Ni are number of fish at start and end (alive) of experiment (Ellis *et al*., 2002; Abdullah, 2007).

2.5 Statistical Analysis

The results of the assessment of fish density and growth rate in tanks were statistically analysed using one way Analysis of Variance (ANOVA) from Ms Excel Statistics. Test applied would be F-test statistic at p= 0.05.

III. Results

2.1 Growth performance

Table 1 shows the summary of the results obtained for growth responses of *Clarias gariepinus* fingerlings raised in tanks with different stocking density. There was a general increase in weight and length in all fish during the experimental period. The mean weight of fish in tank one was 5.13 ± 0.23 g and tank two 5.09 ± 0.19 g and specific growth rate (SGR) for tank one (1.92 ± 0.01 %.day^{-1}) was lower than that of tank 2 (3.62±0.01 %day^{-1}). Condition factor of 12.21 ± 0.37 and 14.14 ± 0.84 were observed for tank one and tank two respectively.

Table 1: Growth parameters of African Catfish (*Clarias gariepinus*) grew in different tanks.

Growth parameter	**Fish density/tank**	
	Tank 1 (n=15)	**Tank 2 (n=25)**
No of fish stock	15.0	25.0
Initial length of fish (cm)	2.2±0.05	2.2±0.05
Final length of fish (cm)	14.0±0.2	13.0±0.01
Initial weight of fish (g)	1.15±0.05	1.15±0.2
Final weight of fish (g)	7.05±0.05	7.0±0.05
Mean weight gain (g)	5.13±0.23	5.09±0.19
Percentage weight gain (%)	513±23.0	509±19.0
SGR (%)	1.92±0.01	3.62±0.01
FCR	0.39±0.01	0.39±0.03
Condition factor (k)	12.21±0.37	14.14±0.84
Survival of fish (%)	80.0±0.0	64.0±0.0
Mortality (%)	20.0±0.01	36.0±0.01

Keys: n= number of fish per tank, SGR= Specific growth Rate, FCR= Feed Conversion Ratio in African catfish (*Clarias gariepinus*). Each value represented Mean ± Standard deviations

3.2 Water quality Parameters

The values of temperature, dissolve oxygen and other observed water quality parameters monitored for 42 days were within acceptable ranges for fish culture practice in this study as shown in Figure 1 below. This factor probably enhanced the observed good growth and condition of the test fish throughout the experimental period.

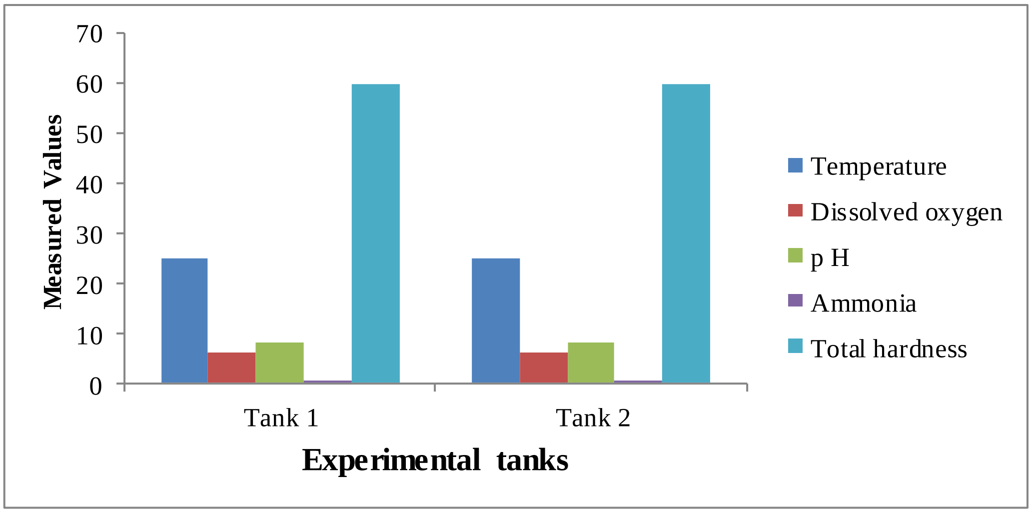

Figure 1: Means values of water quality parameters for *Clarias gariepinus* fingerlings reared in different tanks in Gwagwalada, Abuja

IV. Discussions

The stocking densities investigated in this study did not show a significant effect of group size on growth rate although tank with the least fish tended to produce the greatest growth rate, albeit not significant. Percentage growth gain in tank 1 and tank 2 are as follows 513 ± 23.0 % and 509 ± 19.0 % respectively. However, final length of fish did not differ significantly between tanks, highest and lowest final length of fish were observed at stocking densities of 15 fish/tank (14.0±0.20 cm) and 25 fish/tank (13.0 ± 0.10 cm) respectively. It is possible that a further increase of the stocking density may have resulted in significantly reduced growth rates. In addition, low stock density tank fish were not significantly different from those with high stock density, which agree with the studies by Adewolu *et al*. (2008) in the African catfish (*Clarius garierpinus*) where singularly housed fish grew more slowly than those in pairs or groups. The results obtained for growth responses of *Clarias gariepinus* fingerlings raised in tanks with different stocking density. There was a general increase in weight and length in all fish during the experimental period. The mean weight of fish in tank one was 5.13 ± 0.23 g and tank two 5.09 ± 0.19 g and specific growth rate (SGR) for tank one (1.92 ± 0.01 $\%.day^{-1}$) was lower than that of tank 2 (3.62±0.01 $\%day^{-1}$). Condition factor of 12.21 ± 0.37 and 14.14 ± 0.84 were observed for tank one and tank two respectively. However, fish survival varied between 64.0 ± 0.0 to 80.0 ± 0.0 % for tank two and tank one respectively while the percentage mortality in tank two (36.0±0.01 %) was higher than tank one (20.0±0.01 %). Feed conversion ratio was fairly the same for fish in both tank one (0.39±0.01) and tank two (0.39±0.03). Percentage weight gain was higher in tank one than values obtained for fish in the tank two. However, unlike the previously published studies, this study did not show a significant decline in growth rate as stocking density increased. This may be because stocking densities were not as high as those often used in aquaculture. It is possible that social interaction is not an important motivation for feeding in the Common African catfish. Alatise and Otubusin, (2006) reported effect of different stocking densities on Production of Catfish (*Clarias gariepinus*) in Bamboo-net cage System. These effects may be the result of intensified competition for food or compromised water quality. However, it is more likely that the stocking density never reached the threshold at which food availability and competition among individuals impacted growth rate. The values of temperature, dissolve oxygen and other observed water quality parameters monitored for seven (7) weeks were within acceptable ranges for fish culture practice in this study. The water qualities parameter for all the experimental tanks are as follows temperature 25.05±0.07 ^{0}C each, dissolved oxygen 6.00 ± 0.14 mg/l each, pH 8.20 ± 0.17 each, ammonia 0.40 ± 0.04 each and total hardness of 60.00±0.92 mg/l (Table 1 and Figure 1). This factor probably enhanced the observed good growth and condition of the test fish throughout the experimental period. This agrees with Abdullah, (2007) which reported the evaluation of Fish Farming Potentials in Nigeria.

V. Conclusion

In conclusion, this study has shown that stocking density did not significantly affect growth rate although it affects the growth rate of the fish in the earlier life stages. African catfish responded to increasing density with the formation of dense clusters of fish with constant movement and low aggression. However, the relationship between stocking density and the growth rate of African catfish was strongly mediated through factors such as acute stress experienced by the fish during stocking in the tanks. Such stressors (restocking tanks, grading, handling) are common in a farming situation, indicating that the total farming situation may influence the effects of stocking density.

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