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Effect of stocking density on growth and survival rate of African catfish (*Heteroclarias*) hybrid

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Abstract
The optimal stocking density and the survival rate of African Catfish *Heteroclarias* Hybrid under laboratory condition was conducted. 180 fingerlings of *Heteroclarias* Hybrids of four weeks old were bought from Markudi, Benue State and were randomly chosen after acclimatization for two weeks. They were each counted 4, 8, 16 and 32 with two replicates each in to 16litres bawls filled up to 10litres level in treatments DI, D2, D3 and D4 respectively. Their various weights, total and standard lengths, were measured using 30 cm meter rule for their lengths and 200 (g) digital Weighing Scales Camry (model T1432682) of 5000g (5kg) after every week. The mean percentage weight, total length and standard length were calculated and subjected to one way ANOVA analysis to determine their level of significance. The result indicated that D2 (8 fingerlings) had the best stocking density with ICTL (39.75), SR (100), SGR (0.489), RGR (24.10) and PI (10.71) which were significantly ($P<0.05$) different from other densities (treatments).

Keywords: density, *Heteroclarias*, hybrid, catfish

Introduction
Catfish species are the dominant aquaculture animals and the fastest in growth among others. They are sold alive, dead or smoked dried compare to other species. Their availability than others could be as a result of technological strategies for advancement in the fish industry, and its genetic ability to withstand any harsh environmental conditions (Owodieinde and Ndimele, 2011) [15]. Technology increases fish productivity in Nigeria, but such increases declined as a result of small size and low weight of fish due to the cost and densities in raising the catfish in captivity (Watanabe *et al*., 2002) [18].

Intensive system of fish farming usually employs circular tanks, raceways and cross ways that generally requires high capital that leads to increases in the cost of production in addition to good management practices, which is a pre-requisite to successful fish culture as observed by Watanabe *et al*. (2002) [18]. They also stated that, Nigeria has high potentialities of fish farming which will increase the amount of fish and fish products to cater for its high demand and will give the consumers favorable price. In 2013, fish accounted for about 17% global human population that take animal protein and is usually high in unsaturated fatty acids that provide health benefits against cardiovascular disease (FAO, 2016) [9]. The most cultured fish species in Africa especially in Nigeria are *Clarias gariepinus (*Akinwole and Faturoti, 2006) [2] and *Heterobranchus species* (Ellis *et al.*, 2002) [7] and their hybrids under different cultures system. The above species exhibits different utilization efficiency; growth performance and disease resistance, which make them more profitable to others (Ofonime *et al*., 2019; Adewolu *et al*., 2008 and Bartley *et al.*, 2000) [1, 3]. Viveen *et al.* (1985) also observed that growth response and survival rate of *Clariid* catfish, particularly *C. gariepinus* and *H. Species* showed that both species exhibits fast growth and withstand adverse conditions in earthen and concrete ponds but *Heterobranchus species* matures earlier with less environmental and disease resistance, while *Clarias species* has higher fecundity and matures lately with high resistance than the other. Hybrids fingerlings of any species with high quality could be produced, provided the optimal brood stocks with matured gametes are procured with the right quantity of feed in addition to optimum temperatures for both the parents and seedlings. However, without appropriate spacing or stocking density for the seedlings, the needed growth effectiveness and fast maturity will be a mirage. Despite the aqua cultural achievement of the *Heteroclarias* hybrid fish production, not much research has been conducted on the fingerlings, especially in determining their stocking densities in growth and survival rate. This work therefore, aimed at determining the stocking densities and survival rate of *Heteroclarias* fingerlings in the laboratory.

Materials and Methods
Two hundred (200) fingerlings of *Heteroclarias* Hybrid were obtained from Avese Fisheries Technology and Consult Farm, Gboko, Benue state and transported in a plastic of 50 liters containers from 1:30 pm to 6:41 pm (about 5 hours journey). They were all transferred into two 50liters plastic containers with subsequent removal and addition of fresh water after an interval of 2hrs journey. At the hatchery, they were all allowed in 100litres bawls of water for acclimatized after 10 days. A total of 180 fingerlings of *Heteroclarias* were chosen at random and weighed using a digital weighing balance of 200 g and their lengths were measured using transparent 30cm meter rule. The design of the stocking Densities were D1, D2, D3 and D4 with their respective fingerling numbers of 4, 8, 16 and 32 with two replicates each. Twelve of sixteen liters plastic containers were filed with borehole water to 10 liters mark and stocked with their respective numbers of fingerlings. Mosquitoes net were cut in to pieces and used to cover the containers to prevent the fingerlings from jumping out. They were all fed with Copan feed (floating diet) 1.5mm of the average body weight 3.86g twice daily morning (8:30 am to

10:00am) and evening between (5:30 to 6:30pm) during the research period. The lengths, weight and mortality from each treatment was recorded every week by removing each from the water for the measurements.

The data collected were subjected to statistical analysis using analysis of variance (ANOVA) and correlation coefficient. At the end of the experiment, results from total, standard lengths as well as weight data were used to determine growth performance parameters such as Mean Final Weight (MFW), Mean Weight Gain (MWG), Specific Growth Rate (SGR), and Survival Rate (SR) using the equations below:

1. Specific growth rate (SGR) = Log_e WF - Log_e WI x 100/Time (days) **(**Hepher, 1988**)** [10]

Where WF= Final weight at the end of the expt. WI = Initial average weight at the beginning of the expt. Log_e =Natural logarithm reading. Time = number of days for the expt.

2. Survival Rate (SR) % = Mean number of survived fish at the end of the expt. x 100/ Mean number of initial fish stocked

3. Mean weight gain = Wf - Wi

Where Wf = Final weight, Wi = Initial weight.

4. % Mean weight gain = Wf- Wi x 100 / Wi

Where Wf = Final weight, Wi = Initial weight.

5. RGR (%) = MWG X 100 /t (Wannigamma *et al*., 1985) [17]

Where MWG = Mean weight gain, t = Time (days)

6. Production index (PI) = SR X MWG/Time (days) (Mohanty, 2004)

Where SR = Survival rate, MWG = Mean weight gain, Time = Duration of rearing period in days

Result and Discussion

The result in Table 1 shows the weekly percentage increased in total length of the *Heteroclarias* fingerlings with the highest percentages observed in D2 (19.29), D3 (12.47) and D2 (28.30) for weeks 1, 2 and 3 respectively, While the lowest was observed in D4 (11.49) in week 1, D1 (7.94) in week 2 and D4 (23.28) in week 3. The cumulative percentage increase of total length after the experimental period indicated 39.75% under D2 and the lowest was 30.17 under D4, While that of standard length was 34.72(D3) and the lowest was 24.85(D1) in Table 2.These agrees with the work of El–Sayed (2006) [8] and Okeke (2014) [14] where they stated that the stocking density of 8 fingerlings in 10 litres of water was the best in length and weight. This is contrary to the works of El–Sayed (2006) [8], Dasuki *et al*. (2013) [6], Nwipie *et al*. (2015) [13] and Maucieri *et al*. (2019) [11]. The differences could be because of species difference and management practice of the fish. The highest percentages of weight gained in weeks 1, 2 and 3 were 76.95, 41.90 and 35.04% from D2, D2 and D1 respectively as observed in Table 3. At the end of experiment (cumulative), the highest mean weight gain (MWG) was observed in D2 with 208.23% and the lowest was from D4 with 112.80%. This agrees with El–Sayed (2006) [8] and Okeke (2014) [14]. Using weekly assessment, week one had the highest MWG of 76.95% (D2) and the lowest from D3 (40.27%), followed by week 2 with 41.90% (D2) as the highest and lowest of 2.72% (D4), however, week 3 had the highest of 30.04% from D1 and the lowest of 21.86% from D2. This could be because of the inconsistency in the types of feed, temperature, changing of water and the number of feeding times per day. The survival rate of the fish at the end of the experiment was highest 100% (D2) as observed in Table 3 & 4 and was significantly different (P>0.05) from D1 but was not with the other treatments (densities). The Specific growth rate, Relative growth rate and Production index were observed to be highest in D2 with 0.489, 24.10 and 10.71 respectively. The lowest survival rate was observed in D1 (75%), specific growth rate was 0.328 (D4), relative growth rate was 13.43 (D4) and production index was 5.82 (D1). These did not follow the pattern of the above. However, the desire of the fish farmer is always the highest in the growth parameters. Cannibalism was not recorded in any of the densities because there were no bruises, lesions or wound on the morphology of the live and death fish. It is important to note that, D1 was expected to be the best in all the results but was the reverse. This could be due to lack of competition among the members in that treatment for space and food. Bergit *et al.* (1989) [4] reported the reduced growth rate on grass carp *Ctenopharyngodon idella,* when the species were stocked at high density even if the fish was fed to satiation. This could be as a result of high competition for space and food.

Conclusion

The total length, standard length, weight and survival rate of the researched hybrid fingerlings as per stocking densities were all best at rearing of 8 hybrid fingerlings in 10litres of water. The specific growth rate, relative growth rate and production index were all observed to be highest in D2. Fish farmers are now recommended to rear 8 *Heteroclarias* hybrid fingerlings in 10litres volume of water (D2). By implications, you can culture 80 fingerlings of the species in 100litres of water, 800 fingerlings in to 1000litres and can continue to be, as that as it may.

Table 1: Weekly Mean and Percentage Increase in Total Length of the *Heteroclarias* Fingerlings after three weeks of the Experiment Period

Weeks	Weight	D1	D2	D3	D4
1	Final	8.06	8.31	8.02	7.70
	Initial	7.11	7.27	7.06	6.96
	Mean	0.95	1.40	0.96	0.80
	% ICTL	13.36	19.29	13.60	11.49
2	Final	8.70	9.27	9.02	8.41
	Initial	8.06	8.31	8.02	7.70
	Mean	0.64	0.96	1.00	0.65
	% ICTL	7.94	11.55	12.47	8.44
3	Final	9.47	10.14	9.41	9.06
	Initial	8.70	9.27	9.02	8.41
	Mean	0.77	0.87	0.39	0.65
	% ICTL	24.92	28.30	24.97	23.28
EXP.P	Final	9.47	10.14	9.41	9.06
	Initial	7.11	7.27	7.06	6.96
	Mean incr.	2.36	2.89	2.35	2.10
	%ICTL	33.19	39.75	33.29	30.17

Where EXP.P = Experimental period (21days), ICTL = Increase on Total Length

Table 2: Weekly Mean and Percentage Increase in Standard Length of *Heteroclarias* Hybrid after three Weeks of the Experiment Period

Weeks	Weight	D1	D2	D3	D4
1	Final	7.49	7.70	7.42	7.15
	Initial	6.56	6.64	6.48	6.63
	Mean	0.93	1.09	0.94	0.79
	% ISTL	14.18	16.42	14.51	11.92
2	Final	7.66	8.13	7.88	7.34
	Initial	7.49	7.70	7.42	7.15
	Mean	0.17	1.00	0.46	0.19
	% ISTL	2.27	12.99	6.20	2.66
3	Final	8.19	8.79	8.73	8.81
	Initial	7.66	8.13	7.88	7.34
	Mean	0.53	0.66	0.82	0.67
	% ISTL	19.90	24.45	25.77	20.60
EXP.P	Final	8.19	8.79	8.73	8.81
	Initial	6.56	6.64	6.48	6.63
	Mean	1.63	2.15	2.25	2.18
	%ISTL	24.85	32.38	34.72	32.88

Table 3: Weekly mean and Percentage Increase in Weight of *Heteroclarias* Hybrid after three Weeks of the Experiment Period

Weeks	Weight	D1	D2	D3	D4
1	Final	3.84	4.32	4.11	4.04
	Initial	2.67	2.43	2.93	2.50
	Mean	1.17	1.87	1.18	1.55
	% MWG	43.82	76.95	40.27	62.00
2	Final	4.88	6.13	5.09	4.15
	Initial	3.84	4.32	4.11	4.04
	Mean	1.04	1.81	0.78	1.10
	% MWG	27.08	41.90	18.98	2.72
3	Final	6.59	7.49	6.72	5.32
	Initial	4.88	6.13	5.09	4.15
	Mean	1.71	1.34	1.63	1.17
	% MWG	35.04	21.86	30.02	28.19
EXP.P	Final	6.59	7.49	6.72	5.32
	Initial	2.67	2.43	2.93	2.50
	Mean	3.92	5.06	3.79	2.82
	%MWG	146.82	208.23	129.35	112.80
	SR (%)	75.00	100.00	93.75	93.75
	SGR	0.392	0.489	0.361	0.328
	RGR	18.67	24.10	18.04	13.43
	PI	5.82	10.71	10.04	9.73

Where EXP.P = Experimental Duration Period (21days), MWG= Mean Weight Gain, RGR= Relative Growth, SR= Survival Rate, SGR= Specific Growth Rate, PI= Production Index.

Table 4: Shows Mean and Percentage Survival Rate (SR) of Heteroclarias Hybrid after Three Weeks of the Experiment Period (21days)

Week	TRT	and	Number of	Fish
	D1(4)	D2(8)	D3(16)	D4(32)
1	03	08	16	32
2	03	08	15	31
3	03	08	15	30
Surv.	03	08	15	30
% Surv. Rate	75.00	100.00	93.75	93.75

Key: Where Sur = Survival, Mort. = Mortality

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