The Growth Comparison Of Two Catfishes (C. Gariepinus And Heteroclarias)

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Abstact: Eight weeks (two months) experiment was conducted in the Botanical garden of the department of Biological science at University of Abuja, to evaluate the growth performance in two catfishes (*Clarias gariepinus* & *Heteroclarias*) in circular tanks each having a capacity of sixty liters (60 liters).The fishes were divided into three culture groups, two monocultures and a polyculture. Experimental fishes were fed with copean multifeed (floating diet) a complete dry catfish food.The fingerlings were fed 4% of their body weight twice daily, morning (6.00am – 8.00am) and evening (6.00pm–8.00pm).Growth performance and physiochemical parameters were measured weekly. The results show that treatment B(monoculture of *Heteroclarias*) had the best growth performance with a mean weight gain of 1.46g and mean length gain of 0.985cm which exceed that of treatment A(monoculture of *C.gariepenus*) that had a mean weight gain of 1.0575g and mean length of 0.75cm.In treatment C (polyculture of *C.gariepInus* & *Heteroclarias*), *Heteroclarias* had the best growth performance with a mean weight gain of 1.22g and mean length gain of 0.945cm exceeding that of *C.gariepenus* which had a mean weight gain of 0.6975 and mean length gain of 0.472. At the end of the study period, *Heteroclarias* had the best growth in both monoculture and polyculture systems.

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Introduction

Over the years, rapid increase in population has become an issue of utmost concern in both developed and less developed countries of the world. This is owing to the fact that man is faced with the problem of how to provide both quantitative and qualitative food for himself and his family. To this end adequate conservation of resources to make provision for both present and future consumption needs is deemed necessary.

The quality and quantity of food produced either from land or water is inadequate with the teeming population which appears to be doubling every 35 years (Bell and Counterbery,2000). This rapid increase in population has resulted for more cheaper protein and other nutritional requirements (olatunde,1982). The commonest source of protein for the rural populace has been from crops such as cowpeas, soya beans, groundnuts and animal protein from pork, beef, milk. Of recent, the supply of such products have been insufficient as a result of rapid population growth and hence the need to develop other source of protein such as aquaculture (Bell and Counterbery, 2000). Fish has long been considered as an important source of high quality protein in human diet, providing 16% of the animal protein consumed by the world's population according to Food and Agricultural Organization (FAO) of the united nations,(1997).Fish is rich in thiamine, riboflavin, minerals, polysaturated fatty acid and vitamin A, D,E and K which are essential for healthy living. The absence of these minerals and vitamins in diets may result in dangerous consequences.

The catches from the world captures fisheries was expected to reach 100 million M+ by the year two thousand (2000), after that the gap between demand and supply would have to be filed by aquaculture (Chamberlain, 1993). Aquaculture is the growing and cultivation of different species of fish including other aquatic animals for the purpose of feeding, decoration, ornamental and for advance research. This branch of agriculture has become very important being that they are good source of protein, vitamins, oil e.t.c.. Since prehistoric times aquaculture stood at about 15.3 million M+ in 1990 (Desilva and Anderson, 1995). At the moment it contributes 20% of the world's fish production and may reach 25% by the year 2000 (Ratafia, 1995), with growth rate of over 50% annually, production from aquaculture by the year 2000 was projected at 20 million M+ which is still leaving a deficit balance between demand and supply of sea food (Chamberlain 1993).

Aquaculture scientist and fish farmers through out Africa and in Europe and Asia have benefited immensely from the wealth of biological and ecological research which has been undertaken in different fish species. There are however great species of fish that can grow in the pond cages. All warm water fish can grow in the ponds. But some are predominantly fresh water while some are brackish water fish. It is observed that the fresh water fish do better in fresh water ponds and brackish water fish grows better in brackish water ponds although in some cases fresh water fishes can be acclimatized to grow in brackish water and vice versa. The fin fishes that has been successfully raise in a pond are; *tilapia*, crabs, mullets, *clarias* e.t.c. Since the last three decades, *clariid species* has been considered to hold great interest for fish farming in Africa and Nigeria in particular. The fishes having wide geographical spread, a high growth rate, resistance to handling and stress and well appreciated in a wide number of African countries (Clay, 1979).

The objective of fish farming is to obtain the maximum increase in weight (biomas) of fish/ unit area of volume/unit with a specific level of management practice. These requires the knowledge of fish growth, carrying capacity, nutrition, yield and water quality parameters. The sharp tooth catfish C*larias gariepinus* is an important aquaculture candidate in the tropics. Huisman (1985) reported that a number of the characteristics which confer on this species a great aquaculture suitability is directly or indirectly related to the breathing habit. Other workers (Awachie, 1975: Holden and Reed; 1972) have mentioned the need to explore the aquaculture potentials of other air breathing *clarids* especially species of the genus *Heterobranchus* which was reported to be the heaviest *clarid* in the Niger river. Inyang et al (1972) have reported the recent interest in the study *H. Longifillis* compared to the other species of *Heterobranchus*. Both Legendre (1986) and Amibeze (1995) observed remarkable yield. In the culture of *H. Longifillis* in ponds. Hetcht and Lublinkhof (1985) reported the successful hybridization of *H. Longifillis* and *C. gariepinus* with hybrid fingerlings reaching an average total length of 108.9 or 19.0 mm while the control group of *C. gariepinus* fingerlings under identical environmental conditions reached an average of size of 74.31 or 18.8mm.

The story of aquaculture in Nigeria is essentially the story of catfish culture and hope of fish supply in Nigeria hangs on its development and culture. Recent trends allover the word, points to a decline in landing from capture fisheries, an indicator that fish stock have approached or even exceeded the point of maximum sustainable yield. Aquaculture therefore remains the only viable alternative for increasing fish production in order to meet the protein need of the people. It was observed that of the over 30,000MT of various freshwater and brackish water fish species caught in the year 2000, catfishes were more abundant next to Tilapias. FAO (1992) reported that 27,488MT of catfishes produced in 1990 were consumed locally. This implies that there is still great need for high production for both local and international markets. In aquaculture, fish require adequate food supply in the right proportions and with proper nutritional contents need for growth, energy, reproduction, movement, and other activities which they carry out.

The African catfish (*Clarias gariepinus*) are choice food species in Nigeria. It commands high demand from consumers and is mostly preferred by aquaculturists. This is due to the ideal characteristics of this species (Eding *et a*l, 2001), which includes high growth rate at high stocking densities, a high food conservation, good meat quality and smoking characteristics as well as year round production(Ita, 1985).Fish culture production in Nigeria includes stocking of lakes and production in ponds, cages and tanks (Ita, 1985). Pond culture is the most prevalent (Akinwole *et al,* 2006). Virtually all aspect of pond culture of African catfish (C*larias gariepinus*) in Nigeria has been developed and documented to ensure profitable production of the species. The appreciable quality of water and large expense of land require for pond culture has however limited the expansion of African catfish culture in Nigeria (Akinwole *et al*, 2006).

Intensive culture of finfish in recirculation aquaculture system(RAS), a production technique that reuses fish culture water more than once, thereby saving space and water for fish culture, has been adopted to African catfish (C*larias gariepinus*),in Europe and America (Akinwole *et al*,2006). Reports by Ending and Kamstra, (2001) confirms that RAS has been adopted to successfully culture in African catfish (C*larias gariepinus*) at full commercial scale in Denmark and in Northern land (Akinwole *et al,* 2006).

Nigeria has a high potential to develop its fish farming so as to increase the amount of fish that is produced in the country because of its high demand and favorable scale price.

Literature Review

Aquaculture in Africa is a relatively new industry, it is not practiced on a large scale. Fish pond culture in sub-saharan Africa started in Kenya in 1924 and later spread to other parts of the continent (Huisman, 1986 and Jackson *et al*, 1982). FAO (1998) stated that, fish supplier over 50% of the total animal protein consumed in developing countries. However in Nigeria fish constitutes 40% of animal protein intake (Olatunde, 1982).

Aquaculture in Nigeria has turned a new leaf, In that it has become wide scale since the FAO introduced modern aquaculture and aquaculture technology into the system. Cultivable fish species include clariid catfishes, tilapia and exotic carps (Maar *et a*l, 1996) which are facilitated with the acquisition of induced breeding technology.

In Nigeria, today aquaculture practices seeks to improve fish yield and fish productivity. It’s benefit ranges from rural development, income generation, farm sustainability as well as reduction in vulnerability. This practice also makes use of land which is considered unsuitable for agriculture such as swamps or saline areas. Anyila (1991) stated that over 9.570 of all fish protein consumed in Nigeria comes from the wild. Eyo (2001) reported that since aquatic resources are finite although renewable, every effort should be made towards increasing fish production through improved resource management and conservation and also intensive aquaculture practices.

Currently aquaculture production in Nigeria has witnessed slow pace of development. Aquaculture contributes only about 25000MT of fish annually which is about 69% of domestic fish production, whereas the projected requirement for fish products by the year 2000 was 4million MT (Ita, 1998). Nigeria has high potentials in aquaculture which is hardly tapped. Anyinla, (1998) stated that aquaculture provided food of animal protein, generated income and employment, thereby promoting the socio-economic development of Nigerians. Fish production when combined with improved inland fisheries management to eliminate fish importation and earn substantial foreign exchange.

The Culture of Clarid Catfish

Clarias gariepinus family *claridae* is generally considered to be one of the most important tropical catfish species for aquaculture in west Africa (Clay, 1979). Other species include; *Heterobranchus* and their hybrids. 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. Catfishes inhabit calm fresh waters ranging from lakes, streams, rivers, swamps to flood plains, many of which are subjected to seasonal drying. The most common habitats of catfish are flood plains, swamps and pools. The catfish can survive during the dry seasons due to the possession of accessory air breathing organ (Bruton, 1979, Clay, 1979).

Catfishes are cultured conveniently under monoculture and poly culture system. The monoculture is the culture of the same fish species while polyculture, is the culture of two or more fish species of different habits and ecological niches. This type of culture is favored in pond system(Maar *et al*,1966). However, with the intensification of tank culture system where fish culturist rely solely on artificial feed as the only food to feed their fish, the advantages of polyculture therefore diminish. There are therefore, the culture of two species of fish; a system that could be referred to as duoculture. Also, there are the culture of three closely related species of the same family and the same feeding habit, this type of culture could be referred to as trioculture system.

There is the culture of only one single species known as monoculture. Most culturist in Africa especially in Nigeria have practiced any of these culture system for their fish. These farmers believes that culturing different species of catfish together or separately have little or no effect on their growth performance. Studies on the growth performance of fish especially the salmon species on the mono and the duoculture system have been reported.The work of Ogunsanmi *et al*;(2000) show that *clariid* catfish culture under the monoculture system gave weight gain followed by the duoculture and least in the triculture system. The results also show that the hybrid had the best weight gain in all the three culture systems followed by *clarias gariepinus* and least with *heterobranchus longifillis.*

MATERIALS AND METHODS

Description of Experiment Site.

The experiment was conducted in the biological science department botanical garden located in the south west of the mini campus of the university.

Collection of Acclimatization of Experimental Fish

Fingerlings of *Clarias gariepinus* and *Heteroclarias* were bought from hatcheries within FCT, and were transported in plastic containers and on arrival at the experimental site were allowed to remain in the bucket for at least three hours to allow them recover from transportation stress and acclimatize to their new environment.

Experimental Procedure

The total number of experimental fishes were sixty (60) and divided into three culture groups namely:
Treatment A:- Monoculture of *Clarias gariepinus*
Treatment B:- Monoculture of *Heteroclarias*
Treatment C:- Polyculture of *Clarias gariepinus* and *Heteroclaris.*

Feeding and Measurement

Each culture treatment was fed with copean multifeed (floating diet) a complete dry catfish food containing 45% of protein, 12% fat, 2.2% of calcium, 1.2% potassium, 0.5% Ash,2.2% fiber, 60 ppm minerals and vitamins A 10000iu/kg, E 200 mg/kg, and C 100mg/kg. The fingerlings were fed 4% of their body weight twice daily, morning (6.00am – 8.00am) and evening (6.00pm – 8.00pm). Sampling of fish for measurement and length measurement were done by reducing by reducing the volume of water with a rubber siphon before the fish is collected. All fishes in each tank in monoculture system were weight together while in the polyculture system, they were weight separately according to species. This was done once a week. On weighing days, the fishes were not fed until the whole exercise was completed. Feeding rate was recalculated to accommodate the weight changes. The feeding trials lasted for eight weeks.

Circular Tank Management.

The circular tanks were bought at Gwagwalada market. The tanks are of the same size each having a capacity of sixty (60) liters. Before the introduction of the fishes, the tanks were thoroughly washed with salt to kill any pathogen. The tanks were then filled with dechlorinated tape water to thirty (30) liters capacity. Ten (10) fingerlings were then introduced into each of the tanks in the monoculture system. In the polyculture, Ten(10) fishes of each of the two species were introduced. The circular tanks were then covered with nets to prevent the fishes from jumping out of the tanks and to also prevent reptiles and some other predators from getting to the fish. The water in the tank were changed after every seventy-two (72hr) hours intervals to avoid the accumulation of toxic waste which will be harmful to the fishes. On weighing days the fish were taken to the laboratory for weighing using automated top weighing balance(Ohaus E 400 ohaus precision plus) and the length of the fishes using a meter rule.

Physio-Chemical Parameters

Water parameters were taken daily for the first week of the experiment to determine the maximum period of accumulation of toxic levels and subsequently at one day interval to monitor misappropriation of water quality. Both surface water temperature and atmospheric temperature were read daily to the nearest ^{0}C with the aid of a mercury in-glass thermometer. Dissolve oxygen was determined using the wrinkle method. PH, ammonia and nitrate level were determine using the urinalysis strip.

Proximate Analysis

Weight Gain (g): This was calculate as the difference between the initial and the final mean weight for fish in each aquarium.

Specific Growth Rate (SGR): This was calculated from data on changes of body weight over a given time intervals;

$$SGR = \frac{w_2 - w_1}{\text{culture days}}$$

where w = initial weight(g) at time t

w = final weight (g)at time t

Food Conservation Efficiency (FCE): The fish conservation efficiency was calculated as;

$$\frac{\text{Weight gain}}{\text{Feed intake}} \times \frac{100}{1}$$

(Utne, 1979)

Mean Growth Rate (MGR): This was computed using the standard equation:

$$MGR = \frac{W_2 - W_1}{0.5(W_1\ W_2)} \times \frac{100/t}{1}$$

Where: W_1 = Initial Weight

W_2 = Final Weight

t = Period of experimental days

0.5 = Constant

Percentage Weight Gain (% WG): This is expressed by the equation:

$$MGR = \frac{Wt - W_o}{W_o} \times \frac{100\%}{1}$$

Where: W_o = Initial weight

W_t = Weight at time t

Survival Rate (SR): The survival rate SR was calculated as total fish number harvested/total fish number stocked expressed in percentage.

$$SR = \frac{\text{total fish number harvested}}{\text{Total fish number stocked}}$$

(Akinwole et al, 2000)

Statistical Anaysis:

Analysis of growth data using analysis of variance (one-way ANOVA).

Result

The results are shown in the following tables (Table 1, Table 2, Table 3, Table 4, Table 5, Table 6, Table 7; and figures (Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7).

Table 1: Production Parameters for Treatment A

Week	1	2	3	4	5	6	7	8
Gross total weight(g)	43.8	55.2	68.4	78.	95.8	105	100.2	115.8
Mean weight (g)	4.38	5.52	6.84	7.8	9.58	10.5	10.02	11.58
Weight gain (g)	0.00	1.14	1.32	1.0	1.73	0.92	0.6	1.74
Gross total length(cm)	65.0	78.0	82.2	88.	93.0	98.6	106.2	112.6
Mean length (cm)	6.5	7.8	8.22	8.8	9.3	9.86	11.8	12.5
Length gain (cm)	0.00	1.3	0.42	0.5	0.49	0.56	1.94	0.7
Gross feeding rate (g)	19.2	30.5	46.8	61.	91.8	110.	100.4	133.6
Specific growth rate (cm)	0.00	1.43	1.65	1.2	2.16	1.15	0.6	1.93
Mean growth rate	0.00	0.94	0.69	0.3	0.46	0.18	-0.09	0.27
Gross food conversion efficiency %	0.00	51.6	48.2	32.	45.1	21.9	15	38.5
Survival rate	100	100	100	100	100	100	90	90

Table2: Physiochemical Parameters for Treatment A

WEEK	1	2	3	4	5	6	7	8
Water temperature (^{O}C)	27	26	27	27	26	27	27	26
Dissolve oxygen mg/l	6.83	6.62	6.4	6.24	6.12	6.1	6	5.96
Ph	8.0	7.2	7.7	7.9	8.0	8.3	8.5	8.4
Ammonia mg/l	0.01	0.23	0.29	0.35	0.4	0.49	0.54	1.0
Nitrate mg/l	0.001	0.01	0.01	0.02	0.02	0.02	002	0.02

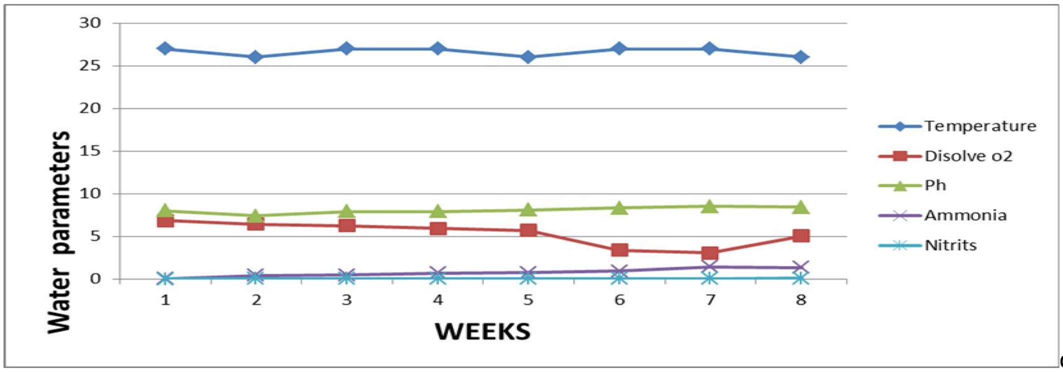

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Figure 1: Production Parameters for Treatment A

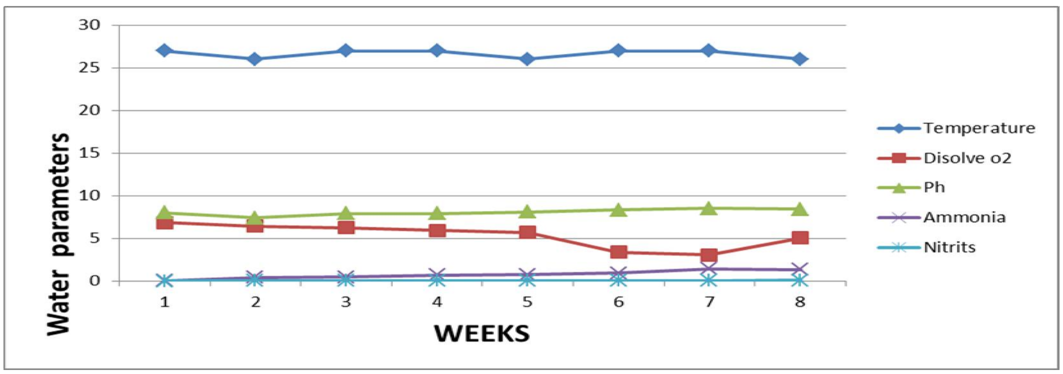

Figure 2: Physiochemical Parameters for Treatment A

Table 3: Production Parameters for Treatment B

Week	1	2	3	4	5	6	7	8
Gross total weight(g)	85	105	128	141.	158.5	166.2	161.	178.5
Mean weight (g)	8.5	10.5	12.8	14.8	15.85	16.62	17.8	19.82
Weight gain (g)	0.00	2.0	2.3	1.28	1.77	0.77	1.21	2.0
Gross total length(cm)	102.2	118.5	128	134.	148.0	157.6	154.	162.8
Mean length (cm)	102.2	11.85	12.8	13.4	14.8	15.76	17.1	18.1
Length gain (cm)	0.00	1.63	0.95	0.62	1.38	0.96	1.34	1.00
Gross feeding rate (g)	72.25	110.3	163.84	198.	251.2	276.2	258.	318.6
Specific growth rate (cm)	0.00	2.5	2.9	1.6	2.2	0.96	0.71	2.25
Mean growth rate	0.00	0.45	0.34	0.01	0.15	0.585	0.43	0.126
Gross food conversion efficiency %	0.00	47.6	54.7	36.9	27.9	11.82	18.8	29.7
Survival rate	100	100	100	100	100	100	90	90

Table 4: Physiochemical Parameters for Treatment B

WEEK		2	3	4	5	6	7	8
Water temperature (^{O}C)	27	26	27	27	26	27	27	26
Dissolve oxygen mg/l	6.83	6.4	6.23	5.9	5.67	3.34	3.04	5.03
pH	8	7.4	7.9	7.9	8.1	8.3	8.5	8.4
Ammonia mg/l	0.01	0.38	0.46	0.68	0.74	0.9	1.4	1.3
Nitrate mg/l	0.001	0.01	0.02	0.02	0.03	0.03	004	0.05

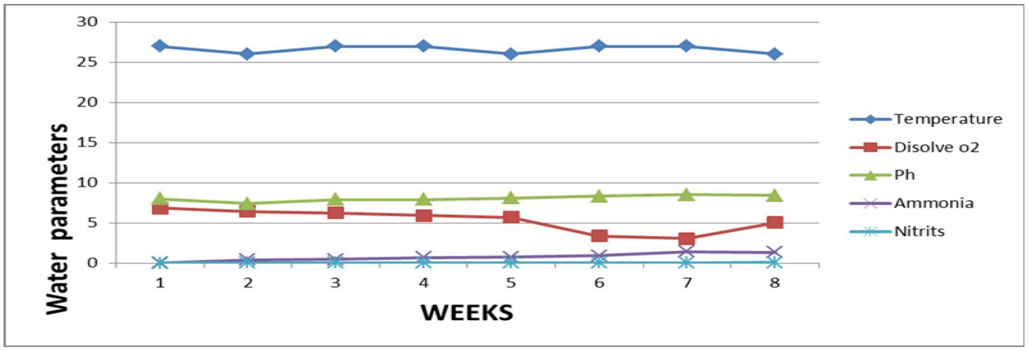

Figure 3: Production Parameter for Treatment B

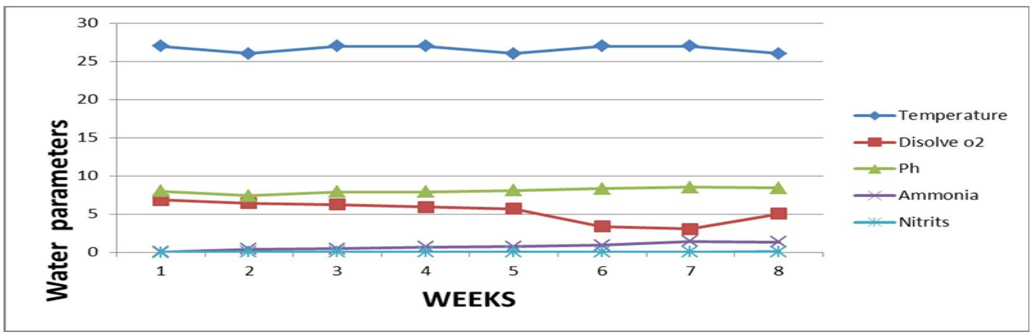

Figure 4: Physiochemical Parameters for Treatment B

Table 5: Production Parameters for Treatment C

Week	1	2	3	4	5	6	7	8
Gross total weight(g)	36.2	41.7	45.8	52.1	59.8	54.4	53.2	64.5
Mean weight (g)	3.62	4.17	4.58	5.21	5.98	6.8	7.6	9.2
Weight gain (g)	0.00	0.55	0.41	0.63	0.77	0.82	0.8	1.6
Gross total length(cm)	48.1	52	58.3	65.8	71.4	57.4	54.8	60.1
Mean length (cm)	4.81	5.2	5.83	6.58	7.14	7.18	7.83	8.98
Length gain (cm)	0.00	0.39	0.63	0.75	0.56	0.04	0.65	0.76
Gross feeding rate (g)	13.1	17.4	20.98	27.1	35.8	37.0	40.4	59.3
Specific growth rate (cm)	0.00	0.69	0.513	0.79	0.963	0.68	0.15	1.41
Mean growth rate	0.00	32.97	22.38	30.2	32.19	37.7	36.8	62.0
Gross food conversion efficiency %	0.00	0.73	0.43	0.53	0.49	0.33	0.08	0.66
Survival rate	100	100	100	100	100	80	70	70

TABLE 6: Production Parameters for Treatment C

Week	1	2	3	4	5	6	7	8
Gross total weight(g)	35.2	48.1	62.8	78.2	81.0	95.2	88.0	100
Mean weight (g)	3.52	4.81	6.28	7.82	8.1	9.52	11.0	12.5
Weight gain (g)	0.00	1.29	1.47	1.54	0.28	1.42	1.48	1.5
Gross total length(cm)	53.2	65.4	85	96.4	104.	119.	108	115
Mean length (cm)	5.82	6.54	8.5	9.34	10.4	11.9	13.5	14.38
Length gain (cm)	0.00	0.72	1.96	0.84	1.08	1.43	1.65	0.88
Gross feeding rate (g)	12.4	23.1	39.4	61.2	65.6	90.6	96.8	100.8
Specific growth rate (cm)	0.00	1.613	1.84	1.93	2.8	1.78	0.9	1.5
Mean growth rate	0.00	67.05	58.6	49.36	8.64	37.3	42.1	39.14
Gross food conversion efficiency %	0.00	1.52	0.97	0.63	0.09	0.38	0.17	0.0
Survival rate	100	100	100	100	100	100	80	80

Table 7: Physiochemical Parameters for Treatment C

WEEK		2	3	4	5	6	7	8
Water temperature (^{O}C)	27	26	27	27	26	30	30	26
Dissolve oxygen mg/l	6.83	6.22	5.8	4.8	4.3	3.11	3.86	3.88
pH	8	7.5	7.6	7.8	8.1	8.4	8.6	8.5
Ammonia mg/l	0.01	0.43	0.54	0.68	1.02	1.42	1.83	2.11
Nitrate mg/l	0.001	0.02	0.02	0.03	0.04	0.04	004	0.06

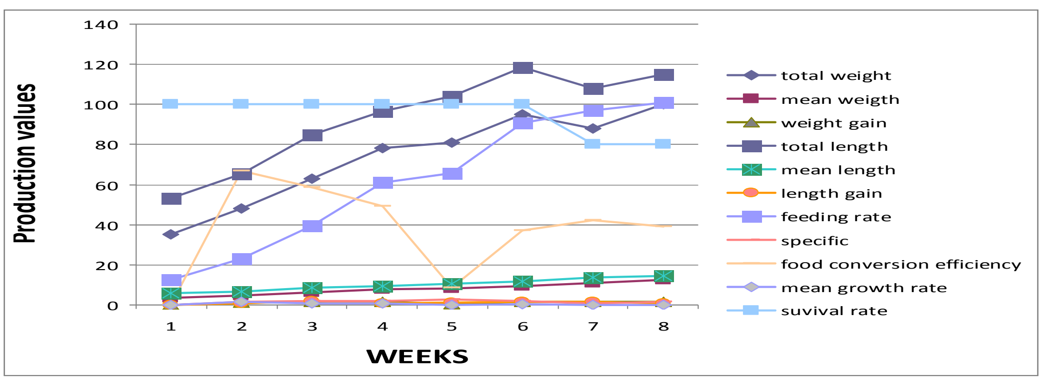

Figure 5: Production Parameters for Treatment C

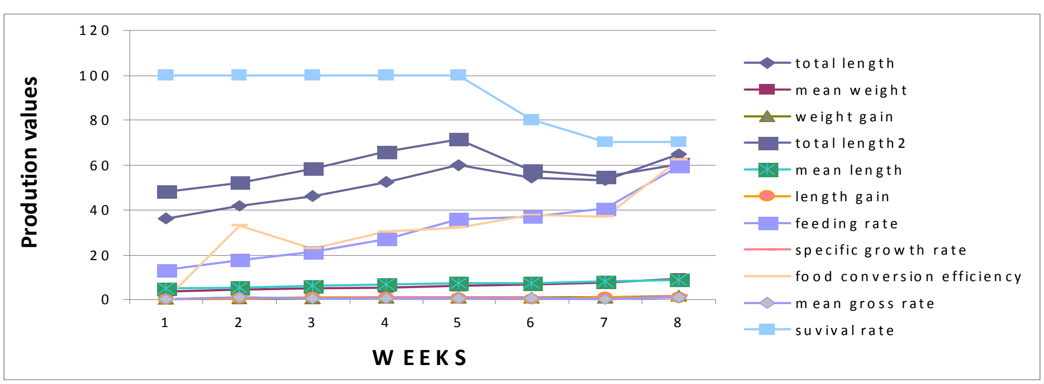

Figure 6: Production Parameters for Treatment C

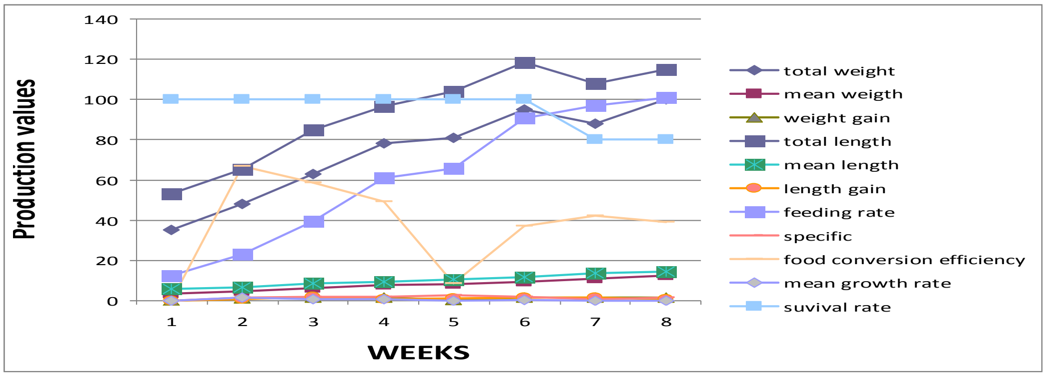

Figure 7: Physiochemical Parameters for Treatment C

DISCUSION AND CONCLUSION

General Rearing Aquarium

Adverse concentration of water quality parameters especially oxygen and unionizing ammonia were noticeable through the rearing period, apart from saving as likely stressors some of the stressors could have been direct cause of death. In addition, nutrition and density stress may have also been in play throughout the part of the rearing cycle.

Temperature

The water temperature recorded during the experimental period ranged $26^{O}C$ to $28^{0}C$ (tables 2,4,7 and fig. 2,4 and 7). The temperature readings in all the treatment were within the same range and this shows that the readings were within the tolerable range for the culture of catfishes as recommended by Swann *et al*,(1990), the acceptable range of temperature for catfish (*Clarias gariepinus*) is between $23\text{-}32^{0}C$.

Hydrogen-ion Concentration (PH)

The hydrogen ions concentration pH recorded during production cycle for the three treatments ranged between 7.2 and 8.6. Treatment A had the lowest pH value of 7.2 while treatment C had a value of 8.6 and is attributed to difference in stocking density. These shows that the concentration of pH in all the three treatments were alkaline and were within the tolerable range (6.0-9.0) for the culture of catfish, although high level may have influenced elevation of some of the water quality parameters (Akinwole *et al*, 2006).

Nitrite (NO_2)

Throughout the production period the nitrite level never reached significant that could affect the fishes health or growth. The ranged between 0.01mg/l and o.6mg/l with treatment A had the lowest value of while the highest value occurred in treatment C(polyculture of *Clarias gariepinus* and *Heteroclarias*). High nitrite levels are dependent on nitrifying bacteria, which are generally slow growers. Nitrite levels greater than 0.06mg/l are considered toxic for the culture of catfish (*C. gariepinus*) as recommended by the Federal Ministry of Environmental (2006).

Ammonia (NH_3)

Ammonia concentration throughout the study period for the three treatment prevailed 0.23mg/l to 2.1mg/l (table 2,4 and 6) and the highest level was recorded in treatment C(2.11 mg/l) while the lowest level was obtained in treatment A(0.23mg/l). High concentration of ammonia occurred towards the end of the production period, which could be attributed to increase in biomass. Although the concentration were within tolerable range and results agreed with guidelines from Eding *et al*,(2001), which started that the value less than 8.8mg/l are considered tolerable for the culture of catfish (*Clarias gariepinus)*.

Dissolved Oxygen (DO)

At the beginning of the of the study period concentration of oxygen were initial being higher but gradually reduced as growth of fingerlings were achieved especially in treatment C, dissolve oxygen fell as low as 3.11mg/l(table 6) and this could be considered frequently below the optimum for good growth of catfish (Oyewole *et al*, 2006). This low levels was attained at as the result of metabolism of the fish and of bacteria decaying organic material such as underutilized feed were the major contributors to these demands. As stated by Brown, (1957), the survival of *Clarias* is not dependent oxygen in the water since it is equipped to obtain energy by gulping air.

While inadequate dissolve oxygen is not itself lethal, it may seriously affect the health of fish and facilitate the spread of disease Mayer,(1970) for example indicates that the role of low dissolve oxygen levels in promoting bacteria infections is often unsuspected. Whatever the condition that prevailed in the aquariums, it is apparent that the production in the aquarium was minimal during the last few weeks and may have affected performance of fish.

Production Performance at Different Stocking Densities

Values of the treatment of the various production parameters in the three different stocking densities 10 fishes/m^2,10 fishes/m^2 and 20 fishes/m^2(treatments A,B and C) shows that the mean weight gain of treatment B (monoculture of *Heteroclarias* 1.416g) exceeds that of treatment A(monoculture of *C.gariepinus* 1.0575g). The mean weight gain for treatment C (polyculture of *C.gariepinus* and *Heteroclarias*) shows that the mean weight gain of *Heteroclarias* (1.22g) exceeds that of *C.gariepinus* (0.6975g). Also the mean length gain for treatment B (0.985) exceeds that of treatment A (0.75) and for treatment C the mean length gain of *Heteroclaria*s (0.945cm) surpassed that of *C.gariepinus*(0.472cm)(from tables 1,3,5and 6 respectively).The difference in both mean weight gain and mean length gain in the three treatment shows that *Heteroclarias* grows faster than *C.gariepinus* in both mono and polyculture system and both *Heteroclarias* and *C.gariepinus* grows best in monoculture systems were there is enough space without much competition for food and space.

The specific growth rate for treatment B (2.25) at harvesting surpassed that of treatment A (1.93). The specific growth rate of *Heteroclarias* (1.5) exceeds that of *C.gariepinus* (1.413) in treatment C. These results may be as a result of less competition.

Teng *et al*,(1978) among others have demonstrated that survival decreases as stocking density increases. The principle is also demonstrated to hold in this study. percentage survival was higher in treatment A and B(90%) and the percentage survival of fishes in treatment C is (80% for *Heteroclarias* and 70% for *C.gariepinus*). The highest mortality was recorded in treatment C this may be due to handling stress as most of it occurs after the weekly samplings, overcrowding and the reduced oxygen level towards the end of the production period. This may mean that fishes in treatment C are most probably under stress than those in treatment A and treatment B.

The performance of growth in *C.gariepinus* and *Heteroclarias* was statistically analyzed using the one-way ANOVA. The analysis shows a significant difference in the mean weight(f =6.407, df =1, p = < 0.05), and gross total length(f =7.844, df = 1, p = <0.05) in appendix 1(one). The difference in production might be due to water quality, opportunistic disease infection and genetics. However the analysis show no significant difference in the gross total weight(f = 3.511, df =1, p = >0.05), weight gain(f =0.088, df = 1, p = > 0.05), mean length(f =0.157, df =1, p = >0.05), length gain(f = 4.29, df = 1, p = >0.05), feeding rate(f = 0.578, df = 1, p = >0.05), specific growth rate(f = 1.732, df= 1, p = >0.05), food conversion efficiency(f = 0.168, df =1, p= > 0.05).

Appendix 2, the analysis only shows significant different in the mean length(f=8.724, df= 1, p = <0.05) while there was no significant difference in the gross total weight(f=2.697, df=1, p = >0.05),mean weight(f=5.881, df=1, p= >0.05),weight gain(f=0.95, df=1, p= >0.05),gross total length(f=3.200, df=1, p= >0.05), feeding rate(f=3.242, df=1, p= >0.05), specific growth rate(f=0.755, df=1, p= >0.05), food conversion efficiency (f=o.123, df=1, p= >0.05), length gain(f=0.320, df=1, p= >0.05)and mean growth rate(f=3.391, df=1, p= >0.05).

Appendix 3, the analysis only shows significant different in the mean weight(f=10.975, df= 2, p = <0.05) while there was no significant difference in the gross total weight(f=1.3114, df=2, p = >0.05),mean length(f4.945, df=, p= >0.05),weight gain(f=2.904, df=2, p= >0.05),gros total length(f=0.35, df=2, p= >0.05), feeding rate(f=2.178, df=2, p= >0.05), specific growth rate(f=5.468, df=2, p= >0.05), food conversion efficiency (f=2.169, df=2, p= >0.05), length gain(f=2.178, df=2, p= >0.05)and mean growth rate(f=2.067, df=2, p= >0.05).

Appendix 4, the analysis shows that there is significant different in the mean weight(f=8.865, df= 1, p= <0.05) and mean length(f=9.109, df=1, p= <0.05) while there was no significant difference in the gross total weight(f=2.596, df=1, p = >0.05), weight gain(f=0.943, df=1, p= >0.05),gros total length(f=1.775, df=1, p= >0.05), feeding rate(f=5.293, df=1, p= >0.05), specific growth rate(f=2.361, df=1, p= >0.05), food conversion efficiency (f=0.35, df=1, p= >0.05), length gain(f=0.242, df=1, p= >0.05)and mean growth rate(f=2.174, df=1, p= >0.05).

Conclusion

The result of the performance of growth in two *clariid* catfishes ; *Clarias gariepinus* and *Heteroclarias* reveals that the fish were able to utilize the diet effectively under the monoculture and polyculture system. The hybrid (*Heteroclarias*) has the highest growth rate followed by *Clarias gariepius.* This work is in line with the work of Jensen *et al*;(1983),Madu *et al*;(1991,1992),Bakos (1987), Salami and Fagbenro (1993) who observed that hybrid in most cases were superior to their parental line in terms of growth, food conversion and resistance to disease. The result is also in line with the work of Okoye *et al*;(2000) on the growth performance of pure strain of *Clarias gariepinus*, hybrids of *Heterobranchus longifilis* and *Clarias gariepinus* (*Heteroclarias*) in polycuture with *Oreochromis niloticus*. They observed that the hybrid catfish had the fastest growth rate and showed better conversion of feed into fish flesh than the pure *Clarias gariepinus* .

However, the report are contrary to the work of Basavaraju and Varghese (1980) who reported that the parental species of *Labeo rohita* (female) grows faster than their hybrids. It was also observed in the present study that *Clarias gariepinus* and *Heteroclarias* performed best in terms of growth and feed utilization in monoculture than in the polyculture. The hybrid (*Heteroclarias*) weight best in all the systems. Alikunhi *et al*; reported that hybrid (*Heteroclarias*) grows better in monoculture than in polyculture supporting the result of the present day study. This result however contradicts the work of Mork (1982), Holm (1989), and Nordverdt and Holm (1991) who reported that the rearing of Salmonid species in douculture led to improve growth compare to those reared in monoculture. The basis of this improve growth under douculture condition was unknown, but it was suggested that intraspecific competition may be reduced in salmonid held in douculture (Holm, 1989).

In conclusion, this work has clearly indicated that fingerlings of different species of *clariid* catfish have different performance of growth and feed utilization efficiency under the different culture system examined in the study. If the results were applied to commercial scale, the culture of hybrid of *Clariid* catfish on monoculture would improve the total fish yield and profitability. If farmers wants to rear two different catfish together, if there were shortage of rearing facilities or for studies on growth performance and feed utilization of two *Clariid* catfish and their hybrid reared under different culture system or any other reason, a combination of *Clarias gariepinus* with their hybrid catfish (*Heteroclarias)* is recommended base on the result of this study.

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