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LENGTH -WEIGHT RELATIONSHIP AND CONDITION FACTOR IN THE POLYCULTURE OF CLARIAS AND TILAPIA IN CONCRETE TANKS

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ABSTRACT
The experiment was conducted to determine the length weight relationship and condition factor of Clariasgariepinus and Oreochromisniloticus in five different stocking combinations for a period of twelve weeks from 17th July – 9th October, 2009. A total of 1,509 juveniles of C. gariepinus with average weight of 24.88g and average length of 14.52cm, and 2,991 juveniles of O. niloticus with average weight of 24.90g and average length of 10.93cm were stocked at 30 fish/m² in clarias:tilapia ratios of 0:1, 1:0, 1:2, 1:4, and 1:6. The fish were fed at 3% body weight per day (BWD) over a period of 84 days. The monoculture of the two species (Treatments 1 and 2) yielded the lowest growth indices (WG, %WG and SGR), while the performance of clarias at each of the three polyculture systems were higher than those of tilapia. For clarias Treatment 5 (1:6) had the maximum length (17.92±0.37cm) while the monoculture recorded the minimum of 16.60±0.29. The monoculture of tilapia gave the lowest length gain (4.83±0.41cm) while the highest (11.60±0.51cm) for tilapia was recorded in Treatment 4 (1:4). From the regression parameters and the associated statistics (r and SE) for the validation of the models, it is evident that there was a strong positive relationship between length and weight. Even though the relationship was curvilinear there were still higher percentages of regression coefficient in all the treatments and between the species. The SE was also low in all the treatments which further validated the log transformed models. Therefore, the models are valid for estimating weight of the fishes from the length measurements without necessarily measuring the weight. Stocking ratio of 1:6 should be encouraged for better growth performance.
Keywords: Polyculture, length – weight, condition factor, clarias, tilapia, juveniles.

INTRODUCTION

Various factors may be responsible for differences in length-weight relationships of fish. Some of these factors are sex, stage of maturity, season and time of the day (Bagenel and Tesch, 1978). King (1996) also observed that temperature, salinity, food (quality, quantity and size), time of the day/year and stage of maturity are responsible for differences in length-weight relationship. Length-weight relationship (LWR) is of great importance in fishery assessments (Garcia *et al*. 1998; Haimovici and Velasco, 2000). Length and weight measurements in conjunction with age data can give information on the stock composition, age at maturity, life span, mortality, growth and production (Beyer, 1987; King, 1996 and Diaz *et al*., 2000*)*. Frota *et al.* (2004) reported that the parameter 'b' of the length-weight relationship equation ($W=al^b$), also known as allometry coefficient has an important biological meaning, indicating the rate of weight gain relative to growth in length. The author noted that marked variability in estimates of 'b' is observed among different groups of the same population at different times. King (1996) observed that the marked variability in the value of 'b' may reflect changes in the condition of individual related to feeding, reproductive or migratory activities.The aim of this study was to determine the effect of stocking ratio on growth performance in the polyculture of *C. gariepinus*and*O. niloticus* in concrete tanks.

MATERIALS AND METHODS

The Study Area

The study was conducted at Khasu integrated farm located at 15km along Kano – Madobi Road in Kumbotso Local Government Area of Kano State. The study area lies between latitudes 11^0 20′ and 11^0 45′ North and longitudes 8^0 15′ and 8^0 30′ East.

Experimental Fish

A total of one thousand five hundred and nine juveniles of *Clariasgariepinus* (average body weight 24.88g and average body length of 14.52cm) were obtained from A4 Global fisheries, Karkasara Road, behind Aminu Kano Teaching Hospital, Kano. Also two thousand nine hundred and ninety one juveniles of *O. niloticus* (average body weight of 24.90g and average body length of 10.93cm) were obtained from Bagauda Fish Seed Multiplication Centre, Kano, Nigeria. A total of four thousand five hundred experimental fish were used for the study from 17th July – 9th October, 2009.

Pond Preparation

The study was conducted using fifteen concrete tanks of (2x5x1.2m) sizes in triplicate.Prior to stocking, ponds were drained, washed and filled with water from the reservoir to a depth of 1.0m.

Both the inlet and outlet were screened to prevent incoming of unwanted organisms and escape of fish, respectively. Water levels in all the treatments were maintained by changing the water weekly. The water quality parameters measured included dissolved oxygen (DO), hydrogen ion concentration (pH) and temperature (^{0}C)

Experimental Design

The fishes were acclimatized for a period of fourteen days and five treatments were randomly allocated to the tanks in triplicate. The experiment was laid out in a Completely Randomised Block Design (RCBD). Fifteen tanks of 2mx5mx1.2m sizes were stocked at 30 fish/m^3. The treatments comprised of the following clarias:tilapia stocking ratios ; (T1) 300 Tilapia only, (T2) 300 Clarias only, (T3) 100:200, (T4) 60:240 and (T5) 43:257. The experiment lasted for 84 days.

Feeding Rate and Frequency

Fish in all the treatments were fed experimental diet (Multifeed, 2mm) containing 45% crude protein, at 3% body weight per day (BWD). Feeding rate was adjusted weekly based on weight gain and the feeding frequency in all the treatments was twice daily. The total feed fed per day was divided into two, one part was fed in the morning around (9:00am) and the second part in the evening at (5:00pm).

Data Collection

All fishes were weighed individually at the beginning and end of the experiment, while one third of the population was sampled weekly to monitor growth performance. Length measurement was carried out to the nearest centimeters using a measuring board graduated in centimeters. Total length (TL) was measured from the anterior most extremity of the fish to the end of the caudal fin. The total weight was measured in grams using Ohaus electric balance of 310g capacity.

Water Quality Monitoring

The parameters monitored on a weekly basis were dissolved oxygen (DO), hydrogen ion concentration (pH) and temperature at 8:00am adopting the method of Boyd (1979). Temperature was measured with a simple centigrade mercury thermometer. The pHwas done with Jenway pH meter while the dissolved oxygen level was determined according to Winkler's method.

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) to test the effect of different stocking ratios on growth performance of clarias and tilapia. Where there was significant difference, the means were separated using Duncan's Multiple Range Test at 0.05 probability level. Regression analysis was used to establish the length-weight relationships with the aid of Statistical Package for Social Scientists (SPSS) version 12.

RESULTS

Weight and length were measured weekly for a period of 12 weeks as the baseline for growth increment determination. The results in Table 1 present the regression coefficients in terms of species and treatments with the following model forms:

Table 1: Regression coefficients of *Tilapia* and *Clarias* in the polyculture system

Treatment	n	a	b	SE of a	SE of b	r
Trt 1 Tilapia	1500	-0.776	1.819	0.192	0.076	0.53
Trt 2 Clarias	1500	-3.863	2.668	0.029	0.010	0.99
Trt 3 Tilapia	997	-5.119	3.496	0.054	0.021	0.98
Trt 3 Clarias	496	0.359	1.272	0.186	0.064	0.67
Trt 4 Tilapia	1200	-1.846	2.223	0.131	0.051	0.79
Trt 4 Clarias	300	-3.916	2.674	0.663	0.021	0.99
Trt 5 Tilapia	1287	1.986	0.776	0.064	0.025	0.65
Trt. 5 Clarias	211	-4.071	2.740	0.168	0.055	0.96

a, b = regression parameters of estimate; r = correlation coefficient; SE = standard error; n = number of fish.

logW = a + blogL (tilapia)

logW = a + blogL (clarias)

logW = a + blogL (treatments)

The values obtained for the length weight relationship showed that Treatment 2 (clarias), Treatment 3 (tilapia), Treatment 4 (clarias) and Treatment 5 (clarias) with 'b' values ranging from 2.6 – 3.4; exhibited isometric pattern of growth while other treatments with 'b' values of 0.78 – 1.82 were allometric in their growth.

Table 2 presents length growth parameters of *C. gariepinus and O. niloticus.* For clarias Treatment 5 (1:6) had maximum length growth performance (17.92±0.37cm) while the monoculture recorded the minimum (16.60±0.29cm) with more than 1cm less than the highest value. The monoculture of tilapia gave the lowest length gain (4.83±0.41cm) while the highest length gain (11.60±0.51cm) for tilapia was recorded in Treatment 4 (1:4).In terms of the percentage length gain, Treatment 5 (1:6) recorded the highest (P<0.05) 123.30±2.26 and the lowest 115.53±1.83 was recorded in Treatment 3 (0:1) for clarias within 12 weeks. For tilapia the highest percentage length gain (109.69±9.44) was recorded in Treatment 4 (1:4) and the lowest (45.62±5.90) in Treatment 1 (0:1).

Table 2: Length growth parameters of *C. gariepinus* and *O. niloticus* in a polyculture system

Parameter	Trt 1(0:1)	Trt 2(1:0)	Trt 3 (1:2)		Trt 4 (1:4)		Trt 5 (1:6)	
			Clarias	***Tilapia***	***Clarias***	***Tilapia***	***Clarias***	***Tilapia***
IML(cm)	10.64±0.45 (1500)	14.35±0.33 (1500)	14.5±0.10 (496)	10.50±0.39 (997)	14.47±0.25 (300)	10.60±0.43 (1200)	14.53±0.06 (211)	10.37±0.56 (1287)
FML(cm)	15.47±0.11^{g}	30.96±0.05^{c}	31.25±0.05^{c}	17.05±0.05^{f}	31.55±0.01^{b}	22.21±0.10^{d}	32.45±0.41^{a}	19.27±0.46^{e}
LG(cm)	4.83±0.41^{f}	16.60±0.29^{b}	16.75±0.15^{b}	6.54±0.37^{e}	17.08±0.26^{b}	11.60±0.51^{c}	17.92±0.37^{a}	8.89±0.37^{d}
%LG	45.62±5.90^{e}	115.72±4.79^{ab}	115.53±1.83^{ab}	62.45±5.92^{d}	118.13±3.88^{ab}	109.69±9.44^{b}	123.30±2.26^{a}	86.03±10.89^{c}

IML = initial mean length; FML = final mean length; WG = length gain; %LG= % length gain
*Means in row with same letter are not significantly different (p>0.05)

As presented in Table 3 clarias outweighed tilapia in terms of weight gain. Treatment 5 gave the best result in terms of weight gain for both clarias (236.20±3.20) and tilapia (105.65±3.95) while the minimum weight gain was recorded for tilapia monoculture in Treatment 1 (69.28±0.85) and (186.34±1.28) for *Clarias* in Treatment 2.The monoculture of the two species (Treatments 1 and 2) yielded the lowest growth indices (WG, %WG and SGR), while the performance of *Clarias* at each of the three polyculture systems were higher than those of tilapia. This indicated increased growth performance of the tilapia with increased ratio of *Clarias* to be significantly (p<0.05) higher level of *Clarias*:*Tilapia* (1:6) than the lower ratios and their monocultures.

Table3: Growth parameters of *C. gariepinus* and *O. niloticus* in a polyculture system

Parameter	Trt 1(0:1)	Trt 2(1:0)	Trt 3 (1:2)		Trt 4 (1:4)		Trt 5 (1:6)	
			Clarias	***Tilapia***	***Clarias***	***Tilapia***	***Clarias***	***Tilapia***
IMW(g)	24.85±0.33 (1500)	24.91±0.39 (1500)	24.85±0.29 (496)	24.83±0.35 (997)	24.80±0.29 (300)	24.99±0.30 (1200)	24.80±0.33 (211)	24.98±0.31 (1287)
FMW(g)	94.13±0.78^{h}	200.29±1.27^{d}	211.19±1.16^{c}	105.4±0.57^{g}	241.12±1.12^{b}	121.17±1.09^{f}	261.00±3.24^{a}	130.64±3.97^{e}
WG(g)	69.28±0.85^{h}	175.38±1.28^{d}	186.34±1.28^{c}	80.56±0.69^{g}	216.32±1.26^{b}	96.18±1.17^{f}	236.20±3.21^{a}	105.65±3.95^{e}
%WG	278.88±5.92^{h}	704.24±12.91^{d}	750.03±12.16^{c}	324.41±6.55^{g}	872.36±13.98^{b}	384.91±7.73^{f}	952.57±17.90^{a}	422.86±16.66^{e}
SGR(%)	0.015±0.00^{h}	0.024±0.00^{d}	0.025±0.00^{c}	0.017±0.00^{g}	0.027±0.00^{b}	0.018±0.00^{f}	0.028±0.00^{a}	0.019±0.00^{e}
K	1.60	2.11	2.30	0.52	2.37	1.70	1.87	1.40

IMW = initial mean weight; FMW = final mean weight; WG = weight gain; %WG= % weight gain; SGR = specific growth rate; K = Condition factor.
*Means in row with same letter are not significantly different (p>0.05).

Variation in weight and length

Mean weight gain is presented in Table 4. Treatment 5 (1:6) favored higher weight gain of 99.35±82.24 and 58.39±29.99, for clarias and tilapia, respectively. As such that ratio gave the best performance, while monoculture of both species yielded the lowest weight gain of 69.40±56.67 and 50.36±22.56 for clarias and tilapia, respectively. For clarias, Treatment 5 (1:6) had the maximum length growth performance (21.72±6.56cm) while the monoculture recorded the minimum (19.48±5.67cm) with more than 2cm less than the highest value. The monoculture of tilapia gave the lowest length gain (12.58±1.68) and was statistically (P>0.05) similar to Treatment 3 (1:2); while the highest length gain (13.67±3.62) for tilapia was recorded in Treatment 5 (1:6).

Table 4: Growth variation in weight and length per treatment during the experiment

Treatment	Weight (g)	Length (cm)
O. niloticus O. niloticus		
Trt 1(0:1)	50.36±22.56^{d}	12.58±1.68^{c}
Trt 3(1:2)	52.20±22.26^{c}	13.10±1.80^{bc}
Trt 4(1:4)	55.36±27.82^{b}	13.17±4.11^{b}
Trt 5(1:6)	58.39±29.99^{a}	13.67±3.62^{a}
C.gariepinus C. gariepinus		
Trt 2(1:0)	69.40±56.67^{d}	19.48±5.67^{d}
Trt 3(1:2)	75.22±59.79^{c}	19.23±6.74^{c}
Trt 4(1:4)	83.58±69.14^{b}	20.99±6.29^{b}
Trt 5(1:6)	99.35±82.24^{a}	21.72±6.56^{a}

Means followed by the same superscript along the column are statistically the same (P>0.05)

DISCUSSION

From the regression parameters and the associated statistics (r and SE) for the validation of the models, it is evident that there was a strong positive relationship between length and weight. Even though the relationship was curvilinear there were still higher percentages of regression coefficient in all the treatments and between the species. The SE was also low in all the treatments which further validated the log transformed models. Therefore, the models are valid for estimating weight of the fishes from the length measurements without necessarily measuring the weight.

In fish, the condition factor (K) reflects, through its variations, information on the physiological state of the fish in relation to its welfare (Le Cren, 1951). K also gives information when comparing two populations living in certain feeding, density, climate and other conditions; and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source (Bagenal and Tesch, 1978). Braga (1986), through other authors, showed that values of the condition factor vary according to season and are influenced by environmental conditions. The same may be occurring in the environment under study since the concrete tank is influenced by many factors that may affect the well being of both species.

The condition factors 1.87 to 2.37 for *Clarias* and 0.52 to 1.60 for tilapia obtained in this study were similar with the results from other studies. Bagenal and Tesch (1978) documented 2.9 to 4.8 for mature fresh water fish. Ajayi (1982) reported K=0.77 to 0.81 for *Clarotesfilamentosus*in lake Oguta; Nwadiaro and Okorie (1985) obtained K = 0.49 to 1.48 in Andoni river. Gayando and Pauly (1997) reported that certain factors including, data pulling, sorting into classes, sex, stage of maturity and state of the stomach affect the well being of a fish.

CONCLUSION

Higher stocking combination of (1:6) should be encouraged to achieve better growth performance and enhanced feed utilization for polyculture practice of *Clarias* and *Tilapia*. Further research should be focused on prey-predator relationship of this stocking ratio (1:6) in concrete tank. There is the need to introduce and encourage the polyculture of *Clarias* and *Tilapia* so as to reduce the cost of production.

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