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Length-weight relationship and condition factor of four fish species from Wasai Reservoir in Kano, Nigeria

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ABSTRACT: Study on length-weight relationship and condition factor of four fish species i.e. *Tilapia zilli, O.niloticus, Hemichromis bimaculatus* and *Clarias gariepinus* from Wasai reservoir in Kano was conducted seasonally from January to December, 2009. Six hundred and sixty six (660) fish samples were collected by artisanal fishermen using various fishing gears, the fish samples were preserved in formalin and taken to laboratory for identification and measurement of length and weight. The results recorded in this study shows negative pattern of allometric growth in which all of the species b values analysed do not reach up to 3. With maximum b values of 2.5 obtained from *T.zilli* in wet season as the highest at $P<0.01$. The maximum condition factor (K) of 3.4 was recorded during the wet season from *T.zilli*. The b values of the all the four fish species indicated a negative allometric growth of the fish sampled.

Keywords: Length-weight relationship, Condition factor, Wasai reservoir,

Introduction

Fishes are highly important in the development of Nigeria both economically and healthwise as source of protein with low cholesterol level in the diets of many populace as well as an intermediate host to some parasites. Knowledge of some quantitative aspects such as length-weight and condition factor (K) or ponderal index of fishes is an important tool for the study of fishing biology. The condition factor in fish serves as an indicator of physiological state of the fish in relation to its welfare (Le Cren, 1951). K also provides information when comparing two populations living in certain feeding density, climate and other conditions (Weatherly and Gills 1987). Thus, condition factor is important in understanding the life cycle of fish species and it contributes to adequate management of these species, hence, maintaining the equilibrium in the ecosystem.

In sub-Saharan Africa, fish accounts for 10% of the animal protein consumed, and 98% of this is finfish (Delgado and McKenna, 1997). The average per capita consumption of fish in Africa in 1992 was about 8Kg having increased from an average of 7Kg per annum from 1969-1974(Ahmed, 1997). Almost 40% of fish consumed in Africa, south of the Sahara is freshwater fish as compared to the global average of 25%. In West Africa finfish is largely consumed, while per capita consumption has not grown over the last 20 years (Bonga, 1999).

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When fishes are kept in lentic water, their feeding capacity tends to be negatively affected, more especially polluted water. Dams and/or reservoirs have down stream effects on riverine environments and subsequently block nutrient flow along the strata of the ecosystem, thus, telling on fisheries production in downstream reservoirs and river channels. Such patterns reflected dams acting as nutrient traps.

Haruna (2003) reported that some aquatic plants that are hazardous to navigation and fishing show explosive population growth in new impoundments e.g. Phragmites, *Typha,* and *Cyperus* spp in lake Jakara. Growth of fish is subject to natural environmental changes particularly climate. However, some problems are caused by human activities including fishing where more fish are taken than are replaced by birth and subsequent new fish recruitment and growth. In Nigeria over 80% of reservoirs or dams that are in existence in the country are located in the northern region which produced up to 410, 000 metric tons of fish annually. Studies on the assessment of heavy metals and other pollutants in the Bompai-Jakara catchment basin of which Wasai reservoir is located has shown high amount of heavy metals contamination (Mustapha, 2008; Mustapha, 2008a; Imam, 2010).

This study aimed at length-weight relationship and condition factor analyses of four fish species (i.e. *Oreochromis niloticus, Tilapia zilli, Hemichromis bimaculatus* and *Clarias gariepinus*) from Wasai reservoirs in Kano, Nigeria.

Materials and Methods

Study Area

Wasai reservoir is situated within the following location: longitude $8^0 31^I$-$8^0 45^I$E and latitude $12^0 13^I$-$12^0 10^I$N with altitude of 400-700M above sea level. The dam was impounded by state government in 1976 (WRECA, 1994). It has two major tributaries which are River Jakara and River Getsi which receive most of Kano city domestic and industrial wastewater. The basin forms the North eastern watershed of Kano metropolitan.

Sampling Stations and Collection of Fish Samples

Six hundred and sixty six fish samples were collected by artisanal fishermen , using various fleet of gill net made up of nine (9) mesh sizes: 1inch,$1^{1/2}$inch,2inch,$2^{1/2}$inch,3inch,$3^{1/2}$, 4inch, 5inch and 7inch. The nets were set at approximately 2 hours before sunset and lifted two hours after sunrise. Six hundred and sixty six (660) samples were collected within the dry and wet seasons cutting across early, mid and late periods spanning from January to December, 2009.

Fish identification

The sampled fish were identified in the laboratory of Biological Sciences Department, Bayero University, Kano up to the specie level with the aid of standard reference texts of Holden and Reed (1972), Idodo-Umeh (2003) and Olasebikan and Raji (2004). Confirmation of the identified species was performed by fisheries experts in the department.

Total Length (TL) and Weight Measurements

Fish total length (cm) was measured using measuring board as described by Lagler (1970), while weight was measured using OKI weighing balance with sensitivity of 0.1g after identification of the sampled species.

Length-Weight Relationship and Condition Factor

Estimation of species length-weight relationship was done using the formula $W=aL^b$ (Ricker,1975), which is transformed into natural logarithmic form $\ln W=\ln a+b (\ln L)$. While condition factor (K) was computed using the formula: $K=100W/L^3$ (Pauly,1983).

Where: W=weight of fish; L=total fish length.
Length-weight data obtained were tested statistically for significance within species and between species using ABee: Length-weight coefficients Software Version 1.0 (ICLARM, 1997).

Results and Discusion

A total of six hundred and sixty six (660) fish species that composed of one hundred and eighty each of *Tilapia zilli, Oreochromis niloticus* and *Hemichroms bimaculatus* which are in the family of Cichlidae, and one hundred and eighty species of *Clarias garipienus* which is in the family Claridae were collected during the study period. Highest total length of 22cm was recorded from *C.garipienus* (Table 1). The specie also recorded highest weight more than the three other cichlids with 140g(Table 1).. Total length among *C.gariepinus* and *H.bimaculatus* was highest during the wet season, 22cm and 17cm respectively while in *O.niloticus* and *T.zilli* dry season recorded highest total length (Table 1).

The maximum weight of 50g, 72g, 41, and 140g was obtained from *O.niloticus, T.zilli, H.bimaculatus* and *C.gariepinus* respectively during wet season (Table 1). Maximum b values of 1.4, 2.5, and 2.0 was obtained by *O.niloticus, T.zilli,* and *H.bimaculatus* respectively during wet season while 2.0 b value was recorded from *C. gariepinus* during the dry season (Table 2). Thus, when b is not equal to 3, allometric pattern of growth occur, which could be positive if >3 or negative if <3. Rationale behind this can easily be deduced by the fact that the reservoir obtains its water mainly from wastewater tributaries of rivers Jakara and Getsi which carry domestic as well as industrial wastewater into the reservoir. Studies on the assessment of heavy metals and other pollutants in the basin has shown high amount of heavy metals contamination (Mustapha, 2008; Mustapha, 2008a; Imam, 2010).

It is noteworthy that physico-chemical parameters of water influence vertical and horizontal migration of fishes in aquatic ecosystem, their distribution and feeding pattern. *O.niloticus* has the maximum b values ranging from 1.2 during the dry season to 1.4 in the wet season with 1.4 as the annual maximum b values. The result obtained on *O.niloticus* is below the b values recorded from the recent works of Haruna (2006), Nyaku *et al.*(2008) and that of Bala *et al.* (2009). While K factor of *O.niloticus* was highest in the wet season with 2.44 and lowest in the dry season with 2.1, it is above the results obtained in the works of Olurin and Aderigbe (2006), Nyaku *et* al. (2008) and Bala *et al.*(2009) although it is below that of Bagenal and Tesch (1978) which indicated a range of 2.9-4.8 as the ideal range of K factor for the normal growth and utilization of nutrient by a normal freshwater fish.

T. zilli showed a relatively more improved performance in terms of growth in which maximum b values of 2.5 and 1.53 for wet and dry seasons respectively were recorded with annual maximum of 2.5 but it is comparatively lower than the b values obtained from the studies of Haruna (2006) and Bala *et al*. (2009). The K factor of 2.63 and 3.4 were obtained during the dry and wet seasons respectively which showed higher value during the wet seasons and the value comfortably fall within the ideal set by Bagenal and Tesch (1978), but the result of dry season was out of the range set for ideal growth of freshwater fish. Generally, the K factor of *T.zilli* was comparatively higher than the one recorded in the work of Bala *et al*. (2009), although it was lower than that of Anene (2005).

H. bimaculatus was 1.52 and 2.0 during the dry and wet seasons, of which there was a relatively increased value from the former to the latter, the b values were below 3. Thus, there was a negative allometric growth of the sampled fish. Although the b value during the wet fall barely within the range obtained in the work of Haruna (2006). The maximum K factor of *H.bimaculatus* in the current study was 2.58 and 2.73 in the dry and wet seasons respectively with improved value during the latter. But it falls out of the range recommended by Bagenal and Tesch (1978).

C.gariepinus showed maximum b values of 1.28 and 2.0 during the wet and dry seasons respectively. It is worthy of note that the value obtained during the dry seasons was relatively higher than that recorded in the wet season, which is in sharp contrast with the results observed among the three Chichlids previously discussed (i.e. *O.niloticus, T.zilli,* and *H.bimaculatus*). Rationale could be due to the fact that it belongs to the Claridae family and the nature of its feeding habit. The b values recorded were quite below the recommended 3 for normal length-weight ratio (Ricker, 1975) and was comparatively below the b value observed in the work of Bala *et al*.(2009). The maximum K factor of *C.gariepinus* was 2.77 and 0.93 for dry and wet seasons respectively, despite the fact that the dry season value was higher, it does not fall within the ideal range of 2.9-4.8 for the normal growth in freshwater

fish (Bagenal and Tesch, 1978). Also maximum K factor of *C.gariepinus* was generally lower than that of the 3 Chichlids fish (Table 2).

In this study, efficient sampling was carried out to include the widest possible range of lengths, which were generally obtained using non-selective fishing techniques. The variations in fish sizes indicate that the fish population ranged from immatured specimens to fully matured ones. The maximum b value recorded in this study indicate a negative allometric growth i.e. the body growth does not conform with proportioned growth as regards to length and weight (Weatherly and Gill, 1987).

Species	a			b			K			P
	DRY	WET	ANNUAL	DRY	WET	ANNUAL	DRY	WET	ANNUAL	
O.niloticus	1.183	1.3	1.34	1.2	1.4	1.4	2.1	2.44	2.44	0.01
T.zilli	1.5	1.2	1.37	1.53	2.5	2.5	2.63	3.4	3.4	0.01
H.bimaculatus	0.77	0.7	0.6	1.52	2.0	2.0	2.58	2.73	2.73	0.01
C.garipienus	-1	-0.5	0.23	2.0	1.78	2.0	2.77	0.93	2.77	0.01

This study shows that the condition of the Wasai reservoir in comparison to fresh water may be extremely unfavourable to fishes in the reservoir irrespective of season. The result reinforces the result of past works on physico-chemical parameters of the reservoir which showed serious contamination thus endangering sustainability of biodiversity of the reservoir (Mustapha, 2008; Mustapha, 2008a' Imam, 2010).

Table 1: Seasonal Sizes ranges of *Tilapia zilli, T.nilotica, Hemichromis bimaculatis* and *Clarias garipienus* from Wasai reservoir in Kano.

Fish Species	N*	Total Length(cm) range			Weight (g) range		
		DRY	WET	ANNUAL	DRY	WET	ANNUAL
O.niloticus	180	4-21	4-20.5	4-21	13-40	13-50	13-50
T.zilli	180	6-20	5.5-16	5.5-20	12-41	10-72	10-72
H.bimaculatus	180	2-12.5	3-17	2-17	4-33	4-41	4-41
C.garipienus	180	5.5-21.5	6-22	5.5-22	8-103	8-140	8-140

*n=number of fish sampled

Table 2: Seasonal Length-weight relationships and condition factors of *Tilapia zilli, O.niloticus, Hemichromis bimaculatus* and *Clarias garipienus* from Wasai reservoir in Kano.

a,b=regression coefficient; K=condition factor; *P<0.01(2-tailed).

Table 3: Comparing Length-weight relationship b values of the current study with past works.

	Fafioye & Oluajo (2005)	Haruna (2006)	Nyaku *et al.*, (2008)	Bala *et al.*, (2009)	Current Study
O.niloticus		2.9-3	3.22	3.07	1.2-1.4
T.zillii		2.7-3.2		2.91	1.53-2.5
H.bimaculatus		2-3.4			1.52-2.0
C.gariepinus	2.88			3.21	1.78-2.0

Table 4: Comparing Condition Factor (K) values of the current study with past works.

	Bagenal & Tesch (1978)	Anene (2005)	Olurin and Aderigbe (2006)	Nyaku *et al.* (2008)	Bala *et al.* (2009)	Current Study
O.niloticus	2.9-4.8		1.11	1.48	1.027	2.1-2.44
T.zillii	2.9-4.8	4.3				2.63-3.4
H.bimaculatus	2.9-4.8					2.58-2.73
C.gariepinus	2.9-4.8				0.732	2.77-0.93

Conclusion

The result obtained in this study showed general negative allometric growth among the three Chichlid fishes i.e *O.niloticus, T.zilli* ,and *H.bimaculatus* with the highest maximum b values of 1.4, 2.5 and 2.0 respectively, while *C.gariepinus* belonging to Claridae family recorded maximum b value of 2.0. The maximum values of condition factor (K) of the three Chichlids i.e. *O.niloticus, T.zilli* ,and *H.bimaculatus* were 2.44, 3.4 and 2.73 respectively. While that of *C.gariepinus* was 2.77. Wet season showed a relatively better b values among the three Chichlids with the exception of *C.gariepinus* where dry season showed higher K factor value.

Recommendations

i. Government should step up effort in ensuring that all effluents released into the catchment basin are pretreated by the factories in the Bompai industrial estate, Kano

ii. Regulatory bodies on rate of fishing should be set up by the government concerned in order to dissuade the fishermen from using fishing nets that will catch even the smallest fish e.g. fryers etc.

iii. Fishermen should be educated on alternate method of fish farming like using fish pond etc this will curtail the problems observed in terms of growth and health of the harvest.

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