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RELATIVE ABUNDANCE AND MORPHOMETRIC ASSESSMENT OF *Heterobranchus bidorsalis* AND *Heterotis niloticus* TO OTHER SPECIES OF RIVERS IN KOGI STATE, NIGERIA

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ABSTRACT
The study assessed the relative species abundance share and morphometric assessment of Heterobranchus bidorsalis and Heterotis niloticus to other species in Rivers in Kogi State, Nigeria. Specifically, the relative abundance of the fish species and percentage composition and families were identified and the morphometric parameters of the selected species; Heterobranchus bidorsalis and Heterotis niloticus were estimated. Samples were collected using three stage sampling technique along river Niger and Benue following on-board assessment of fish samples by different gears. Descriptive and inferential statistics were adopted and also Length-Weight relationship and Condition factor of the selected fish species were computed. The result revealed that between the selected species; the length relationships were close for Heterobranchus bidorsalis (31.1±6.8 cm, /31.1±6.9 cm) and Heterotis niloticus (29.0±9.1 cm/28.8±9.27 cm) in Rivers Niger and Benue respectively. Records showed no difference in size of Heterobranchus bidorsalis (279.1±148.7 g, 279.1±148.7 g) in both Rivers, while Heterotis niloticus had higher figure along River Benue (279.1±148.7 g) compared to (125.5±68.6 g) along River Niger, showing a better healthy environment for growth in River Benue. Correlation coefficient (r^2) at $\alpha_{0.05}$ of the length –weight relationship are: Heterobranchus bidorsalis (0.54, 0.54) and Heterotis niloticus (0.13, 0.09). Mean condition factor (K) ranged from 0.07±0.93.

Keywords: Abundance, Morphometrics, Species Composition, Length-weight relationships, Condition factor, River Benue, River Niger, Growth Performance.

INTRODUCTION
Freshwater bodies are supporters of variety of fish species, though the abundance and variety of fauna present in a given water body differ one from another. Their distribution is subject to natural endowment of the ecological location, life supporting as well as inhibiting substances and conditions; but their abundance and diversity have been influenced overtime by many factors which interfere with natural occurrences that should sustain the population and variety. The Rivers Niger and Benue fall within a massive freshwater basin, with various fish species, pelagic or benthos, having been observed in this region; the river course have over time experienced massive alterations of the natural ecosystem. These conditions alter the system ecology and induce various responses by the species, from inabilities to survive the stress conditions to subsequent migration of fish species to tolerable locations (Alum-Udensi, *et al.*, 2016). Various reports present differing views, statistics and composition of fish within Nigeria inland waters Ita (1993), Gregory *et a.* (2009), Lawson and Olusanya (2010), Josef *et al.* (2015), but these may be influenced by natural locations, sampling gears used, season or occurrences (natural or man-made) preceding such research activity. Thus, catch composition of fish species within a definite location, may differ based on prevailing circumstances. When there are ecological changes, growth in length and weight will be influenced. Growth is the change in absolute weight (energy content) or the length of fish over time (Bake and Sadiku, 2004); it can also be seen as a function of fish size (Adedeji and Araoye, 2005). Growth performance of an organism depends on the health status of the environment or habitat in which it lives. The length or weight of fish species becomes indicators of level of environmental viability. As the environment or habitat is influenced by various factors (internal or external) such as stress, sex, season, availability of feeds, as well as other water quality parameters (Khallaf *et al.*, 2003), the degree of fish wellbeing points at conditions that support its growth. The pattern of fish growth is a

change in magnitude, which could be in size (weight and length) and is a morphometric feature that deals with body proportion; thus, morphometric analyses have become increasingly common in biological studies to quantify and investigate biological shapes (Fabre *et al.*, 2013). The study of growth patterns in fish has been based principally on length-weight relationships (LWRs) or relationships between sizes of scales or other calcified tissues and body length, because of their importance in age and growth analyses (Adeyemi, *et al.*, 2009). Length-weight relationships (LWRs) of fishes which are also referred to as growth index (Abowe and Hart, 2009) is an important management tool used in estimating the average weight at a given length growth; though they are known to vary seasonally and spatially (Alex *et al.*, 2012), (Levent *et al.*, 2007). The most widely used form of the length-weight relationship is the standard allometric model (Huxley, 1932; Gayon, 2000), also referred to as `differential scaling. The condition factor of fish, also called `length-weight factor' is expressed as `coefficient of condition' (Haruna and Bichi, 2005). Several investigations by different research teams to establish the correlation between the LWRs and condition factor of fish species, tend to support the inevitability of healthy environment to optimum growth performances of fish species.

Fish species are natural endowment of the aquatic ecosystems, though their distribution varies. This variation indicates slight differences in the ecological structure of aquatic taxonomical units. These units, which are discrete locations within the marine and freshwater habitats, are homes to many and different types of fish species. The fundamental determinant of the distribution of a species is its physiological tolerance of the physical environment. Every species has a range of physico-chemical conditions under which it can survive, and these tolerances regulate where a species can be found; thus, within the freshwater ecosystem, the diversity of fish species may be restricted. Flowing through Kogi State is the course of Rivers Niger and Benue, which covers a distance of about 386.4 km (FMARD, 2014). This length of water environment features floodplains with extensive perennial swamps (Akpan-Idio *et al.*, 2013). This quality of the environment is very crucial to sustaining high population of fish species, since rivers that have extensive floodplains are more productive than those without, or with limited floodplains; the productivity is seen in the abundance of relative nutritive substances which enhances survival as well as reproductive activities. Thus, the Niger and Benue River basin is rich and supports a wide array of fish species (Reed, 1967). Members of the families: Clariidae and Arapaimidae/Osteoglossidae (Idodo-Umeh, 2003) are commonly abundant in swamps and floodplains, having flesh of high quality and high demand by consumers. This may influence their prevalence and abundance. The aim of this study is to assess the species composition share and the growth performance of selected *Heterobranchus bidorsalis* and *Heterotis niloticus* in Rivers Benue and Niger in Kogi State, Nigeria. Specifically, the relative fish species composition sharewere mapped, the relative ranked order positioning of fish species were ascertained, the morphometric parameter of the selected *H. bidorsalis* and *H. niloticus* were evaluated and the length-weight relationship of *H. bidorsalis* and *H. niloticus were estimated*

MATERIALS AND METHODS

The study was focused on two major fresh water rivers Niger and Benue in Kogi State, Nigeria. It is situated in the savannah region between longitude 05°20" and 08°00" East and latitude 05°30"and 08°50" North. The range in mean monthly minimum and maximum temperatures during the wet and dry seasons in the region are 21.9-26.5°C and 30.7-36.7°C, respectively. The potential for fish production is very high, with over 2000 fishing households and 200 major fishing villages sustained by Rivers Niger and Benue. The major landing sites in Kogi State are riverside and major fish markets. The study population consists of all the fisher folks along Rivers Niger and Benue in Kogi State, Nigeria. A three-stage sampling technique was used in selecting the study locations and respondents. At first stage, the purposive sampling technique was adopted to select eight (36%) local government areas (LGAs) along River Niger (Kogi, Ajaokuta, Ufo and Lokoja,) and River Benue (Omala, Idah, Ibaji, and Igalamela) in Kogi State, according to the intensity of fishing operation. At the second stage, three fishing villages were selected by the simple random technique from each of these LGAs. At the third stage, the simple random technique was used to select ten fishing households from each of these villages. Fish samples for length-weight relationship and condition factor were randomly collected from purposely chosen fishing grounds of River Niger (Kabawa) and River Benue (Ogegele) between July 2009 and December 2010. The number of individual

species and total number of all fishes caught by number of gears were counted and recorded against it. Identifications were made with the aid of relevant texts (Schneider, 1990; Holden and Reed, 1991; Idodo-Umeh, 2003; Olasebikan and Raji, 2013). The length and weight were taken using the method described by Adebayo and Kusemiyu (1994). Total length in centimeters from the tip of the snout (mouth closed) to the extended tip of the caudal fin was done using a measuring board. Body weight was measured to the nearest gram using a top loading balance. Information on on-board catch and effort appraisal was extracted on a per-boat basis through actual fishing operations and interview, using a structured questionnaire in the eight fishing grounds. Each fishing household was sampled once a month for a period of eighteen (18) months, between July 2009 and December 2010. The primary data were on length and weights of the fish families landed for the biological data. This study employed adoption of descriptive and inferential statistics.

Lengths-weight relationships and condition factor (CF or K)

The length-weight relationship (LWR) was estimated by using the equation: $W= aL^b$

Where: W= weight (g), L= total length (cm), a = constant and b= growth exponent.

A logarithmic transformation was used to make the relationship linear log W=log a + log bL.

The traditional power law model, $W (L) = aL^b$, finds widespread application for length-weight relationships in fish. Taking the logarithm of both sides in this equation allows estimation of best-fit parameters by means of linear least-squares regression (Anderson and Neumann, 1996). The elements of the resulting equation, particularly the 'b' parameter, is used to describe the growth relationship between the increase in fish length and the concurrent increase in weight of the fish where b<3, the length weight relationship is said to be negatively allometric that is for a unit increase in length the fish weight increases by less than 3g. Where b=3, the length-weight relationship is said to be isometric that is for every unit increase in length there is the weight increases 3times its initial weight, while when b>3; the length weight relationship is said to be positively allometric i.e. for every unit increase in fish length, the weight increases more than three times its initial weight. Isometric growth has been documented to be the ideal growth relationship for most fishes but in reality, many populations of fish species show a deviation from this assumption. Condition factor for each sample was determined according to Arunlertaree and Moolthongnoi (2008), using the Fulton's coefficient formula:

$$K = \frac{100W}{L^3}$$

where: K = condition factor, W = weight in grams, L = total length in centimeter

RESULTS

A. Relative Abundance and Percentage Composition of Heterobranchus bidorsalis and Heterotis niloticus in Rivers Niger and Benue in Kogi States

The relative abundance of fish fauna by number and percentage in River Niger (RN) and River Benue (RB) throughout the sampling period is shown in Table 1, A total of 5,272 individuals representing 15 species were recorded. The *Heterobranchus bidorsalis* (17.24 %, 667 samples (River Niger); 15.41 %, 217 samples (River Benue), *Heterotis niloticus* (7.74%, 299 samples (RN); 8.38%, 118 samples (RB).

The outcomes of the relative abundance order positioning (RAOP) across the three RN, RB and Pooled relative abundance ranked order positioning revealed that *Heterobranchus bidorsalis* constituted the second most abundant species our of 15 identified during the study window across the Rivers in Kogi State. *Heterotis niloticus* differed in abundance between the two water bodies constituting 5th most abundant (17.23%) and 4th most abundant species (15.41%) in Rivers Niger and Benue respectively. However, the supply of these fish species is most harvesting from River Niger. This portrays a supply ratio 3:1 as computed based on total fish abundance row on Table 1. The relative abundance ranked order positing of all the fish species suggest lots of information on what is likely the dominance species and what financial benefits that will likely accrue in different seasons

Table 1: Relative Abundance and Rank Order Positioning of fish species in River Niger and River Benue between July, 2009 and December, 2010

Item	Species	River Niger		River Benue		Pooled
		%(No)	RAOP	(%) No	RAOP	RAOP
1	*Alestes* sp	7.53 (291)	6th	6.82(96)	6th	387 6th
2	*Bagrus* sp	5.64 (218)	8th	4.9(69)	10th	287 8th
3	*Clarias gariepinus*	9.11(352)	3rd	8.38(118)	4th	470 3rd
4	*Chrysichthys* sp	6.52(252)	7th	5.54(78)	8th	330 7th
5	*Clarotes* sp	1.63(63)	13th	1.49(21)	12th	84 13th
6	*Distichodus sp*	0.02(7)	15th	0.28(4)	15th	11 15th
7	*Gymnarchus niloticus*	9.06 (350)	4th	8.66(122)	3rd	472 4th
8	*Heterobranchus bidorsalis*	17.23(667)	2nd	15.41(217)	2nd	884 2nd
9	*Heterotis niloticus*	7.74(299)	5th	8.38(118)	4th	417 5th
10	*Lates niloticus*	0.37(14)	14th	0.36(5)	14th	19 14th
11	*Labeo* sp	2.3(89)	12th	3.41(48)	11th	137 12th
12	*Mormyrops* sp	3.0(116)	10th	5.75(81)	9th	197 10th
13	*Ophiocephalus* sp	2.95(114)	11th	5.54(78)	8th	192 11th
14	*Synodontis* sp	5.07(196)	9th	6.04(85)	7th	281 9th
15	*Tilapia zillii*	21.64(836)	1st	19.03(268)	1st	1104 1st
	Total Fish Abundance	**3864**		**1408**		**5272**

Note: RAII – Relative Abundance Order Positioning

B. **Morphometric parameters, percentage composition and result of regression analysis for LWR of *Heterbranchus bidorsalis* and *Heterotis niloticus* from Rivers Niger and Benue in Kogi State**

I. Length-Weight Relationship and Condition Factor of the two Fish species along Rivers Niger and Benue

Table 1 show the ranges and mean values of total length and weight of two selected species studied. Total length (TL) ranged from 14.2-44.5 cm, 14.0-44.1cm; and 7.4-40.7 cm, 5.4-43.2 cm for *Heterobranchus bidorsalis* and *Heterotis niloticus* in Rivers Niger and Benue, respectively. Body weight obtained for the two selected species ranged from 31.8-552 g, 32.8-552 g and 18.8-256 g - 82.4-250 g for *Heterobranchus bidorsalis* and *Heterotis niloticus* in Rivers Niger and Benue, respectively.

The length-weight relationship and growth pattern of the two selected fish species were shown in Table 4.6. A total of 3,417 samples were obtained from Rivers Niger and Benue during the study period with individual number of 268, 352 and 672, 836 for *Heterobranchus bidorsalis* and *Heterotis niloticus* in Rivers Niger and Benue, respectively.

Negative allometric growth (b<3) was recorded for *Heterobranchus bidorsalis* (2.50) and *Heterotis niloticus* (0.52) while *Heterobranchus bidorsalis* (2.26) and *Heterotis niloticus* (0.24) in River Benue showed negative allometric growth pattern. The respective correlation of regression (R^2) were 0.5.3, 0.56 (*Heterobranchus bidorsalis*) and 0.12, 0.08 (*Heterotis niloticus*) in Rivers Niger and Benue, respectively (Figs 4.1 – 4.8).

Condition Factor (CF, K) of the selected fish species in Rivers Niger and Benue as presented in Table 4.7 revealed CF values of 2.65 (*Heterotis niloticus*), 2.62 (*Tilapia zillii*), 1.08 (*Clarias gariepinus*) and 0.93 (*Heterobranchus bidorsalis*) in River Benue and 1.27 for *Heterotis niloticus*, 1.70 (*Tilapia zillii*), 0.95 (*Clarias gariepinus*) and 0.89 for *Heterobranchus bidorsalis* in River Niger. Generally, River Benue fish were in better condition than River Niger fish.

Table 2: Morphometric parameters, percentage composition and result of regression analysis for LWR of *H. bidorsalis* and *H. niloticus* from Rivers Niger and Benue in Kogi State

Species	*Heterobranchus bidorsalis*			*Heterotis niloticus*		
Rivers	Benue	Niger	*Pooled*	Benue	Niger	*Pooled*
Number (N)	118	352	470	268	836	1104
Percentage (%)	17.56	16.97	17.27	39.88	40.33	40.11
TLR(cm) Min-Max	14-44.1	14.2-44.5	14.0-46.5	5.4-43.2	7.4-40.7	5.0-46.5
Mean length (cm)	31.1±6.9	31.1± 6.8	31.1±6.8	28.8±9.27	29.0±9.1	28.8±9.2

WR (g) Min-Max	32.8-552	31.8-552	31.8-552.0	82.4-250	18.8-250	18.8-250.0
Mean weight (g)	279.1±148.7	279.1±148.7	277.0±145.0	279.1±148.7	125.5±68.6	131.5±63.0
A	-0.98	1.38		1.74	1.26	
B	2.25	2.5		0.26	0.54	
(r^2)	0.54	0.54		0.09	0.13	
K	0.93	0.91		0.58	0.07	
G	NA	NA		NA	NA	

Significant at 95% probability level
N = sample size
TLR =Total lengths in cm; WR =Weight in g
a, b= regression coefficients; the parameters of the length-weight relationship
r^2 = the coefficient of determination;
K= Condition factor; G=growth pattern; PA=positive allometric; NA=negative allometric

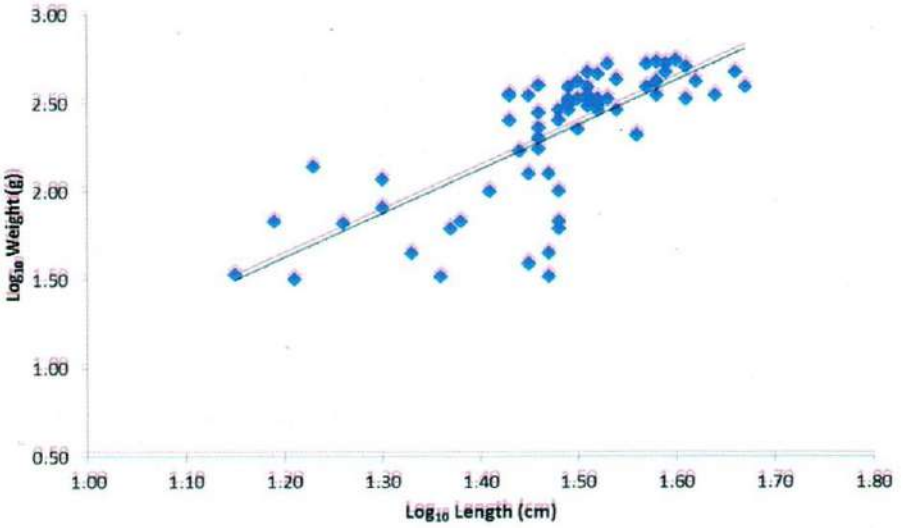


Figure 1: Length-weight relationship of *Heterobranchus bidorsalis* along River Niger

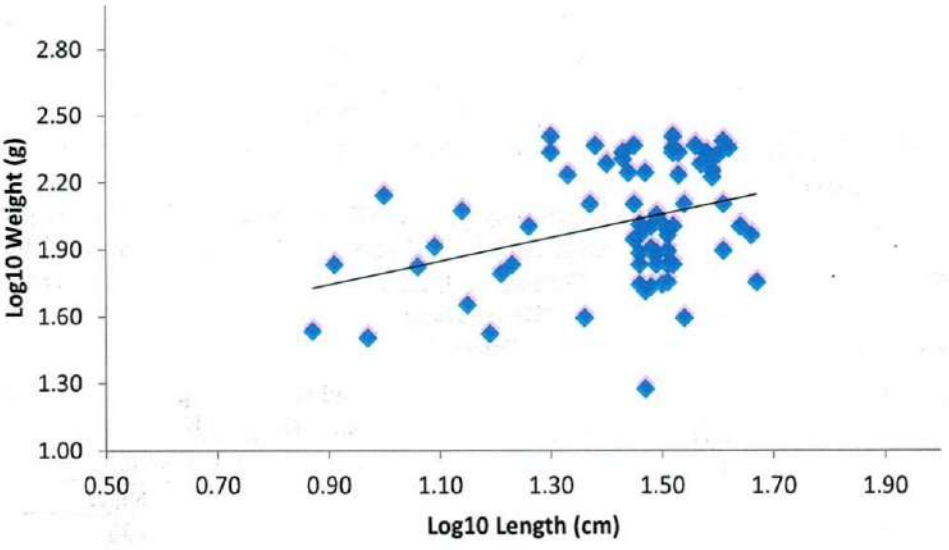


Figure 2: Length-weight relationship of *Heterotis niloticus* along River Niger

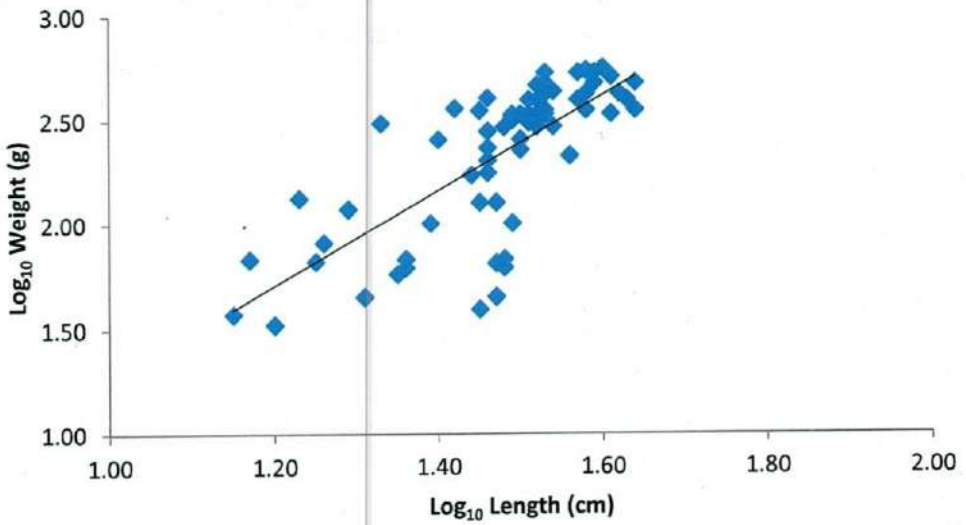


Figure 3: Length-weight relationship of *Heterobranchus bidorsalis* along River Benue

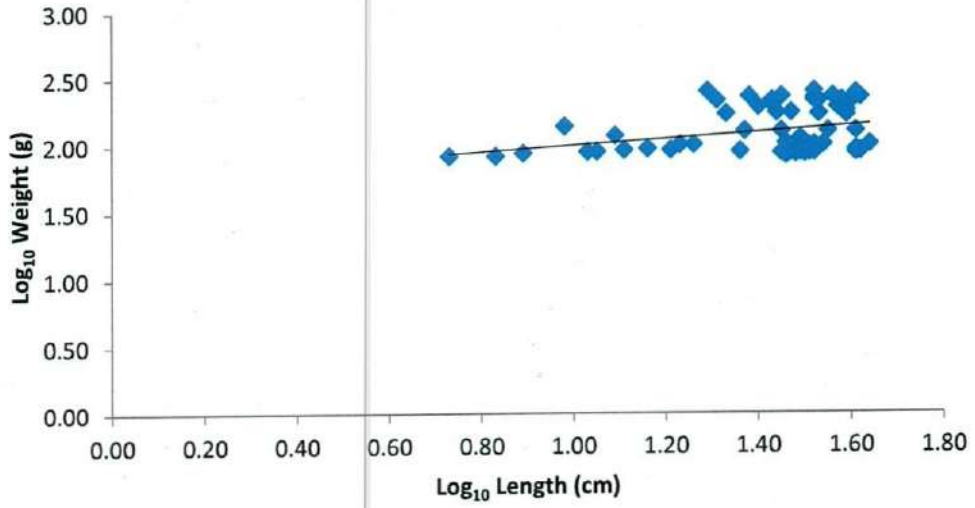


Figure 4: Length-weight relationship of *Heterotis niloticus* along River Benue

DISCUSSION

The prevalence and survival of *H. bidorsalis* in the study location is typical to its natural environment (Idodo-Umeh, 2003; Abowe and Davies, 2009) and high proportions of *H. niloticus*, a bottom dweller, (Ayanwale *et al.*, 2013) could be attributed to its adaptation to lentic aquatic environmental qualities; adjustments to productivity and changes in the hydrological regime of the ecosystem (Toyisi and Effiong, 2005), as well as their high prolific breeding nature (Dan-Kishiya, 2012) give a considerable advantage in the colonization of their habitat (Toyisi and Effiong, 2005). This agrees with the findings of Komolafe and Arowomo (2008).

Generally length and weight are fundamental parameters of growth. Treating these parameters statistically helps to establish their relationship and to arrive at the formulae for length-related body measurements. This formula forms the basis for inter-conversion to evaluate fish size, and suitability of environment. The length relationships were quite close for *H. bidorsalis* (31.1±6.8 cm, /31.1±6.9 cm) and *H. niloticus* (29.0±9.1 cm /28.8±9.27 cm) in both Rivers Niger and Benue. Records for *Heterobranchus bidorsalis* in Rivers Niger and Benue showed no difference in size (279.1±148.7 g and 279.1±148.7 g) whereas for *Heterotis niloticus*, bigger fishes were recorded in River Benue (279.1±148.7 g) than in River Niger (125.5±68.6 g). This indicates sensitivity of *H. niloticus* to the River Niger location and that River Benue shows a better healthy environment for its growth.

The exponent value (b value) showed negative allometric value (b<3) for *Heterobranchus bidorsalis* (2.50) and *Heterotis niloticus* (0.54) and were categorized as light fish. *Heterobranchus bidorsalis* (2.25) and *H. niloticus* (0.26) along River Benue (Ogegele fishing ground) showed negative allometric growth coefficient of the regression (r^2) at 95% confidence limits. The negative value for *Heterobranchus bidorsalis* and *Heterotis niloticus* indicated a negative slope. The range of $0.41 < b < 3.67$ was within the values confirmed by Froese (2006) and Froese and Pauly (2007). Etim (2000) and Fafioye and Oluajo (2005) also respectively reported 2.951 and 3.042 b-value *Chrysicthys nigradigitatus*.

According to Frosta *et al.* (2004) the slope value b indicates the rate of weight gain relative to growth in length and varies among different populations of the same species or within the same species. Udoidiong (2005) also claims that the ''b'' values for most intertidal macro-benthos in Southeast were less than three (b>3). In this study, b-value was ±3, hence the null hypothesis is rejected. This implies that H_A - b=< 3 and b> was accepted. King (1996) asserts that most inland water fish in Nigeria had negative allometric growth pattern. However, Taiwo (2011) reported a positive allometry for *Chrysichthys nigrodigitatus* and *Schilbe ntermedius* from Owalla and Ekoende reservoirs. In agreement with this study, Lawal-Are and Kusemiju (2000); Arimoro and Idoro (2007) made similar observation on *callinecte samnicola* in Badagry, Lagos State and Warri River, Niger Delta Nigeria.

The correlation coefficient (r^2) for *Heterobranchus bidorsalis* (0.54) and *Heterotis niloticus* along river Niger and *Heterobranchus bidorsalis* (0.54) and *Heterotis niloticus* (0.99) along river Benue indicated an average degree of correlation between length and weight in the sampled population.

The condition factor is the morphometric index used to evaluate physiological status of fish based on the principle that those individual lengths which have a higher mass are in better ''condition''. The condition factor could be influenced by size or age (Anwa-Udondiah and Pepple, 2011). In this study, mean values of ''K'' along Rivers Niger and Benue for *H. bidorsalis* and *H. niloticus* were respectively 0.91, 0.93; and 0.07, 0.58.

The condition factors were generally higher in River Benue (0.93 and 0.58) than River Niger (0.91 and 0.07) for *Heterobrocus. bidorsalis and Heteroris niloticus,* respectively. Much lower values were recorded in River Niger and k = 0.07 recorded for *Heterotis niloticus* was quite remarkable. The lower K values may probably be as a result of the dredging of the River Niger during the cause of study. Since Heterotis has gill apparatus, its state of well-being (K-factor) may have been deterred due to asphyxiation. Much higher correlation coefficients were recorded (r = 0.54 and 0.13) for River Niger, compared to $r^2 = 0.54$ and 0.09 for River Niger as shown in Table 2.

These values agree with Odo *et. al.* (2013) who observe a mean monthly ''K'' value of 0.78 ± 0.11 for *Gymanarcus niloticus* in the floodplain of River Anambra, Nigeria. Though higher values ''K'' of (2.39 and 2.38, for 2006 and 2007, respectively) were obtained for *Sarotherodon melanotheron*in Ologe Lagoon, Lagos, Nigeria by Ndimele *et al.* (2010).

CONCLUSION:

The success and availability of H. bidorsalis and H. niloticus in the location assessed could be attributed to their adaptation to lentic aquatic environmental qualities, productivity of the floodplains and changes in the hydrological regime of the river, their high prolific breeding nature as well as their parenting tendences which gives a considerable advantage in the colonization of their habitat. The b-value was ±3 implies that H_A – b = < 3 and b > was accepted. LWR revealed " b" value for *Heterobranchus bidorsalis* (0.54,2.25) and *Heterotis niloticus* (0.13,0.26) for rivers Niger and Benue, respectively indicating negative allometric growth. The mean condition factor for all fish species indicated a good state of well being. K-value along river Benue are significantly higher compared to their respective species for in river Niger. Hence, River Benue shows a higher tendency towards isometric and a healthier environment for growth than along River Niger, due to the dredging activities and over-exploitation of resources. The river Niger environment produced fish of lower *b* value, which may be attributed to pollution status or anthropogenic activities that occur in it. The physico–chemical properties of an environment is very essential to the sustainability of fishery resources. Upgrading its status promote sustainable management of the rivers.

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