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Length-weight relationship and condition factor of *Heterobranchus bidorsalis* (Geoffroy St-Hilaire, 1809) caught in Njaba River, Southeast, Nigeria

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Abstract
The length-weight relationship of a fish has importance to aqua-culturist for its use in determining growth patterns between separate stocks of the same species or determining weight from established length. A total number of 211 specimens of *Heterobranchus bidorsalis*, were harvested from the River, for six month (January to June 2015). They comprised 55 males and 156 females, giving a sex ratio of 1:2.8 male to female specimens. The regression co-efficient was (2.79) for females, which revealed negative allometric growth while the males showed positive allometric growth with a value of (3.39). Significant differences ($p<0.05$) existed between male ($r^2=0.76$) and female ($r^2=0.71$) specimens with regard to length weight relationship. Condition factor was (2.89 ± 0.68) for males and (0.79 ± 0.18) for females, showing that the males which had value greater than one and higher than value for females, were in better condition. It could be concluded that the males rather than the females were doing better in terms of wellbeing.

Keywords: Length-weight, *Heterobranchus bidorsalis*, Njaba River, Nigeria.

Introduction
Length-weight relationship is of great importance in any fishery venture because it gives information on stock composition, size increment, growth patterns and wellbeing of the fish (Fafioye and Oluajo, 2005) [11]. It was also used to estimate the status of a particular species, because such estimation was relevant for its management (Nurl-Amin *et al.,* 2005) [18]. The regression co-efficient resulting from length-weight relationship was also used to estimate weight from length because direct weight measurement was time consuming (Sinovcic *et al*., 2004) [24]. Fisheries scientists have estimated the weight of individual fish from its length, especially when comparing life history and morphology of fish population belonging to different regions, as well as studying ontogenetic allometric changes in fish species (Hossain, 2010) [14]. According to (Pauly, 1984) [22], it was also possible to stabilize taxonomic characteristics of a species by mere dependence on length-weight relationships.
Again, length-weight measurement was not only population specific, but changes with developmental stages and differences in ecological areas. The empirical data realized from length and weight measurements of the fish enhanced the knowledge of the natural history of commercially important fish species, thus making their conservation possible.
Catfishes are economically important groups of fresh water fishes in the world. There are two genera of the species of study. Between them *Heterobranchus bidorsalis* has its head strongly depressed compared to its relative *Heterobranchus longifilis* whose upper surface was rather granulated and not depressed. *Heterobranchus bidorsalis* grows to about 1.2 m and weigh about 30.0 kg for very large samples, Fagbenro (1992) [12]. Due to the paucity of information on *Heterobranchus bidorsalis* harvested from Njaba River, Southeast, Nigeria, the study determined their length-weight relationship and wellbeing.

Description of Sampling Stations
The study was carried out in Njaba River in Oru-East local government area of Imo state Nigeria. Njaba River is one of the prominent river in Imo state, the origin of Njaba River can be traced from Isu Njaba where the river begins with a spring call Njaba spring. It lies between latitude 5° 41[1] and 55° 97[1] North and longitude 6° 48[1] and 45° 86[1] East.

The river runs through Amucha, Ekwe, Okwudo, Umuaka, Awo-omamma and empties itself at Oguta lake. Fishing gears were set in the river on monthly basis between the hours of (1800-2000 hrs) and retrieved the following morning between (0600-0900 hrs) from January to June 2015. The climate of the area is characterized by two distinct seasons: the dry (November – March) and rainy seasons (April to October). Gears used for fishing included set gill nets, cast nets, trigger traps, foul-hook long lines and Bangana cage nets. Detailed descriptions of the specimens and gears used are contained in Reed *et al.,* (1967) [23]. Fish samples were obtained at five stations (S1 to S5) located at equal distances of 5km along the stretch of Njaba River (Figure 1). Fish specimens were conveyed to the Department of Fisheries and Aquaculture Technology Laboratory, Federal University of Technology, Owerri, where serial number was assigned to each specimen, preceding other measurements that commenced immediately.

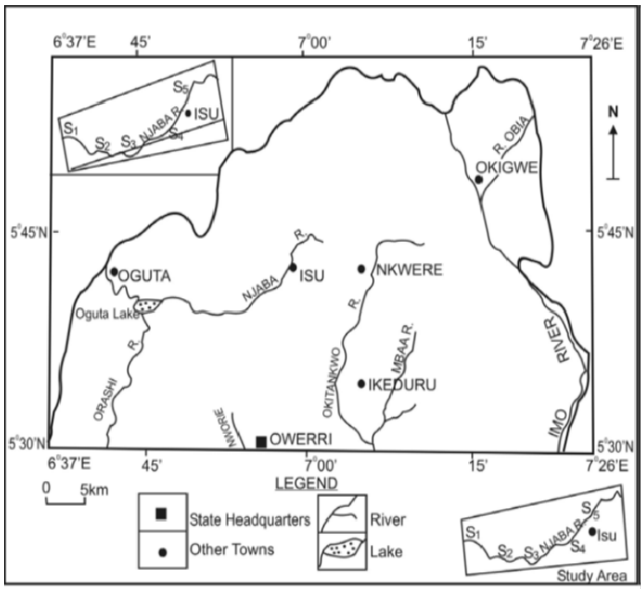

Fig 1: Sampling locations

Length and Weight Measurements

Length measurement

Using a measuring board, the total lengths (T_L) of the specimens were measured from the tip of the snout with mouth closed to the tip of the longest caudal fin ray. Standard length (S_L) was also measured from the tip of the snout to the end of the caudal peduncle. Both measurements were recorded to the nearest 0.1cm

Body weight measurement

Body weight measurement was derived by initially drying the specimen with a filter paper. Each specimen was then placed on top of a Triple Beam weighing balance (OHAUS® 2,610 Model, 700 SERIES) and the data realized recorded to the nearest 0.01g.

Length-weight relationship and condition factor

The length-weight relationship was determined by using the formula of (Abowei *et al.,* 2009) [1] written thus: $W=aL^b$ Where; W=Total weight of fish (g), L= Total length of fish (cm), b= regression coefficient and a= regression constant.

The logarithmic transformation of the equation gave a straight line relationship thus: Log W = Log a + b Log L. The Log of weight was plotted against the Log of length which gave a regression coefficient of 'b' while ´a' was the intercept of the line on the 'Y' axis.

The condition factor (k) was calculated using the formula: $K = 100w/L^3$ (Pauly, 1984) [22], where K = condition factor, L = total body length of fish (cm) and W = body weight of fish (g).

Result

Length-Weight Measurement

Out of the total number of 211 specimens of *Heterobranchus bidorsalis* harvested for the study, 55 specimens are males with total length ranged from 12.3 cm to 68.3 cm and a body weight between 23.1 g to 1350.70 g. Also, the total length of 156 female specimens ranged between 10.2 cm to 58.80 cm, with a body weight between 20.7 g to 734.7g as shown in Tables 1 and 2 respectively. Although the males had the longest size, the females were heavier.

Table 1: Size class, total length and body weight measurements of male *Heterobranchus bidorsalis*

Class size	Number of male	$\overleftrightarrow{x}$ total length (cm)	$\overleftrightarrow{x}$ body weight (g)	Total length (cm) min max	Body weight (g) min max
10-19.9	05	14.12	45.20	12.3-19.7	23.1-55.6
20-29.9	16	22.07	110.30	22.7-29.0	72.1-144.0
30-39.9	26	35.53	303.30	30.3-38.2	180.6-490.0
40-49.9	04	43.00	505.60	41.9-49.1	500.9-544.3
50-59.9	02	52.3	555.20	51.4 -55.3	565.3-750.7
60-69.9	02	63.4	960.00	61.2-68.3	872.0- 1350.7
Total	55				

Table 2: Size class, total length and body weight measurements of female *Heterobranchus bidorsalis*

Class size	Number of females	$\overleftrightarrow{x}$ total length (cm)	$\overleftrightarrow{x}$ body weight (g)	Total length (cm) min max	Body weight (g) min max
10-19.9	10	12.50	43.50	10.2-16.7	20.7-45.2
20-29.9	84	25.60	119.80	22.5-29.30	76.2-170.0
30-39.9	50	34.50	118.70	30-35.80	175-480.0
40-49.9	12	42.40	527.40	43.9-48.80	570-734.7
Total	156				

Length-weight relationship

The length-weight relationship of the specimens studied revealed that significant differences ($p<0.05$) exists between total length and body weight of male (0.76) and female (0.71) specimens as shown in Figures 1 and 2 respectively. The regression co-efficient '*b*' in figures 1 and 2 revealed positive

allometric growth (3.39) for males while for females, it was negative allometric growth (2.79).

The values computed for condition factor obtained for the sexes were (2.89 ± 0.68) for males and (0.79 ± 0.18) for females.

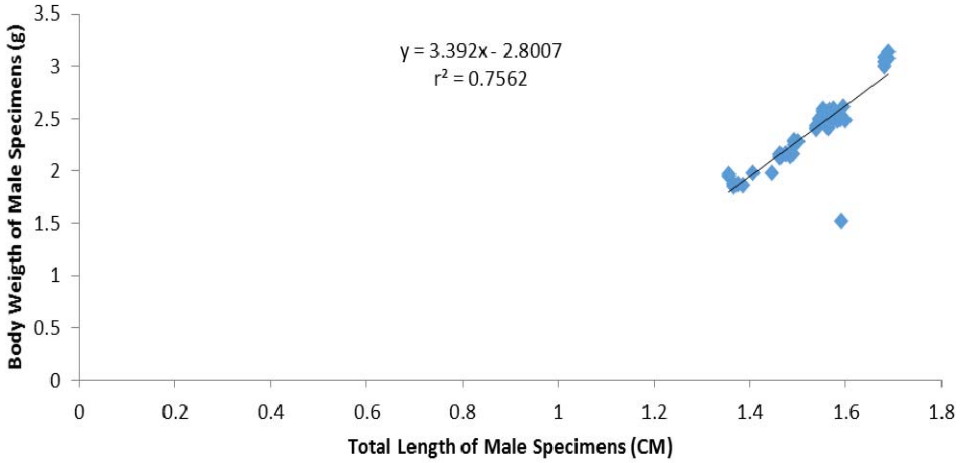

Fig 1: Log relationship of total length and body weight of male specimens

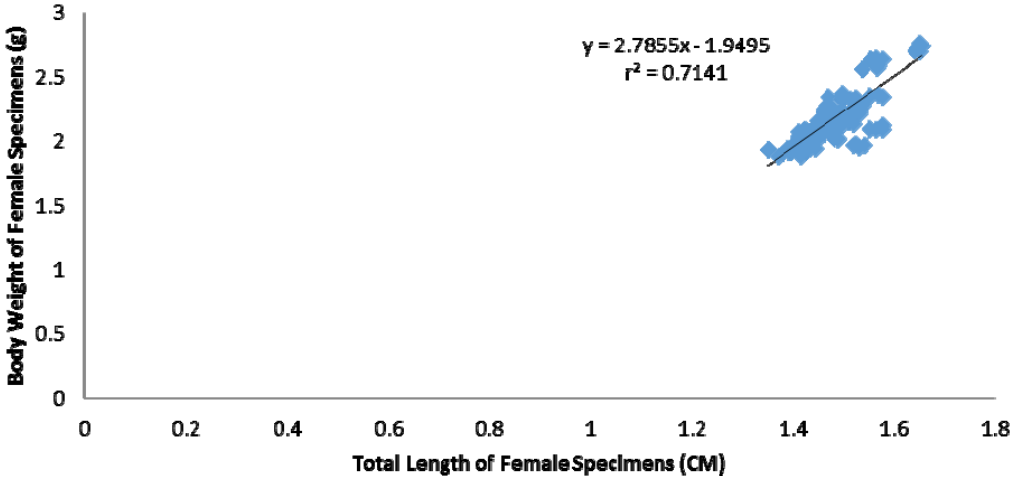

Fig 2: Log relationship of total length and body weight of female specimens

Discussion

Length-weight relationship

Length-weight data of specimens revealed that there were variations in total length and body weight of the fish. Such variations were reflected in the differences realized in length and weight increments where increases in body weight with corresponding increases in total length often results in isometric growth. When such variations changed such that total length increases were no longer directly proportional to body weight increase; the resulting relationship was referred to as positive allometric growths. On the contrary, when body weight increase proceeded faster than total length increase, the resulting relationship was referred to as negative allometric growths (Adeyemi, 2011) [3]. In the present study, differences in length weight relationship gave rise to a regression co-efficient whose *'b'* value was 3.39 for male and 2.79 for females. Both results revealed positive allometric growths (for values higher than 3) and negative allometric growths (for values lower than 3). The '*b*' value of the present study which was 3.39 for male and 2.79 for females) could be compared with the report of Fafioye and Oluajo (2005) [11] who reported *'b'* values of 2.95 and 3.04 for *Chrysichthys nigrodigitatus*. Ofori-Danson *et al.,* (2002) [19] reported *'b'* value of 2.9 to 3.01, Abowei *et al.*, (2009) [1] reported '*b'* value of 3.5, while Adeyemi, (2010) [2] reported '*b*' value of 2.6 for *Protopterus annectens* which was in contrast with (3.12 and 3.22 for male and female) with values reported by Oniye *et al*. (2006) [25] also for *P. annectens* in Jachi dam, Nigeria. Furthermore, Olele and Obi (2004) [21] reported positive allometric growth (3.1) value for *Citharinus citharus* caught in Onah Lake. On the contrary (Akombo *et al*., 2013) [4] reported a negative allometric growth where the *'b'* value was less than 3. Growth patterns in fish are affected by several factors such as seasonality, nature of the habitat, sex, food availability (Henderson, 2005 [13] and Adeyemi, (2010) [2]; sample size (Morey *et al*., 2003) [16] and or habitat suitability (Nieto-Navarro *et al*., 2010) [17].

Length-weight relationships of specimens were also highly significant ($p<0.05$), thus giving rise to an r^2 value of 0.76 for male and 0.71 for female specimen. These findings are not in agreement with the result of (Lawson *et al*., 2003) [15] who documented an r^2 value of 0.90 to 0.99 in *Synodontis ocellifer*, *Liza facipinnis*, and *Pseltas sebae* from Ogudu Creek, Lagos. Ecoutin *et al.,* (2005) [9] values of (r^2 = 0.89 to 0.99) were also higher than those of the present study.

Condition Factor

The condition factor observed in this study is (2.89 + 0.68) for males and (0.79 + 0.18) for females. Adeyemi, (2011) [3] reported values 1.57-3.83 higher than that of present study. Bolarinwa and Popoola (2013) [8] reported values (0.56 and 1.62) that could be compared to the present study. Both values are comparable to Bagenal and Tesch (1978) [7] who recommended that the condition factor suitable for matured fresh water fish should range between (2.4 -4.8).

Differences in condition factor could be as a result of pollution and or anthropogenic activities (sawmilling, sewage disposal and presence of industrial effluents) (Alfred-Ockiya 2000 [5]; Anene 2005 [6] and Olawusi-Peters, 2008 [20]).

Conclusion

This research revealed that *Heterobranchus bidorsalis* male exhibit positive allometric growth while the female exhibit negative allometric growth pattern. The female specimens were heavier while the males were lengthier. Also a significant relationship exists between total length and body weight of specimens. The values for the condition factor revealed that the males were in a better condition than the females

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