

Length-Weight Relationship, Condition Factor and Gut Content of *Chrysichthys Furcatus* Gunther, 1864 (Bagridae) from Cross River at Ahaha

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Abstract

The study aimed to estimate the length weight relationship, condition factor and gut content of *Chrysichthys furcatus* a commercial important food fish in Obubra, central Cross River State. Monthly samples were collected for six month between May to October 2014. During the period a total of 187 specimens comprising of 125 females and 62 males were collected. The length - weight frequency distribution shows a total length ranged of 16 cm-60 cm and weight 50 g-549 g. The female fish have the highest length and weight frequency distribution except at weight ranged of 50 g-99 g where the males were more. Both sexes exhibited negative allometric growth pattern with an increased in length resulting to increase in weight of the fish. The condition factor (k) decreased with increased in the size of fish, why July and August recorded the least monthly condition factor. About 102 (54.55%) stomachs had some degree of food items in their guts with medium size specimens having the highest number of stomachs with some degree of food than small and large respectively. A total of 7 major categories with 27 food items comprising of animals, plants and detritus materials were identified. The sum total of 3,486 prey item with Cyclops (531) 15.24% constituting the most encountered while coleopteran (10) 0.29% was the least encountered prey. The most occurred prey item was detritus (100%) and Cyclops (98.12%) while the least coleopterans 3.67% with sand grains (11.44%) constituting the bulks of the gut content. The index of relative importance (IRI) reveals that Cyclops (1736.72), keretela (1394.82), tublex (1251.06), crustacean (1238.33) and crustacean eggs (1238.33) were the important and preferred prey item in the guts of *C. furcatus*. The ability of fish to capitalize on any available food items in the environment (*euryphagous*) is an important characteristic of culturable fish species. This implies that *C. furcatus* have brighter prospects for culture in ponds and proper species management and sustainability.

Keywords: *Chrysichthys furcatus*; Length-weight; Condition factor; Gut content; Cross river

Introduction

The genus *Chrysichthys* represents one of the most abundance bagrid in major Rivers of Africa, and is represented in Nigeria water by five species [1], most of which are considered commercially important [2]. *Chrysichthys furcatus* is esteemed as food on account of invigorating qualities of its flesh and also as a good aquaculture candidate [1]. *Chrysichthys furcatus* is identified by its smooth head with narrow occipital process. Its mouth is rounded, wide and with a rounded snout. The dorsal fin is large, fan-shaped and without filament and pectoral spine strongly serrated on the inner border. The caudal fin is moderately forked with both upper and lower lobes equal in length. The body colour is greyish-blue on the back and sides while belly is white. Knowledge on their biology is essential for evaluating the commercial potentialities of the stock, life history, culture practice and management of its fisheries. Length - weight relationship is important fishery management stool. Its importance is pronounced in estimating the average weight at a given length group and in assessing the relative wellbeing of a fish population [3]. The length weight parameters "a" and "b" are important in stock assessment studies, for conversion of length observation into weight estimates to provide some measurement of biomass and sub growth of fish species [4]. Fish found

in tropical water system experience frequency growth fluctuation due to changes in food composition, environmental variables and spawning conditions.

According to Anderson et al. [5] length weight data of population is basic parameters for any monitoring study of fishes, since it provides important information concerning the structure and function of populations. Abowei [6] reported that differences in the condition factors of different populations of same species are indicatives of food supply and timing duration of breeding. Pauly [7] also reported that the numerical magnitude of the condition factors can be influenced by factors such as sex, age, period stage of maturity and stomach content.

Studies of the food and feeding habits are useful in determining the population level, since the number of individuals on the population depends on the amount of food available. Gut content analysis gives information on seasonal and life history change of fish because the types and magnitude of food available as well as the season it occurs plays on important role in the life history of fish. The length- weight relationship, condition factor and dietary composition of some fish species including *C. nigrodigitatus* of Cross River have been studied [8-10]. No such study on the *C. furcatus* have been conducted in the Cross River system especially at Ahaha.

Length frequency, distribution, condition factor and dietary composition are important to know the status of the size structure of

that fish population in nature. Fishermen of Ahaha depend on the fish resource of *Chrysichthys spp* which is their major resource. The livelihood of these artisanal fishermen therefore depends on the continual availability of the river resource. The study on the length-weight condition factor and dietary composition of *C. furcatus* will contribute to knowledge by providing information on population structure and dynamics of this resource required for proper scientific management. Although considerable information is available on varied aspects of the length weight relationship, condition factor and gut content of other species of *Chrysichthys* in Nigeria waters [2,8,11,12], no such studies have been conducted on *C. furcatus* in the Cross River at Ahaha fish landing site. Therefore, this study present information on the length-weight, relationship, condition factor and dietary composition of this valuable fish species and will aid its management in the Cross River.

Material and Method

Study site

The study site was Cross River at Ahaha in Obubra Local Government area of Cross River State. It is a major perennial rivers in the central Cross River, Nigeria and is located at latitude 4° 30'1 to 7°15'N and longitude 7°15' - 9°30' E. It covers an area of 54,000 km², with 39,500 km² within Nigeria and 14,500 km², in the republic of Cameroon (Figure 1). The Cross River lies in an area within the tropical rainforest climate with two main seasons, the raining and dry seasons. The wet season is characterized by high precipitation between April October, while the dry season (November-March) is marked low precipitation. Fishing, petty trading, civil service and tarring have remained the traditional occupation of the people.

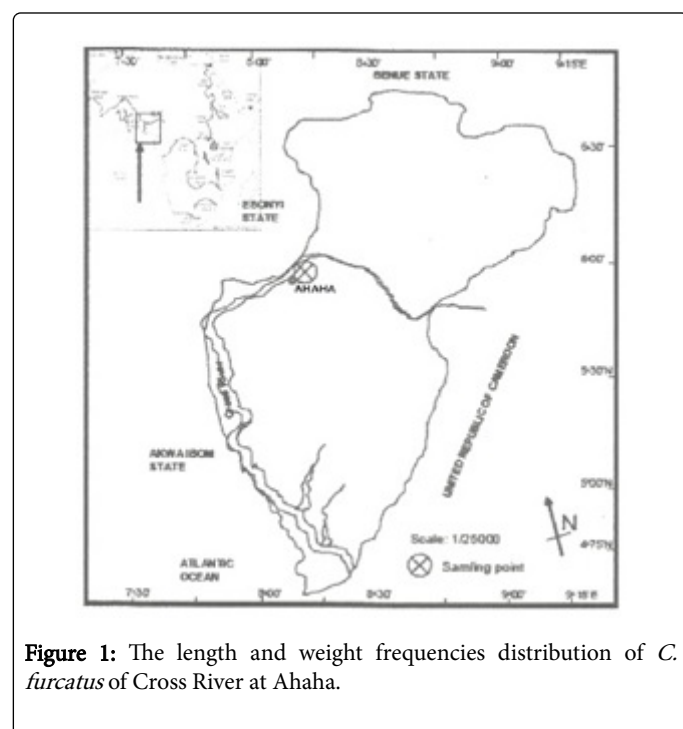


Figure 1: The length and weight frequencies distribution of *C. furcatus* of Cross River at Ahaha.

Sampling

Monthly samples of *C. furcatus* were collected for six months between May-October, 2014. Fish gears mostly used by fishermen in the study area constitute principally beach seine, gill nets, cast nets, hooks and lines. Fishing at Ahaha is basically artisanal with fishermen using non-motorized boat to carry out fishing both in the day and night.

Collection and preservation of specimen

The collection was done once a week for six month from May-October 2014 from fresh catches of artisanal fisher using gill nets of different mesh sizes. The samples were transported in ice box to the Wet Laboratory of Fisheries Department of CRUTECH for measurements and weighing. The guts were removed and preserved in 10% formaldehyde prior to laboratory analysis.

Laboratory procedure

Records of the total length in (cm) and body weight (g) measurements of individual fish was taken, the length was measured using a meter rule and weight using an OKI weighing balance. The guts were removed and content powered into a Petri dish for examination of the different food organism using a microscope. The identification was made to the simplest taxonomic level according to the methods described by Ugumba et al. [13]. The frequency of occurrence (O), Numerical (N) and gravimetric (G) methods were employed in the analysis. Dietary importance of the prey items were determined using the index of relative importance calculated as $(\%N + \%G) \times \%F$.

Frequency of occurrence methods: The number of gut with a particular food item were listed and expressed as a percentage of the total number of guts examined. It expressed as frequency of occurrence $O_i = J_i/P$.

Where J_i is number of fish containing prey i and P is the number of fish with food in their stomach.

Numerical methods: The total number of each food item in each gut were sum up for all guts, and express as a percentage of the total number of all food items $N = N_i/EN$

Where N is the number of food category.

Gravimetric method: The weight of the food items which expressed as percentages of weight of the total gut content $W_1 = w_1/Ew_1$

Data analysis

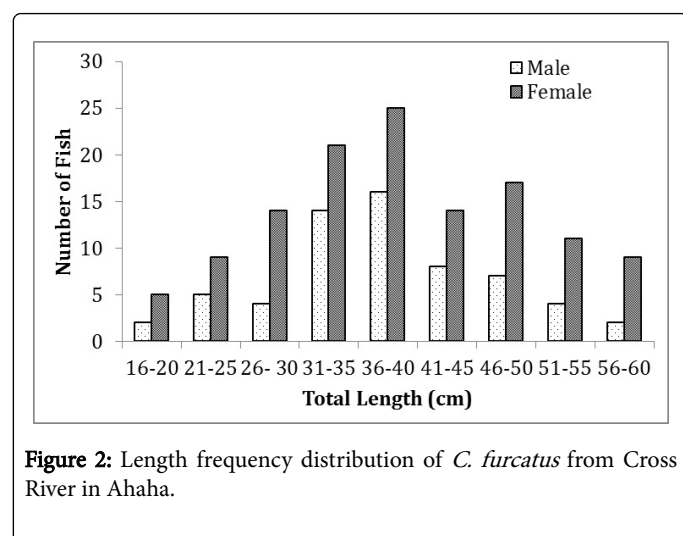
The data collected was analyzed using the computer on an SPSS package version 20. Estimation of species Length-weight relationship will be done using the formula $W = aL^b$, which was transformed into natural logarithmic form $\ln W = \ln a + b \ln L$. Where W =body weight (g), L =Total length (cm), a =constant; b =exponent: allometric coefficient. Condition factor (k) was computed using the formula $k = 100 w/L^3$ [7]. Where W =Fish weight (g) L =Fish total length (cm)

Results

Length and weight frequencies distribution

The length and weight frequencies distribution of 187 specimens of *C. furcatus* of Cross River at Ahaha during the period of this study are

shown in Figures 1 and 2 respectively. The total length throughout the period of the study range from 16 cm-60 cm. It shows that females had the highest frequency across all the ranges of total length with the highest of 24 (36 cm-40 cm) and lowest frequency of occurrence of 4(16 cm-20 cm) the highest frequency of occurrence of 14(36 cm-49 cm) was recorded for males with the least of 2 each for total length ranges of 16 cm-20 cm and 56 cm-60 cm. The weight frequency distribution ranged from 50 g- 549 g in the study area. The females also have higher frequencies of occurrence across all the body weight except in (50 g-99 g where the males were higher. The highest frequency of 22 in females observed at the body weight ranges of (250 g-299 g with the least of 2 at 50 g-99 g. This highest body weight of 9 was observed between the range of 250 g-349 g whereas the least of the range of 500 g-549 g.



Length-weight relationships

The length weight relationship of both sexes of *C. furcatus* and the growth parameters was used to describe the growth pattern. The graphical representations of the regression equations of combined (sexes) males and females for *C. furcatus* are shown in Figures 4-6 respectively. The regression was estimated using the formulae described by Le Cren [14]. The values of “a”, “b”, and r^2 were estimated as shown in Table 1. The ‘a’ values for males and female *C. furcatus* was 0.54 and 0.40 respectively.

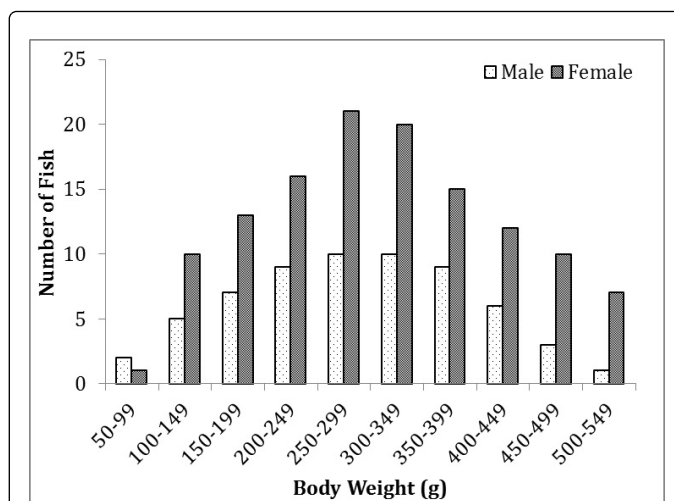


Figure 3: Length frequency distribution of *C. furcatus* from Cross River in Ahaha.

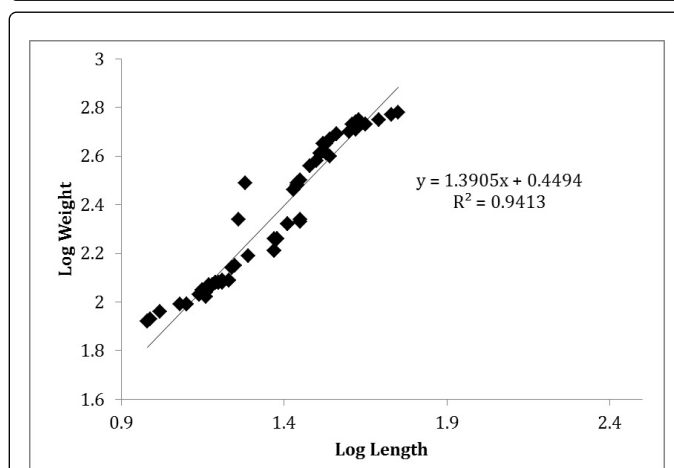
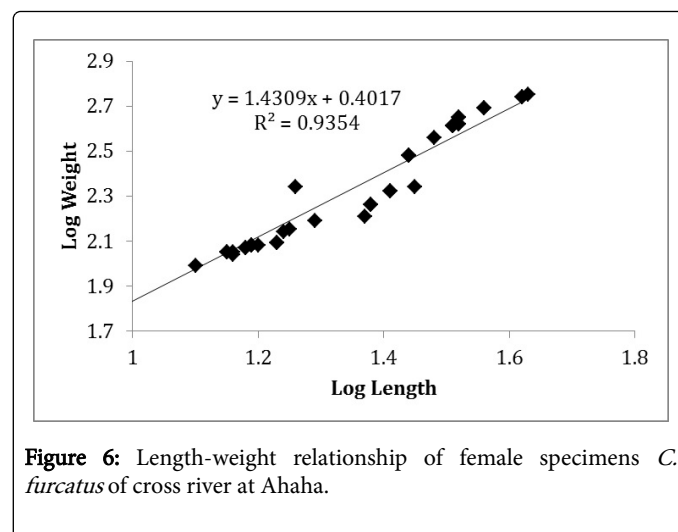
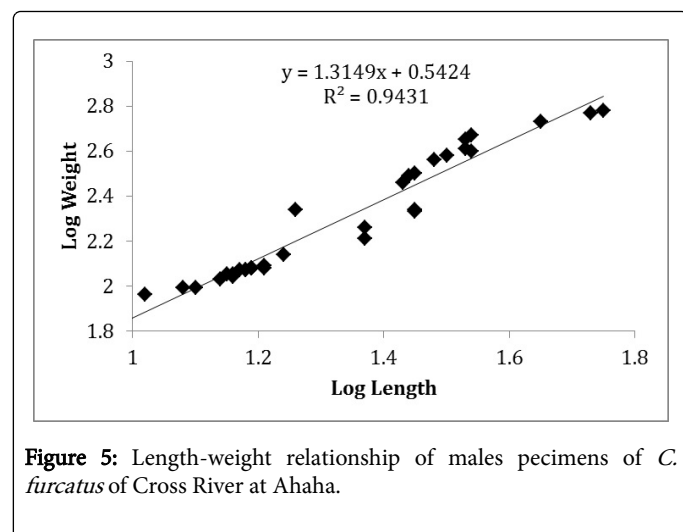


Figure 4: Length-weight relationship of combined sexes of *C. furcatus* of Cross River at Ahaha.



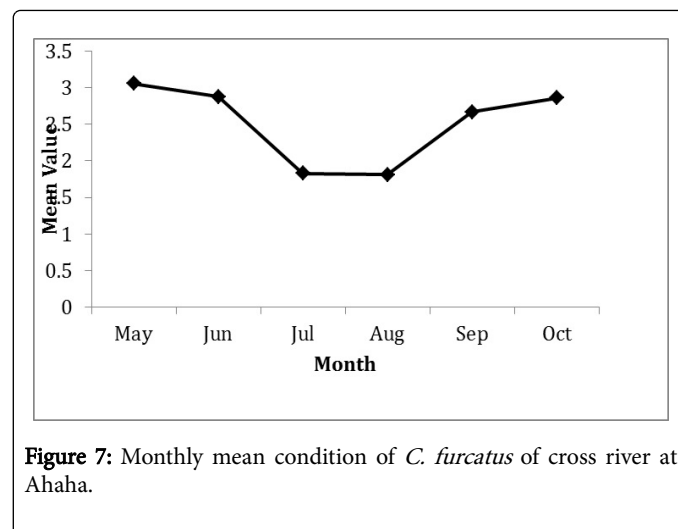
The regression equation for estimating length of male and females *C. furcatus* of known weight are $\text{Log } W = 0.542 + 1.315 \text{ Log } L$ ($r_2 = 0.943$) and $\text{Log } W = 0.4017 + 1.431 \text{ Log } L$ ($r_2 = 0.935$) respectively. The combined sexes of the length-weight relationship is expressed by the equation $\text{Log } W = 0.449 + 1.391 \text{ Log } L$ ($r_2 = 0.941$). The correlation coefficient values in the length-weight for male were higher than that of combined sexes and female respectively. Both sex exhibited negative allometric growth pattern. The relationship also showed that the length increase as the weight increased as shown by the positive “a” value and high correlation (r_2) values 0.941 (combined), 0.943 (male) and 0.935 (female).

Sex	“a”	“b”	r	n
Combined	0.45	1.39	0.9413	187
Male	0.54	1.31	0.9431	62
Female	0.4	1.43	0.9354	125

Table 1: The regression parameters of Length- weight relationship of *C. furcatus* of cross river at Ahaha.

Condition factor

The condition factor (k) value was calculated for *C. furcatus* and examined in the relation to sex, size and variation in month under which this study was conducted. The condition factor ranged from 1.34 to 3.01 and 0.92 to 3.12 for males and female respectively. The mean monthly variation in condition factor revealed that May and October recorded the highest mean condition factor (Figure 7). The k values decreased with size of *C. furcatus*. The small size (less than 26 cm) had better and higher condition factor than the medium (26 cm-36 cm) and large (greater than 36 cm) specimen respectively (Figure 8).



Dietary composition

The gut content of specimens of *C. furcatus* was examined for food. It was observed that (54.32%) of the stomach had some degree of food items present. It was also revealed that in terms of size, median size (51.82 ± 3.07) categories had more specimens with food than small (39.66 ± 2.56) and large (34.46 ± 4.78) sizes respectively (Figure 9). The results also revealed that a total of 27 major food items with numerical value of 3486 prey was estimated (Table 2). The major group of insects, crustaceans, rotifera, plantae, mollusca, worms, detritus and some unidentified material were also estimated. Insects and crustaceans form the dominant food items in terms of occurrence and numbers. Cyclops (531) about 15.24% was the most encountered food items followed by keretella (415) with 11.91% whereas the least found were coleopteran (0.29%) and chironomus (0.89%). The frequency of occurrence revealed that detritus materials (100%) and cyclops (98.12%) constituted the most occurred in almost all the guts of specimens with the food items. These were closely followed by keretella (97.20%), gamerus (96.29%) and crustaceans' eggs (92.62%).

Similarly the least occurred food items were members of the group insect coleopteran (3.67%) and chironomus (12.83%). The food items that constituted the bulk content were sand grain (11.44%) and mud

(9.28%) whereas coleopteran (0.78%), chironomus (1.23) and Dipteran (1.03%) were the least gravimetrically. The number of prey items in the

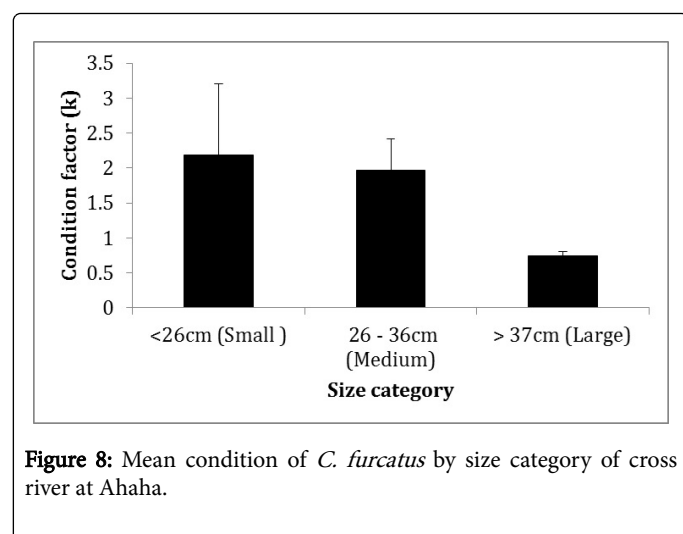
gut *C. furcatus* ranged between 10-531 while the frequency of occurrence ranged from 4-106 guts with the weight ranged of 1.02 g-5.08 g.

Major food item	Prey item	Numerical method (N)		Frequency of occurrence (O)		Gravimetric method (G)		IRI
		N	%	O	%	(G)	%	
Insecta	Hemiptera larvae	42	1.21	32	29.34	2.1	1.61	82.74
	Chironomus	31	0.89	14	12.83	1.6	1.23	27.2
	Coleopterans	10	0.29	4	3.67	1.02	0.78	3.93
	Chaoborid	96	2.76	63	57.78	2.8	2.15	283.7
	Ephemeroptera	341	9.79	99	90.78	4.09	3.14	1173.73
	Trichoptera Larvae	98	2.81	41	37.6	1.82	1.4	158.3
	Dipterans larvae	129	3.7	81	74.28	1.34	1.03	351.34
	Unidentified insects	133	3.82	100	91.7	4.21	3.23	646.49
	Insect remains	*	*	38	34.85	4.82	3.7	128.95
Crustaceans	Crustacean larvae	201	5.77	98	89.87	5.08	3.9	869.04
	Crustacean eggs	372	10.68	101	92.62	3.5	2.69	1238.33
	Cyclops	531	15.24	107	98.12	3.2	2.46	1736.72
	Neuplius	89	2.55	63	57.78	1.4	1.08	209.74
	Cladocera	196	5.63	76	69.69	4.2	3.23	617.45
	Gammarus	156	4.48	105	96.29	2.08	1.6	585.44
	Crustacean remains	*	*	101	92.62	4.82	3.7	342.69
Rotifera	Keratella	415	11.91	106	97.2	3.18	2.44	1394.82
	Testudinella	157	4.51	78	71.53	2.71	1.31	416.3
Plantae	Algae	*	*	102	93.53	2.52	1.94	181.45
Mollusca	Veliger larvae	68	1.95	51	46.77	3.21	2.47	206.72
Worms	Tubifex	301	8.64	92	84.36	8.06	6.19	1251.06
	Oligochaete	76	2.18	39	35.76	7.11	5.46	273.21
	Leech	46	1.32	24	22.01	6.01	4.82	130.74
	Worms remain	*	*	79	72.44	11.21	8.61	623.71
Detritus	Mud	*	*	109	100	12.08	9.28	928
	Sand grain	*	*	109	100	14.9	11.44	1144
Unidentified material	Unidentified material	*	*	109	100	13.08	10.05	1005
Total		3486				130.13		

Table 2: Prey items in the guts content of *C. furcatus* of Cross River at Ahaha.

The index of relative importance (IRI) reveals that cyclops (1736.72), keretela (1394.82), tubex (1251.06), crustacean (1238.33) and crustacean eggs (1238.33) were the important and preferred prey item in the guts of *C. furcatus* whereas hemiptera (82.74), chironomus (27.20) and coleopteran (3.93) were the least. Prey items found in the guts shows that species ranges from plant, animals and detritus

material. This is an indication that *C. furcatus* feeds on a wide range of materials, hence are omnivorous.



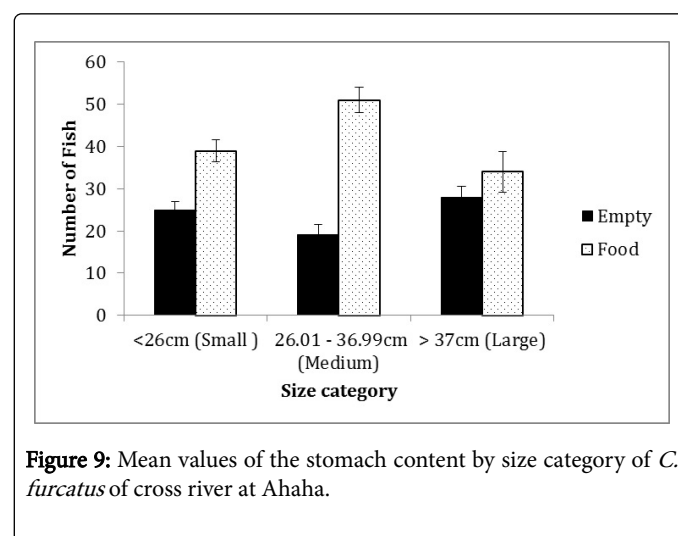
Discussion

Length-weight frequencies and relationship

These are importance in the determination of age and growth. The length composition of a population often exhibits modes among fishes with short spawning season, and uniform growth from which the modal length of the first few age groups can be easily determined [15]. The total length range of 16 cm-60 cm recorded in this study was higher than the 11.00 cm-35.30 cm reported by Oboh et al. [16] of *C. furcatus* from Jamieson River. This was also higher than the total length of 16.70 cm to 42.4 cm ranged reported for *C. nigrodigitatus* from Ahaha [8]. The least frequencies recorded at the total length ranges of 16 cm-20 cm and 56 cm-60 cm were in line with that reported by Onah [10] for *M. rume* at Ahaha. The maximum size attained by *C. furcatus* in this study varies from those of other researchers [1]. This implies that the maximum size attainable in fishes generally is location specific, sampling season is very important and determines the size of fish caught [17]. Another reason for variation of fish size may either be generic or environmental [18]. The relationship is useful in differentiating population as variations occur in populations of different localities. The values of the "b" values obtained for *C. furcatus* in this study shows that it exhibited a negative allometry in growth pattern. This is an indication that the population of the species had heterogeneous groups with body weight varying differently with the cube of the total length [8].

The values for both sexes of *C. furcatus* exhibited allometric growth pattern. Several authors have reported allometric and isometric growth pattern for different fish species from various water bodies. The values of growth pattern in study agrees with 1.34 and 1.32 reported by Onah [9,10] for *M. rume* and *L. coubie* respectively at Ahaha. Positive allometry is also reported for various species of Chrysichthyes in fresh water of Nigeria [2,8]. However, positive allometry and isometry have also been reported for Chrysichthyes and other fish species in various water bodies. Abowei et al. [19] reported an isometric growth pattern for *C. nigrodigitatus* from Amasomma River flood plains. Growth is isometric when the length exponent is equal to 3 and allometric when it is greater or equal less than 3 [15]. Ogbe et al. [20] reported an isometric growth pattern for malapterurus electricus while Ogbe et al.

[21] reported a positive allometric growth pattern for *Bargrus bayad* all from lower Benue River.



The graph of log transformation show that the "b" values for males (1.31) was smaller than for females (1.43) indicated that the females had a better growth coefficient than the males. Similar observation was reported by Onah [10] and for *M. rume* of Cross Rivers at Ahaha et al. [22] on *Mormyrus rume* caught in Osi River. The correlation value of 0.94 obtained in this study showed that there was strong association between length and weight. This implies that as the length of the fish increase, the weight also increase in almost the same proportion. A similar high correlation coefficient of $r=0.97$ was also reported by Ikongbeh et al. [23] for *Bagrus docmac* from Lake Akata, Benue State. The values recorded in this study however were greater than $r=0.90$ earlier reported for *M. rume* from this same study area by Onah [10].

Condition Factor

The mean condition values in this study area ranged from 0.92-3.12. The higher value of 3.12 was recorded in females' samples. These were higher than 0.81-2.36 reported by Onah [10] for *M. rume* and 0.31 to 2.70 reported by Ikpi [9] for *L. coubie* from the same location. The condition factor values of the formal is an indication that the fish species under investigation is doing well. The fall in the monthly mean condition factor in the months of July and August in this study conform to findings of other researches [23-26]. This period is mostly referred to as the peak spawning season in most tropical fishes. The reason for this disparity may be due to reduced availability of food and prey items. According to Oni et al. [27] condition factor is not constant for a species or population over a time interval and might be influenced by both biotic and abiotic factors such as feeding regimes, and state of gonadal development. Gomiero et al. [28] reported that better condition especially during the wet season is due to the availability of food and enhancement during their gonad development. There are also suggestion that fish condition can be influenced by certain extrinsic factors such as changes in temperature, food availability and photoperiod. Perhaps this may have accounted for the fall in the condition factor in the months of July to August in this study. This however agrees with Ikomi et al. [12] who reported the monthly fluctuation in the condition factor of *C. nigrodigitatus* which was attributed to the influence of the breeding cycle and season variation in the abundance of fish food.

Dietary composition

The variable of food items observed in the guts of *C. furcatus* ranging from plants to animals and detritus material implies that the specimen could be termed an omnivore and opportunistic feeder as suggested by Ipinjolu et al. [29]. The dominant food items recorded in this study were similar to those observed by Onah [10] for this *M. rume*, Ikpi et al. [9] for *L. coubie* and Offem et al. [8] for *C. nigrodigitatus* from the same location. Feeding intensity of fish can be determined based on degree or fullness of stomach. A relatively higher percentage of full stomach suggested that food was abundant throughout the period of study in this location. This may also suggest wider food habit, active feeding and earlier stoning of fish after capture. According to Abdullahi [30] higher non-empty stomachs in *Bagrus bayad* was due to diversified feeding habits. Whereas few empty stomachs may be due to post harvest digestion while struggling in fishing gear. This was in line with the studies of Badamasi et al. [31,32], who reported a higher percentage of full stomachs in *T. gallileus* in Jakata dam and *B. bayad* of Rima River respectively hence referring to their feeding intensity as high. However Ipinjolu et al. [29] rather reported higher percentage of empty stomach in *B. bayad* Rima River. The wide food spectrum exhibited by *C. furcatus* revealed tropic flexibility, an ecological advantage that enables a fish to switch from one food category to another in response to fluctuation in their abundance. It also enables species to utilize many different foods effectively. This is an agreement with the findings of [1,33]. The ability of fish to capitalize on any available food items in the environment (*eurypagous*) is an important characteristic of culturally fish species. This implies that *C. furcatus* have brighter prospects for culture in ponds where production of planktons can be significantly influenced by fertilizer application.

Conclusion

During the period of this study and from the result obtained *C. furcatus* population were dominated by female and feed on all type of prey items. The monthly changes recorded for these parameters could have managed implication for resources sustainability. However, further research is needed in this area between the November to April so that the proper assessment of the very important management parameters.

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