International Journal of Fauna and Biological Studies
Available online at www.faunajournal.com

E-ISSN 2347-2677
P-ISSN 2394-0522
www.faunajournal.com
IJFBS 2022; 9(5): 56-61
Received: 07-08-2022
Accepted: 13-09-2022

Odo SN
Department of Fisheries and Aquatic Resources Management, Michael Okpara University of Agriculture, Umudike, P.M.B 7267 Umuahia, Abia State, Nigeria

Iwuji AC
Department of Statistics, Michael Okpara University of Agriculture, Umudike, P.M.B 7267 Umuahia, Abia State, Nigeria

Odo MK
Department of Environmental Management and Toxicology, Michael Okpara University of Agriculture, Umudike, P.M.B 7267 Umuahia, Abia State, Nigeria

Urama KU
Department of Statistics, Michael Okpara University of Agriculture, Umudike, P.M.B 7267 Umuahia, Abia State, Nigeria

Corresponding Author:
Odo SN
Department of Fisheries and Aquatic Resources Management, Michael Okpara University of Agriculture, Umudike, P.M.B 7267 Umuahia, Abia State, Nigeria

Evaluation of abundance, species diversity and well-being of *cichlidae* fish species in Anambra river basin, Nigeria

Odo SN, Iwuji AC, Odo MK and Urama KU

Abstract
Fish abundance and well-being is dependent on the condition of their inhabiting environments and it can be estimated with length-weight relationship and condition factor. In this survey, the abundance of cichlid and length-weight relationships with condition factor 'K' of four dominated species were studied for 10 Months (February, 2019 - November, 2019). A total of 638 individual fish belonging to nine species; *Oreochromis niloticus* (316, 46.68%), *Oreochromis aureus* (77, 11.37%), *Hemichromis fasciatus* (35, 5.17), *Tilapia zilli* (230, 33.90%), tilapia daget (8, 1.18%), *Tilapia guineensis* (1, 0.01%) *Tilapia mariae* (2, 0.03%), *Tylochromis jintkin* (4, 0.04%) and *Sarotherodon galileaus* (5, 0.07%).Ecological index were high; dominance-D (0.322-0478), Simpson index (0.522-0.678), Shannon_H (1.035-1.267), evenness (0.4226-0.8041 and Margelef (0.775-1.772). Wellbeing of four dominants species were *Oreochromis nioloticus* [condition factor, k ranged from 0.69-5.59 (1.79), b (2.83) and r(0.88)], *Tilapia zilli* [k ranged from 1.39-3.05 (2.02), b(3.32), and r(0.93)], *Oreochomis aureus* [k ranged 0.29 -2.90 (1.56), b(1.57) and r(0.90) and *Hemichromis fasciatus* [k ranged from 0.39-2.57(1.87), b (2.27) and r(0.82)]. The 'b' value for the three dominant species showed negative allometric growth whereas *Tilapia zilli* exhibited positive allometric growth in weight (b>3). The present study provided the first baseline data about LWRs and relative condition factor of *cichlidae* fish species from Anambra River Basin and as such the data is valuable for establishing a monitoring and management system of these fish species.

Keywords: Species diversity, fish species in Anambra River, Nigeria

Introduction
Length-weight relationship (LWR) is one of key assessments tools in fishery studies (Ayoade and Ikulala (2007) [27]. It is widely recognized as an important tool in ecology population dynamic and stock management studies (Abdoli and Rasooli, 2008) [1], due to the relationship permits estimating the weight of fish specimen when the total length is known. These relationships are useful for rapid estimation of biomass (Getso *et al*., 2017) [11]. The relationship of length-weight estimates condition factor of the fish species and fish biomass through the length frequency (Fishbase, 2013) [9]. The condition factor is an index reflecting physiological conditions of fishes in relationship interaction between biotic and abiotic factors (Getso *et al*., 2017) [11]. The condition factor varies among fish species in different locations and season.

In ecological studies, the condition factor (K) is employed to evaluate the wellbeing of fish species (Seher and Suleyman, 2012) [25], with assumption that heavier fish of a given length is in a better physiological condition. Fish is said to exhibit isometric growth when length increases in equal proportion with body weight, the regression co- efficient for isometric growth is '3' and values greater than '3' indicates allometric growth (Olurin and Aderibigbe, 2006) [23]

Condition factors and length-weight tools evaluate the well-being of the fishes as well as give insight on the productivity level and the "ecological health" of the ecosystems (Imorou et al., 2019) [4]. Environmental contamination, season and location may affect the growth and condition of fishes. Water quality alterations and intrusions of contaminants in the water body will negatively affect the growth and condition of fishes (Adite *et al*. 2017). Successful fisheries management needs proper knowledge of length-weight relationship and condition factors that represent hosting aquatic environmental status, the quality of the environment (Ecoutin and Albaret 2003) [8].

Thus, the present work seek to proper document length-weight patterns and condition of

dominant fish species of Anambra River Basin in order to evaluate their well-being and enhance database for proper fisheries management of the River.

Materials and Methods

Description of study area

Anambra River basin lies coordinates of N 05° 47”.282 - N 06° 36’’.419 and E 006° 36”.486 -E 007 ^{O} 12″.518 with surface area of approximately 14 014 km^2 (Awachie and Hare 1977) [28]. The River Anambra is approximately 207.4 km in length, rising from the Ankpa hills (ca. 305-610m above sea level) and discharging into the River Niger at Onitsha. There are two main seasons, the dry season (November – March) and the rainy season (April – October) with annual temperature and precipitation range from 24 ºC to 31ºC and 5 cm to 85 cm, respectively (Odo 2004) [18]. Lower section of Anambra

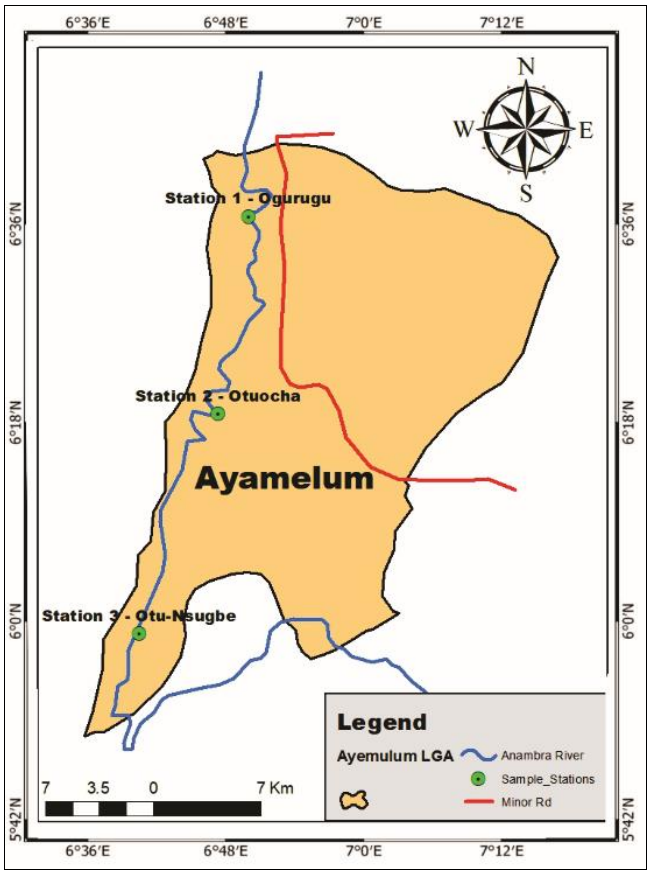

Fig 1: Map of study Area covering three sampled stations (GPS, 2019)

Description of Sampled Points

Sampling was done across three fishing points: Ogurugu, Otuocha and Otu-Nsugbe. The fishing points are associated with numerous anthropogenic activities such as daily market along its bank mechanical dredging, laundry, swimming, fishing, extraction of drinking water, extraction of water for irrigation, manual sand mining, and farming (rice, cassava), at flood plain, transportation of different goods and human being and lumbering. The surface was partially canopied with aquatic plants and the flow velocity was moderate

Fish Sample Collection and Identification

A total of 638 individual fish of *cichlidae* family were collected from fishermen at the landing sites in Anambra River basin from February 2019 to November 2019. These samples were caught with different fishing gears. Fish specimens was identified from monographs, description checklist and fish identification guide of Olaosebikan and Raji (1998) [21], Idodo-Umeh (2003) [12] and Fish Base databases (Froese and Pauly, 2018) [10].

Laboratory procedure

The total length (TL) of the fish was measured from the tip of the anterior part of the mouth to caudal fin using meter ruler calibrated in centimeter. Fish weight of individual fish was measured to the nearest ‘g’ with an electronic balance (exthech instruments, SC600) after removing the adhered water and other particles from the body surface.

Statistical analysis

The relationship between length and weight of fish was expressed by equation [Pauly, 1983] [10]: $W = aL^b$

Where
W = the weight (g) of fish in grams
L = The Total length of fish in centimeters
a = Exponent describing the rate of change of weight with length (= the intercept of the regression line on the Y axis)
b = the slope of the regression line (also referred to as the Allometric coefficient)
The log transformed data gave a regression equation. Log w = log a + b log L

Where
a = the slope
b = the regression co-efficient

Condition factor

The condition factor (k) of the experimental fish was estimated from the relationship: $K = 100\ w/L^b$

Where
W = Weight of the fish in grams
L = the total length of the fish in centimeters
b = the value obtained from the length-eight equation formula.

Results and Discussion

A total of 683 individual fish belonging to nine species of *cichlidae* was registered. Four dominants species are: *Oreochromis niloticus* (316 individual fish) with relative abundance of 46.68%, followed with *Tilapia zilli* (230 individual fish) with relative abundance of 33.97%, *Oreochromis aureus* (77 individual fish) with relative abundance of 11.37% and *Hemichromis fasciatus* (35) with relative abundance of 5.17. The highest number of individual fish was registered in May, 2019 among the four dominant species with exception of *Hemichromis fasciatus* which was caught highest on July (Table 1) whereas the lowest catch was registered in February in the four dominated species. The total of individual fish under encountered species were quite higher than numbers recorded by Odo et al. (2009) [19] in the same river basin and. The variation could be attributed to flooded fish into the river basin resulting form 2012 and 2015 flood incidents experienced in the area. However, Oladipo et al. (2021) registered high fish catch for *O. niloticus* (N = 375), *T. zilli* (N = 309), and *O. aureus* (N = 69) in upstream of Jebba Hydro-Electric Power (HEP) dam

Table 1: Summary of mean seasonal variation of species diversity and relative abundance (Cichlidae)

Species	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Rel. Abund. (%)
Hemichromis fasciatus	1	13	3	4	0	7	1	1	2	3	35	5.17
Oreochromis aureus	1	2	0	24	1	1	13	14	18	3	77	11.37
Oreochromis niloticus	5	35	24	84	10	15	44	26	32	41	316	46.68
Tilapia daget	0	1	0	3	0	0	0	0	3	1	8	1.18
Tilapia zilli	3	12	11	69	38	25	37	7	14	14	230	33.97
Tilapia guineensis	0	0	0	0	1	0	0	0	0	0	1	0.01
Tilapia mariae	0	0	0	0	2	0	0	0	0	0	2	0.03
Tylochromis jentinki	0	0	0	0	3	0	0	0	0	1	4	0.04
Sarotherodon galilaeus	0	0	1	0	2	0	2	0	0	0	5	0.07
No of individual fish	10	63	40	178	59	48	99	48	75	63	683	

The diversity analyses (Table 2) showed no significantly ($p > 0.05$) across the months. The diversity indexes of fish species were presented in table 2. The dominance-D ranged from 0.3216 (October) - 0.478 (November, 2019), SIMSON_1-D were between 0.522 (November) - 0.6784 (October, 2019), Shannon _ H ranged between 1.035 (November, 2019) - 1.267 (October, 2019). Evenness and Magarlef were between 0.4226 (June, 2019) – 0.8041 (February, 2019 and 0.775 (September and July, 2019) -1.303 (February, 2019). The results of diversity indices with the results obtained by Odo et al. (2009) [19] in the same river basin and Emmanuel and. Modupe (2010) [29] in in Three Tributaries of River Ore, South West, Nigeria. Magarlef's ecological index values > 3.0 point out clean water and vales < 1.0 indicate adverse pollution and intermediate values indicate moderate pollution (Lenat et al, 1980) [15]. Shannow_H values > 3.0 indicate stable and balanced habitat structure (Akindele AND Adeniyi 2013) [4]. There two ecological indices revealed that Anambra River Basin is polluted, unstable and unbalance habitat structure for cichlidae fish species.

Table 2: Diversity Indices for the Seasonal Distribution of Cichlidae in Anambra River Basin

	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Taxas	4	5	5	5	8	4	6	4	5	6
Individuals	10	63	40	178	59	48	99	48	75	63
Dominance_D	0.36	0.3888	0.4425	0.384	0.4502	0.3906	0.3554	0.4002	0.3216	0.478
Simpson_1-D	0.64	0.6112	0.5575	0.616	0.5498	0.6094	0.6446	0.5998	0.6784	0.522
Shannon_H	1.168	1.143	1.04	1.108	1.218	1.065	1.199	1.053	1.267	1.035
Evenness_e^H/S	0.8041	0.6274	0.566	0.6054	0.4226	0.725	0.5527	0.7165	0.7099	0.4693
Margalef	1.303	0.9655	1.084	0.7719	1.717	0.775	1.088	0.775	0.9265	1.207

The results of the Length weight relationship are presented in (Table 3). The length weight relationship is an important tool for estimation of the mathematical relationship between length and weight. It is also useful to measure the condition, i.e., the variation from the expected weight for length of individual fish or group of individual as an indication of fatness, general well-being and gonad development, etc. [21]. Total length (TL) and body weight (BW) of *O. niloticus* varies from 9.53- 34.20 and 19.80-728.50 respectively. The highest TL (34.20 cm) and BW (728.5) was registered in May and August, 2019 respectively while the least of both total length and body weight were registered in November, 2019. Total length (TL) and body weight (BW) of *O. aureus* varies from 7.80 - 21.4 cm and 14.00-98.10 g respectively. Both the highest (21.40cm) and the least total length (7.80 cm) of *O. aureus* were recorded in Total length and body weight of *Tilapia zilli* varies from 10.8 cm (May, 2019) – 19.80 cm (May, 2019) and 29.4 g (June, 2019) – 195.0 g (March, 2019) respectively. The total length of Tilapia zilli registered in this current study was lower compared to value (27.5cm) recorded by Odo et al. (2009).Total length of *Hemichromis fasciatus* varies from 9.5 cm (July, 2019) – 24.6 cm (March, 2019) whereas the body weight varies from 22.0 g (July , 2019) – 315.8 g (March,2019). The maximum total length (24.6cm) registered for *Hemichromis fasciatus* agreed with Ecoutin and Albaret (2003) [8] in the Ebrie Lagoon (TLm = 23 cm) in Ivory Coast.

Table 3: Summary of body indices of four dominated *Cichlidae* species in Anambra River Basin.

Species	Total number	BW Range(g)	TL Range(cm)	BW Mean (g)	TL Mean(cm)	'a'	'b'	'R^2'	W= aLb
O.niloticus	316	19.8-728.5	9.53-34.20	213.89	20.99	-1.57	2.83	0.77	$W= -1.57TL^{2.83}$
O. aureus	77	14.0 -98.1	7.8-21.4	38.88	14.49	-0.24	1.57	0.82	$W= - 0.24TL^{1.57}$
T.zilli	230	29.4-195.0	10.8-19.8	71.87	14.61	- 2.04	3.29	0.87	$W= -2.047TL^{3.29}$
Hemichromis fasciatus	35	22.0-315.8	9.5-24.6	93.011	15.633	-0.94	2.27	0.65	$W= - 0.94TL^{2.27}$

Species	No. of individual fish	Relative Abundance (%)	Min. K	Max. K	Mean K	'r'
Oreochromis niloticus	316	57.00	0.69	5.54	1.79	0.88
Oreochromis aureus	77	11.89	0.29	2.90	1.56	0.90
Tilapia zilli	230	34.10	1.39	3.05	2.02	0.93
Hemichromis fasciatus	35	5.01	0.39	2.57	1.87	0.82

Length-weight relationship and condition factor

The Length-weight relationship among pairs of plotted data, values of determination coefficients (R) are demonstrated in Table 3. The value of the regression coefficient obtained from

the LWR were 0.88, 0.90, 0.93, and 0.82 for *O. niloticus*, *O.aureus*, *Tilapia zilli* and *Hechromis fasciatus* respectively. There was a significant correlation between length and weight. Allometric coefficients (b) varied from 1.57 (*Oreochromis aureus*) - 3.29 (*Tilapia zilli*). Species *Oreochromis niloticus*, *Oreochromis aureus* and *Hemichromis fasciatus* exhibited negative allometric coefficients ($b < 3$; $p < 0.05$).The results of ''b'' in this survey were not in line with values (K) of *Oreochromis niloticus* and *Hemichromis fasciatus* registered by Imorou et al.(2019) from Okpara Stream, Oueme River, Northern-Benin. The variations may be ascribed to habitat disturbances, quantity of natural food available and weather variability.

In this survey, condition factors (K) varies between 0.30 - 5.543. The mean condition factor (K) for the four dominated species were 1.79, 1.56, 2.02, and 1.87 for *O. niloticus*, *O.aureus*, *Tilapia zilli* and *Hechromis fasciatus* respectively. The mean condition factors (K) registered in this survey indicates that the four dominants species were in good condition and were in agreement with the findings of Ighwela et al.(2011) in feeding experiment with oreochromis niloticus and within the range(1.80 - 2.60) recorded in Tilapia zilli by Odo et al.(2009) [19] in survey of study in the same river basin. Nehemia et al. (2012) [17] reported quite similar K values of 2.07 for *Tilapia zilli* in freshwater natural pond in Tanzania. Bennet (1970) [6] pointed out that fishes with condition factor value more than 0.56 are considered to be in good condition but Ayode (2011) [5] opined that condition factor higher than one suggests good fish health condition. Variations in the condition factor among the four species may be attributed to age, physiological state of fish and tolerance limit of the fish. Changes in condition factors of many fishes is believed to be associated with their reproductive cycle (Narejo et al, 2002) [16], feeding rhythms, physico-chemical factors of environment, age, or some other unknown factors (Dar et al., 2012) [7]. In this study, the mean condition factors obtained for the four fishes were above 1.50, which is an indication that the environment in which the fishes thrives is favorable.

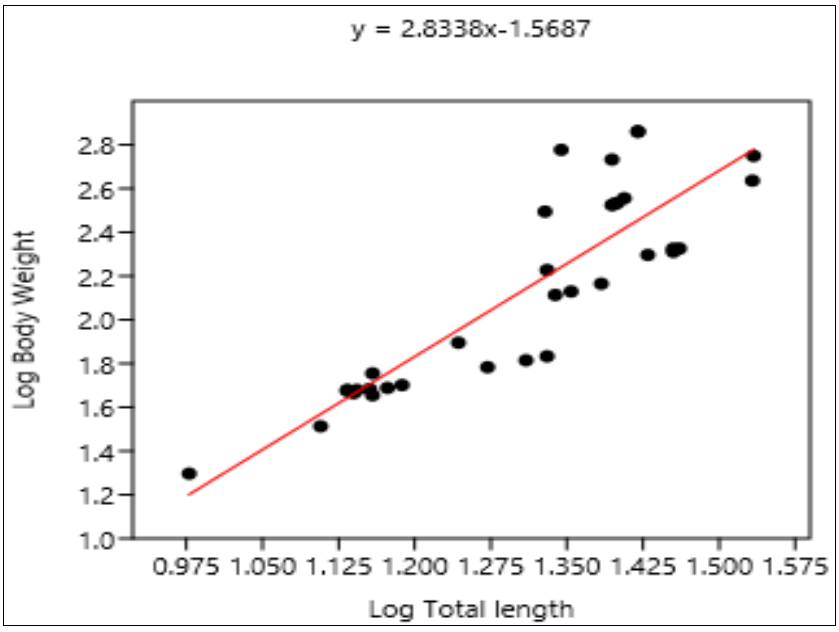

Fig 2: Scatter diagram showing length-weight relationship of Oreochromis niloticus

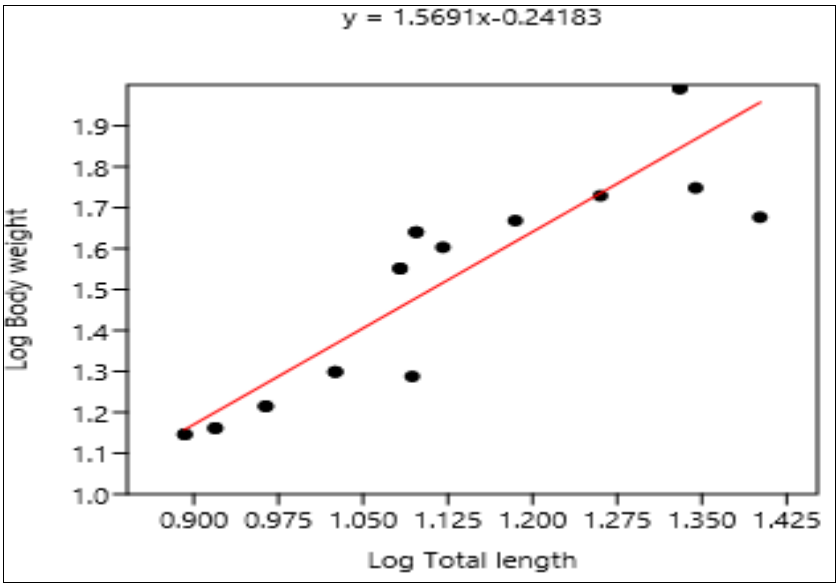

Fig 3: Scatter diagram showing length-weight relationship of Oreochromis aureus

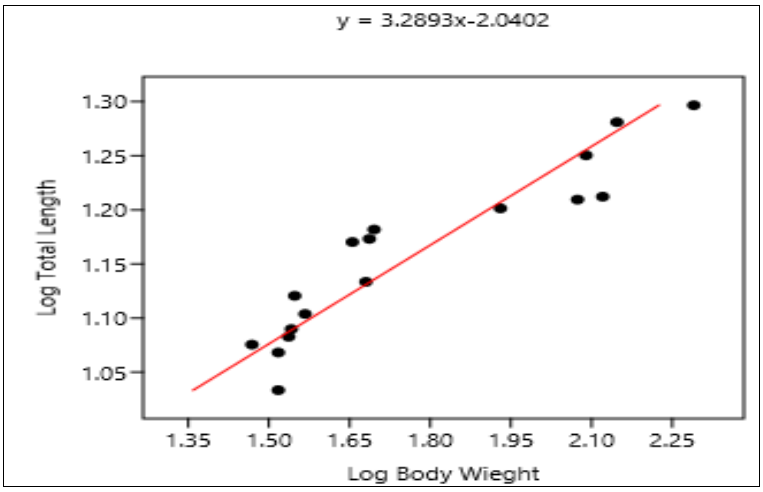

Fig 4: Scatter diagram showing length-weight relationship of Tilapia zilli

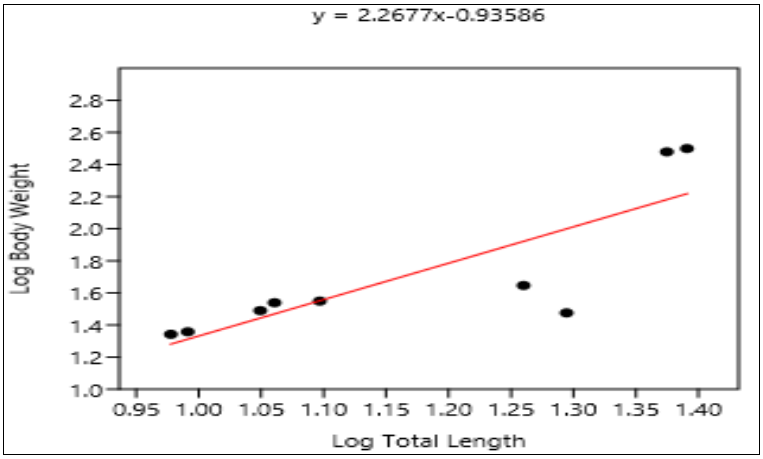

Fig 5: Scatter diagram showing length-weight relationship of Hemichromis fasciatus

Acknowledgement
Authors acknowledge the Directorate of Research and Development, Michael Okpara University of Agriculture Umudike, Umuahia Abia State Nigeria for providing funds for this project through Tertiary Education Trust Fund (TET fund), Nigeria.

Conclusion
The current study provided the first baseline data about LWRs and relative condition factor of *Cichliae* fish species from Anambra River Basin after inception of annual floodin 2012. Such data is valuable for establishing a monitoring and management system of these fish species. Based on the results of ecological indices, Anambra River Basin is unstable and unbalance habitat structure for *cichlidae* fish species it harbours. Therefore, it is important to advise that there is a need urgent attention and constant monitoring to save fish species inhabiting in the river basin.

References
1. Abdoli A, Rasooli P. Length-weight relationship of 10 Species of fishes collected from Iranian fresh waters, Journal of Applied Itchyology. 2008;22:156-157.
2. Adite A, Gbaguidi HMAG, Ibikounle M. Growth patterns and Fulton's condition factor of the silver catfish Chrysichthys nigrodigitatus (Actinopterygii: Siluriformes: Claroteidae) from a sanddragged man-made lake of Benin. African Journal of Agricultural Research. 2017;12(27):2283-2294. DOI: 10.5897/AJAR2017.12375
3. Agali GN, Edema CU. Physico- chemical characteristics, diversity and relative abundance of fishes of Obueyinomo River, Southern Nigeria. European International Journal of Science and Technology. 2016;5(8):1-10.
4. Akindele EO, Adeniyi IF. Zooplankton composition and community structure in Lake Tiga, Kano, Nigeria. African Journal of Aquatic Science. 2013;38(3):279-286.
5. Ayode AA. Length -Weight Relationship and Diet of African Carp Labeo ogunensis (Boulenger, 1910) in Asejire Lake Southwestern Nigeria. J. Fisheries and Aquatic Sci.; c2011. p. 1816-4927.
6. Bennet GW. Management of lakes and ponds. Van Nostrand Reinhold, New York; c1970. p. 385.
7. Dar SA, Najar AM, Balkhi MH, Rather MA, Sharma R. Length weight relationship and relative condition factor of Schizopyge esocinus (Heckel, 1838) from Jhelum River, Kashmir. Int. J Aqua Sci. 2012;3:29-36.
8. Ecoutin JM, Albert JJ. Length -weight relationship of 52 fish species from West African estuaries and lagoons. Cybium. 2003;27:3-9.
9. Fishbase. Online fish identification sheet. 2013. Available at http://www.fishbase.org/search.php, accessed on 10/06/2013
10. Froese R, Pauly D. Editors. Fish Base. World Wide Web electronic publication. 2018. www.fishbase.org, version (01/2019)

11. Getso BU, Abdullahi JM, Yola IA. Length-Weight Relationship and Condition Factor of Clarias gariepinus and Oreochromis niloticus of Wudil River, Kano, Nigeria. Journal of Tropical Agriculture, Food, Environment and Extension. 2017;16(1):1-4.
12. Idodo-Umeh G. Freshwater fishes of Nigeria: taxonomy, ecological notes, diet and utilization Benin-City, Nigeria: Idodo-Umeh Publ., 2003, 232.
13. Ighwela A, Ahmed AB, Abol-Munafi AB. Condition Factor as an Indicator of Growth and Feeding Intensity of Nile Tilapia Fingerlings (Oreochromis niloticus) Feed on Different Levels of Maltose Keri. American-Eurasian J. Agric. & Environ. Sci. 2011;11(4):559-563.
14. Imorou RS, Adite A, Sossoukpe E, Abou Y. Length-weight models and condition factors of fishes from Okpara Stream, Oueme River, Northern-Benin. International Journal of Forest, Animal and Fisheries Research (IJFAF). 2019;3(3):65-80. https://dx.doi.org/10.22161/ijfaf.3.3.1
15. Lenat DR, Smock LA, Penrose DL. Use of benthic macroinvertebrates as indicators of environmental quality. In: Douglass LW (ed.), Biological monitoring for environmental effects. Toronto: Lexington Books; c1980. p. 97-114.
16. Narejo NT, Rahmatullah SM, Mamnur M. Length-weight Relationship and Relative condition factor (Kn) of Monopterus cuchia (Hamilton). Indian J Fis. 2002;8:54-59. 36.
17. Nehemia A, Maganira JD, Rum C. Weight relationship and condition factor of tilapia species grown in marine and fresh water ponds. Agriculture and Biology Journal of North America. 2012;3(3):117-124.
18. Odo GE. Studies on the ecology of macro invertebrate fauna as fish food in Anambra river basin, Nigeria. Ph.D. Thesis. University of Nigeria, Nsukka, Nigeria; c2004. p. 192.
19. Odo GK, Nwani CD, Eyo JE. The fish fauna of Anambra River Basin, Mageroa Species abundance and morphometry. Revista de Biología Tropical. 2009;57(2):177-186.
20. Oladipoab SO, Nnejic LM, Iyiolab OA, Nnejid IC, Ayoolac AO, Adelakune KM, *et al*. Patterns of ichthyofaunal diversity and distribution across Jebba Hydro-Electric Power (HEP) dam, Jebba, north-central Nigeria. Brazilian Journal of Biology. 2021;81(2):258-26. https://doi.org/10.1590/1519-6984.222952
21. Olaosebikan BD, Raji A. Field guide to Nigerian freshwater fishes New Bussa: Federal College of Freshwater Fisheries Technology; c1998.
22. Olufemi LO, Sellu JM, Mansaray A. Length-weight Relationship and Condition Factor of Notopterus afer (Günther, 1868) and Lates niloticus (Linnaeus, 1762) in river Jong, Sierra. Journal of Fisheries and Life Sciences. 2019;4(1):15-18.
23. Olurin KB, Aderibigbe OA. Length-weight relationship and condition factor of pond reared Oreochromis niloticus. World Journal of Zoology. 2006;1(2):82-85.
24. Pauly D. Some simple methods for the assessment of tropical fish stock. FAO Fish. Tech. Paper No. 1983. p. 234-52.
25. Seher D, Suleyman CI. Condition factors of seven cyprinid fish species from Çamligöze Dam Lake on central Anatolia, Turkey. African Journal of Agricultural Research. 2012;7(31):4460-4464.
26. Ujjania NC, Kohli MPS, Sharma LL. Length-weight relationship and condition factors of Indian major carps (*C. catla*, L. rohita and C. mrigala) in Mahi Bajaj Sagar, India. Research Journal of Biology. 2012;2(1):30-36.
27. Ayoade AA, Ikulala AO. Length weight relationship, condition factor and stomach contents of Hemichromis bimaculatus, Sarotherodon melanotheron and Chromidotilapia guentheri (Perciformes: Cichlidae) in Eleiyele Lake, Southwestern Nigeria. Revista de biologia tropical. 2007 Dec;55(3-4):969-77.
28. Awachie JB, Hare L. The fisheries of the Anambra, Ogun and Oshun river systems in Southern Nigeria. InFAO, Rome (Italy). Fisheries Dept. Symposium on River and Floodplain Fisheries. Bujumbura (Burundi). 21 Nov 1977. 1977.
29. Emmanuel LO, Modupe OO. Fish diversity in three tributaries of River Ore, South West, Nigeria. World Journal of Fish and Marine Sciences. 2010;2(6):524-31.