

Original Research Article

Length-Weight Relationship, Morphometric Characteristics and Age Determination of *Oreochromis niloticus* Caught from Onah Lake, Asaba, Nigeria

¹Okoro, P.U. ²Ikenga E.E; ³Garba, A.A. and ¹Olele, N.F.

¹Department of Fisheries,
Delta State University, Abraka, Nigeria

²Federal College of Education (Technical)
Asaba, Nigeria

³Department of Fisheries and Aquaculture
Bayero University, PMB 3011, Kano, Nigeria

Corresponding Author: nfolele@gmail.com; +2348062905921

Received 22nd October, 2018; Accepted 21st January 2019; Corrected 21st March 2019

Abstract

Essential biological parameters such as length-weight relationships, morphometric characterization of body parts, length frequency histogram and eye diameter, were investigated for three months, in ninety-eight (98) specimens of *Oreochromis niloticus* purchased from fishermen by the bank of Onah Lake, Asaba, Nigeria. Data analysis showed that the regression coefficients were significant for male ($r^2=0.634$) and female ($r^2=0.704$) specimens. Morphometric characterization of body parts showed that female specimens attained higher values for total length (14.68 ± 0.87 cm), standard length (12.18 ± 0.41 cm), body weight (89.52 ± 6.28 g), left eye diameter (0.63 ± 0.02 mm) and right eye diameter (0.62 ± 0.02 mm) than their male counterparts whose values were 11.82 ± 0.56 cm, 10.09 ± 0.40 cm, 64.71 ± 6.69 g, 0.53 ± 0.02 mm and 0.51 ± 0.02 mm for same afore-mentioned body parts respectively. The specimens attained one year old (1^+) at a modal length of 71-81mm. Specimens that attained 2^+ , 3^+ , and 4^+ years of age ranged between 93-125mm, 136-147mm and 148-220mm in body length respectively. Also, eye diameter increased by approximately 0.01mm with each unit increase in age, as shown by the values of 0.03, 0.05, 0.06 and 0.07 at ages 1^+ , 2^+ , 3^+ , and 4^+ years respectively. It was concluded that although female *Oreochromis niloticus* had higher values in terms of morphometric characterization of body parts, regression coefficients involving these values were significant for both sexes. Moreover, eye diameter and standard length of the fish proved to be most conducive for determining the age of *Oreochromis niloticus* specimens from Onah Lake, Nigeria.

Keywords: Morphometric characterization, *Oreochromis niloticus*, age, length-weight relationship

Introduction

Determination of essential biological parameters such as length-weight relationships, morphometric characterization of body parts, and eye diameter in fish is important in understanding

Copyright © 2019 by The Faculty of Agriculture, Delta State University, Abraka, Nigeria

This work is under Open Access within the terms of the [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

changes in the fishery of any water body. Such parameters are used in fisheries science to estimate stocking, growth, mortality and productivity that guide management decisions regarding harvest strategies and conservation programs (Maceina *et al.*, 2007).

Fish age is a significant of all biological parameters, because it provides the means to examine the population structure of the fish species. Age data of a fish population therefore play a vital role in its sustainable management because it is the key component of most stock assessments (Appelberg *et al.*, 2005). Length frequency data provide valuable information with which the life history of a fish species can be estimated. However, the reliability of the analysis does not only depend largely on sampling strategy adopted, but also on the size of the samples investigated. Fish length provides a measure of growth with which other populations across a species' native and non-native ranges can be compared. Fish age data can be obtained through various means: including direct use of known age of individual species, analysis of length-frequency histograms and interpretation of hard parts.

Selection of any method for age estimation in fish requires balancing precision and accuracy of the method within the limitation of the sample size. There has been a tendency to view fish age estimation as an art rather than a science. Nonetheless, fish age estimation is not a creative process but a diagnostic and analytical one that increases and strengthens with practice, knowledge and experience (Morison *et al.*, 2005). The present study investigated different biological parameters in *Oreochromis niloticus* caught from Onah Lake.

Materials and Methods

The description and map of Onah Lake is presented in (Olele and Obi 2004). The study lasted for three months (March to May, 2018). Collection of fish specimens was done immediately after fish capture from the Lake, and the fish placed in an ice-chest to maintain freshness. The specimens were sorted into sizes and identified using the key published by Idodo-Umeh (2003).

The sexes of mature specimens were determined by visual observation of the ventral side of the fish, where the presence of two reddish round swellings of at the position of the genital aperture was indicated female, while the presence of a protruded genital papilla indicated male. Immature specimens were dissected, and the smear of their gonads viewed under a binocular microscope, after histological preparation.

Lengths of body parts and body weights were measured to the nearest 0.1cm and 0.1g respectively. Length-weight relationship and condition factor were determined according to procedures described by Datta *et al.* (2013).

Results

The length and weight relationships of male specimens are presented in Figure 1, which shows the statistical significance of log of body weight ($\log W=2.439$), log of standard length ($\log L=68.49$) and coefficient of determination ($R^2=0.634$).

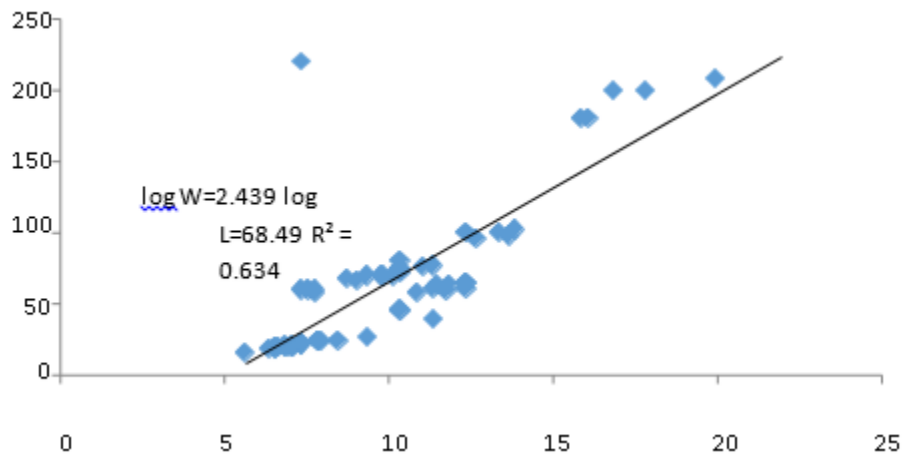


Figure 1: Length-weight relationship of male *Oreochromis niloticus*

The length-weight relationship of female specimens is presented in Figure 2. The result shows the statistical significance of log of body weight ($\log W=1.182$), standard length ($\log L=67.06$) and coefficient of determination ($R^2=0.704$)

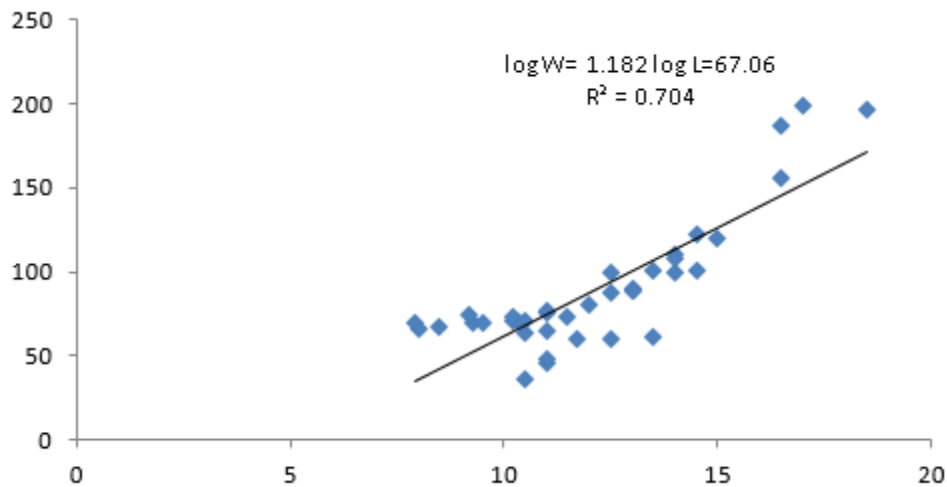


Figure 2: Length weight relationship of female *Oreochromis niloticus*

The morphometric measurement of specimens is presented in Table 1. The result shows that females specimens recorded the highest higher mean values in all parameters: namely standard length (12.18 ± 0.41 cm), total length (14.68 ± 0.57 cm), body weight (89.52 ± 6.28 g), left eye diameter (0.62 ± 0.02 mm) and right eye diameter (0.62 ± 0.02 mm) than for male specimens with

10.09±0.40 cm, 11.82 ± 0.56 cm, 64.71±6.69 g, 0.53±0.02 mm and 0.51±0.02 mm values respectively.

Table 1: Morphometric measurements of *Oreochromis niloticus* caught from Onah Lake.

Morphometric Parameters	Male	Female
Standard length (cm)	10.09 ± 0.40	12.18 ± 0.41
Total length (cm)	11. 82 ± 0.56	14.68±0.57
Body Weight (g)	64.71 ± 6.69	89.52 ± 6.28
Left eye diameter (mm)	0.53 ± 0.02	0.62 ± 0.02
Right eye diameter (mm)	0.51 ± 0.02	0.62 ± 0.02

The sex ratio and condition factor of specimens is presented in Table 2. Male specimens were more in number (60) than the females (38) specimens, which resulted in a sex ratio of 1:0.6. Female fish accounted for a higher K value (0.37) as against that of male fish the least value thus which was 0.24.

Table 2. Sex ratio and condition factor of *Oreochromis niloticus* caught from Onah Lake

Parameter	Male	Female
Number per sex type	60	38
Condition Factor	0.239	0.374

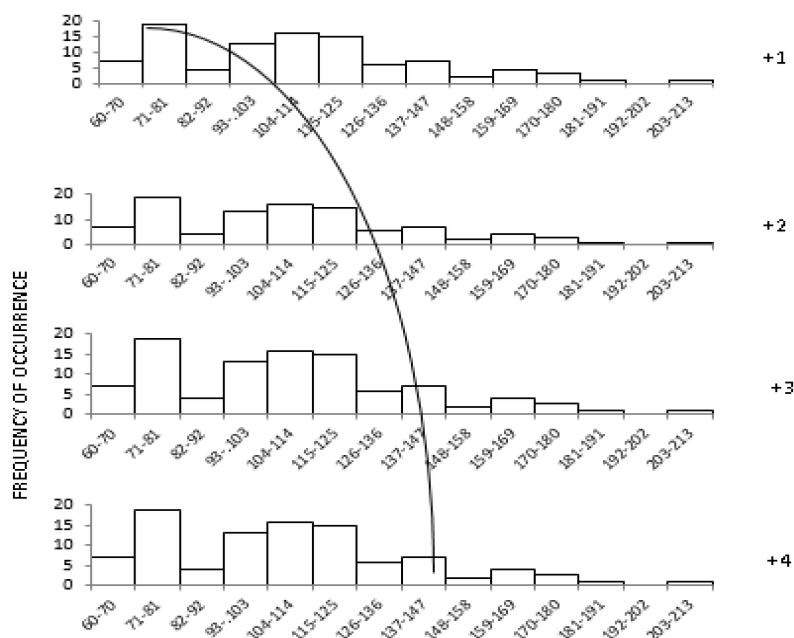


Figure 3: Standard length frequency histogram of specimens

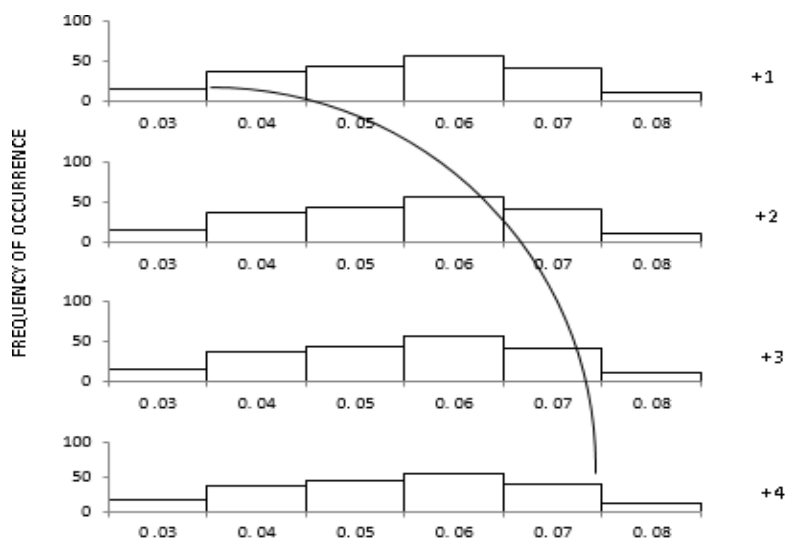


Figure 4: The length frequency histogram of eye diameter of specimens

The length-frequency histogram revealed that the specimens attained one year (1⁺) at a total length of 71-81 mm. Specimens that attained 2⁺, 3⁺ and 4⁺ years ranged from 93-125 mm, 136-147 mm and 148-220 mm in total length measurements respectively (Figure 3).

The length frequency histogram showed that the specimens increased in eye diameter by approximately 0.01 mm at each age interval as shown by the values (0.03, 0.05, 0.06 and 0.07) for ages 1⁺, 2⁺, 3⁺ and 4⁺ years plus respectively (Figure 4).

Discussion

The graphical presentation of results of the standard length-frequency distribution, and eye diameter histograms showed that *Oreochromis niloticus* from Onah Lake was within the age range of 1⁺ to 4⁺ years with a modal distribution of length frequency histogram values of 71-81mm, 93-125mm, 136-147mm and 148-220mm for the ages stated. These values were above the report (25.86-31.90mm) established by Lawal *et al.* (2010). The record of total length range, stated in this study was 8.03 – 25.0cm, and body weight 5.80g to 18.50g. Both values are lower and therefore not comparable with those of Abari *et al.*, (2015) who reported 12.5 – 22.5cm and 34 – 201.4g for same parameters respectively in *O. niloticus*. Dan-Kishiya (2013) also reported a total length range of 10.74 – 11.94cm, and body weight range of 23.89 – 31.94 for *Oreochromis niloticus*, which are also at variance with values obtained in the present study. Factors such as differences in habitat may have influenced these variations.

Length and weight of fish play a significant role in fishery management, because they give an indication of fish weight at a given body length, as well as the well-being of the fish population, their maturity and their growth.

The present study revealed a dominance of male (60) over female (38) specimens. Various reasons have been adduced for variations in sex ratio. Olele (2008) reported that differences in sex ratio could arise from differences in gear selectivity. Variations could also be explained by seasons because once the eggs are fertilized, the females hide under vegetation for incubation, protection and feeding thus making them less vulnerable to capture (Idodo-Umeh, 2003).

Length - weight relationships usually show positive or negative allometric growth based on the “*b*” value. Values above 3 indicate positive allometry, whereas values below 3 show negative allometry (Baijot *et al.*, 1997). The specimens used in this study exhibited negative allometric growth because their “*b*” values were less than 3. Olele and Obi (2004) reported positive allometric growth with a value of 3.1. Khaironizam *et al.* (2002) also reported values ranging from 2.5 – 3.5 for “*b*” values. Differences in these values could be due to sex, maturity stages, seasonality, and time of day food was eaten or available to the fish which could be shown by fullness of stomach content.

A condition factor (*K*) greater than or equal to one (1), was the standard for an excellent well-being of fish species.. This study reported a mean “*K*” value less than 1 (0.239 and 0.374) for male and female specimens respectively. This observation shows that the fish specimens experienced poor well-being suggesting that food was not readily available for their consumption; especially at the time of this study. Values obtained in this study were below values (0.77-1.80) reported by Boyd (2004) for *Parachanna obscura* in Cross River, Nigeria. Morison *et al.* (2005) reported a value of 0.44 for male and 1.74 for female *Clarias gariepinus* obtained from Kainji, Nigeria. Araoye *et al.* (2008) reported 1.67 for male and 0.53 for female with a mean value of 0.95 for both sexes of *Parachanna obscura*. According to Ali *et al.* (2015) the mean condition factor of *Oreochromis niloticus* was 1.69, with the best conditions being realized in the dry months of April and May, in which they recorded values of 1.74 and 1.94 respectively. These reports were in contrast with those of the present study.

The present study showed that eye diameter and standard length frequency histogram could be used to determine age of *Oreochromis niloticus*. However, further studies are recommended using specimens found in other regions or those occurring at different seasons to age other species of fish.

References

- Abari, M.A., Usman, M. and Yusuf, K. (2015). Food and feeding habit of Nile Tilapia (*Oreochromis niloticus*).in Doma Dam, Nasarawa State, Nigeria. *PAT June* 11(1): 67-74.

- Ali, A., Sam, A., Zahra, A.L. and Addi, E. (2015). Feeding habits and condition factor of *Oreochromis niloticus* in Lake Alau, Northeastern Nigeria. *International Journal of Fisheries and Aquatic Studies* 3(1): 406-409.
- Appelberg, M., Formigo, N., Geffen, A.J., Hammer, C., McCurdy, W.J., Modin, J., Moksness, E., Mosegaard, H., Morales-Nin, B., Troadec, H. and Wright, P. (2005). A cooperative effort to exchange age reading experience and protocols between European fish institutes. *Fisheries Research* 76(8):167-713.
- Araoye, P.A., Fagade, S.O. and Jeje, C.Y. (2008). Age and growth study of *Syndontis schall* (Teleostei: Mochokidae) in the environment of Asa Dam, Ilorin, Nigeria. *Nigeria Journal of Pure and Applied Sciences* 17(10):1235-1243.
- Baijot, E.J, Moreau, J. and Bouda, S. (1997). *Hydrobiological Aspects of Fisheries in Small Reservoirs in Sahel Region*. Technical Centre for Agricultural and Rural Cooperation (ACP-EU).The Hague, Netherlands.
- Boyd, E.C. (2004). Farm-level issues in aquaculture certification: Tilapia. Report commissioned by WWF-US in 2004. Auburn University, Alabama, 36831.
- Dan-Kishiya, A.S. (2013).Length tropical water supply reservoir in Abuja, Nigeria. *American Journal of Research -Weight relationship and condition factor of five fish species from a Communication* 1(9):32-41.
- Datta, S. N; Kaur, V. I , Dhawan, A and Jassal, G. (2013). Estimation of length-weight relationship and condition factor of spotted snakehead *Channa punctata* (Bloch) under different feeding regimes. [Springerplus](https://doi.org/10.1186/2193-1801-2-436). 2013 Sep 4; 2:436. doi: 10.1186/2193-1801-2-436. eCollection 2013.
- Idodo-Umeh, G. (2003). *Freshwater fishes of Nigeria (Taxonomy, Ecological notes, diets and utilization)*. Idodo-Umeh Publishers Limited, Benin City, Nigeria. 232pp.
- Khaironizam, M.Z., Norma, Z. and Rashid, Y. (2002).Length-weight relationship of mudskippers (*Gobudae: xudercinae*) in the coastal areas of Selangor, Makaysia, NAGA. *The ICLARM Quartely* 25(4): 20-22.
- Lawal, M.O., Sangoleye, O.J. and Seriki, B.M. (2010).Morphometry and diet of *Chrysichthy snigrodigitatus* (Lacepede, 1803) in Epe Lagoon, Nigeria. *African Journal of Biotechnology* 64(9):7955-7960.
- Maceina, M.J., Boxrucker, J., Buckmeier, D.L., Scott, R., Gangl, D.O., Lucchesi, D.A., Isermann, A., Jackson, J.R. and Martinez, P.J. (2007). Current status and review of freshwater fish ageing procedures used by state and provincial fisheries agencies with recommendations for future directions. *Fisheries* 32(9):329-340.
- Morison, A.K., Burnett, J., McCurdy, W.J. and Moksness, E. (2005). Quality issues in the use of otoliths for fish age estimation. *Marine and Freshwater Research* 56(34):773-782.

- Olele, N.F. and Obi, A. (2004). Reproductive biology of *Citharinus citharusin* Onah Lake, Asaba. Delta State. of Nigeria. ISSN: 0795-0101. *Tropical Freshwater Biology*. 12/13: 119 – 129. Faculty of Science. University of Benin, Benin City. Nigeria
- Olele, N. F. (2008). Reproductive biology of *Heterotis niloticus* in Onah Lake, Delta State, Nigeria. *Journal of Sustainable Tropical Agricultural Research (JoSTAR)*. Vol 28, 59-68. Faculty of Agriculture. University of Uyo, Uyo, Nigeria.