



SEX IDENTIFICATION IN *HETEROTIS NILOTICUS* (CUVIER, 1829) USING MORPHOMETRIC AND MERISTIC CHARACTERS FROM ALAU LAKE, BORNO STATE NIGERIA

*Mohammed, Z. B., Diyaware, M. Y., Umar, H. M., Agaji, M. I and Aliyu, M.

Department of Fisheries, Faculty of Agriculture, University of Maiduguri.

Corresponding authors email: zbmohammed@unimaid.edu.ng Phone number: 07039798743

ABSTRACT

Sex identification in *Heterotis niloticus* based on morphometric and meristic structures was carried out in Maiduguri with the aim of sex differentiating in *Heterotis niloticus* using morphological structure. Twenty (20) adults males and females *Heterotis niloticus* were randomly collected from Alau lake and conveyed to fish hatchery complex of department of fisheries university of Maiduguri. The weight and length of each specimen were taken using a top-loading weighing balance and a meter rule. Morphometric measurements such as ratio of dorsal fin length, pre-dorsal fin length, head length, peduncle length, anal fin length, pectoral fin length, pelvic fin length, caudal fin length, the standard length were measured while the meristic characters counted include the number of lateral lines, sensory pits, number of genital openings, number of anal, pelvic, dorsal, caudal and scales above the lateral line. The data obtained from the experiment were subjected to descriptive and inferential analysis using Statistix 8.0 as a package. The result shows that, both the morphometric and meristic characters were the same for both sexes. However, the presence of small papillae on a loop separating the two openings in the male differentiates the male from the female. Therefore, meristic features can be used to identify male *Heterotis niloticus* fish especially during selection for breeding.

Keywords: Sex identification, *Heterotis niloticus*, morphometric, meristic

INTRODUCTION

The African bonytongue *Heterotis niloticus* is a large fish that is widespread in many parts of Africa (Moreau, 1982). This species is native to many parts of Africa, and has also been introduced to many African rivers and lakes to increase fish production (Micha, 1973). The hardiness of this fish, together with its high growth rate, make it a candidate for aquaculture in Africa and it has been transported to a number of countries for this purpose (Welcomme, 1988). Escapes from ponds into the wild have resulted in the establishment of populations which can form the basis for fisheries (Welcomme, 1988). Froese and Pauly (2012) said that several countries report adverse ecological impacts after introduction, but these ecological impacts were not specified. They further mentioned the fish as a potential pest. Due to general environmental degradation including oil spillages, pollution and destruction of mangrove swamps, this species has lost an estimated 60% of its previous breeding and nursery habitat in Nigeria. Bake and Sadiku (2005) described a decline in the population density of *Heterotis niloticus* from Oyun reservoir, Nigeria, over a two-year period (January 2002–December 2003), and they recorded decline of the species from similar reservoirs in Nigeria indicates that the species is threatened in the environment. *Heterotis niloticus* is a pelagic species, found in freshwater such as rivers, streams, floodplains, lakes and swamps (Froese and Pauly, 2012). It occurs in shallow water where it feeds on invertebrates, copepods and chironomids. Juveniles are found in swampy places among aquatic vegetation; adults live in the open water of rivers and lakes, where they can be found in the pelagic zone as well as the littoral zone (Moreau, 1982). The species can survive in deoxygenated waters (Moreau, 1982; Adite *et al.*, 2006). Reizer (1964) reported an age at maturity of 20 months

for *Heterotis niloticus* reared in fish ponds. In Madagascar, *Heterotis niloticus* matured between 2 and 2.5 years old (Moreau, 1982). Micha (1973) reported a size at first maturity of 400 mm (600 g) in Lake Oubangui. The size at first maturity for *Heterotis niloticus* in the Lake Hlan River Sô system of Benin was about 575 mm total length (TL) for both male and female. The smallest mature male was 560 mm TL (515 mm Standard Length, 1490 g), and the smallest mature female was 545 mm TL (499 mm Standard Length; 1770 g) (Adite *et al.*, 2006). In Lake Oubangui, Micha (1973) reported fecundity between 3572 and 15,246 oocytes. Fecundity increased with body length and body weight. Ovarian weight increased with body size. The number of oocytes per gram of ovary was not influenced by body size. Relative fecundity (number of oocytes per gram of body mass) revealed no general association with body size (Adite *et al.*, 2006). According to Adite *et al.* (2006), it was observed that the Gonadosomatic Index (GSI) of *Heterotis niloticus* was significantly higher for both males and females during the wet season (May to August) and it declined progressively throughout the flood period until the beginning of the dry season in November to December. These indicated that the spawning period of bonytongues was restricted to the wet and flood period margins (Adite *et al.*, 2006). The culture of *Heterotis niloticus* was enhanced with the development of techniques for controlled breeding. One major obstacle in this regard is the absence of distinct external feature to distinguish the male of the fish from the female. Broodstock selection is much difficult and controlled breeding could not be possible without distinguishing the male from the female. This study reports the results of investigations of possible presence of physical external features in *Heterotis niloticus* that can be easily used to differentiate male *Heterotis niloticus* from the female in Alau Lake.

MATERIALS AND METHODS

Study area

Alau is located on latitude 11° 51' N and longitude 13° 05' E at the South Eastern part of Maiduguri, Borno State, Nigeria. It is situated within Konduga local government area about 18 kilometers from Maiduguri (Idowu *et al.*, 2004).

Collection of specimen

Twenty (20) adults of males and females *Heterotis niloticus* were randomly collected from Alau lake Maiduguri and placed in into 50 litre capacity jerricans at appropriate stocking density and transported live to the Department of Fisheries hatchery complex where all measurements and dissections were made.

Morphometric and meristic observations

The weight and length of each specimen was taken using a top-loading weighing balance and a meter rule, respectively. Morphometric and meristic parameters were made for each specimen as described by Teugels (1986). Morphometric measurements and meristic counts used were shown in Fig 2. The ratios of dorsal fin length, pre-dorsal fin length, head length, peduncle length, anal fin length, pectoral fin length, pelvic fin length and caudal fin length, to the standard length were measured and calculated, same was done for the ratio of inter-orbital and snout lengths to the head length. The meristic features that were counted include the number of lateral lines, sensory pits, number of openings, number of anal, pelvic, dorsal, caudal and scales above the lateral line.

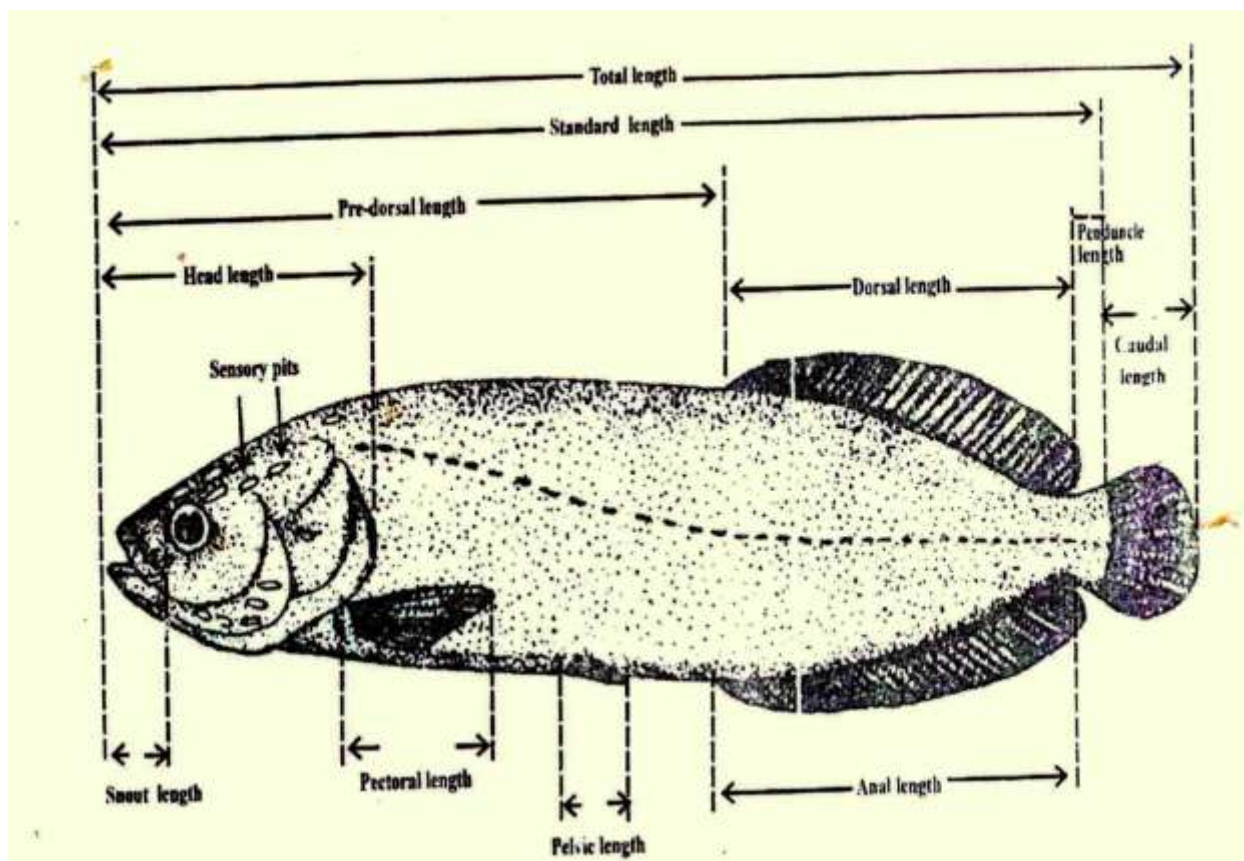


Fig. 1: *Heterotis niloticus* showing morphometric and meristic features

Gonadal Examination

Subsequent to morphometric and meristic observations, each specimen was dissected and the gonad located, removed and preserved in 4% formaldehyde. Ovary with eggs indicates female sex of the specimen and those with milts indicates males.

DATA ANALYSIS

Data obtained from the study were subjected to descriptive and inferential analysis while total length/weight relationships were calculated using the equation $\log w = \log a + b \log L$.

RESULTS AND DISCUSSION

Table 1 presents the result of descriptive analysis of the morphometrics characters of *Heterotis niloticus* from Lake Alau. The mean Weight of the samples was 213.50g with a minimum value of 128.1 and a maximum of 377.3g. The mean total Length was 26.87 ± 1.72 while the mean standard length

was 24.30 ± 1.49 . The mean dorsal fin length, peduncle fin length, caudal fin length, anal fin length, pelvic fin length, pectoral fin length were 8.32 ± 0.08 , 1.99 ± 0.18 , 9.26 ± 0.65 , 1.34 ± 0.19 and 2.32 ± 0.22 mm respectively with a minimum values of 7.0, 0.9, 1.0, 7.4, 1.0 and 1.3 while the maximum values were 11.5, 1.5, 3.6, 13.0, 3.8 and 4.5mm.

Other parameters such as the snout length, length of right lateral lines, Head length, predorsal fin length, body depth, Eye diameter, length of left lateral line and length between sensory pit revealed the means of 1.21 ± 0.09 , 19.55 ± 1.25 , 2.35 ± 0.45 , 10.77 ± 0.74 , 5.88 ± 0.36 , 1.06 ± 0.07 , 19.42 ± 1.27 and 1.93 ± 0.19 mm respectively. The minimum values of the snout length, length of right lateral lines, Head length, predorsal fin length, body depth, Eye diameter, length of left lateral line and length between sensory pit were 1.0, 17.1, 4.6, 7.1, 5.3, 1.0, 17.1 and 1.2mm while the maximum value were 1.9, 25.2, 8.6, 14.9, 7.3, 1.5, 25.5 and 3.9mm. The weight of fish recorded in

this result was lower than the result reported by Oladosu *et al* (2003) that reported the mean weight value of 1.66kg with a range of 0.6-3.8kg. The differences in the mean weight could be due to difference in their location (environment). The total length, standard length, dorsal length, anal fin length and head length recorded in this study (34.50, 29.9, 11.5, 13.0 and 8.6mm) were all lower than the work reported by Bailey *et al*, (1999) as 77.50, 69.0, 35.00, 37.33 and 37.54mm respectively.

The variation in terms of the standard length, dorsal length, anal length and head length could be contributed by differences in the ages of the fish. Figure 2 and 3 shows the differences in the anal opening of male and female *Heterotis niloticus*, both the female and the male has two openings with the male having small papillae on the loop that divided the two opening while the female has no papillae.

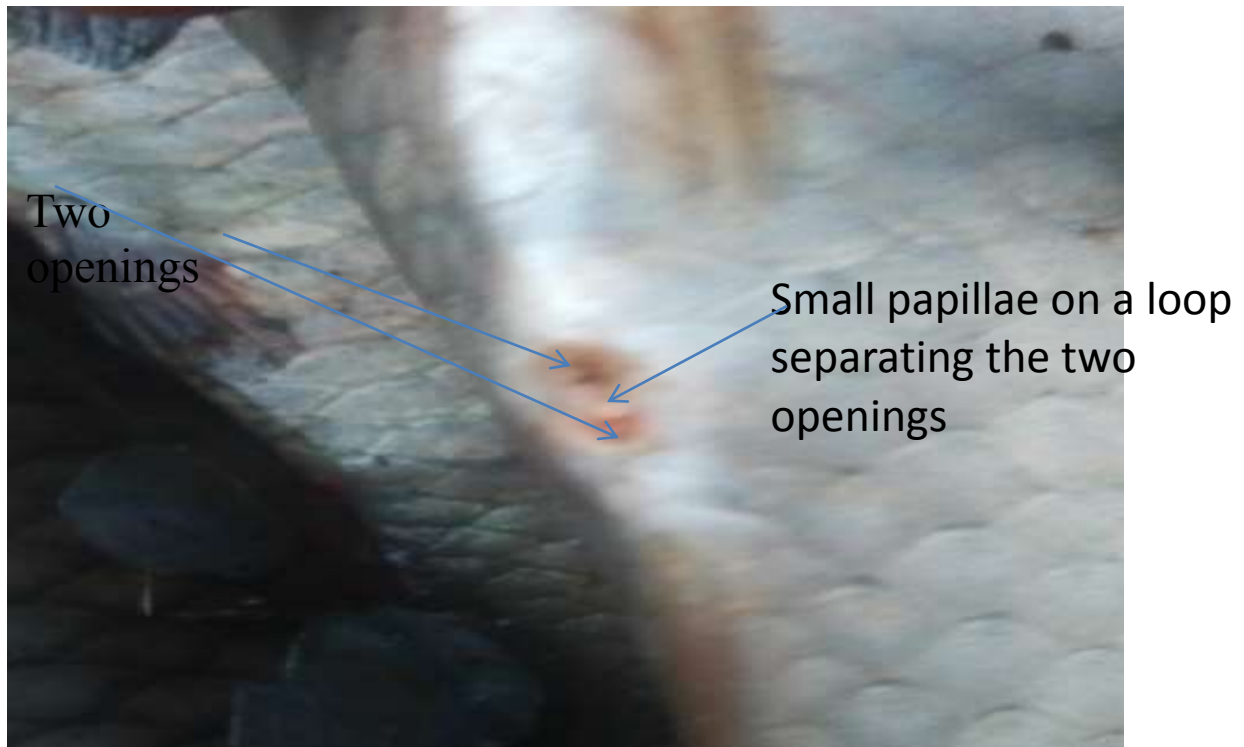
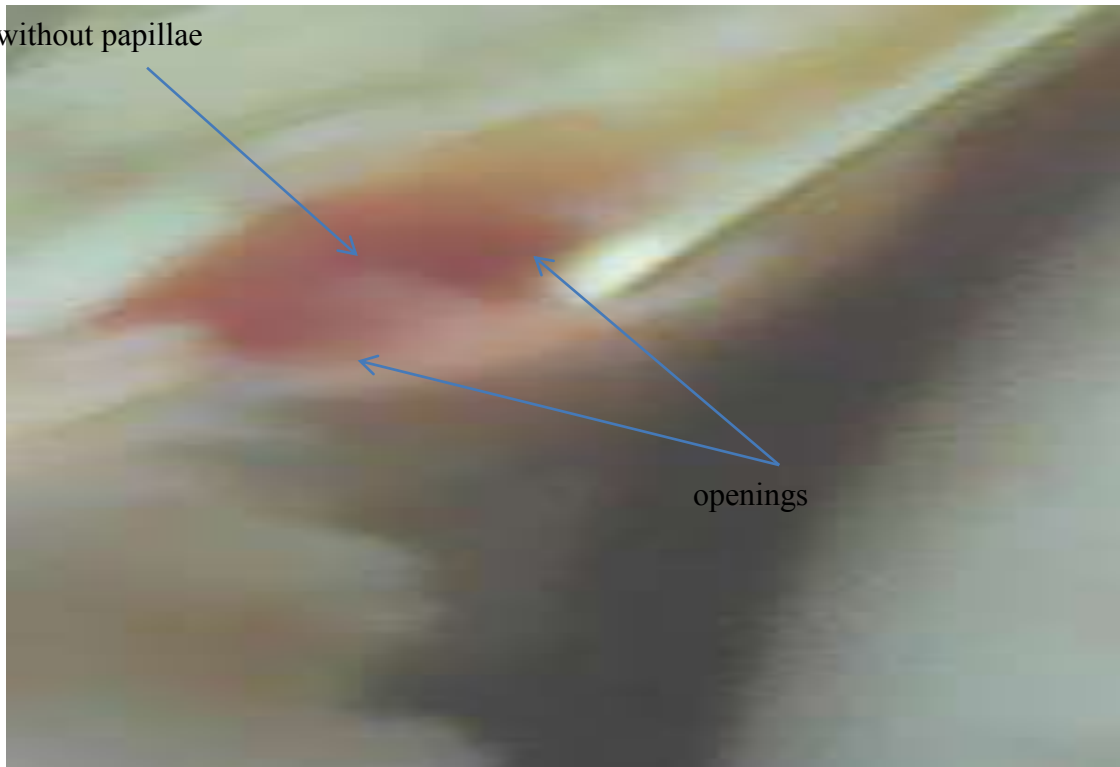


Fig. 2: showing two openings with small papillae on a loop separating the two openings in male *Heterotis niloticus*

Loop without papillae

Fig. 3: showing two openings and a loop without papillae on female *Heterotis niloticus***Table 1: Mean Morphometric of *Heterotis niloticus* from Lake Alau**

Characters	Acronyms	Minimum	Maximum	mean \pm S.E
Weight(g)	WGT	128.1	377.3	213.50 \pm 18.86
Standard length (mm)	SL	21.0	29.9	24.3 \pm 1.49
Total length(mm)	TL	22.2	34.5	26.87 \pm 1.72
Dorsal fin length(mm)	DFL	7.0	11.5	8.70 \pm 0.58
Peduncle fin length	PDCL	0.9	1.5	1.19 \pm 0.08
Caudal length(mm)	CL	1.0	3.6	1.99 \pm 0.18
Anal fin length(mm)	ANFL	7.4	13.0	9.26 \pm 0.65
Pelvic fin length(mm)	PLFL	1.0	3.8	1.34 \pm 0.19
Pectoral fin length(mm)	PCFL	1.3	4.5	2.32 \pm 0.22
Snout length(mm)	SNL	1.0	1.9	1.21 \pm 0.09
Length of right lateral line	LRLL	17.1	25.2	19.55 \pm 1.25
Head length(mm)	HL	4.6	8.6	2.35 \pm 0.43
Predorsal fin length (mm)	PDFL	7.1	14.9	10.77 \pm 0.74
Body depth(mm)	BD	5.3	7.3	5.88 \pm 0.36
Eye diameter	ED	1.0	1.5	1.06 \pm 0.07
Length of left lateral line	LLLL	17.0	25.5	19.42 \pm 1.27
Length between sensory pit	LBST	1.2	3.9	1.93 \pm 0.1999

Table 2 presented the means of meristic characters of *Heterotis niloticus* from Lake Alau. The mean number of anal openings was two in all the specimens. Number of lateral lines from both the left and right side was 34.00 each. Number of pectoral fin rays was 11.00 throughout the specimens. The number of spiny fins on both side (left and right) were the same as 6.00. Number of anal fins, dorsal fins and caudal fins were 34.00, 33.00 and 15.00 respectively. Number of dorsal and anal fins in this study were 33.00 and 34.00 which were lower than the number reported by Mohammed, (2010) on the morphometric and meristic characters of F1 hybrid of *Clarias garepinus* × *Heterobranchus bidorsalis* as 61-70 and 46-59. The number of lateral lines obtained in this study was similar to the work reported by Mohammed, (2010). Numbers of spiny fins sensory

pits, pelvic fins in both sides were lower than 46 produce by Umar (2010). The differences are as results of differences in the species use in both experiments.

Figure 4 shows the result of linear regression of Length - Weight relationship of twenty *Heterotis niloticus* from Lake Alau. The linear relationship observed between the total length and weight was $\log \text{WGT} = 2.20 \times \log (\text{TOL}) - 1.71$. The correlation coefficient was 0.85 while the coefficient of determinant (R^2) was 0.69 which were all lower than the result reported by Odulate, (2015) as $\log \text{WGT} = 3.30 \times \log (\text{TOL}) - 2$ the slope of 3.3 correlation coefficient of 0.96.0 and coefficient of determinant R^2 of 0.96.0 on the morphometric and meristic characterization of *Macrobrachium vollenholeenii* in Abeokuta.

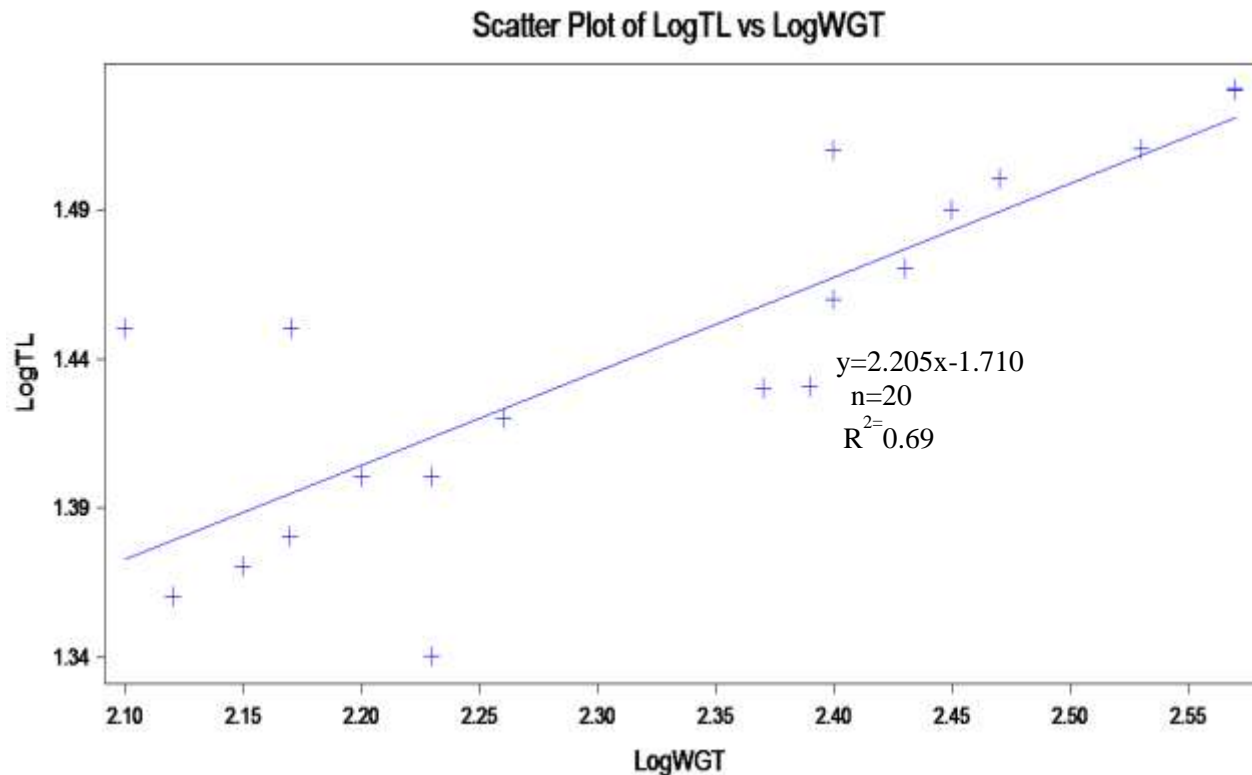


Fig. 4: Linear regression of the total length and weight of *Heterotis niloticus*

The condition factors of the samples were 0.20 which was negative allometric, meaning the fish grows faster in length than in weight. The condition factor obtained in this experiment was lower than the result reported by Mohammed *et al* (2017) as 0.59 after feeding *Oreochromis niloticus* with camel testes base diet at 100% inclusion level

Table 2: Mean meristic characters of *Heterotis niloticus* from lake alau

Characters	Acronymes	Mean
Number of lateral lines on the right	NRLL	34.00
Numbers of lateral lines on the left	NLLL	34.00
Numbers of pectoral fin rays	NPCFR	11.00
Numbers of anal openings	NAO	2.00
Numbers of spiny fins on the right	NSPR	6.00
Numbers of spiny fins on the left	NSPF	6.00
Numbers of sensory pit on the right	NSPTR	6.00
Numbers of sensory pit on the left	NSPTL	6.00
Numbers of pelvic fin rays on the right	NPLFRR	6.00

Numbers of pelvic fin rays on the left	NPLFRL	6.00
Numbers of anal fin	NAF	34.00
Numbers of dorsal fins	NDF	33.00
Number of caudal fins	NCF	15.0

CONCLUSION AND RECOMMENDATION

The morphometric characters that were studied such as total length, standard length, head length, pre-pectoral distance, pre-pelvic distance, snout length, lateral line distance, eye diameter, body depth were grown symmetrically. On the other hand, Meristic characters such as the number of lateral lines, number of anal opening, number of pectoral ray fins, number of spiny fins, number of anal caudal and dorsal fins remains the same among all the sexes examined. The only feature that tends to distinguish the male from the female was the presence of small papillae between the two openings in the male (loop). The length – weight relationship showed to be linear with correlation coefficient of 0.85 and coefficient of determinant of 0.69. The condition factor was 0.20 which indicate negative allometric. It is recommended that, further study should be carry out on the morphology of *Heterotis niloticus* from Lake Alau with the aim of identifying the sexes for breeding purpose.

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