# BASIC MORPHOMETRIC MEASUREMENTS AND GROWTH PATTERN, OF *HETEROTIS NILOTICUS* FROM RIVER KADUNA FLOOD PLAINS, NIGERIA

Bake, G. G.*[1] & Sadiku, S.O.E. [1]
Department of Water Resources, Aquaculture and Fisheries Technology,
School of Agric and Agricultural Technology,
Federal University of Technology Minna,
P.M.B 65 Minna. Niger State, Nigeria
E-mail: gabbygana@yahoo.co.uk
Phone No: +234-816-285-0992

## Abstract
*A total of 144 Heterotis niloticus specimen were collected from River Kaduna flood plains using the gill net. Relationship between basic morphometric measurement, growth pattern, food and feeding habit of H. niloticus, were examined and evaluated using linear regression and correlation through length-weight relationship (LWR), Sampling of the specimen was done fortnightly The specimens had mean standard length of 27.09± 4.73 cm, total length of 24.3-49.4 cm, mean body weight ranges between 261.5±145.0 g, mean eyes diameter of 1.30±0.15cm, mean head length of 6.29±1.75 cm and mean snout length of 4.8±0.86 cm. There was a strong relationship between the standard length and the body weight, the eyes diameter and the standard length, snout length and standard length, head length and the standard length, snout length and the weight, head length and the weight (P<0.05). However, the correlation of the eye diameters and the weight was insignificant (P>0.05). We can conclude from this investigation that the growth pattern analysis of H. niloticus from River Kaduna flooded plains depicts a negatively allometric growth pattern with a b value of 1.16.*

Keywords: K value; Length –weight relationship, Snout length, head length, *Heterotis niloticus*.

## Introduction
Fish provides 22% of the protein intake in sub-Saharan Africa (FAO, 2007), however in some countries where other animal proteins are scarce or expensive it can exceed 50%. In sub-Sahara African, per capital fish consumption is the lowest compared with other regions of the world and it is still on the decline FAO (2007). This is largely due to decline in capture fisheries in comparison to and the growing population. Since fishing products cannot meet the rising demands for fish, the importance of fish in the economy and ecology of island water has generated a lot of interest. Over the years aquaculture has gained a rapid interest worldwide due to the importance of fish as a cheap source of animal protein, since beef is beyond the reach of the average citizen especially in the developing nations (FAO, 2007).

*Heterotis niloticus* (Cuvier 1829) of the family Osteoglossidae is among the most highly valued species in West African inland fisheries and it is widely distributed in tropical rivers and freshwater lakes of western and central Africa (Moreau 1982, Leveˆque *et al*. 1990).

In spite of their great evolutionary and fishery significance, the bony tongue fishes of the family Osteoglossidae (Osteoglossiformes) generally have not received extensive study. All six of the known bony tongue species inhabit tropical lowland rivers, lakes, and wetlands (*Heterotis niloticus* (Cuvier, 1829) in Africa, *Arapaima gigas* (Schinz, 1822) and *Osteoglossum spp*. in the Amazon Basin, and *Scleropages spp*. in Southeast Asia, the East Indies, and northeastern Australia). All bonytongue practice some form of parental care, ranging from nest guarding (*Heterotis* and *Arapaima*) to mouth brooding (*Osteoglossum* and *Scleropages* ). *Heterotis* *niloticus*, the only species of bonytongue (Osteoglossidae) in Africa (Greenwood 1973, Moreau 1982, Li and Wilson 1996), occurs in rivers of West Africa, the Nilo-Sudanian region and the Congo region of Central Africa (Daget, 1957 and Leveque *et al*. 1990), and has been introduced in many lakes and aquaculture centers such as Lake Kossou in Ivory Coast, Lake Nyong in Cameroon (Moreau 1974, Depiere and Vivien 1977). *Heterotis niloticus* (Cuvier 1829) is a species widely distributed in the Nigerian waters especially in the fresh waters rivers of Nigeria. There is only one specie of this genus *Heterotis* hence species *niloticus* (Bard *et al*; 1976 Akegbejo-Samson, 1999; Idodo-Umeh 2003). It constitutes an important food source within the region and comprises a portion of the inland fish in Nigeria due to its delicacy. It is widely know in Nigeria but not widely use in research and production probably due to its in ability to easily adapt to environmental changes. Although under suitable condition and proper feeding, *Heterotis niloticus* grow reasonably fast to 1m in 11 month culture, (Reed *et.al* 1967).

In fisheries science the uses of length–weight relationships, includes calculation of condition factors comparing observed and expected length–weight values (e.g. Le Cren, 1951; Sparre, and Venema, 1998; Knaepkens *et al*., 2002) and the elucidation of causal factors of spatial differences in condition (Fortin *et al*., 1990; Copp, 2003). They also enable determination of weight of fish during stock assessment when only lengths are available (Oscoz *et al*., 2005). Length and weight data are useful standard results of fish sampling programs (Morato *et al*., 2001). In fish, size is generally more biologically relevant than age, mainly because several ecological and physiological factors are more size-dependent than age-dependent. Consequently, variability in size has important implications for diverse aspects of fisheries science and population dynamics (Erzini, 1994). One of the most commonly used analyses of fisheries data is length - weight relationship (Mendes *et al*., 2004), hence length-weight regressions have been used frequently to estimate weight from length since direct weight measurements can be time-consuming in the field (Sinovcic *et al*., 2004).

However inspect of River Kaduna richly blessed with a lot of commercially culturable fish species little studies have been done on the relationship between basic morphometric measurement, growth pattern and food and feeding habits especially *Heterotis niloticus.* It is in this view that this research was carried out. The main objective of this research is to investigate the relationship between basic morphometric measurement and growth pattern of *Heterotis niloticus* from River Kaduna flood plain in Niger state of Nigeria through their length and weight measurement and condition factor.

## Materials and Methods

### Sampling area

The Kaduna River is a major tributary of the Niger River, which took its source from Jos Plateau and flows in a northwesterly direction then southwards to join the Niger downstream of Wuya at Nupeko in Niger state. It covers a distance of about 575km and drains on area of about 66,300km$^2$ of diverse topography. The river is dammed at Shiroro also in Niger state about 348km down its course to form a reservoir with a surface area of about 312 km$^2$. The river is divided into two topographical zones. The upper zone; from its source to Zungeru town. This area is undulating with many rocky hills and rapids. While the lower zone starts downstream of Zungeru town to the confluence a distance of about 150 km (Folorunsho, 2004). This area is characterized by the presence of an extensive flood plain covering a total of about 150,000 hacter down the Niger.

### Fish sampling and measurement

Specimens of *Heterotis niloticus* were collected fourth nightly from fishermen at three sampling sites namely Nku, Nupeko and Fokpo along river Kaduna flood plains from May 2006 – October

2006. Gill nets of mesh sizes ranging from 5-10 cm were the fishing gear used. Specimens collected were kept chilled in an ice chest to reduce post humous digestion of the stomach contents while in transit to the laboratory. At the laboratory total length (TL) was measured from the tip of the snout (mouth closed) to the extended tip of the caudal fin. Standard length (SL) was measured from the tip of the snout to the caudal peduncle, other basic morphemetric features; head length, snout length and eyes diameter were measured with the aid of a measuring board and a mathematic set divider. The lengths were taken with measuring board to the nearest 0.1 cm. Body weight of individual fish was measured to the nearest 0.1 g with an electric balance after removing the adhered water and other particles from the surface of body.

Linear regression was employed to determine the type of relationship between any given pairs of variables and their linear equation. Correlation analysis was used to ascertain the significance of this relationship a derivative of length weight study is the ponderal index denoted as
Where W = weight (g) L= standard length (cm)

The length-weight relationship (LWR) was expressed by the equation:

$$\text{Log weight} = \text{Log } a + b \text{ Log length}$$

Where a and b are regression constants.
The condition factor was calculated using the formular:
$K = [100\ W] / L^3$
Where K = condition factor, L = standard length (cm) and W = weight (g).

## Results

### Morphometric measurement of Heterotis niloticus

The result of the biometrics of *Heterotis niloticus* specimens examined provides information on standard length of the specimens which ranged from 21-45 cm with a corresponding body weight ranging from 90-900g and total length ranging from 24.3 – 49.4. The result of the morphometric measurement of *Heterotis niloticus* specimens examined provides the following information; the snout length ranged from 4.2-8.4 cm with a mean standard deviation of 1.30±0.15, while the head length ranges between 4-9 cm with a mean deviation of 6. 29±1.75.

### Relationship between the morphometric measurements

Body weight- snout length relationship

The snout length was regressed against the bodyweight as shown in fig 1 it was observed that there was a strong positive relationship between the snouts length and the weight as correlation co-efficient r was 0.80 and was significant ($P<0.05$) This means that an increase in weight was associated with an increase in snout length.

### Standard length- Snout length relationship

Snout length was regressed against the standard length as shown fig 2 it was observed that there was a significant relationship between the snout length and the standard length as correlation co-efficient r was 0. 66 ($P<0.05$). This means that a proportional increased in the standard length was associated with increase in head length.

### Body weight- head length relationship

The head length was regressed against the weight as shown in fig 3 it was observed that there was a strong positive relationship between the head length and the body weight. Correlation co-efficient r was 0.56 and was significant ($P<0.05$). This indicates that a proportional increase in the body weight can be associated with an increase in the head length

### Standard length - head length relationship

The head length was regressed against the weight as shown in fig 4 it was observed that there was a strong positive relationship between the head length and the body weight correlation co-efficient r was 0.54 and was significant ($P$ <0.05). This indicates that a proportional increase in the standard length can be associated with an increase in the head length

### Body weight – Eyes diameter Relationship

Eye diameter was regressed against the weight as shown in fig 5 it was observed that there was no relationship between the eye diameter and the body weight correlation co-efficient r was 0.05 hence in significant ($P$ >0.05). This means that an increase in weight does not necessary increase the eye diameter.

### Standard length –eye diameter relationship

Eye diameter was regressed against standard length as shown in fig 6 it was observed that there was a very strong relationship between the eye diameter and the standard length as correlation co-efficient r was 0.36 and was significant ($P$ <0.05) hence an increase in standard length was associated with a proportional increase in eye diameter.

### Length –Weight relationship and growth pattern of *Heterotis niloticus*

The condition factor and growth of the fish were derived from the standard length and the body weight measurement of the specimens. Log weight was regressed against log length as shown in fig 7 and Table 2.

Growth in fish is exponential as described by equation Y=ax (Huxley 1932 and Wooten 1992) Linearised as log U=log +log (Lecren, 1951). It was observed that the growth of *Heterotis niloticus* was negatively allometric with b value 1.16. There was a very strong relationship between the standard length and the total body weight and the correlation co-efficient r was 0.91.

Table 2 the condition factors otherwise called ponderal index denoted, as K of *Heterotis niloticus* from River Kaduna flooded plains ranges from 0.73-2.63 with a mean value of 1.21±0.33.

### Discussion

From the result of the basic morphometric measurement of the 144 *Heterotis niloticus* specimens examined, it was observed that the fish must have the ability to grow big, hence can be a fast growing fish.

Biometric analysis of body parts showed that when the snout length was regressed against the standard length; there was a strong positive correlation. This correlation was significant hence; it was observed that an increase in the length of the fish also leads to an increase in the snout length. The head length also showed a strong positive correlation when regressed against the standard length, hence an increase in the length was associated with an increase with head length Eye diameter regressed against the standard length gave a positively linear correlation. This means that for an increase in length there was also a proportional increase in the eye diameter. From the above analysis it can be said that, any increase in size could be associated to all part of the fish. This agrees with the theory of proportionality of growth state of the organism (Mosby 2009). There was a strong positive linear relationship between the snout length and the body weight; this implies that for any increase in weight there is also a proportional increase in the snout length. The head length also showed a strong positive relationship when regressed against the body weight this means that for increase in the body weight of the fish the head length also increased, however the above statement cannot be said of the eye diameter when it was regressed against the weight; it was negative and insignificant meaning that weight as no any relationship with the eye diameter hence increase in weight does not lead to an proportional increase in the eyes diameter.

A broad spectrum of the fish sizes was examined as evident in the significant, co-efficient variation of the standard length, weight and condition factor table. Data analysis of the length – weight relationship gave useful information concerning the growth and body physiology of the fish. Growth was described as the change in the absolute weight (energy content) or length of fish over time (Wooten 1992), while Sadiku and Oladimeji (1991) summarized growth as a function of fish size. Wooten (1992) reported that fish grow in length as well in bulk. Linear regression of standard length and weight gives very useful co-efficient of regression "b" in determining growth pattern. It was noted that "b" value of 3.0 indicates isometric growth pattern. The values below this represent negatively allometric growth while values greater than 3.0 show positively allometric. In this study *H. niloticus* of River Kaduna flooded plain is negatively allometric with "b" value of 1.16. This means that the length growth is faster than body weight growth rate. Condition factor (K) is a measure of the fish condition, which reflects physiological condition of the fish. Although it is not a constant for individuals, species and population (Sadiku and Oladimeji 1991), it is still a useful measure of relative robustness. In this investigation *H. niloticus* from river Kaduna flood plains were identified as robust fishes with the mean K value of 1.21±0.33.

## Conclusion

In conclusion, this study shows that there is a proportionate growth reflecting a good physiological growth of the fish. The growth of *H. niloticus* of River Kaduna flood plain is negatively allometric, which is the normal growth pattern of the fish other morphometric characters studied were proportionate to the length and weight of the fish.

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Table 1: Summary of range and mean standard deviation of the biometrics measurements of *H. Niloticus* sample

| Measurement | Range (cm) | mean value |
|---|---|---|
| Total length | 24.3 – 49.4 | 22.9±2.04 |
| Standard length | 20.2 - 45.0 | 27.7±5.0 |
| Body weight (g) | 140.0 - 900.0 | 265.2±145.8 |
| Body depth | 2.4 - 5.6 | 5.42±2.25 |
| Body girth | 5.0 - 7.5 | 6.17±0.95 |
| Eye diameter | 1.0 -1.7 | 1.30±0.15 |
| Head length | 4.0 - 9.0 | 6.29±1.75 |
| Snout length | 4.2 - 8.4 | 4.8±0.86 |

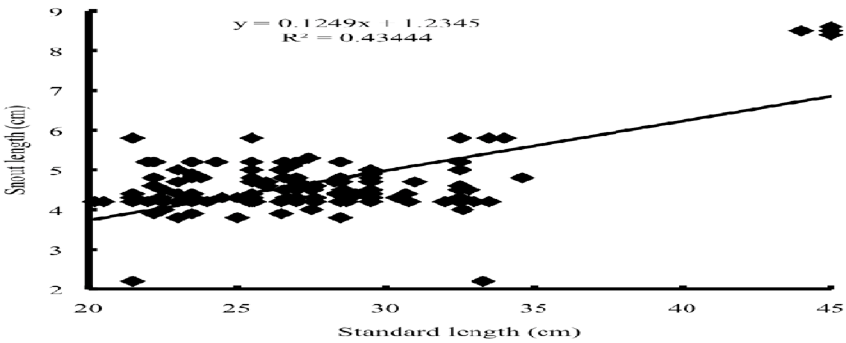


Fig. 1: Body weight-snout length relationship

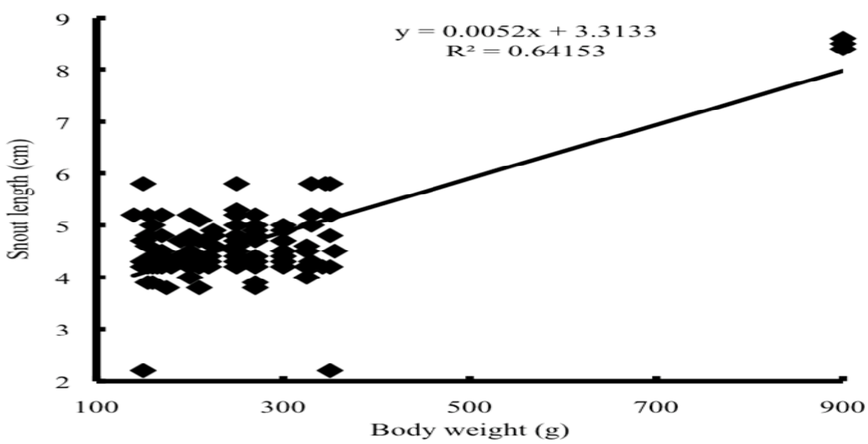


Fig. 2: Standard length -snout length relationship

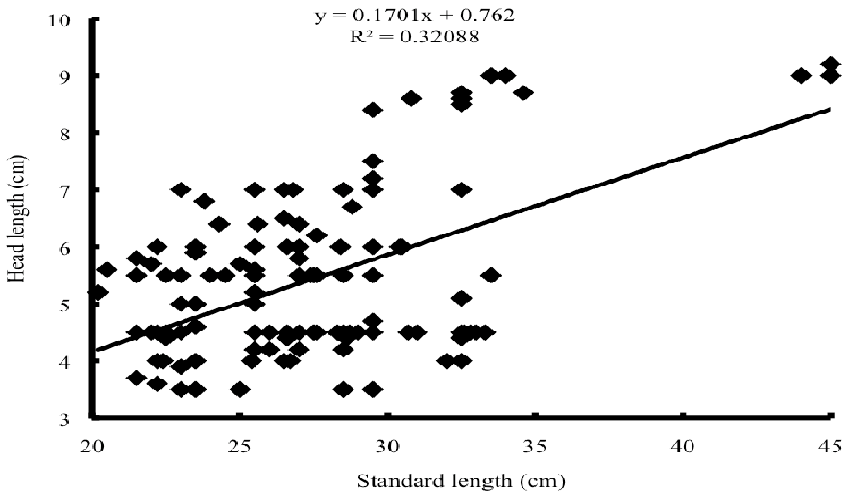


Fig. 3: Standard length - head length relationship

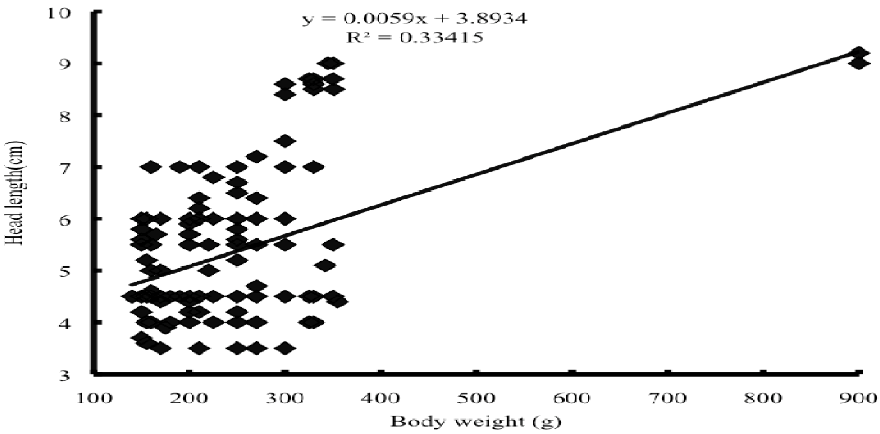


Fig. 4: Body weight-head length relationship

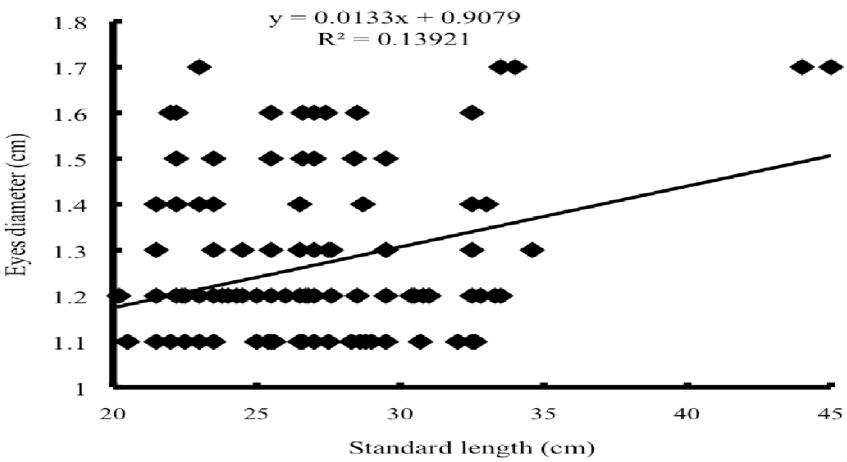


Fig. 5: Body weight-eye diameter relationship

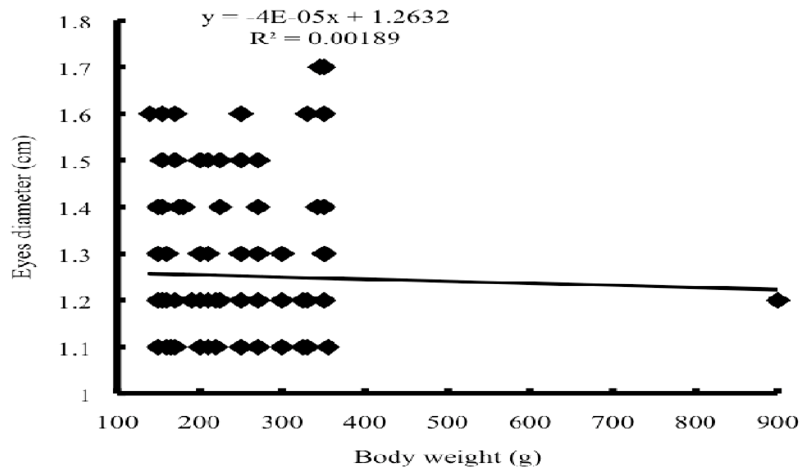


Fig. 6: Standard length - eye diameter relationship

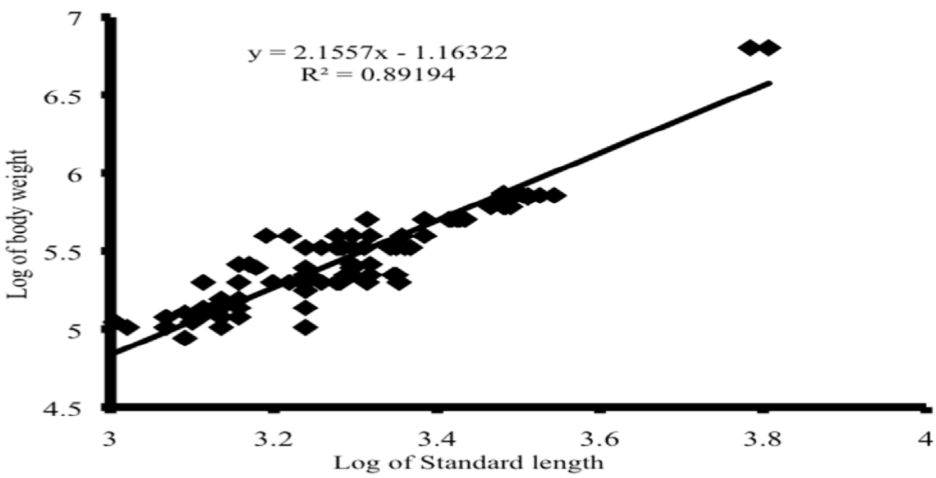


Fig. 7: Standard length – Body weight relationship