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Morphological Characteristics and Body Indices of *Heterobranchus bidorsalis* from Three Geographical Locations in Nigeria

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Abstract: Thirty-one morphometric features and 11 meristic counts were carried out in each of 62 parental *Heterobranchus bidorsalis* broodstock collected from different ecological zones in Nigeria-Onitsha, Gboko and Jos. Thirty landmark references were used to characterize the collection and a correlation point for proper identification of the species. Correlation existed between many body parameters and this revealed association among traits to their level of comparison and similarities. The distance between the posterior end of the dorsal fin and the anterior end of the adipose tissue (gap) was a distinguishing factor in separating the different strains of *H. bidorsalis* from the different ecological zones. The collection with the widest gap was from Onitsha zone. The relationship between the dorsal fin and adipose fin was broader (0.6) in Gboko zone (D = 40-44, A = 48-57), while Onitsha zone (D = 31-44, A = 42-58) was 0.5 and also 0.5 in Jos zone (D = 41-44, A = 47-54). The anal fin ray for the three locations decreased with increasing latitude. Gboko strain was distinct among the three strains.

Key words: Broodstock, collection, correlation, identification, strains, Nigeria

INTRODUCTION

The genus *Heterobranchus* is similar in many respects to *Clarias* but can readily be differentiated from the latter by the rayed dorsal fin followed by an adipose fin (Fagbenro *et al*., 1991). Four members of the genus *Heterobranchus* have been identified: *H. bidorsalis* Geoffroy-Saint Hilaire (1809); *H. longifilis* Valenciennes (1840); *H. isopterus* Bleeker (1863) and *H. boulengeri* Pellagrin (1922). *Heterobranchus* is easily differentiated from other catfishes by the distinct division of its dorsal fin to anterior rayed dorsal and posterior adipose fin. *H. bidorsalis* has its head very strongly depressed when compared with *H. longifilis* and its upper surface granulated. The rayed dorsal fin is relatively long, the adipose fin short and the caudal fin relatively long and slightly pointed. The dorsal has 38-45 rays and the anal fin has 50-59 rays. At the base, the adipose fin is 0.4-0.67 times as long as the rayed dorsal fin and about the same height. This species is very common and grows to about 1.2 m weighing 30 kg (Fagbenro *et al*., 1991; Fagbenro, 1992).

H. bidorsalis has been successfully crossed with *Clarias gariepinus*, *H. longifilis* and *C. anguillaris* to produce fast growing hybrid (Salami *et al*., 1993; Aluko, 1998). The hybrid catfishes are widely used in aquaculture systems. The culture of hybrids without proper genetic and economic evaluation invites more problems into the aquaculture industry. The consequences of indiscriminate production of fertile F_1 hybrid in Nigerian hatcheries require urgent attention of fish genetic conservationists as indiscriminate hybridization would affect the genetic make up of the species (Aluko, 1998; Fagbenro *et al.*, 1993; Salami *et al*., 1993). For any genetic improvement programme to be successful there is need for proper identification and classification of the species. The objective of this study is to describe the morphometric characterization and body indices of *H. bidorsalis* from three ecological zones in Nigeria in order to enable proper identification of the species.

MATERIALS AND METHODS

Twenty-four *H. bidorsalis* broodstock were collected from three geographical locations namely Onitsha (ON)

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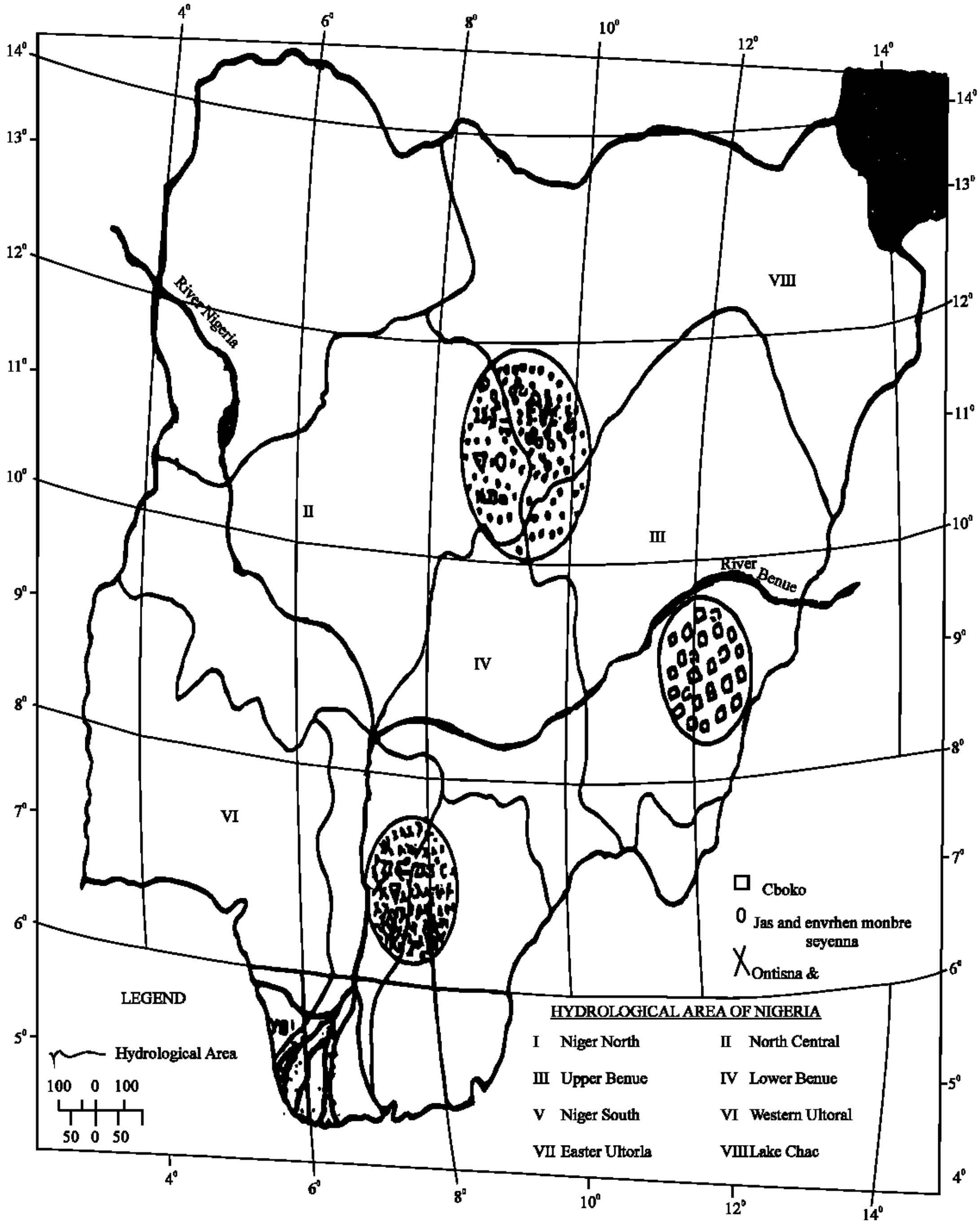

Fig. 1: Map of Nigeria showing hydrological areas and fish collection centres

within the rainforest in Anambra river basin; Jos (JS) within the Hadejia river basin in the montane hydrological area and Gboko (GB) within the rainforest in Benue river basin (Fig. 1). The broodstocks were transported live to National Institute for Freshwater Fisheries Research (NIFFR), New Bussa in 50 L open lid plastic containers, acclimated in 10×5×1 m outdoor concrete tanks in the hatchery and fed twice daily with 40% crude protein diet. Thirty one morphometric features and 11 meristic counts were measured with twine, measuring ruler, dividers and dial-reading callipers in each 62 parental *H. bidorsalis* broodstock. These are Dorsal fin rays no., Caudal fin ray no., Pectoral rays no., Pectoral spine no., Anal fin ray no., Pelvic fin no., fish weight, no. of the gill rakers, sex, total

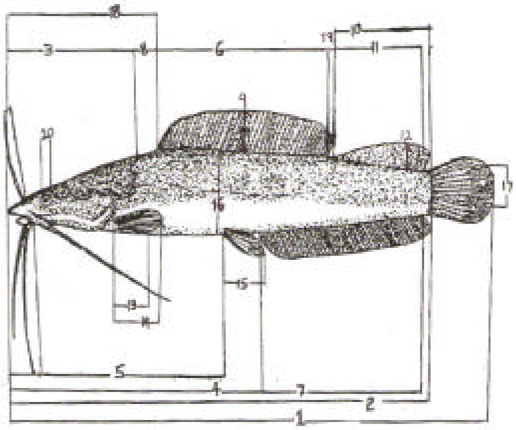

Fig. 2: Important body measurement of *Heterobranchus bidorsalis*: 1. Total Length(TL), 2. Standard Length(SL), 3. Head Length(HL), 4. Pre-anal distance, 5. Pre-pelvic distance, 6. Dorsal fin length, 7. Anal fin length, 8. Distance between occipital process and dorsal fin origin, 9. Dorsal fin depth, l0. Distance between dorsal and caudal fin, 11. Adipose fin length, 12. Adipose fin depth, 13. Pectoral spine length, 14. Pectoral fin length, 15. Pelvic fin length, 16. Body depth at widest point, 17. Caudal peduncle depth, 18. Pre-dorsal distance, 19. Distance between dorsal fin and adipose fin and 20. Eye diameter

length, standard length, head length, Pre-anal fin distance, Pre-pelvic fin distance, Dorsal fin length, Anal fin length, distance between occipital process and dorsal fin origin, Dorsal fin depth, distance between Dorsal fin and Caudal fin length, Adipose fin length, Adipose fin depth, Pectoral spine length, Pectoral fin length, Pelvic fin length, Body depth at anus, Caudal peduncle depth, Pre-dorsal distance, Eye diameter, distance between the eyes, length of Caudal fin, Pre-maxilla teeth width, Pre-maxilla teeth depth, gap between Pre-dorsal fin and Anterior anal fin, Vomerine tooth plate width, Vomerine tooth depth, Frontal fontanelle, depth of Caudal fin, Pre-maxilla barbel, Mandibular barbel, Nasal barbel, gap between Dorsal fin and Adipose fin, Girth. All the counts and measurements were taken following the method described by Cailliet *et al*. (1986) as shown in Fig. 2.

Axial coordinates were generated for the three geographical locations using the Principal Component Analysis (PCA). Pairs of traits that had a correlation coefficient of ±0.6 were considered significantly related enough for use in taxonomic characterization of the fish. The ratio of one trait to the other in a related pair of traits was calculated for every individual fish in various collections. Dimensional scatter graphs of the projections

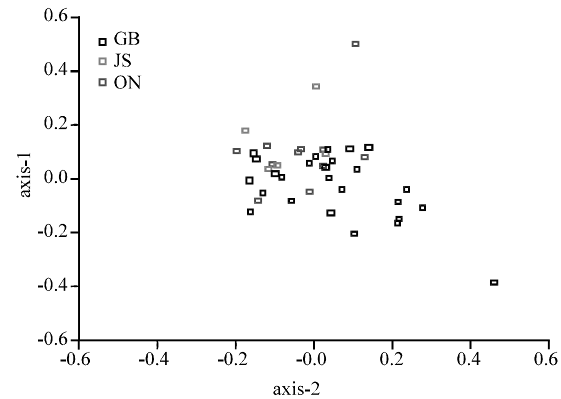

Fig. 3: Scatter plots of specimens on axis 1 and 2 of the PCA based on the 7 pairs of significantly correlated pairs of characteristics

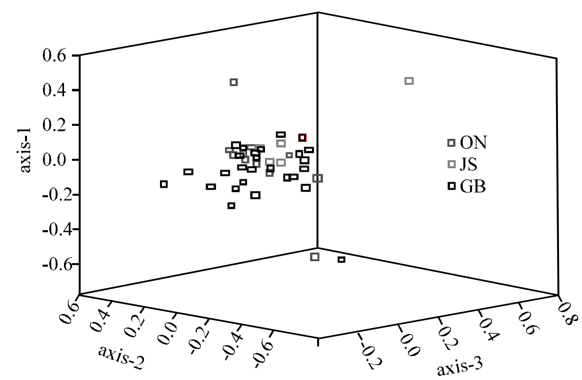

Fig. 4: Projections of specimens on axis 1-2 and 3 of the PCA based on the 7 pairs of significantly correlated pairs

of the fish were plotted using the principal components/measurements. This placed the individual fish relative to each other according to their level of comparisons-similarities and differences. The data from the set of all these ratios were subjected to PCA (Ludwig and Reynolds, 1988) to determine if these traits were strongly correlated in fish from the various collections. Two and three dimensional scatter graphs of the fish were plotted (Fig. 3 and 4) using the first two principal components and then the first three principal components.

This placed the individual fish relative to each other according to their level of similarity to see the extent to which the chosen traits separated the collections from the different locality into different strains. Morphological body indices were carried out and calculation done using the following formula:

$$\text{Profile index} = L\ TM^{-1}$$

Caudal index = L fh^{-1}
Head index = L Fh^{-1}
Width index = L TsZ^{-1}
Height index = TM TSZ^{-1}

Where:

L	=	Total length
TM	=	Height of body
TSZ	=	Width of body
fh	=	Length of tail
Fh	=	Length of head

RESULTS

The different *H. bidorsalis* collections show no major difference (externally) in them. Table 1 gives the variation in mean meristic features observed in the fish from three ecological zones.

The distinguishing factor (gap) in separating the different *H. bidorsalis* strains was widest in Onitsha strain (1.4 cm) followed by Jos strain (1.2 cm) while Gboko strain had the closest gap (0.6 cm). The percentages relationship of the adipose fin to the body length was 22.3, 23.6 and 24.4% for Onitsha, Gboko and Jos strains, respectively.

Mean dorsal fin ray counts were: Onitsha strain, 40.8 (31-44); Gboko strain, 41.7 (40-44) and Jos strain, 42.2 (41-44). The total mean dorsal fin rays ranged between 31 and 44. The mean anal fin length of Jos strain was longer than Gboko and Onitsha strains, while anal fin ray number of Gboko strain had 53.0 followed by Onitsha and Jos strains, which had a relatively equal mean number of 51.4 and 50.8, respectively (Table 1).

Caudal fin ray count variation was not wide, as all the collections had fin rays number ranging from 19-22. Significant correlations (±0.6, $p<0.05$) were found between six pairs of morphological traits in the collections. These were total length/standard length, total length/head length, head length/dorsal fin length, pre-dorsal distance/ gap, total length/adipose fin length, total length/body distance at widest point (girth).

Figure 3 shows the scatter graph obtained by displaying the principal co-ordinates of axis 2 of the PCA representing 62 specimens based on the ratio of the six correlated pairs of morphological characteristics. These axis account for 50% of the similarities between the specimens.

Three clear groupings could be identified reflecting the relationship between the different stains. Gboko strains were clearly separated and distinct from those of other locations. Though, there were overlapping in characterization of these three strains. The distribution of Onitsha and Jos on the scatter plot was reduced. The 3-dimensional graph of axis 1-3 is shown in Fig. 3. The 3 axis account for 65% of the variation in similarity between the strains. However, the overlap in similarity between Gboko and Onitsha strains were interwoven.

Table 1: Variation in meristic features of *H. bidorsalis* from three locations in Nigeria

	Geographical locations		
Features	Onitsha	Gboko	Jos
Dorsal fin ray	40.8(31-44)	41.7(40-44)	42.2(41-44)
Anal fin ray	51.4(42-58)	52.8(48-57)	50.8(47-54)
Anal fin length	21.2(12.0-29.2)	14.5(10.6-19.0)	24.5(23.1-25.5)
Adipose fin length	11.9(8.7-15.7)	8.8(6.8-11.5)	13.6(12.2-14.5)
Gap between adipose fin and dorsal fin	16.7(9.9-22.9)	11.8(7.6-15.3)	21.2(20.7-22.8)
Dorsal fin length	22.3(10.2-32.5)	15.4(11.5-20.8)	27.6(25.4-29.4)
Dorsal fin length as % of SL	41.8(30.4-43.2)	42.5(41.1-43.8)	47.9(83.8-43.5)
Head length	16.4(9.5-23.9)	11.0(7.5-14.6)	19.5(18.5-20.7)
Body height	25.3(15.6-39.3)	17.3(11.3-24.0)	32.1(30.2-35.0)
Standard length	53.3(33.5-75.3)	36.2(28.0-47.5)	57.7(30.3-67.6)
Total length	60.9(37.2-85.5)	41.7(28.4-54.1)	72.7(68.5-77.6)
Caudal fin ray	20.8(18.0-24.0)	20.7(9.0-22.0)	20.0(19.0-22.0)
Pectoral fin ray	11.1(10.0-16.0)	10.6(9.0-12.0)	10.4(10.0-11.0)
Pectoral spine	1	1	1
Adipose fin length relationship with dorsal fin	0.5	0.6	0.5

Table 2: Characteristic body Indices of *H. bidorsalis* from three ecological zones

Indexes	Onitsha	Gboko	Jos
Profile index-L TM^{-1}	2.413	2.411	2.266
Caudal index-T L fh^{-1}	8.801	7.862	8.182
Head index-TL Fh^{-1}	3.718	3.800	3.723
Width index-TL TSZ^{-1}	3.646	3.540	3.432
Height index-TM TSZ^{-1}	1.511	1.468	1.515

TL = total length, TM = body height, TSZ = body width, Fh = head length, fh = tail length

Body ratio: Body indices are shown in Table 2. Out of the three collections the highest profile index was obtained from Onitsha (2.413) closely followed by Gboko strain (2.411) and Jos strain (2.266).

The caudal indexes for the different strain are shown in the Table 2. The highest caudal index was obtained from Onitsha 8.801, followed by Jos 8.183 and Gboko 7.862.

The biggest head index was recorded in strain from Gboko, followed by Jos strain and Onitsha strain. There was a clear indication that the length of the fish was negatively proportional to the size of the fish. However, Onitsha strain has the highest width index (3.646) closely followed by Gboko strain (3.540), Jos strains (3.432). The height indexes obtained were 1.515, 1.511 and 1.468 for Jos, Onitsha and Gboko, respectively.

DISCUSSION

The distinct features in *Heterobranchus* species such as the dorsal fin count, anal fin count, gap between the dorsal and adipose fin showed some levels of variability. The gap between the adipose fin and dorsal fin was very conspicuous in the Onitsha strain being the widest, followed by Jos strain and least in Gboko strain. The adipose fin length relationship with dorsal fin was not equidistant in any strain. The adipose fin lengths were shorter to dorsal fin length. The anal fin counts were relatively close but highest in Gboko strain. This finding was similar to that of Kelsch (1995) in morphometric variation in the channel and headwater catfishes. There was geographic variation in the anal fin ray counts. The anal fin ray count for the three locations decreased with increasing latitude. This was similarly observed in their altitude. Even though numerous studies have shown that meristic variables such as anal fin ray count normally increased with decreasing temperature, development and corresponding latitude (Barlow, 1961). On the basis of these studies, it was expected that anal ray counts increased with latitude. However, in this study, the reverse was observed which agreed with Kelsch (1995) who shown that anal fin counts decreased with increasing latitudes.

Meanwhile, there was overlap in the degrees of multivariate analysis in this study. Teugels *et al*. (1990) indicated such overlapping as similarities. For example the pelvic ray confirmed overlapping in such that the three collections had equal number.

In the three dimensional graph, axis 1-3 (Fig. 4) account for almost 65% similarity between the strains. Gboko was distinctively separated from the Onitsha and Jos collections (Fig. 2-4) and this indicated the uniqueness and distinctiveness of Gboko strains. It is likely that River Benue empties into the adjoining rivers and tributaries along Onitsha river and it's environ. Therefore, Onitsha strain could be made up of mixed population due to influence of both rivers Niger and Benue.

The implication is that pure *H. bidorsalis* is not likely to be collected from Onitsha since some of its natural genetic purity could have been lost. The observation is in agreement with Kelsch (1995) that differences between species from any region were greater than between species from allocations combined. The level of mixing or interrelationship of Jos strain is low (Fig. 3) probably due to ecological and hydrological differences. The sharp temperature differences between Jos compared to high temperature in Benue and Onitsha could cause a distinct variation in the multivariate analysis.

CONCLUSION

The multivariate analysis of variability in traits of *H. bidorsalis* from three different locations in Nigeria indicate that fish from Gboko was distinctively separated from Onitsha and Jos collection. This reveals the uniqueness and distinctiveness of Gboko strains.

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