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Length-Weight Relationship of *Heterobranchus bidorsalis* (Geoffroy St. Hilaire 1809) Diploid and Triploid Progenies Raised Under the Same Environmental Condition

[1]O.T. Agbebi, [2]S.O. Olufeagba, [1]G.N.O. Ezeri, [1]S.O. Otubusin and [1]I.T. Omoniyi
[1]Department of Aquaculture and Fisheries Management, University of Agriculture, P.M.B. 2240, Abeokuta, Ogun state, Nigeria
[2]National Institute for Freshwater Fisheries Research, P.M.B. 6006, New Bussa, Niger State, Nigeria

Abstract: Twenty specimens of triploid with weight and length ranging from 207-300 g and 29-32 cm, diploid 150-200 g and 23-28 cm *Heterobranchus bidorsalis* were subjected to morphometric and meristic characterization, length-weight relationship and condition factor evaluation. Triploid specimens were higher in all the parameters. All morphometric characters were significantly different at $p<0.005$. In the regression analysis of diploid and triploid, the ranges of condition factor (K) were 0.802-1.453 and 0.838-0.906, respectively while the relative condition factor values (Kn) ranged between 0.869-1.087 and 0.968-1.038, respectively. Weight increases directly as the total length increases for both diploid and triploid indicating isometric growth. The R^2 in triploid was higher 96.8% than 42.4% in diploids. In diploid, the length has significant effect on weight at $p<0.05$ while $p<0.01$ in triploid.

Key words: Triploid, morphometric, meristic, condition factor, characterization, Nigeria

INTRODUCTION

Catfishes are economically important groups of fresh and brackish water fishes in the world. *Heterobranchus bidorsalis* has its head very strongly depressed when compared with *Heterobranchus longifilis* and its upper surface granulated. The rayed dorsal fin is relatively long, the adipose fin short and the caudal fin is relatively long and slightly pointed. The first dorsal fin 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 (Reed *et al*., 1967).

Most good characters used in fish taxonomy are morphological features of body form and structure. Morphological characters may be divided into those that are directly measurable and those that are not. A character is any attribute of an organism that can be distinctively detected and described. A good taxonomic character must be easily observable and vary from one taxonomic to another; therefore, good character must be genetically, rather than environmentally (Cailliet *et al*., 1986). A detailed description of the biometric features of a fish is important for the identification and studies on the extent of racial variation of the species (Ikusemiju, 1976).

Fish condition, an expression of the relationship of weight to length can be an important diagnostic indicator of the well-being of the fish in culture (Swingle and Shell, 1971). There is apparently no published information on the composition and biology of *Heterobranchus* populations in any of the inland freshwater systems of Nigeria.

This study describes an analysis of the length weight relationship of *Heterobranchus bidorsalis* diploid and triploid progenies raised under the same environmental condition.

MATERIALS AND METHODS

The study was carried out at HEPA marine consultant firm, a division of HEPA Fisheries Nigeria Limited at Asero, Abeokuta, Ogun State, Nigeria. Twenty triploid strains of weight and length ranging from 207-300 g and 27-32 cm; diploid 150-200 g and 23-28 cm *Heterobranchus bidorsalis* were acclimatized separately in tanks and were fed *ad libitum* with the feed containing 40% crude protein. Forty three traits and meristic counts in each *Heterobranchus bidorsalis* progenies were measured by the system described by Cailliet *et al.* (1986) as shown in Fig. 1.

Each specimen was weighed to the nearest 0.01 g and the total and standard length to the nearest 0.1 cm. The length-weight relationship was calculated based on the average measurement expressed logarithmically, using Minitab Statistical Package:

Corresponding Author: O.T. Agbebi, Department of Aquaculture and Fisheries Management, University of Agriculture, P.M.B. 2240, Abeokuta, Ogun State, Nigeria

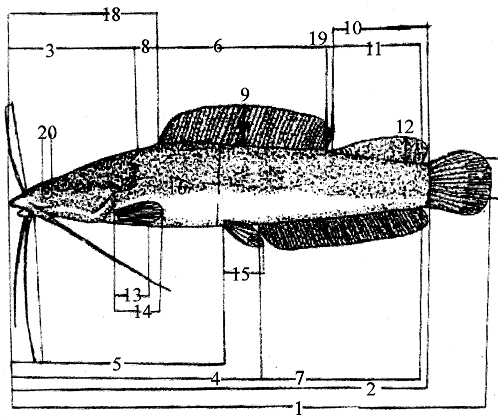

Fig 1: Important body measurements of *Heterobranchus bidorsalis* for the three strains: 1. Total Length (T^L); 2. Standard length (S^L); 3. Head Length (H^L); 4. Pre-anal distance; 5. Pre-pelvic distance; 6. Dorsal fin length; 7. Anal fin length; 8. Distance between occipital process and dorsal fin 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

$$\text{Log W} = \log a + b \log L$$

Where:
W = Weight in grams
L = Total length in centimeters

The condition factor (K) of *Heterobranchus bidorsalis* was computed using the formula by Bennet (1970) as:

$$K = \frac{BW \times 100}{BL}$$

Where:
BW = Body weight in grams
BL = Total body length in centimeters

RESULTS AND DISCUSSION

In morphomeric data (Table I), the average total length in triploid was higher 15.984 compared to 15.108 in diploid. Furthermore, the standard length and head length were higher in triploid than diploid: 14.184 and 13.550, respectively. Head length of triploid 3.380 was longer than diploid which had a mean of 3.379 (Fig. 2). In Table 2, meristic indices the lowest mean value found in diploid was 0.273 found in pre-maxillary tooth plate depth while the highest was found in the number of vertebrate of 64.45. The lowest mean range value of triploid were 0.223 and the highest 66.50 found in pre-maxillary both depth and vertebrate number, respectively (Fig. 3).

Table 1: Morphometric indices of diploid and triploid *Heterobranchus bidorsalis*

Parameters (cm)	Diploid	Triploid
Total length	15.11±2.630	15.98±2.84
Standard length	13.55±1.910	14.18±2.44
Head length	3.38±0.740	3.38±0.96
Frontal frontallele (Longest)	1.10±0.270	1.19±0.22
Frontal frontallele (Shortest)	0.358±0.40	0.360±0.40
Caudal penduncle length	1.838±0.32	2.12±0.49
Head dorsal fin origin	4.88±0.960	4.94±0.95
Distance between eyes	1.22±0.870	1.38±0.94
Body depth at Anus	2.98±0.530	2.97±0.51
Adipose fin length	3.80±0.810	13.20±0.66
Fish weight (g)	9.21±1.680	13.20±0.59

Table 2: Meristic indices of triploid and diploid *Heterobranchus bidorsalis*

Parameters	Diploid	Triploid
Number of dorsal fin	32.55±0.630	32.77±0.650
Number of pectoral fin	7.95±0.320	7.55±0.310
Pelvic fin rays	5.82±0.260	5.73±0.150
Anal fin rays	43.50±0.610	46.23±1.040
Number pectoral spine	1.00±0.000	1.00±0.000
Vomerine plate width	0.79±0.130	0.73±0.097
Vomerine tooth plate depth	0.723±0.14	0.745±0.15
Number of left gill rakers	4.00±0.000	4.00±0.000
Atlas	2.00±0.000	2.00±0.000
Urostyle	1.00±0.000	1.00±0.000
Vertebrae	72.50±3.870	76.50±4.880

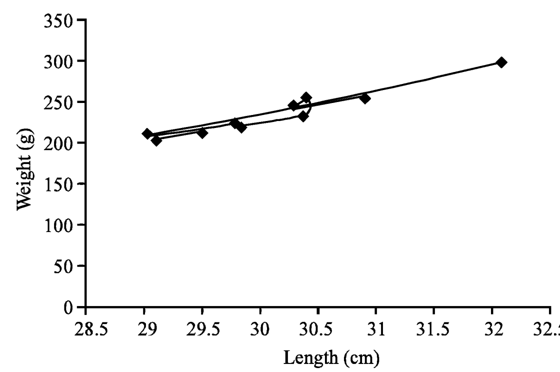

Fig. 2: Relationship between length and weight of triploids

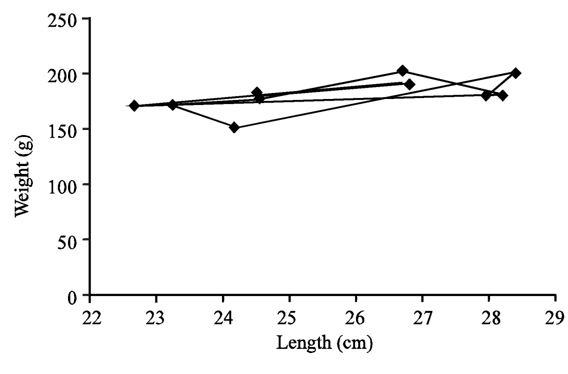

Fig. 3: Relationship between between length and weight of diploid

Table 3: Comparison of the mean, percentage standard length and percentage head length of diploid and triploid *Heterobranchus bidorsalis*

	Mean		Standard length (%)		Head length (%)	
Parameters	2n	3n	2n	3n	2n	3n
Total length	12.41	12.79	105.44	91.03	468.30	535.15
Standard length	11.77	11.45	100.00	100.00	444.15	479.92
Head width	2.65	2.39	22.51	20.84	100.00	100.00
Head length	2.27	2.18	19.29	19.01	85.66	91.21
Frontal frontanelle L	0.86	0.99	7.31	8.63	32.45	41.42
Frontal frontanelle S	0.35	0.40	2.97	3.49	13.21	16.74
Length of caudal peduncle	1.56	1.58	13.25	13.78	58.87	66.11
Distance between head to dorsal fin	3.88	3.88	32.97	33.83	146.42	162.34
Distance between the eyes	0.30	0.26	1.95	22.27	8.68	10.88
Gap between D^F/A^F	0.47	0.47	4.10	4.10	17.74	19.67
Sex	1.20	1.20	10.20	10.46	45.25	50.21
Body depth at anus	2.45	2.50	20.81	2.79	92.45	104.60
Adipose fin length	3.01	3.10	25.57	27.03	113.58	129.71
Weight (g)	9.21	13.20	78.25	115.08	347.55	552.30

*2n represents Diploid; 3n represents Triploid; DF is Dorsal Fin and AF is Adipose Fin

Table 4: Summary of ranges of the regression analysis of diploid and triploid *Heterobranchus bidorsalis*

Treatments	Log weight	Log length	K	Kn	$\hat{W}$
Diploid	2.176-2.255	1.356-1.453	0.802-1.453	0.869-1.087	165.618-191.906
Triploid	2.315-2.477	1.462-1.506	0.838-1.506	0.968-1.038	203.613-297.400

K = The Condition factor; Kn = Relative Condition factor; W = Expected weight of fish

Table 3 shows the percentage length of diploid was higher in almost all the parameters except for the length of caudal peduncle, distance between the eyes, adipose fin length and weight of fish.

In diploid regression analysis (Table 4) the length had a significant effect on weight at $p<0.05$. The log weight and log length ranged from 2.176-2.255; 1.356-1.453. The condition factor (K) value ranged between 0.802 and 1.453. The coefficient of variation (R) was the variation level in the weight responsible by the length which was 42.4%. The relative condition factors (Kn) ranged between 0.869 and 1.087 and (W) which is the expected weight of a fish of the same length were foundto be within the range of 165.618-191.906 g. The regression analysis of the length-weight measurements of diploid fish resulted in the equation:

$$\text{Log weight} = 1.32 + 0.663 \text{ Log length}$$

In triploid regression analysis, the length had a significant effect on weight at $p<0.01$. About 2.315-2.477 and 1.462-1.506 were the ranges of log weight and log length, respectively. The condition factor values (K) ranged between 0.838 and 0.906. The coefficient of variation (R) was 96.8%. The relative condition factors (Kn) ranged between 0.968 and 1.038 and (W) the expected weight of a fish of the same length were found to be within the range of 203.613-297.400.

The regression analysis of the length-weight measurements of triploid fish resulted in the equation:

$$\text{Log weight} = 3.12+3.71 \text{ Log length}$$

Table 5: Summary of regression and test of significance of the diploid and triploid *Heterobranchus bidorsalis*

Treatments	N	Log A	B	R^2	t-value	Remark on growth
Diploid	10	1.32	0.66	0.42	2.42	Isometric
Triploid	10	3.12	3.71	0.96	15.56	Isometric

In both morphometric and meristic indices, triplody fish indicated better performance than the diploid counterpart (Table 4 and 5). Inspite of this, there were some equality in the meristric indices such as the number of right and left gill rakers, pectoral spine, Atlas and Urostyle. All these parameters were equal in triploids and diploids indicating that there were similarities. Possession of a single pectoral spine is an attribute of *Heterobranchus* species. Most teleosts possess one or two Atlas; Urostlye number (vertebrae) features. The cartilaginous termination of the vertebral column is usually constant in most bony fishes.

In the morphometric parameters, triploid performed better than the diploid. The significant effect of the treatment on the parameters especially the fish weight, standard length and body depth at anus were not far fetched to be accounted for the prevention of the second polar body for ploidy production. This eventually increases ploidy species (Tave, 1992).

Both meristic and morphometric characters of the diploid and triploid fish generates distinctive features in the hybrid identification of *Heterobranchus bidorsalis*. This was contrary to Cassani and Carton (1984) report on diploid and triploid hybrid grass carp, *Ctenopharyngodon idella* female x *Hypophthalmichthys nobilis* male where their hybridgrass carp did not show consistent differences in various morphological traits. The most consistent trend differentiating the morphology of diploid and triploid fish was that triploid fish grew faster had fewer scales in the lateral line and the transverse series below the lateral line and overall fewer deformities. In the length/weight regression analysis the value of Log a and Log b in diploid and triploid *Heterobranchus bidorsalis* shows that growth in diploid and triploid are comparatively distinct. The r and t-values also indicate positive growth differences of triploid over diploid. Although, length had significant effect on weight in both, the little change in length in triploid conferred higher change in their weight.

The coefficient of variation of triploid (96.8%) doubles that of the diploid counterpart (42.4%). The irregular pattern in the log weight versus log length in the diploid showed inconsistency in their growth pattern while the linear pattern in the triploid indicate consistency in their length-weight growth relationship signifying better performance. Generally both fish indicated appreciable performance in length-weight relationship via the coefficient of variance which is the predator dictating the pace of variation in weight that is responsible by the length. Therefore both diploid and triploid exhibited isometric growth which means they tend to become fatter as they grew larger. This result was a reverse to the allometric growth reported by Anibeze (2000) in the length-weight relationship of male and female *Heterobranchus longifilis* from Idodo river, Nigeria. *Heterobranchus longifilis* exhibited a negative allometric growth for both sexes and in the pooled sample which means they tend to become thinner as they grow larger. Allometric growth was observed in Ajayi (1972) for *Chrysichthys auratus longifilis* and *Chrysichthys nigrodiogitatus* and Ikusemiju (1976) on *Chrysichthys walkeri* in the Lekki Lagoon in Nigeria. However, these studies tallied with the findings of Otubusin (1990) on the length-weight relationship of supplementarily-fed milkfish *Chanos chanos* where growth was observed to be isometric in the fish fed for three-month duration but allometric in all the other treatments.

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