Length-weight Relationship of *Heterobranchus bidorsalis* (Geoffroy st. Hilaire 1809) Diploid and Triploid Progenies raised under the same Environmental condition

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Abstract

Twenty specimens of triploid with weight and length ranging from 207-300g and 29-32cm; diploid 150-200g and 23-28cm Heterobranchus bidorsalis (Geoffroy St. Hilaire 1809) were subjected to morphometric and meristic characterization, length-weight relationship and condition factor evaluation. Triploid specimens had the higher values in all the parameters examined and were significantly different (P<0.005). Regression analysis of diploid and triploid show the ranges of values (K) of 0.802 1.453 and 0.838 0.906 respectively, for condition factor (k) 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 in diploids (42.4%). In diploid progenies, the length by weight was significantly different (P<0.05) in triploid. Triploid progenies need no special adaptive environment or technique for rearing. Therefore, diploid and triploid progenies can be successfully cultured simultaneously under the same environmental condition.*

Keyword: Diploid, Triploid, Progenies, Morphometric, Meristic, Condition factor, Characterization

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 *H. 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 to 0.67 times as long as the rayed dorsal fin and about the same height (Reed *et al.,* 1982)

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 (Gregor *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). The Heterobrancus is similar in many respects to Clarias but can readily be differentiated from the latter by the fact that he has the rayed dorsal followed by an adipose fin. The development of production techniques for this local species and their successful culture may also help to protect the fish populations, which are threathened in many cases due to unsustainable fishing practices (Aluko, 1999a).

This paper presents 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. Ten triploid strains of weight and length ranging from 207 - 300g and 29.0 - 32.1cm; ten diploid 150 200g and 22.7 28.4cm *H. bidorsalis* of the age were randomly selected and acclimatized separately in tanks. They 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 Gregor *et al.,* (1986) as illustrated in Plate 1.

Legth-weight relationship of H. bidorsalis

Each specimen was weighed to the nearest 0.01g using a sensitive (Ohaus, model Cs200). The total and standard length were measured to the nearest 0.1cm by using measuring board.

The length-weight relationship was calculated based on the average measurement expressed logarithmically, using T-test and analysis of variance (ANOVA) with Minitab Statistical Package, Minitab (2000).

Log W = log a + b log L

Where; W = weight in grammes

L = total length in centimeters

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

K = BW x 100/ BL

Where BW = Body weight in grammes

BL = Total body length in centimeters

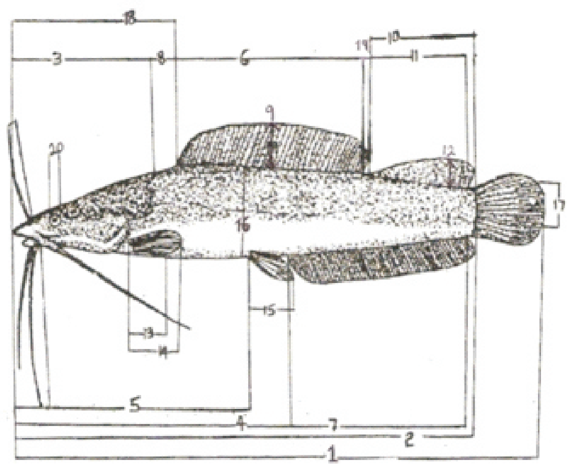

Plate 1: Important body measurements of *Heterobranchus bidorsalis.*

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; 10.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; 20 Eye diameter

Results

Table 1: Summary of range and mean values of physico-chemical parameters of the water during the
experimental period.

Parameters	Range	Average
Temperature (^{0}C)	25.00- 27.80	26.47 ± 0.89
Dissolved oxygen (mg/l)	7.60 – 8.00	7.80 ± 0.64
Conductivity (us/cm)	76.10 – 83.10	79.60 ± 3.21
P^H	6.22 – 6.86	6.54 ± 0.43
Ammonia (mg/l)	0.05 – 0.09	0.07 ± 0.02

Table 1 shows the range and mean average values of physico-chemical parameters of the water during the experimental period. Temperature and Conductivity ranged between 25.00-27.80 and 76.10 83.10 with mean average of 26.47 ± 0.89 and 79.60 ± 3.21 respectively. Dissolved Oxygen ranged from 7.60 8.00 while the mean average, P^H and Ammonia are6.54 ± 0.43 and 0.07 ± 0.02 respectively.

Table 2 shows morphometric indices of diploid and triploid *Heterobranchus bidorsalis*. The average total length in triploid was higher 15.98 ± 2.84cm compared to 15.11 ± 2.63cm 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 3.38 ± 0.74cm was longer than diploid which had a mean of 3.37 ± 0.96cm.

Table 3 gives Meristic indices of triploid and diploid *Heterobranchus bidorsalis*. The vomerine tooth plate depth in diploid was **0.72** ± 0.140 found in diploid while **0.74** ± 0.15 was found in triploid. The pelvic fin rays and anal fin rays in diploid were **5.82** ± 0.26 and **43.50** ± 0.61 respectively compared to triploids **5.73** ± 0.15 and **46.23** ± 1.04 respectively. Vertebrate number in triploid was higher 76.50 ± 4.88 compared to diploid **72.50** ± **3.87.** Both triploid and diploid had equal number of left gill rakers 4.00 ± 0.00, Atlas 2.00 ± 0.00, Urostyle 1.00 ± 0.00 and same number of pectoral spine 1.00 ± 0.00.

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

Parameters (cm)	**Diploid**	**Triploid**
Total Length	15.11 ± 2.63	15.98 ± 2.84
Standard length	13.55 ± 1.91	14.18 ± 2.44
Head length	3.37 ± 0.74	3.38 ± 0.96
Frontal frontallele (Longest)	1.10 ± 0.27	1.19 ± 0.22
Frontal frontallele (Shortest)	0.35 ± 0.40	0.36 ± 0.40
Caudal penduncle length	1.83 ± 0.32	2.12 ± 0.49
Head Dorsal Fin Origin	4.88 ± 0.96	4.94 ± 0.95
Distance between eyes	1.22 ± 0.87	1.38 ± 0.94
Body Depth at Anus	2.98 ± 0.53	2.97 ± 0.51
Adipose fin length	3.80 ± 0.81	13.20 ± 0.66
Fish Weight (g)	9.21 ± 1.68	13.20 ± 0.59

NS = Not Significant (P > 0.05)

Table 3: Meristic indices of Triploid and Diploid *Heterobranchus bidorsalis*

Parameters	Diploid	Triploid
Number of Dorsal fin	32.55 ± 0.63	32.77 ± 0.65
Number of Pectoral fin	7.95 ± 0.32	7.55 ± 0.31
Pelvic fin rays	5.82 ± 0.26	5.73 ± 0.15
Anal fin rays	43.50 ± 0.61	46.23 ± 1.04
Number pectoral spine	1.00 ± 0.00	1.00 ± 0.00
Vomerine plate width	0.79 ± 0.13	0.73 ± 0.09
Vomerine tooth plate depth	0.72 ± 0.14	0.74 ± 0.15
Number of Left gill rakers	4.00 ± 0.00	4.00 ± 0.00
Atlas	2.00 ± 0.00	2.00 ± 0.00
Urostyle	1.00 ± 0.00	1.00 ± 0.00
Vertebrae	72.50 ± 3.87	76.50 ± 4.88

NS = Not Significant (P > 0.05)

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.

Table 5 showed the length (cm) and weight (gm) diploid and triploid Heterobranchus bidorsalis respectively. The length of diploid ranged from 22.7 28.4cm while the triploid length ranged from 29.0 32.1cm. Weight of diploid ranged from 150.0 200.0gm while triploid weight ranged from 207 300.0gm respectively.

The table shows higher length and weight of triploid compared to diploid strains of the same age that were reared under the same environmental conditions

Table 4 shows the comparison of Means, Percentage standard length and Percentage head length of diploid and triploid *Heterobranchus bidorsalis.*

Parameters	Mean		% standard length		% head length	
	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 & AF is Adipose Fin

Table 5: Length / weight of diploid and triploid *Heterobranchus bidorsalis* progenies

Weight of Diploid (gm)	Weight of Triploid (gm)	Length of Diploid (cm)	Length of Triploid (cm)
180	300	28.0	32.1
0	244	28.4	30.3
150	255	24.2	30.4
170	238	23.2	30.4
175	222	24.5	29.8
200	226	26.7	29.8
180	207	28.2	29.1
170	217	22.7	29.5
190	210	26.7	29.0
180	259	24.5	30.9

Table 6 shows the summary analysis of diploid and triploid Heterobranchus bidorsalis. In diploid regression analysis (Table 7) the length had a significant effect ($P < 0.05$) on weight. 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 found to be within the range of 165.62-191.91g.

Table 6: Summary of regression analysis of the diploid and triploid *Heterobranchus bidorsalis.*

Treatment	N	Log a	B	R^2	K	Kn	W	t-value
Diploid	10	1.32	0.66	0.42	0.90	0.89	183.13	2.42
Triploid	10	3.12	3.71	0.96	0.92	1.00	263.11	15.56

Where: K = The Condition factor
Kn = Relative Condition factor
W = Expected weight of fish The regression analysis of the length-weight measurements of diploid fish resulted in the equation:

Log Weight = 1.32 + 0.66 Log Length

In triploid regression analysis, the length had a significant effect on weight at $P<0.01$. 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 203.61 297.40.

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

Log Weight = 3.12 + 3.71 Log Length

Discussion and Conclusion

In morphometric and meristic indices, triplody fish showed better performance than the diploid counterpart. However, there were some equality in the meristric indices such as the number of right and left gill rakers, pectoral spine, Atlas and Urostyle which were equal in triploids and diploids. Possession of a single pectoral spine is an attribute of *Heterobranchus* species (Reed *et al;* 1982). Most teleosts possess one or two Atlas; Urostlye number (vertebrae) features (Reed *et al;* 1982). The cartilaginous termination of the vertebral column is usually constant in most bony fishes (Gregor *et al;* 1986).

The significant effect of the treatment on the parameters especially the fish weight, standard length and body depth at anus accounted for the prevention of the second polar body during 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 *H. 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 hybrid grass 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, and overall fewer deformities.

In the length/weight regression analysis the value of *Log a* and *Log b* in diploid and triploid *H. 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 doubles that of the diploid counterpart. 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 precursor 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. *H. 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 *C.nigrodiogitatus* and Ikusemiju (1976) on *C.walkeri* in the Lekki Lagoon in Nigeria.

However, these studies showed that diploid and triploid exhibit isometric growth during their culture period which means the species tend to become fatter as they grew larger. Triploid progenies need no special adaptive environment or technique for rearing. Therefore, diploid and triploid progenies can be successfully cultured simultaneously under the same environmental condition.

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