AQUATIC RESEARCH

FILLETING YIELD, BODY CHARACTERISTICS AND LENGTH WEIGHT RELATIONSHIP OF FOUR FISH SPECIES FROM LOWER RIVER BENUE MAKURDI NIGERIA

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ABSTRACT

Fillet yield, length-weight relationship and condition factor of four commercial fish species including: *Protopterus annectens, Labeo coubie, Auchenoglanis occidentalis and Mormyrus rume* from lower river Benue Makurdi Nigeria were determined. A total of 600 fish samples were used, 50 individuals regarding each species for the period of three months. Fish samples were collected and transported to the University of Agriculture Makurdi, Department of Fisheries and Aquaculture laboratory where data were recorded on: The Total weight (TW), Total length (TL), Standard length (ST), Visceral weight (VW), Head length (HL), Weight of bones (WB), Weight of fins (WF) and Weight of fillet (WF) from the four fish species. Large differences in the fillet yield were observed among the species studied. L*abeo cuobie* had the highest fillet percentage yield (65.51 %) while *Auchenoglanis occidentalis* had the lowest fillet percentage yield (56.85 %). There was a linear relationship between fish length and fillet, also, significant correlation was found between fillet yield and body measurements (weight and length).

Keywords: Filleting yield, Physical characteristics, Fish species, River Benue, Condition factor

Introduction

Study of characteristics of fish quality requirement and assessment indices are basic trade relations processes in deciding prosperity of commercial fisheries products. Therefore, study of fish products are deemed to be of paramount importance (El Tay, 1994). Processors, nutritionists and consumers, all have direct interest in the physical and chemical composition of fish. This can be done through the studying of general condition of fishes via studying their body weight, body length and filleting yield indices. This allows some flexibility in assessing the actual amount of fish tissue consumed and inedible parts discarded.

River Benue is the major tributary of the Niger River and it is approximately 1400 km long and is almost entirely navigable during the summer months. At this occasion, it is an important transportation route in the regions through which it flows.

It rises in the Adamawa Plateau of northern Cameroon, from where it flows west, and through the town of Garoua and Lagdo Reservoir, in to Nigeria south of the Mandara mountains, and through Jimeta, Ibi and Makurdi before meeting the Niger at Lokoja.

The river's largest tributary is the Mayo Kebbi, which connects it with the Logone River (part of the Lake Chad system) during floods. Other tributaries are Taraba River and River Katsina Ala. The river overflows its banks during the rainy season (May-October), but decreases drastically in volume leaving tiny island in the middle of the river during the dry season (November-April). The river contains several species of fresh water fishes of different families such as Protopteridae, Claroteidae, Mormyridae and family Cyprinidae. Little work has been done in these fish species concerning fish flesh quality, filleting yield and body weight characteristics particularly in River Benue. However, fragmented studies were done by a few researchers on these river namely Solomon and Akogu (2005), Olufeagba and Okomoda (2015) and Solomon *et al.,* (2015), these researchers worked on the aspect of morphometric characteristics composition of some commercial fish species of the River Benue. The species studied included, *Protopterus annectens, Labeo coubie, Auchenoglanis occidentalis* and *Mormyrus rume.* The results of body weight composition and yield indices revealed clearly that the percentage decreased in the order of fillet, head, skeleton, viscera and skin for the most of studied fish species. Therefore, this study is designed to determine the fillet yield, length-weight relationship and condition factor of four commercial fish species from lower river Benue Makurdi Nigeria.

Materials and Methods

Sampling Site

The fish samples were collected from River Benue at Wadata Market, Makurdi the capital of Benue State, Nigeria, located at longitude 7º 43' N and latitude 8° 32' E.

Experimental Fish Species

A total of 600 individuls, belonging to four families, were sampled for this study. These families include, Protopteridae, Claroteidae, Cyprinidae and Mormyridae. The studied fishes were represented by four species, namely, *Protopterus annectens annectens, Labeo coubie, Auchenoglanis occidentalis* and *Mormyrus rume.* Each species were composed of 50 samples each for the period of three months. The samples were collected fresh with cast and set net by the fishermen at landings area. The fish with crushed ice for preservation during assessment. The whole fresh samples were taken to the Department of Fisheries and Aquaculture laboratory Federal University of Agriculture Makurdi where their total and standard length were recorded (in cm) using measuring rule (ruler) and total body weights were recorded in grams using an electronic weighing balance. The fishes were then filleted, eviscerated, beheaded using a sharp knife. The weight of viscera, fillets, heads, and skeletons (frames) were weighed separately using weighing balance. A pooled mean of these weights were calculated and used to estimate the percentage of each part of the dress out - Fillets, head, gut and frame relative to the weight of whole fish.

Data Collection

Data were collected on: the total weight (g), total Length (cm), standard length (cm), visceral weight (g), head length (cm), weight of bones (g), weight of fins (g) and weight of fillet (g) from the four fish species.

Statistical Analysis

The data was analyzed using one way ANOVA statistical methods according to social science software (SPSS, version 17.0), followed by Duncan multiple range tests, and the difference between species was investigated by Independent sample T test Correlations between body size (weight and length) and fillet weight and yield were analyzed by Pearson's coefficient for linear regression (r). The differences were considered significant at $P<0.05$. All data were expressed as mean ±S.E.M

Results and Discussion

Results from this study shows a significant variation in the mean, carcass composition and filleting yield indices of fish investigated. The fillet percentage was highest for the *Labeo coubie* (65.51 %) and lowest for *Auchenoglanis occidentalis.* (56.85 %). The highest filleting yield of *Labeo coubie* was due to small viscera (5.63 %) and skeleton (8.27 %) while the lowest filleting yield of *Auchenoglanis occidentalis sp.* was due to its large head, which measured (25.87 %). These results were in agreement with Eyo (1991), Abanu and Ikeme (1988) and Ali *et al.,* (1992). *Auchenoglanis occidentalis possessed* large head (25.87 %) which had an adverse effect on the filleting yield of their bodies. Also there were some attributes, which were responsible for decreasing the filleting yield such as skeleton and fins in the case of *Auchenoglanis occidentalis*, which recorded 8.89%, for skeleton and 3.69% for fins. *Labeo coubie* had moderate head and skeleton weights which resulted in the high filleting yield (65.51 %) among the studied fishes, although the head of the *Labeo coubie* was large and long compared to the rest of its components. This did not affect its filleting yield which was (65.51 %) because it had lower skeleton percentage (8.27 %).

Generally, the filleting yield of the studied fish species was a reflection of their anatomy i.e. species with large heads and skeleton relative to musculature give lower filleting yield than those with smaller heads and skeletons (Eyo, 1991; Ali e*t al.,* 1992). On the other hand, *Auchenoglanis occidentalis* had high inedible parts (head, skeleton and fins). These inedible parts are often discarded except for a few considerations where head, skeleton and gonads are used as by-products and sometimes used as diet for low-income people.

The edible parts (fillets) weight of studied fishes was very low when compared with fishes such as carp (53 %) and trout (70 %) (FAO, 1985). Since these inedible body components (head, skeleton, skin and viscera) are usually discarded except for a few considerations where heads and skeletons are eaten, the purchaser may thus suffer economic loss. Therefore, the use of such inedible parts for manufacture of fish silage or fish meal in different fisheries sectors is suggested. Length-weight relationships of fishes are often used to study the indication of fatness, general well-being or gonad development. It is also assumed that heavier fish of a given length are in better condition. Venu and Kurup (2003) noted that for an ideal fish, which maintain dimensional equality, the isometric value of b would be 3. The correlation coefficient was all positive and highly significant for *A.*

occidentalis in River Benue which indicates that the length increases with increase in weight of the fish. This is in agreement with previous studies on different fish species from various water bodies (Layèyè, 2006), (Ayoade and Ikula, 2007). However, Shinkafi and Ipinjolu (2010) reported allometric growth pattern for *A. occidentalis* in River Rima, North-western Nigeria and consistent 'b' value for A. occidentalis in this study. Ikongbeh *et al.,* (2012a) reported allometric growth pattern for *B. docmac*, from Lake Akata, Benue State, Nigeria. Isometric growth pattern was also reported for *C. auratus.* (Ikomi, and Odum, 1998). It was observed in the present study, that mean condition factor for *A. occidentalis* were less than '1' which indicates that the condition of the fish species can be improve, this implies that increase in length brought about little proportional increase in weight. Ikongbe *et al.,* (2012b), reported similar observation in *C. nigrodigitatus*, and *B. docmac* from Lake Akata, Benue State, Nigeria. Condition factor is not constant for a species or population over a time interval and might be influenced by both biotic and abiotic factors such as feeding regime and state of gonadal development. There are also suggestions that fish condition can be influenced by certain extrinsic factors such as changes in temperature and photoperiod (Youson, *et al.*, 1998). It was observed that the yield of fish was a reflection of its structural anatomy. Fish with small heads and viscera regardless of the season of spawning as in the case of *Labeo coubie* and Mormyrus *rume* produced a higher filleting yield than those with larger heads and viscera as in the case of *Auchenoglanis occidentalis* and *Protopterus annectens*. *Auchenoglanis occidentalis* had the height mean value of condition factor 0.88 and R^2 value was 0.56 which indicates a negative allometric growth with the variation in the body weight correlating with changes in the length.

The length weight relationship of Protopterus annectens were as shown in figure 5, 6, 7 and 8 showed that the four fish species under this study exhibited negative allometric growth. This indicated that growth in length increase as weight increases and also the rate of increase in body length was not proportional to the increase in body weight. This result is different from the one obtained by Oniye *et al.,* (2006) when he obtained the b-value for male and female P. annectens in Jachi dam, Nigeria to be 3.12 and 3.22 respectively. This could be due to the condition of the fish caught during different season, location, sex, sample site and nature of the water body. The regression coefficient of 0.83 compares favourably with the 0.86 and 0.84 obtained by Oniye *et al.,* (2006) for *Murmyrus rume*. Fafioye and Oluajo (2005) also obtained a condition factor of 1.00 for some other fish species from Epe Lagoon**.**

Conclusion

In conclusion, there was a higher correlation coefficient value in the length-weight relationship for all the fish species in this study. Also, yield of fish was a reflection of its structural anatomy. Fish with small heads and visceral regardless of the season of spawning as in the case of *Labeo coubie* and Mormyrus *rume* produced a higher filleting yield than those with larger heads and viscera as in the case of *Auchenoglanis occidentalis* and *Protopterus annectens*. *Auchenoglanis occidentalis* had the highest mean value of condition factor 0.88 and R^2 value was 0.56 which indicates a negative allometric growth with the variation in the body weight correlating with changes in the length.

Table 1. Mean Percentage Carcass Composition and Fillet Yield of Four Fish Species from Lower Rive Benue.

Body Characteristics	*Protopterus annectens*	*Auchenoglanis occidentalis*	*Labeo coubie*	*Mormyrus rume*	*P-Value*
Total Weight (g)	270.31 ±14.81[c]	211.34 ±12.85[b]	158.04 ±10.00[a]	169.18 ±11.81[a]	0.00
Total Length (cm)	42.85 ±1.24[b]	29.87 ±0.85[a]	28.97 ±0.75[a]	30.03 ±1.05[a]	0.00
Standard Length(cm)	37.95 ±1.15[b]	24.58 ±0.70[a]	23.84 ±0.65[a]	24.82 ±0.78[a]	0.00
% Visceral Weight(g)	13.57 ±0.39[c]	6.41 ±0.34[b]	5.63 ±0.23[ab]	5.24 ±0.14[a]	0.00
% Weight of Head (g)	13.25 ±0.25[a]	25.87 ±0.64[c]	15.54 ±0.44[b]	16.60 ±0.37[b]	0.00
% Weight of Fin (g)	1.24 ±0.10[a]	3.69 ±0.15[c]	2.40 ±0.09[b]	2.26 ±0.11[b]	0.00
% Weight of Bone (g)	9.79 ±0.34[c]	8.89 ±0.21[b]	8.27 ±0.26[b]	7.22 ±0.15[a]	0.00
% Fillet Yield	60.29 ±0.61[b]	56.85 ±0.69[a]	65.51 ±0.60[c]	65.40 ±0.46[c]	0.00

Mean in the same row with different superscripts differ significantly (P<0.05)
(a, ab, b, and c denote the levels of significant different)

Table 2. Body Characteristics of Selected Four Fish Species from Lower River Benue

Body Characteristics	*Protopterus annectens*	*Auchenoglanis occidentalis*	*Labeo coubie*	*Mormyrus rume*	*P-Value*
Total Weight	270.31 ±14.81[c]	211.34 ±12.85[b]	158.04 ±10.00[a]	169.18 ±11.81[a]	0.00
Total Length	42.85 ±1.24[b]	29.87 ±0.85[a]	28.97 ±0.75[a]	30.03±1.05[a]	0.00
Standard Length	37.95 ±1.15[b]	24.58 ±0.70[a]	23.84 ±0.65[a]	24.82 ±0.78[a]	0.00
Visceral Weight	33.42 ±1.54[c]	12.29 ±0.89[b]	9.66 ±0.86[ab]	8.38 ±0.58[a]	0.00
Head Length	6.23 ±0.24[b]	6.36 ±0.23[b]	5.72 ±0.20[b]	4.73 ±0.28[a]	0.00
Weight of Head	37.90 ±2.65[b]	55.07 ±3.73[c]	22.91 ±1.26[a]	25.95 ±1.63[a]	0.00
Weight of Fins	3.54 ±0.34[a]	7.28 ±0.48[b]	3.56 ±0.23[a]	3.84 ±0.32[a]	0.00
Weight of Bone	28.70 ±2.42[c]	18.21 ±1.13[b]	12.70 ±0.82[a]	13.51 ±1.05[a]	0.00
Fillet Weight	161.84 ±8.91[b]	119.81 ±7.97[a]	107.93 ±7.03[a]	114.57 ±8.44[a]	0.00
Condition Factor	0.47 ±0.04[a]	0.88 ±0.06[c]	0.73 ±0.05[b]	0.63 ±0.04[b]	0.00
Fillet Yield	60.29 ±0.61[b]	56.85 ±0.69[a]	65.51 ±0.60[c]	65.40 ±0.46[c]	0.00

Mean in the same row with different superscripts differ significantly (P<0.05)
(a, ab, b, and c denote the levels of significant different)

Table 3. Correlation of the Body Characteristics of *Protopterus annectens* in Lower River Benue Makurdi.

	TW	TL	SL	VW	HL	HW	WF	WB	WFL	K
TW										
TL	0.603*									
SL	0.649*	0.956*								
VW	0.862*	0.643*	0.672*							
HL	0.713*	0.800*	0.835*	0.752*						
HW	0.935*	0.469*	0.511*	0.755*	0.600*					
WF	0.636*	0.316*	0.279*	0.502*	0.383*	0.668*				
WB	0.853*	0.355*	0.395*	0.673*	0.488*	0.950*	0.602*			
WFL	0.973*	0.614*	0.661*	0.840*	0.712*	0.862*	0.600*	0.742*		
K	-0.160	-0.636*	-0.618*	-0.233*	-0.430*	-0.123	-0.062	-0.065	-0.143	
FY	-0.020	-0.032	-0.014	-0.049	-0.065	-0.161*	--0.043	-0.282*	0.175*	0.217*

Correlation significant at P<0.05

KEY: TW= Total Weight, TL=Total Length, SL=Standard Length, VW=Visceral Weight, HL= Head Length, HW=Weight of Head (g), WF=Weight of Fins, WB=Weight of Bones, K Condition Factor, WFL=Fillet Weight.

Table 4. Correlation of the Body Characteristics of Mormyrus in River Benue Nigeria.

	TW	TL	SL	VW	HL	HW	WF	WB	WFL	K
TW										
TL	0.929*									
SL	0.888*	0.976*								
VW	0.925*	0.877*	0.850*							
HL	0.876*	0.829*	0.772*	0.821*						
HW	0.955*	0.906*	0.878*	0.900*	0.812*					
WF	0.835*	0.700*	0.676*	0.731*	0.688*	0.790*				
WB	0.973*	0.909*	0.863*	0.912*	0.890*	0.904*	0.753*			
WFL	0.977*	0.919*	0.877*	0.911*	0.885*	0.932*	0.837*	0.976*		
K	-0.237*	-0.448*	-0.451*	-0.247*	-0.309*	-0.210*	0.012	-0.247*	-0.239*	
FY	0.487*	0.442*	0.452*	0.373*	0.456*	0.296*	0.441*	0.506*	0.542*	-0.138

Correlation significant at P<0.05

KEY: TW= Total Weight, TL=Total Length, SL= Standard Length, VW=Visceral Weight, HL= Head Length, WH=Weight of Head, WF=Weight of Fins, WB=Weight of Bones, K Condition Factor, WFL=Fillet Weight.

Table 5. Pearson Correlation of the Body Characteristics of *Auchenoglanis occidentalis* in River Benue Nigeria

	TW	TL	SL	VW	HL	HW	WF	WB	WFL	K
TW										
TL	0.769*									
SL	0.729*	0.957*								
VW	0.812*	0.654*	0.636*							
HL	0.622*	0.666*	0.610*	0.439*						
HW	0.903*	0.586*	0.567*	0.710*	0.507*					
WF	0.794*	0.565*	0.536*	0.766*	0.442*	0.726*				
WB	0.939*	0.723*	0.696*	0.763*	0.612*	0.820*	0.760*			
WFL	0.929*	0.757*	0.712*	0.723*	0.590*	0.766*	0.689*	0.876*		
K	-0.065	-0.509*	-0.526*	-0.102	-0.249*	0.030	0.002	-0.056	-0.103	
FY	-0.062	0.122	0.134	-0.148	-0.033	-0.326*	-0.139	-0.059	0.121	-0.271

*Correlation significant at P<0.05

KEY: TW= Total Weight, TL=Total Length, SL=Standard Length, VW=Visceral Weight , HL= Head Length, WH=Weight of Head, WF=Weight of Fins, WB=Weight of Bones, K Condition Factor, WFL=Fillet Weight

Table 6. Pearson Correlation of the Body Characteristics of *Labeo coubie* in River Benue Nigeria

	TW	TL	SL	VW	HL	HW	WF	WB	WFL	K
TW										
TL	0.692*									
SL	0.674*	0.973*								
VW	0.898*	0.495*	0.459*							
HL	0.622*	0.906*	0.907*	0.379*						
HW	0.959*	0.706*	0.681*	0.912*	0.646*					
WF	0.904*	0.584*	0.546*	0.856*	0.520*	0.894*				
WB	0.962*	0.681*	0.652*	0.899*	0.616*	0.952*	0.880*			
WFL	0.985*	0.719*	0.714*	0.861*	0.668*	0.937*	0.881*	0.940*		
K	0.047	-0.439*	-0.423*	0.092	-0.328*	-0.019	0.080	-0.019	0.031	
FY	0.294*	0.343*	0.399*	0.044	0.386*	0.159	0.136	0.133	0.394*	0.188*

*Correlation significant at P<0.05

KEY: TW= Total Weight, TL=Total Length, SL=Standard Length, VW=Visceral Weight , HL= Head Length, WH=Weight of Head, WF=Weight of Fins, WB=Weight of Bones, K Condition Factor, WFL=Fillet Weight
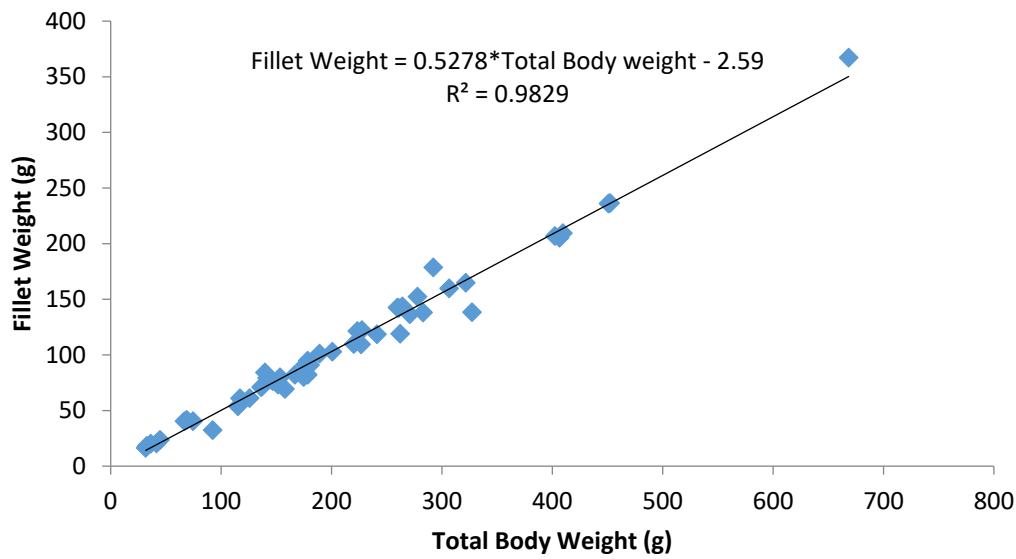
Figure 1. Body Weight and Fillet Yield Relationship of *Auchenoglanis occidentalis* from River Benue
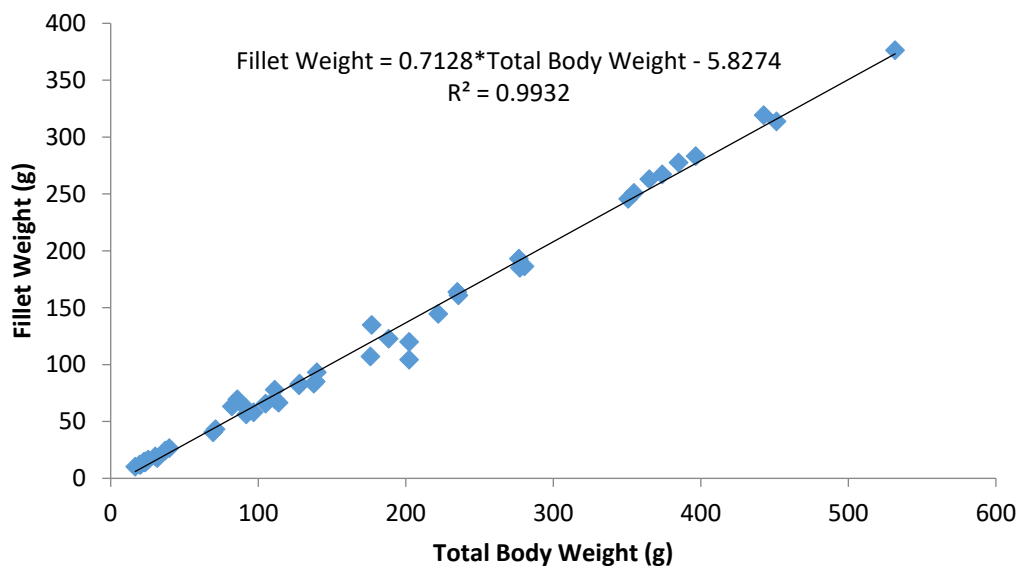

Figure 2. Body Weight and Fillet Yield Relationship of *Mormyrus rume* from River Benue
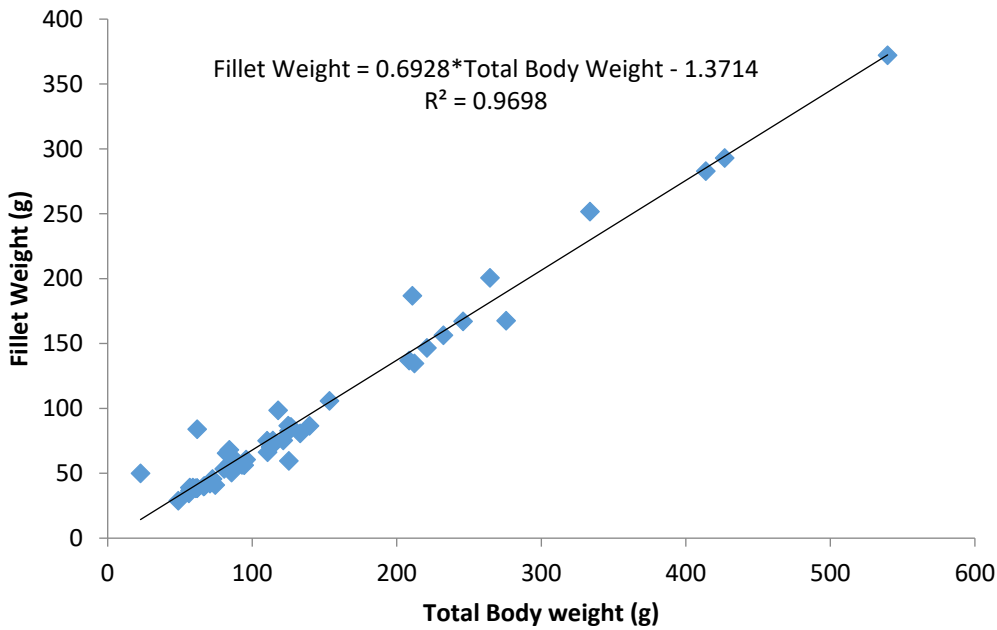
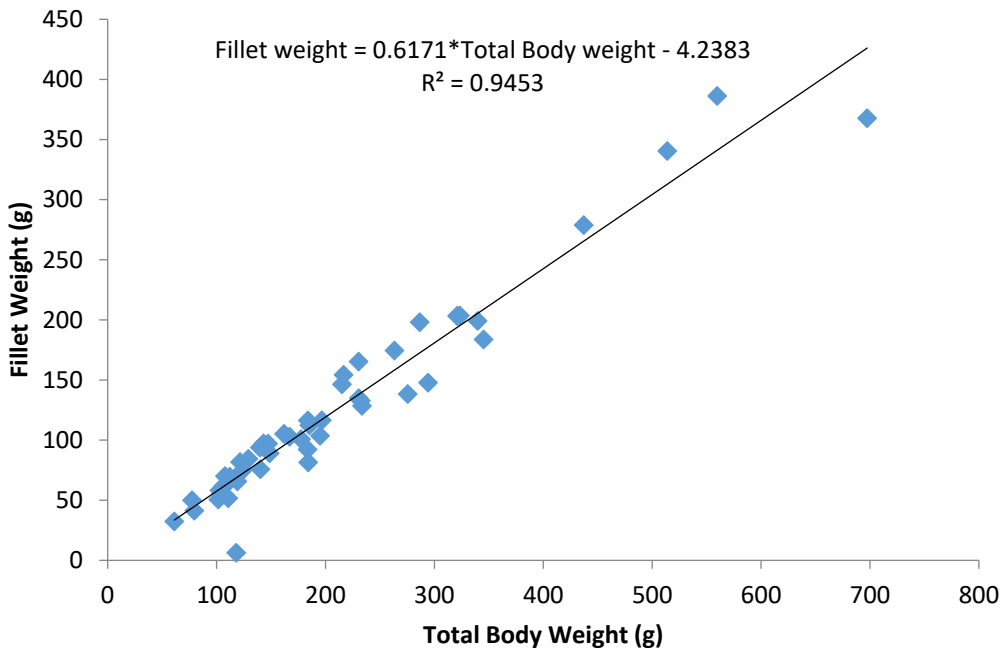**Figure 3.** Body Weight and Fillet Yield Relationship of *Labeo coubie* from River Benue

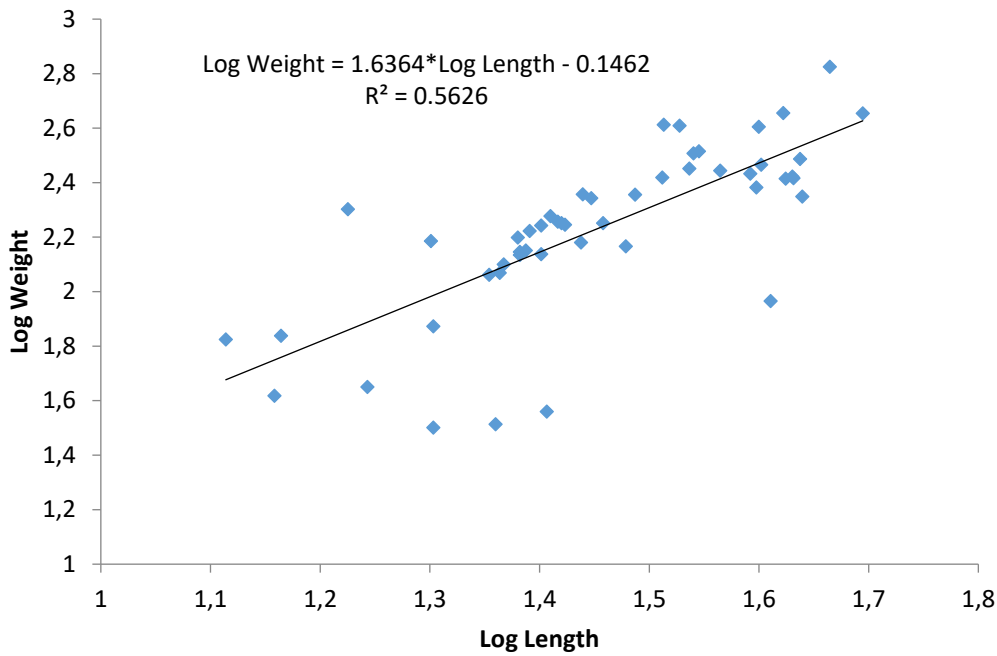**Figure 4.** Body Weight and Fillet Yield Relationship of *Proptopterus annectens* from River Benue

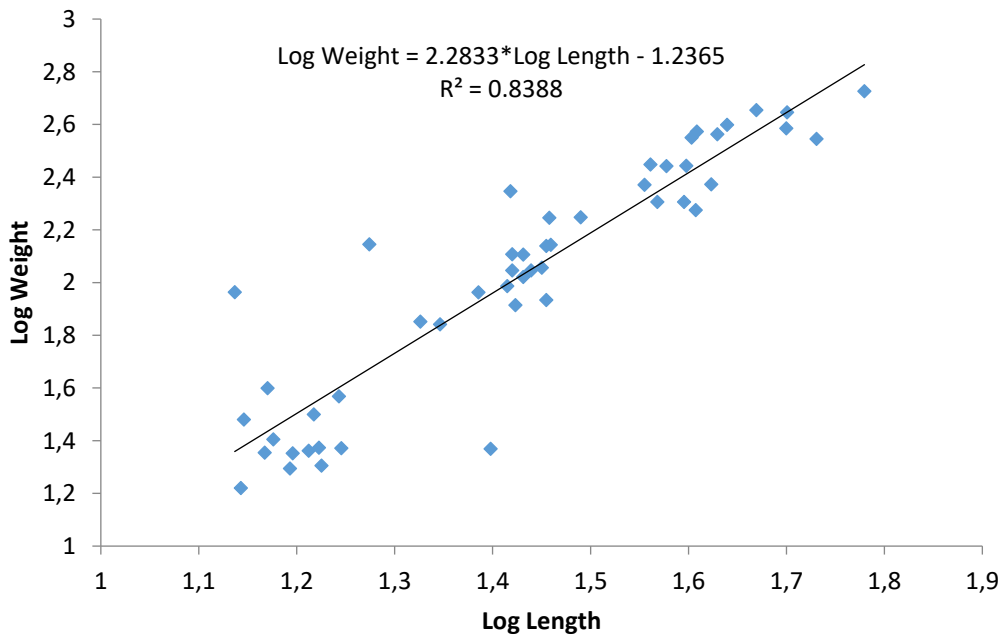**Figure 5.** Length-Weight Relationship of *Auchenoglanis occidentalis* from Lower River Benue

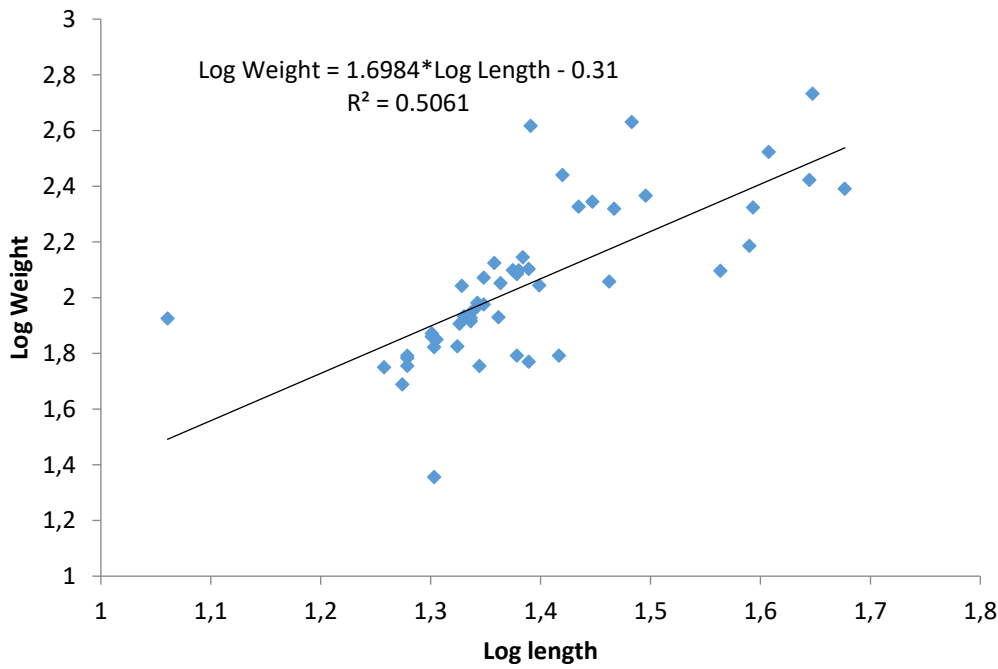**Figure 6.** Length-Weight Relationship of *Mormyrus rume* from Lower River Benue

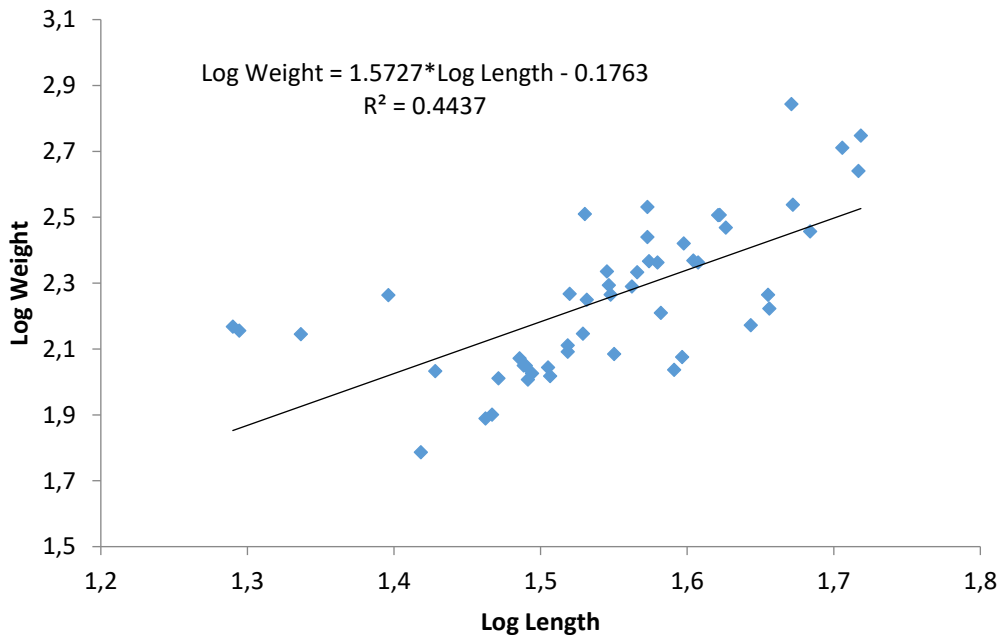**Figure 7.** Length-Weight Relationship of *Labeo coubie* from Lower River Benue

Figure 8. Length-Weight Relationship of *Protopterus annectens* from Lower River Benue

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