FOOD AND FEEDING HABIT OF FRESH WATER MORMYRID (*Hyperopisus bebe occidentalis*, Gunther) IN RIVER RIMA AND GORONYO DAM, NIGERIA.

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ABSTRACT

The food and feeding habits of H. b. occidentalis caught in River Rima and Goronyo Dam in North western Nigeria were investigated. A total of four hundred and fifty four (454) fish samples were collected on monthly basis from October, 2001 to September, 2002 are examined for feeding adaptations and gizzard content. The mouth is terminal in studied species. Two types of teeth were identified viz; cardiform and molariform. The gill rakers were 0.09+0.04cm in length with 0.010±-cm intraspacing. The compartment of gut included gizzard-like stomach. The gut length and fish length (GL-TL) indicated rectilinear positive relationship. The regression coefficient (b) and correlation coefficient (r) of the gut length fish length relationships were significant (p< 0.05). The main taxa of food items identified included substances of plant and animal origins, with overall percentage occurrence of 69.8 and 20.7% for samples from River Rima and 59.1 and 20.0% for those from Goronyo Dam in the same order. During the dry season, the frequency occurrence of plant substances were higher in the juveniles (<30cm, TL) 70.9% and adults (=30cm, TL) 64.7% in River Rima than the values obtained in samples from Goronyo Dam. Their occurrences in Goronyo Dam were fairly higher in the adults (62.9%) than in the juveniles (53.6%) during the same season. The results of this study showed higher occurrence of plant materials in juveniles than in the adults from the two water bodies during the rainy season. Contrary to this, low frequency occurrence of substances of animal in the juvenile samples from River Rima (15.2%) and Goronyo Dam (17.1%) were obtained in adult samples. the occurrence of animal substances were more than those of plants from the two seasons and water body. The feeding adaptive features revealed the ecological roles of the fish species that could be useful in satisfying their food requirements in culture systems and for teaching and further research.

Keywords: Mormyrid; Gizzard content; Feeding habit.

INTRODUCTION

This is one of the member species belonging to family Mormyridae. According to Holden and Reed (1972) *Hyperopisus bebe occidentalis* is the only species representing genus *Hyperopisus* commonly found in abundance in most fresh waters in Nigeria. Reed *et al.* (1967) reported that *H. b. occidentalis* are far more abundant than other Mormyrids in shallow Rivers Niger and Benue. These authors further added that the species has tasty flesh, but contains a lot of fatty oil, which make them difficult to preserve, therefore sold fresh. The food habits of *H. b. occidentalis* were reported by Reed *et al.* (1967), Holden and Reed (1972) and Ipinjolu *et al.* (1996). The morphological traits of fish relating to feeding are the mouth and associated organs (whiskers, lips, and jaw), gill rakers and dentition (Storer, *et. al.* 1972; Gasoline, 1971; Lagler *et al.* 1977 and Wooten, 1992). Reed *et al.* (1967) explained the structural feeding adaptations of the species, while detailed descriptions were reported by Malami *et al.* (2004) and Ipinjolu *et al.* (2004)

Understanding the relationship between the bodily structures and fish diet could be important for predicting the diet of, how they feed and the mechanics of feeding (Wooten, 1992). Studies on stomach composition could provide useful information in positioning of the fishes in a food web in their environment and in formulating management strategy options in multispecies fishery (Joseph and Djama, (1994). Pius and Benedicta (2002) reported the use of stomach content results to reduce intra and inter specific competition for ecological niche. The data on stomach composition of fish is vital in providing straight forward models of stomach content dynamics (Palmores, *et al.* 1997).

This paper presents the results of a study of food and feeding habits of *Hyperopisus bebe occidentalis* collected from River Rima and Goronyo Dam, Nigeria.

MATERIALS AND METHODS

The fish samples were collected from River Rim and Goronyo Dam, Nigeria on monthly basis for a period of twelve months from October, 2001 to September, 2002. A total of four hundred and fifty four (454) fish specimens were identified and procured from fish landing sites, kept chilled under ice blocks in coolers and brought to the laboratory for analysis.

The total length (TL) and standard length (SL) of each fish sample were measured on measuring board graduated in centimeter. The gut system was remove and stretched out and gut length was measured from the anterior tip of the oesophagus to the anus.

The head of each fish sample was split open into upper and lower jaws to expose the internal structures for examination for position and type of teeth.

The gills were removed after detaching them from the palate and section of gills was made. The length of each gill rakers and intra spacing between them were measured to nearest centimeter and analyzed.

The relationship between fish gut length (GL) and total length (TL) .and gut length (GL) and standard length (SL) were computed by linear regression model.

The regressions and correlations analyses were by SPSS package (SPSS, 2001). Test of significance were done by ANOVA.

The specimens were dissected and their gut removed. The gizzards were sectioned and the contents analyzed under light microscope for various food taxa. The gizzard contents not treated were preserved immediately in 10% formalin. The keys guide provided by Needham and Needham (1962) and Quigley (1972) were consulted for identification of food categories. Analysis of gizzard contents was by frequency of occurrence method (Baganel and Tesch, 1978).

RESULTS AND DISCUSSION

Feeding Adaptations

The mouth is terminal in the studied species and is known to feed in mid and open water (Reed *et al*, 1967; Holden and Reed, 1972).

The cardiform and molariform teeth were identified which appeared greatly related to their food habit. The former borne on the pharyngeal bone adapted for grasping and tearing of substances of animal origin (Wooten, 1992). The presence of bicuspid molariform teeth in the later species which may suggest crushing and grinding of food items as part of morphological trait to omnivorous mode of life (Alexander, 1974)

The results of this study showed that the species had numerous closely spaced gill rakers probably for consuming of smaller dietary items (Alexander, 1974). This may indicates that the gill rakers size and the spaces between them determine the food and feeding habits of the species.

The *H. b. occidentalis* possessed medium sized oesophagus, stomach have been substituted with gizzard structure that was found to be similar to that of birds in shape and internal folding. Among the vertebrates, some reptiles such as crocodiles, all birds and some fishes are known to have gizzard that is used to ground the food (Miller and Harley, 1996). Also Lagler *et. al*. (1977) described modification of stomach as grinding organ in some fishes including mullet (Mugil).

There was significant correlation ($p<0.05$) between the gut length and fish length. The regression equations of the relationship was highly significant ($p<0.01$) for gut length total length and gut length standard length.

Gizzard Fullness

The overall results of gizzards fullness analysis of *H. b. occidentalis* in River Rima and Goronyo Dam are shown in Table 1. This study revealed that twenty four (24.4%) percent of gizzards of the species were empty. While varied quantities of food substances were found in seventy- six (75.6%) percent of the fish gizzards analyzed and 1.8% had 100% fullness. This finding of higher non-empty gizzards may suggest active sampling method employed and immediate stoning of fish after capture.

The greater numbers of gizzards with food were attributed to good feeding strategy of species (Haroon, 1996) and probably due to food abundance in most part of the year. Table 2 shows the seasonal distribution of gizzards fullness of the species. The frequency occurrence of gizzards with food were higher in early dry and flood season, which may be attributed to food abundance during flood season and insects and grain/seed availability i9n early dry season. This supported the work of Lowe-McConnell (1975) who reported explosive growth of plants, invertebrates and fish during rainy season in tropical waters, which characterized by active feeding activities by the fish.

Figure 1 and Table 3 represent monthly gizzard fullness of the *H. b. occidentalis.* The results of the gizzard fullness revealed that empty gizzards were higher in June (76.9%) and July (83.3%) than in October (4.8%) in River Rima. This may suggest post harvest digestion of food substances by the fish while struggling in fishing gear. In Goronyo Dam, higher empty gizzards in January and February may correspond with critical feeding period of food scarcity during dry season. This tallied with the obtained results which showed higher frequency occurrence of empty gizzards in fish samples collected in January and February contrary to 7.7% recorded in September.

Occurrence of Food Substances

The frequency of food substances in the gizzard of *H. b. occidentalis* based on two size class, season and two water bodies are shown in Tables 4 &5. The major food categories identified included substances of plant and animal origins and sand grain. The occurrences of these substances were 69.8, 20.0 and 4.4% in samples from River Rima. Their corresponding values for samples from Goronyo Dam were 59.1, 26.8 and 4.16%, respectively. The results suggest that the species is an omnivore feeding more on substances of plant and animal origin. Ipinjolu et al. (1996) reported food habits of the *H. b. occidentalis* in Goronyo Dam where they found that the species is an omnivore feeding more on detritus, seeds, insects, grasses, and crustacean. The major food varieties found were green alga, grain/seed, leaf/plant tissue, root hair, chironomid larva and detrital matter in samples from the two water bodies which may further testify the assertion that *H. b. occidentalis* is an omnivore.

The relative contribution of different food substances to the food categories in the juveniles and adults from River Rima and Goronyo Dam were studied. The results of percentage occurrence of food substances showed that green alga, grain/seed and root hair had higher occurrences in the juveniles from River Rima than their values recorded in adults from the two water bodies. This may be attributed to indignation of the juvenile samples to common food items, while adults had diversify feeding habits..

The percentage occurrence of Beetle parts 53.8% was fairly higher than root hair in Goronyo Dam, which may suggest wider feeding spectrum and ability of the adults to acquire and manipulate animal materials. The adult samples collected from Goronyo Dam consumed more sand grain (28.8%) than animal substances (20.7%) from the same water body.

The percentage occurrence of food substances of *H. b. occidentalis* varied with month, season and size class (Table 4&5). The results of this study showed that the occurrence of plant materials were more in October, July, August and September with higher percentage in July-September (Table 5). This may be attributed to the fact that this period falls within rainy season characterized by abundance of plant materials. This results support the findings of Lowe- McConnell (1975) who reported availability of plant, invertebrates and fish in tropical waters during rainy season. Also the value of animal substances were more in February and April which may suggest abundance of invertebrate insects in lucustrine stable Dam water throughout the year.

The percentage occurrence of Grain/seed and root hair were lower in the stomach of the juveniles than adults from River Rima and Goronyo Dam during dry season. This may suggest the ability of large size class to acquire and manipulate substances of plant in both water bodies. Contrary to this, leaf /plant tissue was preferred by the juveniles (43.6%) than adults (28.6%) from River Rima. The occurrence of animal materials were higher in Goronyo Dam in both size class than the value obtained in samples from River Rima during dry season, which suggest stability of water in lucustrine Dam, hence invertebrate insects availability.

The frequency of occurrence of leaf/plant tissue and root hair were preferred by juveniles and adults in River Rima and Goronyo Dam during rainy season, while juvenile samples from Goronyo Dam had higher occurrence of green alga and grain/seed in River Rima. This may be attributed to abundance of food materials during rainy season relative to the two water bodies and preference of young size class towards common and softer food substances.

The percentage occurrence of food items in the juveniles and adults differed with season and water body. The results of this study showed that substances of plant origin were more in River Rima than in Goronyo Dam during dry season. Contrary to this, higher occurrence of plant materials were recorded in samples from Goronyo Dam (70.1%) than the value from River Rima (69.1%), out of which green alga, grain/seed and leaf/plant tissue had higher percentage than others. This may be attributed to the ability of the species to feed on scarce plant substances during dry season. Also the explosive growth of green plants during the seasons may be due to stability of the Dam water all year round.

The higher percentage occurrence of beetle parts (53.8%) and chironomid larva (46.13%) were found during dry season in Goronyo Dam than those recorded in River Rima with insects as the most dominant food categories (22.5 and 29.0%). This may suggest that lucustrine Dam water stability which contributes to the invertebrate insects' abundance.

During the rainy season the same animal materials occurred highly in River Rima most especially Beetle parts and chironomid larva than those values obtained in Goronyo Dam. This may suggest dynamic abundance of invertebrates during high rainfall. This result supports the finding of Lowe- McConnell (1975) who reported abundant invertebrate insects during flood season in tropical fresh waters.

Table1: Overall Gizzard Fullness of *H. b. occidentalis* in River Rima and Goronyo Dam

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Stomach Fullness (%)	Number of Samples	Percentage
0(empty)	111	24.4
25	150	33.0
50	152	33.4
75	33	7.3
100 (full)	8	1.8
Total	454	100.0

Table 2: Seasonal Gizzard Fullness of *H. b. occidentalis* in River Rima and Goronyo Dam

Season	Fullness of the Stomach (%)									
	0		25		50		75		100	
	(F)	(%)	(F)	(%)	(F)	(%)	(F)	(%)	(F)	(%)
Early dry	19	17.1	42	28.0	29	46.8	16	48.5	7	87.5
Mid dry	36	32.4	39	26.0	3	4.8	5	15.2	0	0.0
Late dry	23	20.7	43	28.7	7	11.3	2	6.1	0	0.0
Early rainy	28	25.1	13	8.7	93	4.8	1	3.0	0	0.0
Flood	5	4.5	13	8.7	20	32.3	9	27.2	1	12.5

Table 3: Monthly distribution of Stomach Fullness and Percentage Occurrence in *H. b. occidentalis* in River Rima and Goronyo Dam

Stomach Fullness (%) | Water body

Month

October L_1=21 L_2= 13 | November L_1=21 L_2=20 | December L_1=21 L_2= 16 | January L_1=18 L2=20 | February L_1=19 L_2=19 | March L_1=18 L_2=15 | April L_1=10 L_2=16 | May L_1=14 L_2=12 | June L_1=13 L_2= 10 | July L_1= 12 L_2=10 | August L_1=6 L_2=15 | September L_1=14 L_2=13

(F) (%) (F) (%) (F) (%) (F) (%) (F) (%) (F) (%) (F) (%) (F) (%) (F) (%) (F) (%) (F) (%) (F) (%)

0

Rima 1 (4.8) 2 (9.5) 1 (4.8) - - 5 (26.3) 3 (16.7) 7 (70.0) 9 (64.3) 10 (76.9) 10 (83.3) - - 4 (28.6)

Goronyo 4 30.8) 6 (30.0) 5 (31.3) 13 (65.0) 11 (57.9) 6 (40.0) - - 5 (41.7) 5 (50.0) 3 (30.0) - - 1 (7.7)

25

Rima - - 15 (71.4) 14 (66.7) 17 (94.4) 13 (68.4) 12 (66.7) 3 (30.0) 5 (35.7) 1 (7.7) 2 (16.7) 2 (33.3) 3 (21.4)

Goronyo 4 (30.8) 7 (35.0) 2 (12.5) 4 (20.0) 5 (26.3) 6 (40.0) 12 (81.3) 4 (33.3) 5 (50.0) 5 (50.0) 6 (40.0) 2 (15.4)

50

Rima 5 (23.8) 4 (19.0) 6 (28.6) 1 (5.6) 1 (5.3) 1 (5.6) - - - - 1 (7.7) - - 2 (33.3) 3 (21.4)

Goronyo 1 (7.7) 6 (30.0) 7 (43.8) - - 1 (5.3) 3 (20.0) - - 3 (33.3) - - 2 (20.0) 7 (46.7) 8 (61.5)

75

Rima 10 (47.6) - - - - - - - - 2 (11.1) - - - - 1 (7.7) - - 2 (33.3) 3 (21.4)

Goronyo 3 (23.1) 1 (5.0) 2 (12.5) 3 (15.0) 2 (10.5) - - - - - - - - - - 2 (13.3) 2 (15.4)

100

Rima 6 (28.6) - 1 (7.1)

Goronyo 1 (7.7) -

Table 4: Frequency of occurrence of food substances of *H. b. occidentalis* in River Rima and Goronyo Dam

Season	Dry season				Rainy season				Overall	
Size Class	<30cm		e30cm		<30cm		e30cm			
Parameter	Rima	Goronyo	Rima	Goronyo	Rima	Goronyo	Rima	Goronyo	Rima	Goronyo
No of samples examine	127	115	17	14	27	43	17	7	187	179
No of non-empty stomach	101	66	14	13	11	34	10	7	135	120
% of non-empty stomach	80.2	57.4	82.4	92.9	40.7	49.1	58.8	100.0	72.2	67.0
No of empty stomach	26	49	3	1	16	9	7	0	52	59
% of empty stomach	20.6	42.6	17.6	7.1	59.3	20.9	41.2	0.0	278	33.0
Food Substances										
Substances of plant origin										
Green algae	57 (53.47)	7 (10.60)	10 (71.42)	4 (30.76)	3 (27.27)	13 (38.23)	3 (33.33)	2 (28.57)	69 (51.11)	26 (21.66)
Diatom	1 (0.99)	1 (1.50)	3 (21.42)	1 (7.69)	- -	- -	2 (22.22)	- -	6 (4.44)	2 (1.66)
Desmid	1 (2.97)	11 (16.66)	1 (7.14)	1 (7.69)	2 (18.18)	13 (38.27)	2 (22.22)	4 (57.14)	8 (5.92)	29 (24.16)
Grain/seed	91 (90.09)	36 (54.54)	14 (100)	12 (92.30)	9 (81.81)	30 (88.23)	8 (88.88)	5 (71.42)	122 (90.37)	83 (69.16)
Fruit	26 (25.74)	19 (15.15)	1 (7.14)	1 (7.69)	3 (27.27)	- -	- -	2 (28.57)	30 (22.22)	13 (10.83)
Leaf/Plant tissue	44 (43.56)	17 (25.75)	4 (28.57)	7 (53.81)	7 (63.63)	5 (14.70)	6 (66.66)	1 (14.28)	61 (45.18)	30 (25.0)
Root hair	30 (29.70)	30 (44.45)	11(78.57)	10 (100)	7 (63.63)	18 (52.92)	5 (55.55)	1 (57.14)	53(39.25)	65 (54.16)
Flower bud	3 (2.97)	- -	-	- -	3 (27.27)	3 (8.82)	4 (44.44)	- -	10 (7.40)	3 (2.5)
Plant Subtotal	251(70.9)	112 (53.6)	44 (64.7)	39 62.9)	34 (73.9)	82 (78.1)	30 (65.2)	18 (62.1)	359(69.8)	251 (59.1)
Substances of Animal origin					1 (9.09)	- -	- -	- -	1 (0.74)	1 (0.83)
Protozoa	- -	1 (1.51)	- -	-					1 (0.74)	5 (4.16)
Colleoptera beetle				1 (7.69)	-	1 (2.94)	- -	- -	14 (10.37)	18 (15.0)
Whole beetle	1 (0.99)	3 (4.54)	- -	7 (53.84)	1 (9.09)	2 (5.88)	1 (11.11)			
Beetle parts	10 (9.90)	9 (13.63)	2 (14.28)						- -	- -
Hemiptera bug	- -	- -	- -	-	- -	-	- -	- -	4 (2.96)	2 (1.66)
Whole bug			2 (14.28)	-	- -	2 (5.88)	1 (11.11)	- -	2 (1.48)	2 (1.66)
Bug parts	1 (0.99)	- -	-	-	- -	- -	2 22.22)			
Nymph	-	2 (3.03)	-						- -	2 (1.66)
Ephemeroptera							- -		- -	-
Whole insect	- -	2 (3.03)	- -	- -	-	- -	- -	- -		- -
Nymph	- -	- -	- -	-	- -	- -	3 (33.33)	1 (14.22)	3 (2.22)	
Insect parts	- -		- -	-	- -	- -			- -	- -
Plecoptera					- -	- -	- -	1 (14.28)	- -	- -
Whole insect	- -	- -	- -	- -	- -	- -	- -	- -	1 0.74)	
Nymph	- -	- -	- -	- -	1 (9.09)	-	1 (11.11)		1 (0.74)	1 (0.83)
Insect parts	- -		-	-	- -	1 (2.94)	- 0	- -		
Odonata	1 (0.99)	1 (1.51)	- -	1 (7.69)						1 (0.83)
Diptera insect	- -	1 (1.51)	- -	- -	- -	1 (2.94)	- -		5 (37.77)	13 (10.83)
Whole diptera		13 (19.69)	7 (50.0)	6 (46.15)	4 (36.36)	11 (32.35)	4 (44.44)	1 (14.28)		11 (9.16)
Chironomous Larva	35 (34.65)	11 (16.66)	-	- -		- -	- -		- -	7 (5.83)
Diptera fragments	- -	4 (6.06)	- -	3 (23.07)	- -				78 (15.2)	861 (20.2)
Maggot	-			18 (29.0)	7 (15.2)	18 (17.1)	12 (26.1)	3 (10.3)		5 (4.16)
Insect Subtotal	48 (13.6)	47 (13.6)	11 (16.2)	1 (7.69)	- -	- -		2 (28.57)	- -	
Crustacea	- -	2 (3.03)	-						3 (2.22)	1 (0.83)
Fish and fish parts	3 (2.97)	1 (1.51)		- -	- -	- -	- -	-	2 (1.48)	2 (1.66)
Bone	1 (0.99)	2 (3.03)	1 (7.14)	-	-	- -	- -	- -	10 (7.40)	5 (4.16)
Flesh	9 (8.91)	5 (7.57)	1 (7.14)	- -	- -	-	-	- -	13 (2.9)	8 (18.8)
Fish, scale, barbell	13 (3.7)	8 (3.8)	2 (2.9)	- -	- -	1 (2.94)	- -	2 (28.57)	- -	22 (18.33)
Fish subtotal	- -	15 (22.72)	- -	4 (30.76)	- -			1 (14.28)	10 (7.40)	15 (10.83)
Gastropod shells	7 (6.93)	12 (18.18)	3 (21.42)	2 (15.38)				6 (20.0)	103 (20.0)	114 (26.8)
Annelid worms	68 (19.2)	69 (33.0)	16 (23.5)	21 (33.0)	7 (15.2)	18 (17.1)	12 (26.1)			
Animal subtotal										
Others					2 (18.18)	3 (8.82)	1 (11.11)	2 (28.57)	6 (4.44)	5 (4.16)
Sand grain	2 (1.98)	- -	1 (7.14)	- -	3 (27.27)	2 (5.88)	2 (22.22)	2 (28.57)	18 (28.14)	16 (13.33)
Detrital matter	27 (26.73)	12 (18.18)	6 (42.85)	- -			1 (11.11)	1 (14.28)	8 (5.92)	19 (15.83)
Unidentified item	6 (5.94)	16 (24.24)	1 (7.14)	2 (15.38)	- -					

Note: The frequency of occurrence and percentages are not equal to number of samples analyzed and 100 respectively, due to multiple occurrences
F = Frequency of occurrence
% = Percentage of occurrence
Dry season = October - May
Rainy season = June - September

Table 5: Monthly occurrence of food substances of *H.b. occidentalis* in River Rima and Goronyo Dam

Food Substance	October N= 38	November N = 21	December N = 31	January N = 25	February N = 22	March N = 24	April N = 19	May N = 9	June N = 7	July N = 18	August N = 23	September N = 24
	(F) (%)	(F) (%)	(F) (%)	(F) (%)	(F) (%)	(F) (%)	(F) (%)	(F) (%)	(F) (%)	(F) (%)	(F) (%)	(F) (%)
Substances												
Substances of plant origin												
Green algae	7 (8.6)	10 (38.5)	4 (8.3)	9 (19.60)	3 (10.7)	15 (22.1)	11 (17.5)	14 (17.1)	1 (7.1)	4 (11.80)	8 (12.7)	8 (9.8)
Diatom	1 (1.2)	- -	1 (1.2)	3 (6.5)	- -	- -	1 (11.6)	- -	1 (7.1)	- -	1 (1.6)	- -
Desmid	5 (6.2)	- -	2 (4.2)	1 (2.20	1 (3.6)	1 (1.50	2 (3.2)	4 (4.9)	1 (7.1)	4 (11.80	8 (12.7)	8 (9.8)
Grain/seed	43 (53.1)	6 (23.1)	6 (12.5)	6 (13.0)	12 (42.9)	24 (35.3)	20 (31.7)	36 (43.9)	4 (28.6)	9 (26.5)	16 (25.4)	23 (28.0)
Fruit	11 (13.6)	3 (11.5)	14 (29.2)	5 (10.9)	- -	- -	- -	5 (6.1)	- -	1 (2.9)	1 (1.6)	3 (3.7)
Leaf/Plant tissue	8 (9.9)	3 (11.5	11 (22.9)	10 (21.7)	4 (14.3)	11 (16.2)	19 (30.1)	6 (7.3)	3 (21.4)	11 (32.4)	14 (22.2)	20 (24.4)
Root hair	6 (7.4)	4 (15.4)	10 (20.8)	12 (26.1)	8 (28.6)	15 (22.1)	9 (14.3)	17 (20.7)	4 (28.6)	4 (11.8)	12 (19.0)	14 (17.1)
Flower bud	- -	- -	- -	- -	- -	2 (2.9)	1 (1.6)	- -	- -	1 (2.9)	3 (4.8)	6 (7.3)
Plant Subtotal	81 (54.0)	26 (44.1)	48 (45.3)	46 (49.5)	28 (38.4)	68 (41.5)	63 (41.2)	82 (45.8)	14 (42.4)	34 (79.1)	63 (67.7)	82 (67.8)
Substances of Animal origin												
Protozoa	1 (0.7)	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (1.1)	- -
Colleoptera beetle												
Whole beetle	- -	- -	- -	3 (17.6)	- -	2 (7.7)	- -	- -	1 (16.7)	- -	- -	- -
Beetle parts	12 (52.2)	2 (40.0)	4 (20.0)	4 (23.5)	7 (53.9)	11 (42.3)	14 (48.3)	- -	1 (16.7)	- -	1 (11.1)	2 (14.3)
Hemiptera bug												
Whole bug	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Bug parts	1 (4.3)	- -	- -	- -	- -	1 (3.8)	1 (3.4)	- -	- -	- -	- -	3 (21.4)
Nymph	1 (4.3)	- -	- -	- -	- -	1 (3.8)	- -	- -	- -	- -	2 (22.2)	- -
Ephemeroptera												
Whole Insect	- -	- -	2 (10.0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Nymph	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Insect parts	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (11.1)	3 (21.4)
Plecoptera												
Whole insect	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Nymph	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (11.1)	- -
Insect parts	- -	- -	- -	- -	- -	- -	- -	- -	1 (16.7)	1 (25.0)	- -	- -
Odanata	2 (8.7)	- -	- -	- -	1 (7.7)	- -	- -	- -	- -	1 (25.0)	- -	- -
Diptera insect												
Whole diptera	- -	1 (20.0)	- -	- -	- -	- -	- -	1 (3.6)	- -	- -	- -	- -
Chironomous Larva	7 (30.4)	2 (40.0)	8 (40.0)	7 (41.2)	5 (38.5)	8 (30.8)	12 (41.4)	22 (78.6)	3 (50.0)	2 (50.0)	4 (44.40	6(42.9)
Diptera fragment	- -	- -	2 (10.0)	3 (17.6)	- -	3 (11.5)	2 (6.9)	1 (3.6)	- -	- -	- -	- -
Magget	- -	- -	4 (20.0)	- -	- -	- -	- -	4 (14.3)	- -	- -	- -	- -
Insect Subtotal	23 (15.3)	5 (8.5)	20 (18.9)	17 (18.3)	13 (17.8)	26 (15.9)	29 (19.0)	28 (15.6)	6 (18.2)	4 (9.3)	9 (9.7)	14 (11.6)
Crustacea	- -	- -	- -	- -	- -	1 (0.6)	2 (1.3)	- -	- -	- -	- -	2 (1.7)
Fish and fish parts												
Bone	- -	- -	- -	- -	1 (5.0)	1 (25.0)	- -	2 (100)	- -	- -	- -	- -
Flesh	1 (50.0)	2 (22.2)	- -	- -	1 (50.0)	- -	- -	- -	- -	- -	- -	- -
Fish, scale, barbell	1 (50.0)	7 (77.8)	2 (100)	- -	3 (75.0)	2 (100)	- -	- -	- -	- -	- -	- -
Gastropod shells	- -	- -	1 (0.9)	- -	5 (6.8)	7 (4.3)	1 (0.7)	5 (2.8)	2 (6.1)	- -	- -	1 (0.8)
Annelid worms	2 (1.3)	- -	3 (2.8)	4 (4.3)	1 (1.4)	4 (2.4)	5 (3.3)	5 (2.8)	- -	- -	- -	- -
Animal subtotal	29 (18.7)	14 (23.7)	26 (24.5)	21 (22.8)	21 (28.8)	42 (25.6)	39 (25.5)	4 (22.3)	8 (24.2)	4 (9.3)	10 (10.8)	17 (14.0)
Others												
Sand grain	- -	- -	- -	- -	- -	- -	1 (0.7)	2 (1.1)	- -	1 (2.3)	4 (4.3)	3 (2.5)
Detrital matter	9 (6.0)	2 (3.4)	6 (5.7)	5 (5.4)	2 (2.7)	5 (3.0)	11 (7.2)	5 (2.8)	2 (6.1)	- -	6 (6.5)	2 (1.7)
Unidentified item	4 (2.7)	3 (5.1)	- -	- -	1 (1.4)	7 (4.3)	- -	10 (5.6)	1 (3.0)	- -	1 (1.1)	- -

Note: The frequency of occurrences and percentages are not equal to number of samples analyzed and 100 respectively, due to multiple occurrences

F = Frequency of occurrence
% = Percentage of occurrence
( ) = Percentage

CONCLUSION AND RECOMMENDATIONS

The finding on feeding adaptations of mouth and associated organs, dentition and gut structure of species showed much modification of structural traits to suit omnivorous feeding habits.

The gizzard structure (pseudo stomach) in place of stomach in mormyrid species studied appeared to be special adaptation for crushing hard food substances for further digestion by elaborate paired tubular pyloric caeca found on midgut.

The gut length fish length ratio appeared medium sized. The positive rectilinear relationship between the fish length gut length indicate that these variables could be described using mathematical expression. The regression and correlation analyses showed that the gut lengths could be predicted using linear regression models. This may have practical application in studies on the nutrition of the fishes in assessing relative digestibility coefficient of feed.

The lower empty gizzards could be attributed to active sampling techniques employed and immediate recovery and stoning of fish samples after capture. This result indicates the need to maintain the sampling procedures used and recovery of fish from fishing gear after capture.

The diversity of food substances identified in the gizzard of *H. b. occidentalis* showed that food habit of the fish species varied with size class and seasons in River Rima and Goronyo Dam. This finding of the gizzard composition revealed the food preference of the species in their natural environment, which may serve as a milestone in satisfying them under culture condition.

In view of the role play by gizzard composition analysis, the study should be further extended to the other indigenous fishes so as to provide the scientific data for their management.

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