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Analysis of Food And Feeding Habits of Catfish (*Bagrus bayad, Macropterus (Daget)* in River Rima and Goronyo Dam, in Sokoto State, Nigeria

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ABSTRACT: Food and feeding habits of the two size class of *Bagrus bayad* caught in River Rima and Goronyo Dam in north western Nigeria between October, 2002 and September, 2003 were studied for feeding adaptations and stomach contents. Feeding adaptive features such as mouth, gill rakers, dentition and gut system were examined. Gut length and fish length indicated rectilinear positive relationship. The regression coefficient (b) and correlation coefficient (r) of gut length to fish length were highly significant ($p<0.01$). Data on stomach contents was subjected to frequency of occurrence analysis. Categorization of the stomachs of the fish samples showed that (62.5%) had food contents, while (37.5%) were empty. The food substances identified included those of animal origin with overall occurrence of 85.1% in the samples from River Rima and 82.4% in those from Goronyo Dam. During the dry season, frequency of occurrence of animal materials were higher in the juveniles (<20cm) (89.5%) and adults (≥20cm) (85.2%) fish from River Rima , while in those from Goronyo Dam, their occurrences were 90.5 and 75.3%, respectively. The results of percentage occurrence of food substances in the rainy season showed that animal substances in the juveniles (58.2%) and adults (75.5%) were higher than the corresponding insects in fish collected during the dry season. Results of this study showed that *Bagrus bayad* is a carnivore and revealed the relative importance of different categories of the food substances in juvenile and adult fish from the two water bodies during the seasons.

Keywords: Bagrus, Stomach content, Feeding habit, Northern Nigeria

INTRODUCTION

The genus *Bagrus* of family the *Bagridae* has three species, *Bagrus bayad, Bagrus docmac* and *Bagrus filamentatus,* forming a great proportion of the commercial catches in Nigerian Fresh waters (Reed *et al*., 1967). According to Sipauba - Tavares and Braga (1999), nature offers great diversity of organisms used as food by the fishes and these differ in size and taxonomic group. The food habit of Bagrus species were reported by several workers (Reed *et al,* 1967; Holden and Reed, 1972; Adebisi, 1980; Ipinjolu, *et al,* 1988; Abdullahi and Abolude, 2001). Understanding the stomach contents of fish is useful in guiding towards formulation of artificial diets in fish culture (Fagade, 1978). Studies on gut contents of fish ascertain dietary requirements in their natural habitat, the relationship between the fish and the abiotic environment and to establish tropic inter- relationship (Ugwumba, 1988). Fish exploit food substances in an aquatic ecosystem according to the adaptations possessed (mouth, gill rakers, dentition and gut system) which are related to feeding. According to Miller and Harley (1996), food habit of fish could be related to its structural morphology, the way it captures

food and how it digests it. Studies on fish structural adaptations could provide useful information on their food habits and management in ponds (Ipinjolu *et al*., 2004; Malami *et al*., *2004)*. This paper presents the results of an investigation carried out on the analysis of food and feeding habits of *Bagrus bayad* sampled from River Rima and Goronyo Dam in Sokoto State North western Nigeria.

MATERIALS AND METHODS

A total of two hundred and ninety – nine (299) fish samples were collected from River Rima and Goronyo Dam in Sokoto State North western Nigeria. The fish samples were harvested on monthly basis from October, 2002 to September, 2003. Each specimen was identified using the description of Holden and Reed (1972) at Kwalkwalawa along River Rima and at Goronyo Dam. They were preserved in coolers, chilled with ice blocks and transported to the laboratory for post mortem examination. The total length (TL) and standard length (SL) were measured to nearest centimeter on measuring board graduated in centimeters.

Each fish sample was viscerally dissected from mouth to anus to expose the internal organs. The gut of each fish was stretched out and the length (GL) was measured. The stomachs were removed and their conditions were assessed on the five point scale, from 0 (empty) to 100 (full) stomachs and the contents emptied into clean Petri dish. The food substances found in the stomach were analyzed under light microscope, and each food category within the content was identified using a guide provided by Needham and Needham (1962) and Quigley (1972). The Data obtained were subjected to frequency of occurrence method as reported by Baganel and Tesch (1978) according to seasons, two size classes and water bodies.

RESULTS AND DISCUSSIONS

Feeding adaptations: *Bagrus bayad* found in this study had wide terminal mouth. They are known to feed in mid and open water and the species could be predators (Reed *et al.*, 1967; Holden and Reed, 1972). The presence of sharply pointed incisors and cardiform teeth may probably relate to predatory and carnivorous food habits. According to Lagler *et al,* (1972) predaceous fishes have sharply pointed teeth for grasping and puncturing of preys.

Stomach Fullness: Categorization of the stomachs of *Bagrus bayad* showed that 62.5% of them had food content, whereas empty stomachs recorded 37.5% (Table 1). This may suggest wider food habit, active feeding and earlier stoning of fish after capture. According to Abdullahi and Abolude (2001) higher non- empty stomachs in *Bagrus bayad* was due to diversified feeding habits. Whereas few empty stomachs may be due to post harvest digestion while struggling in fishing gear.

Table 2 shows the seasonal stomach fullness of the species. The percentage occurrences of empty stomachs were higher in the early dry (33.0%) and flood (22.3%) seasons with low occurrence in early rainy season (13.4%). This may suggest food availability and post harvest digestion in flood season and non- availability of food during critical feeding period (dry season). The results obtained supported the work of Ipinjolu *et al.* (1988) who reported higher empty stomachs in *Bagrus bayad* in the River Rima as a result of post harvest digestion while under captivity in fishing gear. The values of non- empty stomachs which were higher during the early dry and late dry seasons may be attributed to the ability of carnivorous *Bagrus bayad* to hunt

for scarce animal preys irrespective of the season.

The monthly distribution of stomach fullness of *Bagrus bayad* is shown in table 3. The result of stomach fullness showed that empty stomach had higher occurrence in the months of November, December, May, June, July and August in River Rima, in December, February, March, April, May and September, mainly around 25% fullness in River Rima, with few full stomachs in Goronyo Dam. The higher empty and non- empty stomachs found in November – August may suggest active feeding throughout the year by the species in the two water bodies.

Table 1: Categorization of stomach fullness of *Bagrus bayad* in River Rima and Goronyo Dam

Stomach fullness (%)	Number of samples	Percentage
0	112	37.5
25	114	38.1
50	55	18.4
75	14	4.7
100	4	1.3
Total	299	100.0

Table 2: Seasonal stomach fullness of *Bagrus bayad* in River Rima and Goronyo Dam

Season	Stomach fullness (%)									
	0		25		50		75		100	
	F	%	F	%	F	%	F	(%)	F	%
Early dry	37	(33.0)	34	(29.8)	16	(29.1)	8	(57.1)	2	(50.0)
Mid dry	18	(16.1)	21	(18.4)	9	(16.4)	1	(7.1)	0	(0)
Late dry	17	(15.3)	29	(25.4)	12	(21.8)	1	(7.1)	0	(0)
Early rainy	15	(13.4)	7	(6.1)	5	(9.1)	2	(14.3)	0	(0)
Flood	25	(22.3)	23	20.2)	13	(23.6)	2	(14.3)	2	50.0)

F = Frequency of Occurrence
% = Percentage of Occurrence

Occurrence of food substances: The frequencies of occurrence of food substances in the stomach of *Bagrus bayad* with respect to size class, season and water body are shown in tables 4 and 5. The categories of the food items identified in the stomach of the species included substances of plant and animal origins, detrital matter and unidentified items, which formed 9.2, 86.0, 3.3 and 1.5%, respectively of the food items found in the fish samples from River Rima. The values from Goronyo Dam were 13.0, 84.8, 2.1 and none%, respectively for substances of plant origin, animal origin, detrital matter and unidentified items.

These suggest that *Bagrus bayad* is a carnivore feeding more on substances of animal origin (whole Colleoptera, Hemiptera, Ephemiroptera, Plecoptera and Diptera and their parts, annelids and fish or fish parts). The result supports the findings of several workers who reported similar stomach contents in *Bagrus species.* Adebisi (1980) found *Synodontis shall, Alestes nurse, P. bovei, Barbus species,* insects and fish scales in the stomach of *Bagrus docmac.* Ipinjolu *et al.* (1988) reported that the stomach contents of *Bagrus bayad (*Macropterus*)* were mainly, whole Tilapia, fish parts, Odanata,

Hemiptera, Crustacean, Detritus and Plant parts.

The relative contributions of natural food substances identified in the stomach of juveniles and adults from the two water bodies were investigated. Results of percentage occurrence of food substances showed that animal substances were higher (89.5 and 58.3%) in the juveniles from River Rima and (86.4 and 95.0%) Goronyo Dam which indicates that the values from Goronyo Dam were fairly higher than those in River Rima. This may be attributed to the stability of the Dam water throughout the year, which makes food more available.

The percentage occurrences of animal substances in the adult samples from River Rima were higher (85.2 and 75.3%) than the values (75.3 and 60%recorded in the samples from Goronyo Dam. This may suggest the ability of the adult to hunt for and manipulate animal materials. Among the varieties of the animal items with higher occurrence were whole fish and their parts, Colleoptera and Hemiptera parts. Plant materials had lower percentage of occurrence (29.2%) in the juvenile samples. This may suggest that plant items might come from the stomach of the prey fed upon by the species. The results tallied with the findings of Adebisi (1980) who reported that plant substances found in the stomach of *Bagrus docmac* might have been derived from the stomach of the prey consumed.

The frequency of occurrence of food materials found in the stomach of *Bagrus bayad* differed according to month, season and size class. The result of this study showed that insects, crustaceans, annelids, fish and fish parts were dominant during the months of October, November, December, February, March, May, July, August and September. However, fish and fish parts were highly consumed than any other animal materials followed by insects and insect parts. This may be due to the carnivorous food habits of *Bagrus bayad* to catch scarce and fast moving preys during the months of the year.

The occurrence of animal substances was lower in the juvenile samples from Goronyo Dam during the dry season (95.0%) than in the rainy season in the water body. This may be attributed to post harvest digestion of food substances while captured in fishing gear. The adult size class from River Rima had fairly higher (85.2%) occurrence of substances of animal origin during the dry season when compared to 60% recorded for the stomachs of the adults from Goronyo Dam. This may further portray the ability of the large size class to explore scarce animal materials. Similarly, juveniles and adults from Goronyo Dam preferred plant substances hence had higher percentage of occurrence of 9.5 and 19.1% during the dry season, while in the rainy season the same food items dominate the stomachs of juveniles (29.2%) and adults (14.3%) in River Rima. This may suggest explosive growth of plants, invertebrates and fishes during the rainy season. The later two groups fed more on plant substances which when preyed upon by larger fishes occurred highly in the stomachs of predatory *Bagrus bayad.*

Diversity of food substances and their percentage of occurrences varied with water body and season. Results of the occurrence showed that animal substances were fairly higher (86.0%) in River Rima than in Goronyo Dam (84.8%). This shows the diversity in food habit and feeding specialization of *Bagrus bayad* which makes it acquire animal materials in the two water bodies. The stability of Dam water may probably be the reason why

plant materials occurred highly in Goronyo Dam (13.0%) than in River Rima (9.2%). Percentage occurrence of substances of animal origin were higher (89.5%) in the juvenile samples obtained from River Rima than in the adults (85.2%) during the dry season, while in Goronyo Dam the same food items had more occurrences in the juveniles (86.4%) than in the adults (75.3%). However, the categories of animal substances (insects, crustacean, annelids, fish and fish parts) occurred higher (95.0%) in the juveniles in Goronyo Dam during the rainy season, whereas during the dry season, in the same water body, the value was 86.4%. This may be attributed to the fact that the juveniles feed more on available food items since they are less specialized, while the adults showed complex food habit with higher degree of specialization. This result tallied with the findings of Haroon (1998) who reported that small size group of *Babodes gonionotus* fed more on dominant items and moderately specialized, but adults narrow their food habit and become more specialized on larger preys.

Conclusions and Recommendations: Higher empty stomachs could be attributed to the sampling techniques employed and digestion process during capture. This indicates the need for immediate recovery and analysis of fish samples after capture. The diversity of food substances identified in the stomach of *Bagrus bayad* revealed the diversity in the specialized and versatile food habit of the juveniles and adults during the dry and rainy seasons in the two water bodies. Stomach content analysis showed the food requirements of *Bagrus bayad* in the natural habitats which may serve as a yardstick for satisfying the species under culture condition. In view of the importance of stomach content analysis, studies should be extended to other indigenous fish species so as to provide the scientific information for their management.

Table 3: Monthly distribution of Stomach Fullness and Percentage Occurrence in *Bagrus bayad* in River Rima and Goronyo Dam.

		Month											
Stomach Fullness (%)	Water body	October L_1=14 L_2=9 (F) (%)	November L_1=22 L_2=17 (F) (%)	December L_1=20 L_2=15 (F) (%)	January L_1=12 L_2=19 (F) (%)	February L_1=10 L_2=8 (F) (%)	March L_1=10 L_2=7 (F) (%)	April L_1=10 L_2=7 (F) (%)	May L_1=14 L_2=11 (F) (%)	June L_1=7 L_2=5 (F) (%)	July L_1=12 L_2=5 (F) (%)	August L_1=18 L_2=9 (F) (%)	September L_1=20 L_2=18 (F) (%)
0	Rima	4(28.6)	14(63.6	11(55.0)	5(41.7	4(40.0)	3(30.0)	3(30.0)	7(50.0)	4(57.1)	6(50.0)	9(50.0)	7(35.0)
	Goronyo	-(-)	5(29.4)	3(20.0)	6(31.6)	3(37.5)	2(28.6)	-(-)	2(18.2)	3(60.0)	2(40.0)	2(22.2)	7(38.9)
25	Rima	6(42.9)	5(22.7)	6(30.0)	5(41.7)	5(50.0)	5(50.0)	6(60.0)	7(50.0)	2(28.6)	3(25.0)	3(16.7)	8(40.0)
	Goronyo	5(5.6)	4(23.5)	8(53.3)	8(42.1)	3(37.5)	2(28.6)	5(71.4)	4(36.4)	-(-)	2(40.0)	3(33.3)	9(50.0)
50	Rima	2(14.9)	2(9.1)	2(100)	2(16.7)	-(-)	2(20.0)	1(10.0)	-(-)	1(14.3)	2(16.7)	6(33.3)	4(20.0)
	Goronyo	2(22.2)	6(35.3)	2(13.3)	5(26.3)	2(25.0)	3(42.9)	2(28.6)	4(36.4)	2(40.0)	-(-)	3(33.3)	-(-)
75	Rima	1(7.1)	1(4.5)	1(5.0)	-(-)	1(10.0)	-(-)	-(-)	-(-)	-(-)	1(8.3)	-(-)	1(5.0)
	Goronyo	1(11.1)	2(11.8)	2(13.3)	-(-)	-(-)	-(-)	-(-)	1(9.1)	-(-)	1(20.0)	-(-)	1(5.6)
100	Rima	1(7.1)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)
	Goronyo	1(11.1)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	-(-)	1(11.1)	1(5.6)

L_1 = River Rima; L_2 = Goronyo Dam; F = Frequency of Occurrence; (%) = Percentage of Occurrence

Table 4: Frequency of occurrence of food substances in *Bagrus bayad* of River Rima and Goronyo Dam

Season	Dry Season				Rainy Season					
Size Class	<30cm		≥30cm		<30cm		≥30cm		Overall	
Parameter	Rima	Goronyo	Rima	Goronyo	Rima	Goronyo	Rima	Goronyo	Rima	Goronyo
Total of Food Substances	256	169	155	162	24	40	49	45	479	422
Plant Subtotal	19(7.4)	16(9.5)	11(7.1)	31(19.1)	7(29.2)	2(5.0)	7(14.3)	6(13.3)	44(9.2)	55(13.0)
Insect Subtotal	156(60.9)	90(53.3)	80(51.6)	65(40.1)	8(33.3)	31(77.5)	26(55.1)	15(33.4)	270(56.4)	201(47.6)
Annelid worms	1(0.4)	9(5.3)	3(11.9)	10(6.2)	-(-)	-(-)	-(-)	-(-)	4(0.84)	19(4.5)
Fish Subtotal	72(28.3)	47(27.8)	49(31.6)	47(29.0)	6(25.0)	7(17.5)	11(22.5)	12(26.7)	138(28.8)	138(32.7)
Animal Subtotal	229(89.5)	146(86.4)	132(85.2)	132(85.2)	14(58.3)	38(95.0)	37(75.5)	27(60.0)	412(86.1)	358(84.8)
Detrital matter	3(0.78)	2(1.2)	9(5.8)	7(4.3)	2(8.3)	-(-)	2(4.1)	-(-)	16(3.3)	9(2.1)
Unidentified item	5(2.0)	5(3.0)	3(1.9)	2(1.3)	1(4.2)	-(-)	3(6.1)	12(26.7)	7(1.5)	-(-)

Note: The frequency of occurrence and percentages are not equal to number of sample 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 *Bagrus bayad* in River Rima and Goronyo Dam

Food Substance	October N=17 (F) (%)	November N=24 (F) (%)	December N=21 (F) (%)	January N=20 (F) (%)	February N=10 (F) (%)	March N=10 (F) (%)	April N=14 (F) (%)	May N=16 (F) (%)	June N=8 (F) (%)	July N=10 (F) (%)	August N=16 (F) (%)	September N=21 (F) (%)
Total of Food Substances	306	101	67	55	42	71	108	161	29	38	54	58
Plant Subtotal	30(9.8)	16(15.8)	13(19.4)	15(27.3)	3(7.1)	10(14.08)	26(24.1)	22(13.7)	5(17.2)	3(7.9)	7(13.0)	6(10.3)
Insect Subtotal	111(36.3)	55(54.5)	23(34.3)	17(30.9)	16(38.1)	37(52.1)	37(34.3)	72(44.7)	11(37.9)	22(57.9)	28(51.9)	23(39.7)
Annelids	-(-)	-(-)	-(-)	2(3.6)	-(-)	-(-)	10(9.3)	11(6.8)	-(-)	-(-)	-(-)	-(-)
Fish Subtotal	24(7.8)	29(28.7)	30(44.8)	17(30.9)	17(40.5)	17(23.9)	26(24.1)	54(33.5)	2(6.9)	12(31.6)	16(29.6)	26(44.8)
Animal Subtotal	135(44.1)	84(83.2)	53(44.2)	36(39.6)	33(44.0)	54(76.1)	73(67.6)	137(85.1)	13(44.8)	34(89.5)	44(81.5)	49(84.5)
Detrital Matter	4(1.3)	1(1.0)	-(-)	2(2.2)	1(1.3)	3(4.2)	8(7.4)	2(1.2)	-(-)	1(2.6)	3(5.6)	-(-)
Unidentified item	2(07)	-(-)	1(0.8)	2(2.2)	5(6.7)	4(5.6)	1(0.9)	-(-)	11(37.9)	-(-)	-(-)	3(5.2)

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

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