The Food and Feeding Habits of Fishes of a Coastal Nigeria River.

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ABSTRACT

The food and feeding habits of fish community of Qua Iboe River in Akwa Ibom State, Nigeria was studied for eight mouths (January-August, 2009). The total number of fish examined was two hundred and twenty-one (221) out of which one hundred and seventy-seven (80.1%) had food while forty-four (19.9%) specimens were empty stomach. A total of 51 (23.1%) individuals had full stomachs while 72 (32.6%), 33 (14.9%) and 21 (9.5%) were ¾, ½ and ¼ full respectively. The data shows that, the food items consumed by these fish species covered a wide feeding range. Analysis of the stomach contents reveal algae, macrophytes (plants), *shrimps*, insects, fish, fish parts, sand, mud, unidentified plant matter, unidentified animal matter, nematodes and worms as the main food categories selectively eaten by fishes of Qua Iboe River. These fishes exhibited benthopelogic exploitation and grazing tendency. It is shown that, notopterids consumed a wide range of food resources available. The characids: *B. leuciscus, A. spilopterus* and *A. baramose* also fed on a wide variety of food resources (algae, insects, shrimps, crabs, fish parts and unidentified matter). The *bagriids: C macropogon* and *C. nigrodigitatus* fed on a wide variety of fish and other benthic invertebrates. Clariids and *Malapterurus minjiriya* feed on unidentified animal materials. *H odoe* and *P obscura* fed mostly on fish and other animal materials. The family cichlidae had the highest number of eight fish species, feeding on planktonic organisms and occasionally on feed on mud and other sediments. *C. kingsleyae* fed largely on plant materials. *L falcipinnis* fed also on plant materials. *Lutjanus endecacantus* and *Pomadasys jubelini* fed on shrimps, fish scales and unidentified animal matter. However, the dominant food items in the stomachs of many fish species were unidentified organic matter and detritus. It is shown here that, fishes of this area were non-selective, utilizing varieties of food items.

Key words: Food, Feeding habits, Fishes, Coastal River, Nigeria

INTRODUCTION

Food availability is one of the critical factors that influenced the survival of fish. The quality of the available natural food influences feeding habit of fish. The study of the food and feeding habits of fish species is a subject of continuous research because it constitutes the basis for the development of a successful fisheries management programmed on fish capture and

culture[1] and because the aquatic ecosystem is dynamic. The gut content is a reflection of the water quality, all other factors being constant[2]. Examining the food and feeding habits of a species is important for evaluating the ecological role and position of the species in the food web of ecosystems[3]. Information on their diet provides further support on practices of aquatic management, especially agriculture, aquaculture and conservation[4]. Some species of fish found in this area are oligophagous[5], utilizing a limited number of resources while others are polyphagous subsisting on wider spectra of items. Lowe- Seasonality in food availability (habitat condition), which influences qualitative and quantitative changes in growth rate and reproduction has been reported[6]. The adaptive significance of a broad trophic spectrum (high diet diversity) ensures a constant energy source. These facilitate adequate utilization of available food resource and enable the fish to move easily from one source to another in response to natural pulses in their relative abundance[7]. But in the opposite direction, Oliophagous fishes (low diet diversity) would be adversely affected if the food resources dwindle or collapse. However, the diet of fishes is a subject of continued research. Food availability is the basis of development of a successful capture and culture fisheries management[8]. Information on the feeding habits of fish will aid the study of the trophic relationship[9].

There has been a study in the tropical rainforest rivers on aspects of food and feeding habits of fishes[5]. Studies on the ecology, food and feeding habit of snakehead *Parachanna obscura* revealed that, this species feeds on other fishes[10] and sometimes used to control young tilapias in aquaculture ponds. The juveniles of these species feed on copepods and insect larvae while the adult preys on other fishes. Juveniles feed on prawns, copepods and aquatic insect larvae whereas adults feed only on fishes in southern Nigeria[11]. Species of snakeheads are predators eating fish of all sizes, shrimps, prawns and crabs[12]. Under condition of food deprivation, *P. obscura* can be cannibalistic on their young. The family cichlidae, which include *Hemichromis fasciatus* fed mainly on benthic invertebrates and occasionally on species of fish. The young of *H. fasciatus* fed on mosquito larvae and fry of other fishes, while the adults fed on fishes and Crabs[13]. The cichlid is more of insectivorous predator, which frequently feed on fishes and shrimps[14]. The intensity of feeding and the possible competition between *Tilapia guineensis* and *Tilapia melanotheron* has been reported[15]. It was found that a wide variety of items occurred in the stomach of the two species, thus portray that, they were non-selective in their feeding and each species was capable of utilizing many resources. However, some cichilids were known to feed mainly on fish scales. Catfish *Chrysicthys furcatus* was classified as a bottom feeder[16]. It has been observed to feed on algae, detritus and insect larvae, an indication of a bottom feeder[17]. It was observed to feed on several food organisms probably picked up from the bottom and water column. *C. nigrodigitatus* exhibited a more generalized feeding strategy. All generalized predators have been classified as omnivores[18]. Trichoptera, nymphs, ephemeroptara, molluscs and fish have been found in the stomachs of *C. auratus*[14]. Insects were found occurring most frequently in *Erpetoichthys calabaricus* and *Xenomystus nigri*[14,19]. *X. nigri* was reported to be aufwuchs browser[18]. Studies on the distribution, food and feeding activity, feeding behaviour and variations in diet of *Liza falcipinnis* in Bonny River indicated that, this species occurred throughout the year over sandy and muddy bottoms and was described as a euryhaline species[20]. This is also referred to as detrivore-oligovore deposit feeders. It selectively feeds on different particle sizes and showed diversification in diet with growth, which helped to minimize possible

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intraspecific competition, and offered a wider spectrum of food resources for exploitation. The investigation showed that, there was no substantial seasonal variation in diet but that, it feed in school and feeding was active during the day than at night. The food items found in the stomachs of *L. falcipinis* were diatoms, organic detritus and sand grains[21]. He also reported that, the food items identified in the stomachs of species in the family lutjanidae were crabs, mainly the hermit crab, *Chbernarius africanus*, prawns, cyprinodontid and juvenile gobiid. Work on the seasonal dynamics on the trophic status of *Papyrocrannus afer* (notopteridae) in Ikpa River indicated that the stomach contents comprised primarily mid-water invertebrates, allochthonous macrophytes, debris; allochthonous invertebrates, neustonic invertebrates, and miscellaneous insects were the secondary components while zooplankton mass were of incidental importance[5]. Food that occurred in the stomach of *Alestes baremose* were organic detritus, such include: rotifers, copepods, diatoms and sand grains[22]. These food items suggest that, the species has been feeding close to the bottom. Cladocerans, seeds, chiromomid larvae and adult odonata and Isoptera were found in the stomach of characids from the River Niger[16]. He also found food items in *Alestes nurse* to include; insect appendages; insect larvae and unidentified food matter. *Alestes macrolepidotus* feed on insect larvae, insect appendages, crustacean's limbs and terrestrial insects, the bigger specimens (above 250mm) fed on a mixture of invertebrates and fish fractions. These include isopteran and coleopteran insects, crustacean fragments, fish scales and fish skeleton. They also found grasses, algae, seeds and the legs, wings and head of terrestrial insects in the stomachs of *Alestes sp.* Allochthonous plant materials and terrestrial insects were found to be the main diet of this species[11]. Fish remain is only a small fraction.

Qua Iboe river is a vast body of water, which serves as habitat for various fishes. The river had been investigated for its physical and chemical characteristics[23] and profiles of total hydrocarbons and trace metal concentrations[24]. Although the food and feeding habits and condition factors of fish species in Qua Iboe River estuary have been reported[25]; and some aspects of the trophic biology of *Illisha africana* of Qua Iboe River estuary investigated[26,27], the only scientific attention that has been given to the fish species of Qua Iboe River is on the gastrointestinal helminth parasites[28.] This work is the second in a series to provide data on the biology and ecology of fish species of Qua Iboe River which empties into the Qua Iboe River Estuary. The main objective of this study was to determine the food and feeding habits of fish species of Qua Iboe River.

MATERIALS AND METHODS

Description of the Study Area

The Qua Iboe River located between longitude $7^0\ 30^1$ and $8^0\ 20^1$E and latitude $4^0\ 30^1$ and $5^0\ 30^1$N (Figure 1) is the dominant hydrographic feature in Akwa Ibom State, Nigeria and drains a catchments area of 7,092km^2 with a short course to the sea (150.6km). It is among the coastal rivers that empties into the Atlantic Ocean at the Bight of Bonny. It is one of the short rivers with small basin which drain the coastal plain and forms part of the eastern group of the South Atlantic Drainage basin[59,60]. The river flows through different physiographic and forms ranging from level to gently undulating (up and down) coastal plain. It is surrounded by aquatic macrophytes with oil palm and raphia palm dominating[61].

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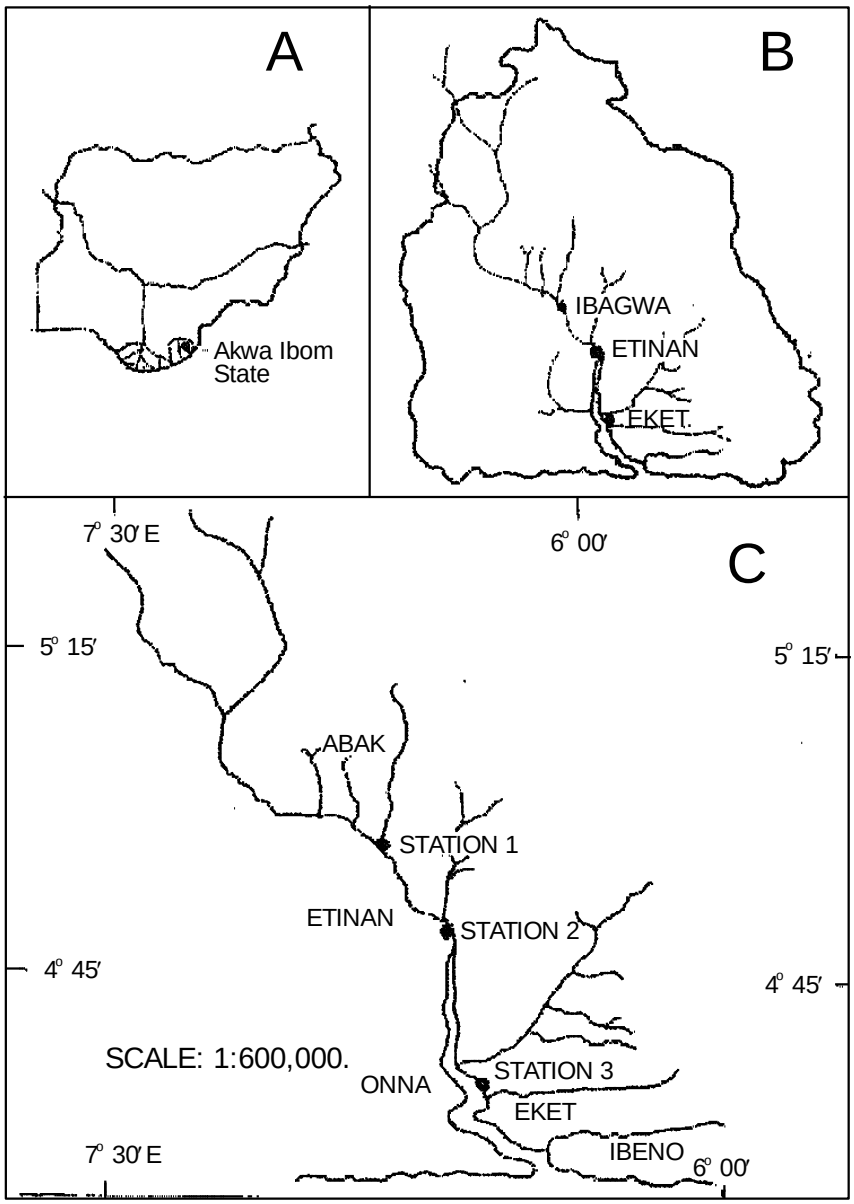

Fig. 1: Map of the study area: **A.** Nigeria showing Akwa Ibom State, **B.** Akwa Ibom showing Qua Iboe River communities sites sampled, **C.** The Study River showing study stations

Sampling Programme and Procedure

The fish samples collected monthly from January to August, 2009 at three sampling stations indicated in Fig. 1 were caught by the use of set net, non-return valve traps, hook and line. The fish samples were ice-packed, kept chilled under ice-blocks in a plastic cooler, and immediately transported to the laboratory.

Laboratory Procedure

Sorting, Identification and Morphometry

The fish samples collected were pooled and transferred to the laboratory for further analysis. The specimens were sorted and identified to species level based on their taxonomic characteristics, with the identification keys[29,30,10]. In the laboratory, each

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specimen was measured to the accuracy of 0.1cm using a measuring board. The body weight was measured to the nearest 0.1g using a scout Pro SPU 401 Ohius 400g Top loading Balance.

Dissection and Analysis of Stomach Contents

On dissection of the specimens, stomachs were removed and the fullness of stomach observed. The contents of the stomachs were preserved in 10% neutral formaldehyde or analyzed directly to establish the diet of the fishes. The slit stomachs were emptied into a petri dish. The macroorganisms were sorted out and the remaining microscopic organisms were examined under a dissecting microscope and a binocular NIKON compound microscope (mag. 40-100x). By this, samples of food organism were identified to the lowest possible taxons and counted.

Analytical Methods

The frequency of occurrence, numerical and fullness methods[31-34] were used for analyzing the food items.

Frequency of Occurrence Method

In this method, food items occurring in each of the stomach were listed. The frequency of occurrence of each food item in all the stomachs was expressed as a percentage of all the stomachs that contained food.

Numerical Method

The number of individuals in each food category was recorded for all stomachs and the total is expressed as a proportion usually a percentage of the total individual in all food categories[35].

Fullness Method

The fullness of each stomach was assessed using a ranking procedure. The degree of fullness was scored empty 0/4, one-quarter (1/4), half (1/2), three quarter (3/4) and full (4/4) stomachs.

RESULTS

A total of 26 fish species belonging to 15 families were examined. During the investigation, stomachs of 221 specimens were examined. The results of analysis of stomach contents of each species using fullness method is shown in Table 1. In all the 221 specimens examined, 44 (19.9%) were empty stomach 51 (23.1%) were fully loaded, while 72 (32.6%), 33 (14.9%) and 21 (9.5%) were ¾, ½ and ¼ full respectively. Among the fishes represented by a single specimen include: *E calabaricus, C. mento, O. niloticus* had empty stomachs. Only *C. macropogon had* fully loaded stomach. *C. submarginatus, H. bimaculatus* and *L. falcipinnis* had ¾ full. *G. petersii, C. gariepinus* and *M. minjiriya* had ½ full stomachs. *A. baremose, P. pulcher* and *P. jubelini* had ¼ full (Table 1).

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Table 1: Filled Portion of Stomachs in Qua Iboe River Fishes, Jan – Aug, 2009.

Fish Species	No. of specimen	4/4	¾	½	¼	0/4
Erpetoichthys calabaricus	1					1
Cynothrissa mento	1					1
Papyrocranus afer	6	4	2			
Xenomystus nigri	2	1	1			
Gnathodemus petersii	1			1		
Hepsetus odoe	4		2	1	1	
Alestes baremose	1				1	
Brycinus leuciscus	38	4	9	3	5	17
Arnoldicthys spilopterus	27	3	6	1		17
Chrysichthys macropogon	1	1				
Chrysichthys nigrodigitatus	10	3	4	2	1	
Clarias gariepinus	1			1		
Clarias submarginatus	1		1			
Malapterurus minjiriya	1			1		
Parachana obscura	25	6	8	4	5	2
Astatotilapia bloyeti	4		1			3
Pelvicachromis pulcher	1				1	
Hemichromis fasciatus	2				1	1
Hemichromis bimaculatus	1		1			
Tilapia mariae	24	10	10	3	1	
Tilapia guineensis	43	19	16	8		
Oreochromis niloticus	1					
Ctenopoma kingsleyae	22		9	8	4	1
Liza falcipinnis	1		1			
Lutjanus endecacanthus	1		1			
Pomadasys jubelini	1				1	
Total	221	51	72	33	21	44
Percentage (%)		23.1	32.6	14.9	9.5	19.9

Food and feeding habits

The results of stomach content analysis using the frequency of occurrence method were based on all the species present except for *E. calabaricus, C. mento* and *O. niloticus* that had single representation and empty stomachs (Table 2 and Table 3). Numerical method was used for all the species, except for *X. nigri, T. mariae, T. guineensis* (Tables 2 and 9) where mud occurred in their stomachs. Food items found in the stomachs of *P. afer, X. nigri, H. odoe, B. leuciscus, A spilopterus, C. gariepinus, C. submarginatus, P. obscura, T. guineensis, L. falcipinis, C. nigrodigitatus, T. endecacanthus and P. jubelini* indicated that, they were predatory fish species. Some were found to have stomachs containing unidentified plant matter and unidentified food particles, others were bottom feeders feeding on detritus and generally feed on a whole variety of foods. Animal preys which dominated the stomach contents of the dominant predatory fishes based on result of both the occurrence and numerical abundance methods were insects, shrimps, crabs, fishes, nematodes and unidentified animal parts, other items found in the stomachs of some species were sand in *T guineensis* and *C. nigrodigitatus*. Mud in *X. nigri, T mariae* and *T. guineensis*. Nematodes were more abundance in the stomachs of *P afer, B lcuciscus, T. guineensis* and *C nigrodigitatus* (Tables 2, 4, 8 and 5) respectively. But *C.*

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nigrodigitatus had the largest number of nematodes (Table 5) while *P. afer* had the least (Table 2). Algae (algal mass, algal filament and algal strands) were found in the stomachs of *B. leuciscus* and *C. kingsleyae* (Tables 4 & 9). Insect parts, dipterans, coleopterans and ants were found in the stomachs of *P. afer, B. leuciscus, A spilopterus, T guineensis, L. falcipinis* and *C nigrodigitatus* (Tables 2, 4, 8, 9 and 5) respectively. Dipterans were found in the stomachs of *P afer, A spilopterus,* T. *guineensis* and *C. nigrodigitatus* other insects were found in the stomachs of *P afer, X. nigri, B. leuciscus, A. spilopterus, L. falcipinnis* and *C. nigrodigitatus* (Tables 2, 3, 4, 9 & 5). Ants were found only in the stomach of *T. guineensis* (Table 5). Decapods such as shrimps, partially digested shrimps and crabs constituted the food items in the stomachs of *P. afer, B. lcuciscus,* (Tables 2 & 4). Partially digested shrimps were also found in *A. spilopterus, C. submarginatus* and *P. obscura* (Tables 4 & 6). Fish, fish parts such as fish scales were found in the stomachs of *P. obscura, H. odoe, B. leuciscus, A. spilopterus* and *P. jubelini* (Tables 6, 3, 4 and 10) respectively. Other parts of the fish such as bones and eyes were found in the stomachs of *P. obscura* and *C. nigrodigitatus* (Table 6 and 5). Partially digested fish were found in the stomachs of *P. afer, H. odoe* and *P. obscura* (Tables 2, 3. and 6). The presence of these food items indicated that, these fish species were carnivores preying on other fishes. Unidentified animal matter was found in all the stomachs of these predatory fishes such as *B. leuciscus, A. spilopterus.* (Table 4). These two fish species indicated that, they feed on a wide variety of foods and in different trophic level in the aquatic ecosystem. Plant materials constituted the dominant food materials in the stomach of *C. kingsleyae* (Table 9). Other food items found in the stomachs of fishes of Qua Iboe River were: nematodes, plants, insects, decapods, fish and mud indicating that; their feeding behaviour varies with the available food. Mud was found only in the stomachs of *X. nigri, T mariae* and *T. guineensis* (Tables 3 and 8). Mud was the dominant food item in the stomach of *T. mariae* (Table 8). Sand was found in the stomachs of *T. guineensis and C. nigrodigitatus*. The presence of mud and sand in the stomachs of these fishes indicate that, they are benthic feeders.

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Table 2: Analysis of food items found in the stomachs of *Erpethoichthys calabaricus, Cynothrissa mento and Papyrocranus afer* in the study area, January – August, 2009

	Erpethoichthys calabaricus				***Cynothrissa mento***				***Papyrocranus afer***			
Food Items	Freq. of Occurrence Method		Numerical Method		Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method	
	Freq.	%0	Num.	% N	Freq.	%0	Num.	% N	Freq	%0	Num.	% N
Nematode									1	16.7	1	1.3
Insects												
Insect parts									1	16.7	15	18.8
Coleopteran larva									1	16.7	1	1.3
Decapods												
Shrimp parts									1	16.7	8	10
Partially digested crab									2	33.3	4	5
Fish												
Fish scales									2	33.3	43	53.8
Partially digested fish									5	83.3	7	8.8
Unidentified animal matter									1	16.7	1	1.3
Mud												
Total number examined	**1**				**1**					**6**		
Number of empty stomach	**1**				**1**					**0**		
Number of Non-empty stomach	**0**				**0**					**6**		

Table 3: Analysis of food items found in the stomachs of *Xenomystus nigri*, *Gnathodemus petersii* and *Hepsetus odoe* in the study area, January – August, 2009

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	Xenomystus nigri				***Gnathodemus petersii***				***Hepsetus odoe***			
Food Items	Freq. of Occurrence Method		Numerical Method		Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method	
	Freq.	%0	Number	% N	Freq.	%0	Number	% N	Freq.	%0	Number	% N
Partially digested plant matter					1	100	15	100				
Insect												
Insect part	1	50	22	91.7								
Fish												
Fish scales									1	25	1	3.7
Partially digested fish									1	25	1	3.7
Undigested fish									1	25	2	7.4
Unidentified animal matter	1	50	2	8.3					3	75	23	85.2
Mud	1	50										
Total No of stomach examined	**2**				**1**				**4**			
Number of empty stomach	**0**				**0**				**0**			
Number of non empty stomach	**2**				**1**				**4**			

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Table 4: Analysis of food items found in the stomachs of *Alestes baremose*, *Brycinus leuciscus* and *Arnoldichthys spilopterus* in the study area, January – August, 2009

Alestes baremose			***Brycinus leuciscus***				***Arnoldichthys spilopterus***					
Food Items	Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method	
	Freq.	%0	Number	% N	Freq.	%0	Number	% N	Freq.	%0	Number	% N
Nematode					3	14.3	12	2.2				
Plant												
Algal filament					1	4.0	37	6.7				
Algal mass					1	4.8	1	0.2				
Dead plant matter					1	4.8	3	0.5				
Digested plant matter					3	14.3	57	10.3				
Unidentified plant matter					2	9.5	29	5.2	3	30	36	24.7
Partially digested leaves									2	20	14	9.6
Unidentified food particles					1	4.8	12	22	1	10	5	3.4
Insect												
Insect parts					9	42.9	188	33.9	5	50	43	29.5
Dipterans larvae									1	10	1	0.7
Decapods												
Partially digested shrimp									1	10	3	2.1
Fish												
Fish scales					1	4.8	2	0.4	1	10	2	1.4
Unidentified animal matter	1	100	28	100	15	71.4	214	38.6	6	60	42	28.8
Total No. of												

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stomach examined	**1**	**38**	**27**
Number of empty stomach	**0**	**17**	**17**
Number of non-empty stomach	**1**	**21**	**10**

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Table 5: Analysis of food items found in the stomachs of *Chrysichthys macropogon*, *Chrysichthys nigrodigitatus* and *Clarias gariepinus* in the study area, January – August, 2009

	Chrysicthys macropogon				***Chrysichthys nigrodigitatus***				***Clarias gariepinus***			
Food Items	Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method	
	Freq.	%0	Number	% N	Freq.	%0	Number	% N	Freq.	%0	Number	% N
Nematodes					2	20	54	9.3				
Earthworms					2	20	3	0.5				
Insect												
Insect parts					1	10	9	1.5				
Dipterans larvae					1	10	1	0.2				
Fish												
Fish parts					4	40	17	2.9				
Unidentified animal matter	1	100	12	100	10	100	197	33.9	1	100	17	100
Sand					1	10	300	51.6				
Total No of stomach examined	**1**				**10**				**1**			
Number of empty stomach	**0**				**0**				**0**			
Number of non-empty stomach	**1**				**10**				**1**			

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Table 6: Analysis of food items found in the stomachs of *Clarias submarginatus*, *Malapterurus minjiriya* and *Parachana obscura* in the study area, January – August, 2009

Clarias Submarginatus			***Malapterurus minjiriya***		***Parachana obscura***							
Food Items	Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method	
	Freq.	%0	Number	% N	Freq.	%0	Number	% N	Freq.	%0	Number	% N
Nematodes									2	8.7	5	0.9
Plant												
Unidentified plant matter									3	13	18	3.4
Decapods												
Unidentified Shrimps	1	100	3	100					5	21.7	8	1.5
Fish												
Fish parts									4	17.4	76	14.2
Partially digested fish									7	30.4	9	1.6
Undigested fish									1	4.3	1	0.2
Unidentified animal matter					1	100	3	100	7	30.4	419	78.2
Total No of stomach examined	**1**				**1**				**25**			
No of empty stomach	**0**				**0**				**2**			
No of non-empty stomach	**1**				**1**				**23**			

Table 7: Analysis of food items found in the stomachs of *Astatotilapia bloyeti*, *Pelvicachromis pulcher*, and *Hemichromis fasciatus* in the study area, January – August, 2009

Astatotilapia bloyeti,	***Pelvicachromis pulcher,***	***Hemichromis fasciatus***

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Food Items	Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method	
	Freq.	%0	Number	% N	Freq	%0	Number	% N	Freq.	%0	Number	% N
Unidentified plant matter	3	100	102	47.9	1	100	2	100	1	100	7	35
Unidentified animal matter	2	66.7	111	52.1					1	100	13	65
Total No of stomach examined	**4**				**1**				**2**			
Number of empty stomachs	**1**				**0**				**1**			
No of non-empty stomach	**3**				**1**				**1**			

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Table 8: Analysis of food items found in the stomachs of *Hemichromis bimaculatus, Tilapia Mariae* and *Tilapia guinneensis* in the study area, January – August, 2009

	Hemichromis bimaculatus				***Tilipia Mariae***				***Tilapia guinneensis***			
Food Items	Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method	
	Freq.	%0	Number	% N	Freq.	%0	Number	% N	Freq.	%0	Number	% N
Nematodes									5	11.6	24	4.9
Unidentified plant matter									9	20.9	355	72.2
Insect												
Dipterans larvae									1	2.3	1	0.2
Ants									3	7.0	8	1.6
Unidentified animal matter	1	100	20	100					1	2.3	4	0.8
Sand									1	2.3	100	20.3
Mud					24	100			31	72.1		
Total No of stomach examined	**1**				**24**				**43**			
Number of empty stomach	**0**				**0**				**0**			
Number of non-empty stomach	**1**				**24**				**43**			

Table 9: Analysis of food items found in the stomachs of *Oreochromis niloticus, Ctenopoma Kingsleyae* and *Liza falcipinnis* in the study area, January – August, 2009

Oreochromis niloticus			***Ctenopoma Kingsleyae***		***Liza falcipinnis***	
Food Items	Freq. of occurrence method	Numerical method	Freq. of occurrence method	Numerical method	Freq. of occurrence method	Numerical method

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	Freq.	%0	Number	% N	Freq.	%0	Number	% N	Freq.	%0	Number	% N
Plant												
Algal filaments					2	9.5	125	24.9				
Algal mass					1	4.8	1	0.2				
Algal strands					1	4.8	5	1.0				
Unidentified plant matter					14	66.7	300	59.7	1	100	5	62.5
Insect												
Insect parts									1	100	1	12.5
Unidentified animal matter					4	19.0	72	14.3	1	100	2	25.0
Total No of stomach examined	**1**				**22**				**1**			
No of empty stomach	**1**				**1**				**0**			
No of non-empty stomach	**0**				**21**				**1**			

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Table 10: Analysis of food items found in the stomachs of *Lutjanus endecacanthus,* and *Pomadasys jubelini* in the study area, January – August, 2009

	Lutjanus endecacanthus,				***Pomadasys jubelini***			
Food Items	Freq. of occurrence method		Numerical method		Freq. of occurrence method		Numerical method	
	Freq.	%0	Number	% N	Freq.	%0	Number	% N
Decapods								
Partially digested shrimp	1	100	1	100				
Fish								
Fish Scales					1	100	3	37.5
Unidentified animal matter					1	100	5	62.5
Total No of stomach examined	**1**					**1**		
No of empty stomach	**0**					**0**		
No of non-empty stomach	**1**					**1**		

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DISCUSSION

The establishment of the food and feeding habits of a particular fish species requires a dietary survey of such species in their natural environment[36]. This is due to the fact that the diet of fish in captivity is never a reliable criterion for determining the food requirement of fishes[37]. The overall study on the food and feeding habits of animals can be discussed under the term "Feeding Ecology". It defines a relationship where the animal adopts a strategy for optimum foraging of predation on its preferred food. The general practice of identification and quantification of gut content in fishes mostly addresses undigested parts of the ingested diet. In the case of plankton feeders, soft bodied zooplankton (e.g. protozoa, some rotifers) are often skipped off the counting procedure for their rapid digestibility[4]. The success on good scientific planning and management of fish species largely depends on the knowledge of their biological aspects, in which food and feeding habits include a valuable portion[38,39].

The food items in the stomachs of Qua Iboe River fish species indicated that, they were polyphagous, that is feeding on wide varieties of organisms[6], except for *T. mariae,* which feed mainly on mud. Seasonal variations of a broad tropic spectrum are reflected in the abundance and availability of food resources, which enable the fish to change from one item or source to the other[7]. *P obscura,* which was reported to be predatory and cannibalistic on their young was found to feed also on plant materials[12]. This could be attributed to differences in habitats, relative abundance of prey organism and individual species and its food habitats[7]. It has been reported that, *H. fasciatus* fed on benthic invertebrates and occasionally on species of fish[13], but this species was found to feed also on plant materials. *T. guineensis* fed on a wide variety of food[15]. *B. leuciscus* and *A. spilopterus* (characids) were non-selective in their feeding and were capable of utilizing many food resources[7]. Only unidentified animal matter was found in the stomach of *A. baremose.* Other bottom feeders, *C. macropogon, C. nigrodigitatus, C. gariepinus* and *C submarginatus* in the study area are largely unspecialized in their feeding habits[34]. This is further confirmed by the feeding of earthworm by *C. nigrodigitatus.* Unspecialized flexible dietary habits are the optimal strategy for their survival in habitats where food sources are subject to fluctuation[18]. Similarly, the inclusion of mud in the diet of *X nigri* is of survival value. *P. afer* in Ikpa River fed on mid-water invertebrates, allochthonous macrophyte debris, allochthonous invertebrates, neustonic invertebrates and other insects[5], but, in this study, items like nematodes, coleopterans, shrimps, partially digested crabs and fish parts were observed.

Shrimps were found in the stomachs of fishes of Qua Iboe River as food item of predatory fishes. These predatory fishes also feed on other decapods such as crabs. This food item serves as dominant at periods where shrimps were absent[34]. These fishes were either benthopelagic or benthic feeders. The occurrence of algal filament, algal mass and algal strands in the stomachs of *B. leuciscus* and *C. kingsleyae* indicated that, these fishes are pelagic feeders which feed on planktonic substances.

Stomach content analysis based on fullness method revealed that, out of 221 fishes examined, only 44 (19.9%) had empty stomachs. This could be attributed to the fact that, predatory fishes have irregular feeding habit and tend to take a large amount of

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food when their prey is available (King 1989). Absence of food in the stomachs of *E calabaricus, C. mento and O. niloticus* is attributed to intermittent feeding; so, the various methods of analysis were not used to these fishes because of their emptiness.

CONCLUSION

The food and feeding habits of the fishes of Qua Iboe River indicated enormous diversity in various ways and the species examined could be grouped into predatory, plantophagous and deposit feeders. The fish fauna in the study area consist of multi-species. Overlaps existed in terms of food items ingested, result in reduction of competition among the species of fish and led to a wider trophic spectra; planktivorous species fed mainly on planktons and large plants. The predators (insectivores and piscivores) fed on benthopelagic organisms, while bottom feeders fed on the bottom sediments and detritus. This study indicated that, most fishes of Qua Iboe River fed largely on animal materials. From this investigation, it can be concluded that, fishes in this area are facultative feeders that utilized more than one source of food items.

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