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Tropical Freshwater Biology, 11 (2002) 47 - 68

THE FEEDING ECOLOGY OF BAGRID SPECIES IN RIVER ASE, NIGER DELTA, SOUTHERN NIGERIA.

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With 8 figures and 9 tables

ABSTRACT

The feeding ecology of seven bagrid species were studied between March, 1982 and February, 1984. A summary of the food items and condition factors (kf) in relation to sized groups were described for all the seven species while feeding habits in relation to sized groups, diel and monthly variations in feeding intensity were provided only for ***Chrysichthys auratus longifilis*** *(Geoffrey St. Hilaire, 1908) and* ***C. nigrodigitatus*** *(Lacepede 1803) due to availability of adequate data for the two species. Variations in food items between dry and rainy seasons were not remarkably different. There were differences in the feeding habits of different sized groups in* ***C. auratus longifilis*** *while in* ***C. nigrodigitatus****, all the sized groups consumed mainly detritus. Both* ***C. auratus longifilis*** *and* ***C. nigrodigitatus*** *fed both day and night. Feeding intensity was highest in* ***C. auratus longifilis*** *from 2100 to 2400(h) and from 2400 to 0300(h) for* ***C. nigrodigitatus****. Based on the food items,* ***Bagrus bayad macropterus*** *Pfaff, 1933 was mainly piscivorous in diet while* ***B. domac niger*** *Daget, 1954 fed on fish and decapod crustaceans.* ***C. auratus, C. nigrodigitatus, C. furcatus*** *(Günther, 1864) and* ***Auchenoglanis occidentalis*** *(Cuvier and Valencienness, 1840) were omnivorous bottom feeders.* ***Clarotes laticeps*** *fed on fish and detritus. The feeding ecology of bagrid species has been discussed and compared with the findings of earlier studies conducted elsewhere.*

Key Words: Bagrid species, feeding ecology, Niger Delta, diets, seasonality.

INTRODUCTION

As human population increases in Africa so all the demand for animal protein increases. Nigeria is blessed with many inland waters but with the rapid increase in industralization and technological development, these water bodies have been subjected to various abuses such as pollution and damming. Pollution and damming are detrimental to riverine fisheries (Obeng, 1965; Patil, 1976; Idodo-Umeh, 2002).

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The need for a better management of riverine fisheries in Africa is still a top priority (Idodo-Umeh and Victor, 1990).

The family Bagridae is one of the dominant fish families in Nigerian waters contributing enormously to fish landing. Three species of Bagridae, *Chrysichthys filamentous*, *C. walkeri* and *C. nigrodigitatus* accounted for 42.5% of all the total fish caught in Lekki Lagoon for two years (Ikusemiju, 1973).

In River Ase, Bagridae was the most dominant family accounting for 24.4% of the total biomass of 346,979.9g of all fish captured for two years (Idodo-Umeh, 1987). The most notable knowledge on the feeding ecology of bagrids in Nigeria is based on the studies conducted in Kainji Lake (Imevbore & Bakare, 1970; Ajayi, 1972) and Lekki Lagoon (Ikusemiju, 1973; Ikusemiju & Olaniyan, 1977). These investigators based the feeding ecology of the bagrids on day and night only.

There are increasing prospects of culturing some of these commercially important bagrids in artificial ponds. Therefore, the need for a long term study on the feeding ecology is considered imperative.

This paper presents the feeding ecology of bagrid species for two years based on three hourly cyclic pattern of feeding in order to determine when feeding is most intense. The knowledge gained will be useful to aquaculturists and managers of water bodies.

STUDY AREA

River Ase is a tributary of Forcados River, the western branch of River Niger in the delta area of southern Nigeria. Its source is Lake Ewuru (6.4°N; 6.30°E) in Oshimili Local Government Area and its confluence is at Asaba-Ase (5.20°N; 6.17°E) in Ndokwa Local Government Area, Delta State (Fig. 1). The length of River Ase is approximately 292 km.

River Ase marks the geological boundary of the Sombreiro-Warri formation and the meander belts of the upper deltaic plains of the Niger delta (Short & Stauble, 1967). Other geological characteristics of this area have earlier been described by Allen (1965). The typical tropical climate, consisting of dry and rainy seasons is governed by the northeastern and southwestern winds which generally influence the climate of Nigeria (Hare & Carter, 1984).

The present study stretch is 19.3 km long and it is located between Ivrogbo and Asaba-Ase towns. Based on the location of human settlements and the drainage characteristics of the river, five study sections were demarcated along this stretch (Fig. 1).

In this area, River Ase flows through fresh water swamps and swamp-rubber forests. The common aquatic macrophytes present during this study were *Pistia stratiotes*, *Lemna* sp., *Azolla africana*, *Salvinia* sp., *Nymphaea odorata*, *Ceratophyllum demersum* and *Utricularia* sp.

The fishing activities in this stretch are intense throughout the year. Fishermen use all types of fishing gear and at times, explosives although illegal are used for catching fish. Sand dredging activities are extensive during the dry season. River transportation using mechanised ferries and motor boats is common during the rainy

season; dug-out canoes are used in both seasons. The river is used for domestic activities like bathing and washing of clothes, utensils and farm products. The banks on both sides are farmed. There are a few boat construction yards along this stretch, but there are no major industrial installations.

MATERIALS AND METHODS

Fish sampling was carried out at fortnightly intervals between March 1982 and February 1984. Fishing commenced at all sections at the same time on a given sampling day. A cyclic pattern of sampling was utilised and fish were collected from 0600 - 0900, 0900 - 1200, 1200 - 1500, 1500 - 1800, 1800 - 2100, 2100 - 2400, 2400 - 0300 and 0300 - 0600(h) on successive sampling days. Fifty-six samples were collected from each section making up a total of 280 samples. Each time interval (e.g. 2400-0300(h) was covered 7 times in a given section during the study period.

In each section, eight bottom-set and eight surface-set drifting gill nets (mesh 0.5, 1.1, 2.0, 3.0, 6.4, 7.7 and 10.2 cm) were placed; each net was 92 m long and 4 m wide. Two fishermen used five cast nets (mesh 3.0, 5.1, 6.4, 7.6 and 10.6 cm) while four fishermen operated a 200 m long and 6 m wide dragnet (mesh 2.0 cm). During the receding period of high floods, two additional fishermen also operated a canoe mounted atalla lift net along the river margins. The same fishing effort was maintained in all five sections. The whole fishing operation was monitored from a boat fitted with an outboard engine (Suzuki 48 HP).

All fish collected were packed in ice blocks and transported to the laboratory. The specimens of bagrid species were sorted and their standard and total lengths measured to the accuracy of 0.1 mm; and weighed to the nearest 0.1 g using a Mettler, E 2000 top loading balance. Fulton's condition factor, (Kf) was calculated using the formula given by Ricker (1968). Each fish was then dissected and its stomach was removed, weighed and stored in a laballed specimen tube containing 10% formalin.

The fullness of the stomachs was evaluated using the method of Smith & Page (1969). Each stomach was cut open and the contents washed into a petri dish using 4% formalin. The food items were identified and counted. Large organisms were counted directly and the microscopic organisms were enumerated by the method of Damann (1950). The frequency of occurrence, numerical and points methods (Hynes, 1950) were used for analysing the food items.

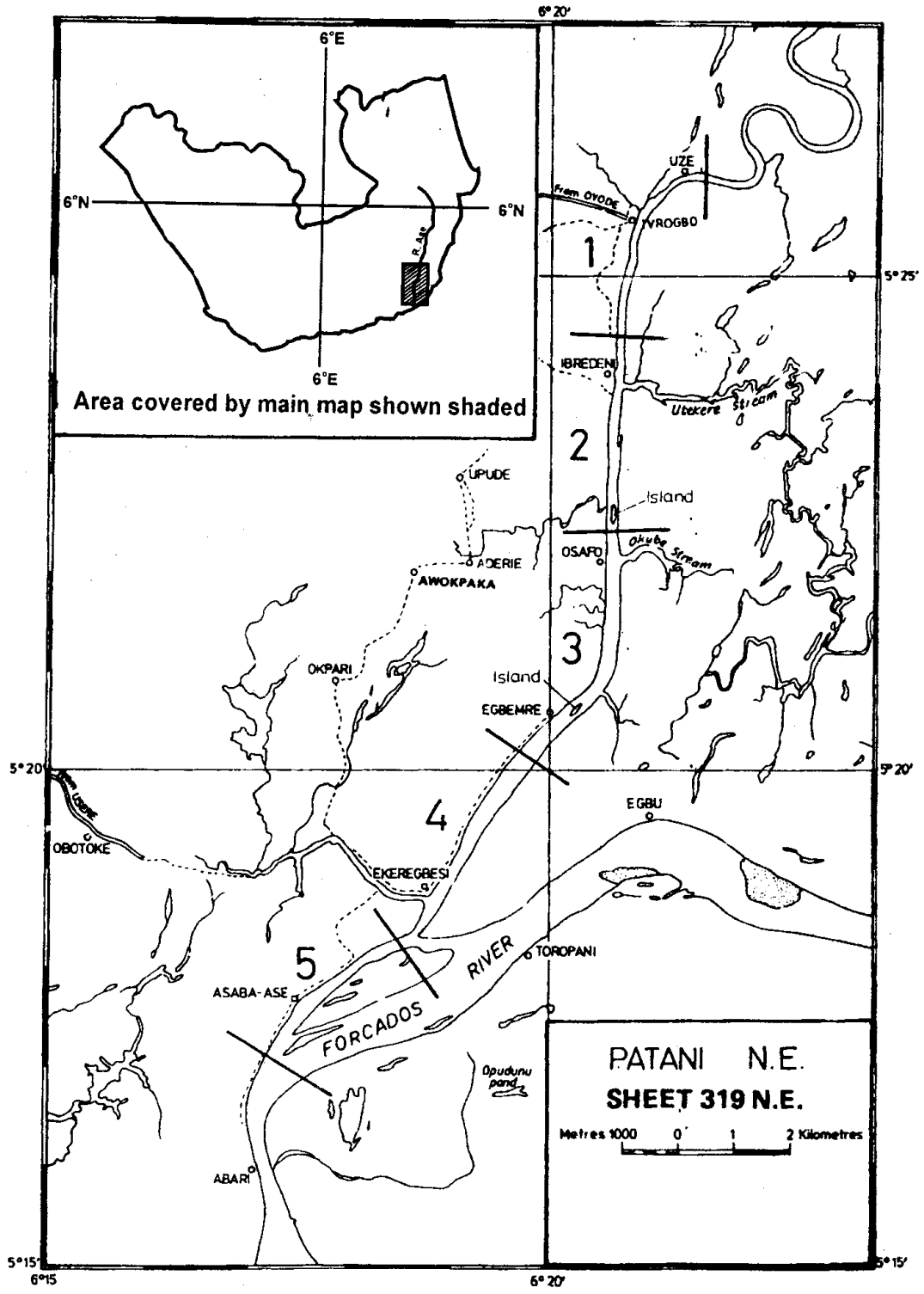

Fig. 1: Map of the study area showing sampling stations; Delta State inset shows study locations.

RESULTS

Details of the food items of all the seven species of Bagridae are described below but details of seasonal and diel variations in food items and feeding intensity are provided only for *C. auratus longifilis* and *C. nigrodigitatus* due to availability of adequate data.

Bagrus bayad macropterus Pfaff, 1933

By frequency of occurrence fish was the most prominent food item with *Chrysichthys* spp. accounting for 42.96% while by numerical and points methods, insect parts (69.28%) and *Chrysichthys* spp. (25.59%) were most dominant food items respectively (Table 1).

TABLE 1

Analysis of the stomach contents of *Bagrus bayad macropterus*

Food Items	Occurrence method		Numerical method		Points method	
	Frequency	%	Number	%	Points	%
Detritus	3	21.43	56	16.87	40	15.75
DECAPODA						
Crayfish	4	28.57	8	2.41	12	4.72
Prawns	2	14.86	8	2.41	49	19.29
Insect parts	3	21.43	230	69.28	10	3.93
FISH						
Clupeids	3	21.43	3	0.90	13	5.12
Chrysicthys sp.	6	42.96	6	1.81	65	25.59
Synodontis sp.	2	14.86	2	0.60	18	7.09
Unidentified fish	5	35.71	5	1.51	31	12.20
Bones	3	21.43	4	1.20	9	3.54
Fish scales	2	14.86	8	2.41	7	2.76

The mean condition factors ranged from 0.7 - 1.4 (Table 8). The lowest calculated value was in December, 1983 while the highest value was in July and August, 1982.

Bagrus domac niger Daget, 1954

Table 2 shows the summary of the food composition of *B. domac niger*. Four out of seven fish examined contained food items in their stomachs. Prawns accounted for 75.00%, 60.00%, 47.18% by occurrence, numerical and points methods respectively

as the most important food items. Other important food items were crayfish, *Chrysichthys* spp. and *Synodontis* spp.

The lowest condition factor was recorded in March, 1982 while the highest was recorded in January and July, 1983 (Table 8).

TABLE 2

Analysis of the stomach contents of *Bagrus domac niger*

Food Items	Occurrence method		Numerical method		Points method	
	Frequency	%	Numbers	%	Points	%
DECAPODA						
Crayfish	1	25.00	2	13.33	5	3.52
Prawns	3	75.00	9	60.00	67	47.18
FISH						
Chrysicthys sp.	1	25.00	2	13.33	30	21.13
Synodontis sp.	1	25.00	2	13.33	40	28.17

C. auratus longifilis Geoffrey St. Hilaire, 1908

One hundred and one fish out of 316 caught had food in their stomachs. By frequency of occurrence, numerical and points methods, detritus was the most prominent diet accounting for 84.58%, 38.67% and 39.41% respectively (Table 3).

Figure 2 presents the monthly variations in feeding habits. Detritus was the mostly consumed food item throughout the year more especially during the floody months of July, August and September. Thereafter, a gradual decrease in its consumption till June was noticed.

Another food item considerably ingested was Insecta. In the months of July and August, insects were not included in the diet while the proportion of this item was equally low in September and October. There was a gradual increase in its consumption from November to May.

Feeding habits in relation to three sized groups in *C. auratus longifilis* using frequency of occurrence are presented in Figure 3. In all three sized groups, detritus was the important food item accounting for 87.50%, 87.57% and 73.08% respectively. Fine and coarse sand in the stomach contents increased with the increase in fish size. Fruits and seeds were consumed more by the medium sized group than other sized groups.

TABLE 3

Analysis of the stomach contents of *Chrysicthys auratus longifilis*

Food Items	Occurrence method		Numerical method		Points method	
	Freq-uency	%	Numbers	%	Points	%
Fine sand	73	36.32	-	-		
Coarse sand	25	12.44	-			
Detritus	170	84.58	176,111	38.67	3399	39.41
Rice	2	1.00	7	<0.01	14	0.16
Garri/fibres	3	1.49	573	0.13	25	0.29
Thread	1	0.50	1	<0.01	24	0.29
Blue green algae	10	4.98	2,454	0.54	4	0.05
Filamentous green algae	25	12.44	20,234	4.44	44	0.51
Desmids	2	1.00	1,827	0.40	3	0.03
Diatoms	57	28.36	48,061	10.55	30	0.35
Fruits	8	3.98	479	0.01	9	0.10
Seeds	4	1.99	1,315	0.29	7	0.08
Nematodes	39	19.40	8,575	1.88	40	0.46
Oligochaetes segments	5	2.49	1,771	0.39	16	0.19
Cladocera	33	16.42	60,364	13.25	60	0.70
Copepoda	47	23.38	12,126	2.66	23	0.27
Ostracoda	57	28.36	21,282	4.67	35	0.41
INSECTA						
Larvae nymphs and eggs						
Ephemeropteran nymphs	2	1.00	6	<0.01	4	0.05
Odonate nymphs	2	1.00	250	0.05	150	1.74
Trichopteran larvae	8	3.98	1,004	0.22	500	5.80
Pentaneura larvae	84	41.79	78,750	17.29	1050	12.17
Pentaneura pupae	7	3.48	3,142	0.69	42	0.49
Chironomus larvae	5	2.49	5,049	1.11	600	6.96
Choronomus pupae	2	1.00	593	0.13	8	0.09
Chaoborus larvae	2	1.00	883	0.19	12	0.14
Mosquito pupae	3	1.49	79	0.02	40	0.46
Unidentified dipteran larvae	4	1.99	259	0.06	9	0.10
Insecta eggs	1					
Odonata	1	0.50	5	<0.01	5	0.06
Hemiptera	2	1.00	12	<0.01	12	0.14
Notonecitidae	1	0.50	158	0.03	4	0.05
Corixidae	11	5.47	3,103	0.68	1009	11.70
Insect parts	17	8.46	210	0.05	4	0.05
Mites	5	2.49	503	0.11	150	1.74
Mollusca (Bivalves)	4	1.99	184	0.04	700	8.12
FISH						
Scales of fish	3	1.49	182	0.04	364	4.22
Bones of fish	5	2.49	1,164	0.26	209	2.42

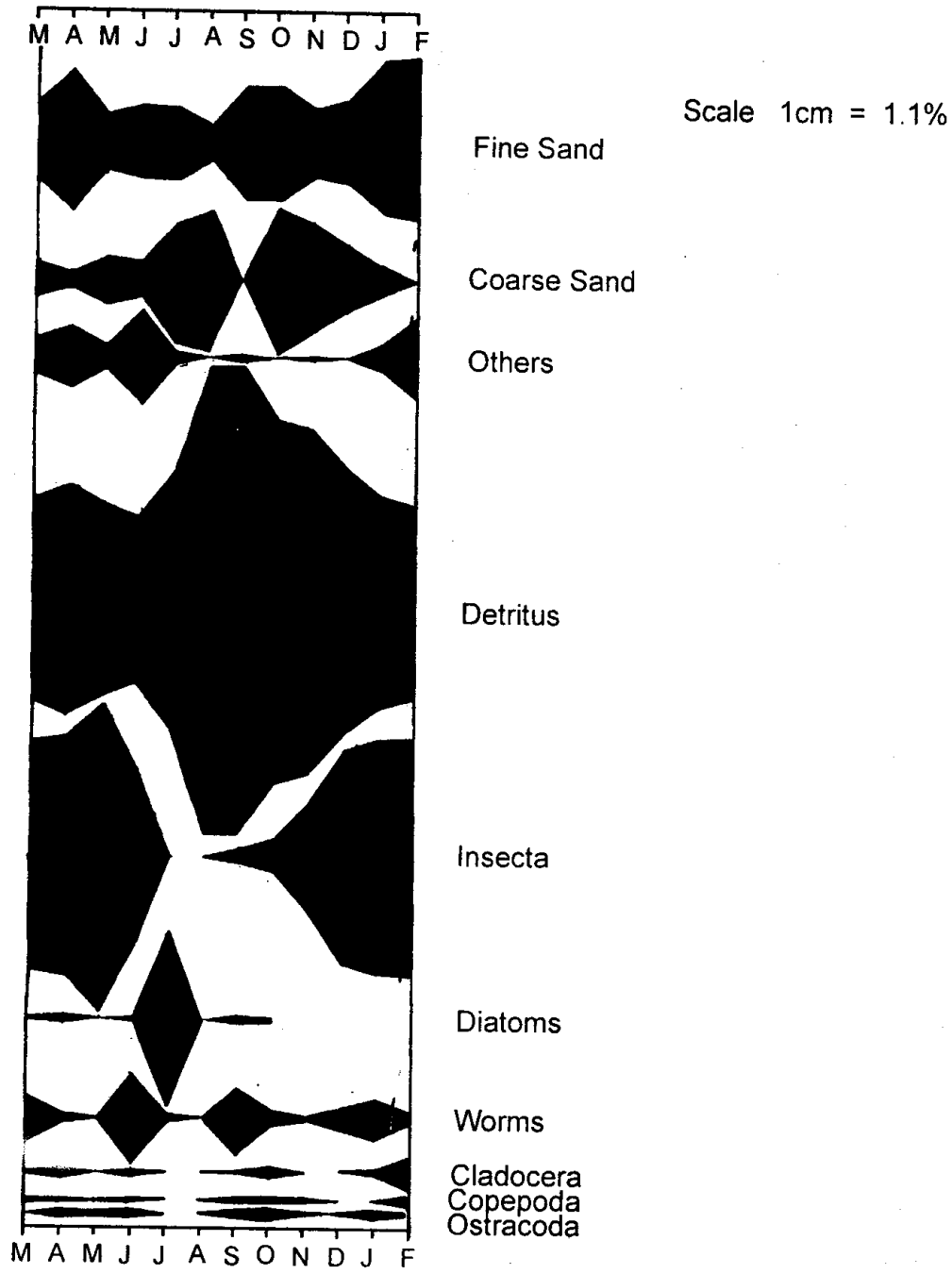

Fig. 2: Monthly variations in relations to feeding habits in *C auratus longifilis* using relative percentage points in River Ase, March 1982 to February 1984.

Blue green algae were present in medium and large sized groups while filamentous green algae although eaten by all three sized groups occurred more in the medium and large fish. Desmids were more common in the small sized group (12.50%) than in the medium sized group (2.50%) but absent in the large sized group. Diatoms were important in all sized groups but occurred more in the large sized group (40.00%).

Nematodes accounted for 46.67%, 35.71% and 39.58% in the small, medium and large sized groups respectively. Cladocera were ingested by all groups but more in the small sized group amounting to 75.00%. Similarly, more copepods and ostracods were eaten by the small sized groups than by other two groups.

In small, medium and large sized groups, *Pentaneura* larvae were important accounting for 70%, 100% and 87.50% respectively. The number of insects consumed increased with the increase in fish size. Mites were consumed more by the medium sized group than other sized groups. Fish was absent in the small sized group.

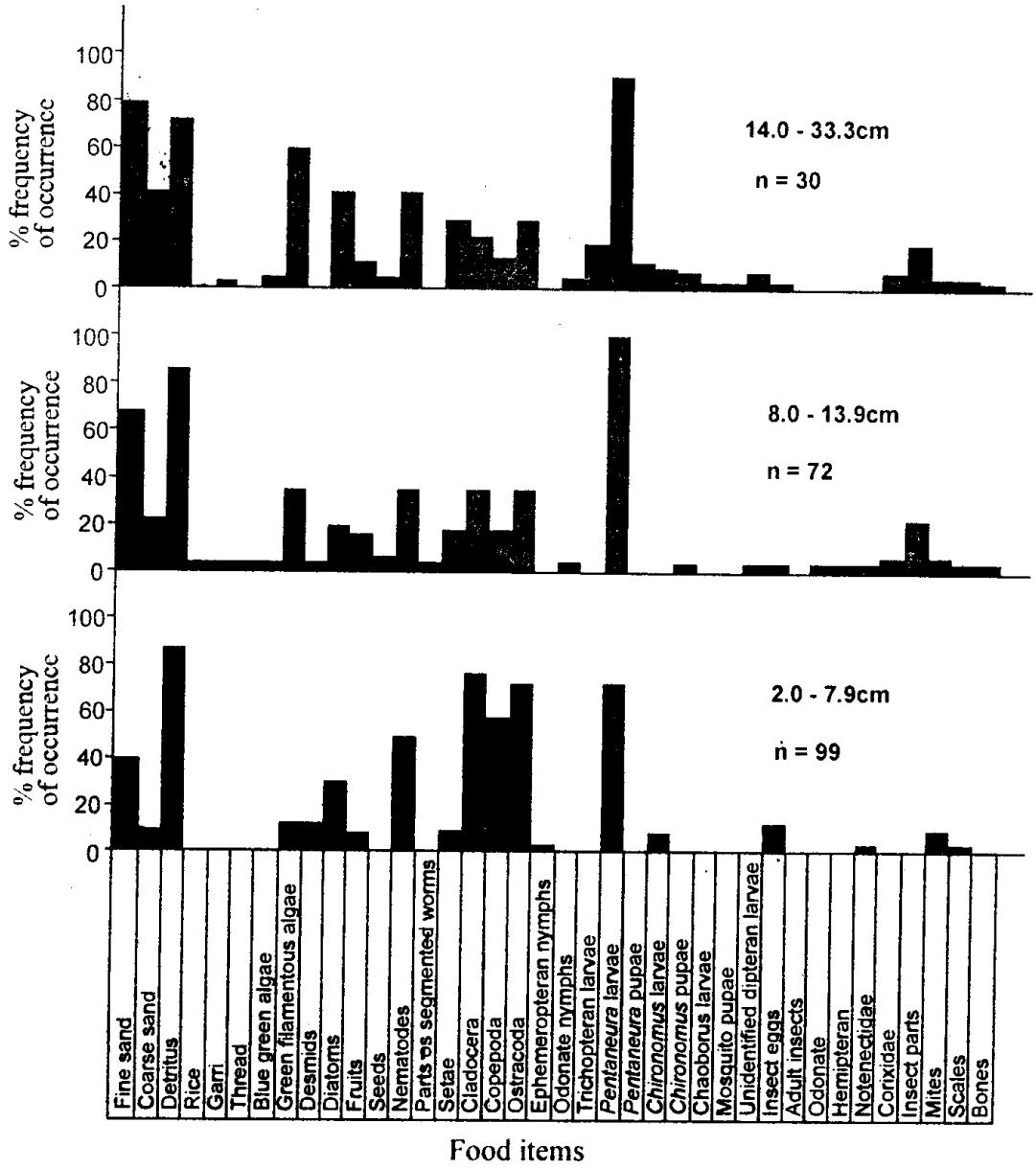

Fig. 3: Feeding habits in relation to sized group in *C. auratus longifilis* using frequency occurrence method in River Ase, March 1982 - February 1984.

Figure 4 shows the diel variations in feeding intensity. Although the mean point per fish was relatively high both during the day and night, there was an increase

in trend from 0600 to 2400(h) after which there was a decrease. From 0600 to 1200(h), the percentage of empty stomachs decreased. Between 1200 and 2400(h), the percentage of empty stomachs was low indicating the period when most fish have food in stomachs. This also corresponds to the increase in the mean points per fish during this period. From 2400 to 0600(h) the percentage of empty stomachs progressively increased and the mean points per fish correspondingly decreased.

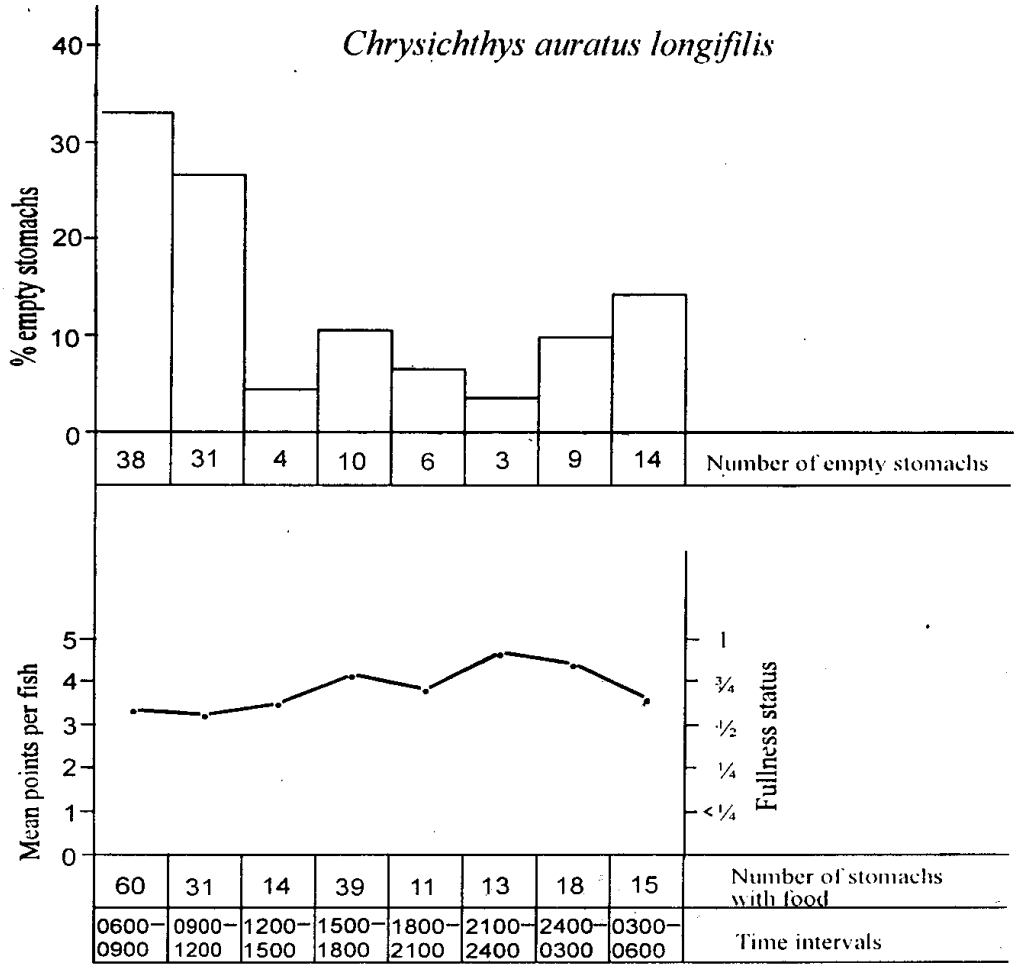

Fig. 4: Diel variations in feeding intensity of *C. auratus longifilis* showing mean points gained and the percentage of all empty stomachs at different time intervals in River Ase, March 1982 - February 1984.

Figure 5 presents the monthly variations in feeding intensity. Feeding was continuous throughout the year with mean points per fish higher in the dry season than in the rainy season. Empty stomachs were absent in November, December and January. More empty stomachs were recorded in the rainy months with relatively low mean points per fish especially in September.

The range of monthly mean condition factors was 1.9 - 3.0. The lowest mean condition factor was in the month of April, 1983 and the highest was in May of the same year (Table 8). The medium sized fish had the highest mean condition factor and this was followed by the small sized group while the large sized group had the lowest (Table 9).

C. nigrodigitatus (Lacepede, 1803)

Table 4 presents the summary of the analysis of stomach contents of *C. nigrodigitatus*. By frequency of occurrence, numerical and points methods, detritus accounted for 75.17%, 44.76% and 58.63% respectively as the most prominent food item.

TABLE 4
Analysis of stomach contents of *Chrysichthys nigrodigitatus*

Food Items	Occurrence method		Numerical method		Points method	
	Frequency	%	Numbers	%	Points	%
Fine sand	61	42.07	-	-	150	1.70
Coarse sand	38	26.21	-	-	130	1.47
Stones	2	1.38	-	-	7	0.08
Detritus	109	75.17	279,503	44.76	5,000	56.63
Blue filamentous algae	35	24.14	29,501	4.72	53	0.60
Desmids	3	2.07	523	0.08	2	0.02
Diatoms	30	20.69	18,089	2.90	21	0.24
Fruits	9	6.21	789	0.13	7	0.08
Seeds	14	9.66	9,415	1.51	9	0.10
Rotifera	6	4.14	1,600	0.26	3	0.03
Nematodes	30	20.69	1,732	0.28	8	0.09
Setae of Oligochaetes	48	33.10	127,662	20.45	26	0.29
Decapoda (Crayfish)	5	3.45	302	0.05	15	0.17
Cladocera	32	22.07	1,998	0.32	4	0.05
Copepoda	27	18.62	2,349	0.38	5	0.06
Ostracoda	12	8.28	2,778	0.44	3	0.03
Mollusca (Bivalves)	8	5.52	150	0.02	40	0.45
INSECTA						
Ephemeropteran nymphs	4	2.76	180	0.03	89	1.01
Odonate nymphs	6	4.14	480	0.08	200	2.27
Adult Hemiptera	5	3.45	260	0.04	130	1.47
Trichopteran larvae	15	10.34	11,810	1.89	700	7.93
Pentaneura larvae	83	57.24	94,216	15.09	664	7.52
Pentaneura pupae	26	17.93	7,182	1.15	96	1.09
Chironomus larvae	10	6.90	3,239	0.52	43	0.49
Chironomus pupae	2	1.38	1,750	0.28	23	0.26
Chaoborus larvae	2	1.38	608	0.10	72	0.82
Coleoptera larvae	13	8.97	7,999	1.28	1,050	11.89
Insect parts	18	12.41	10,609	1.70	212	2.40
Insect eggs	12	8.28	1,196	0.19	13	0.15
FISH						
Fish remains	8	5.52	200	0.03	25	0.28
Fish scales	5	3.45	5,050	0.81	15	0.17
Fish eggs	6	4.14	3,230	0.52	14	0.16

Figure 5 shows the variations in feeding habits of *C. nigrodigitatus*. No specific pattern of food consumption was exhibited. However, detritus was the most dominant food items consumed in a high proportion throughout the year except in November and December when no fish specimen was caught. The highest peak of detritus utilization was in August while the months of October and March showed minor peaks. Insects were ingested in a fairly high proportion in May and June. Other food items were consumed in low proportions.

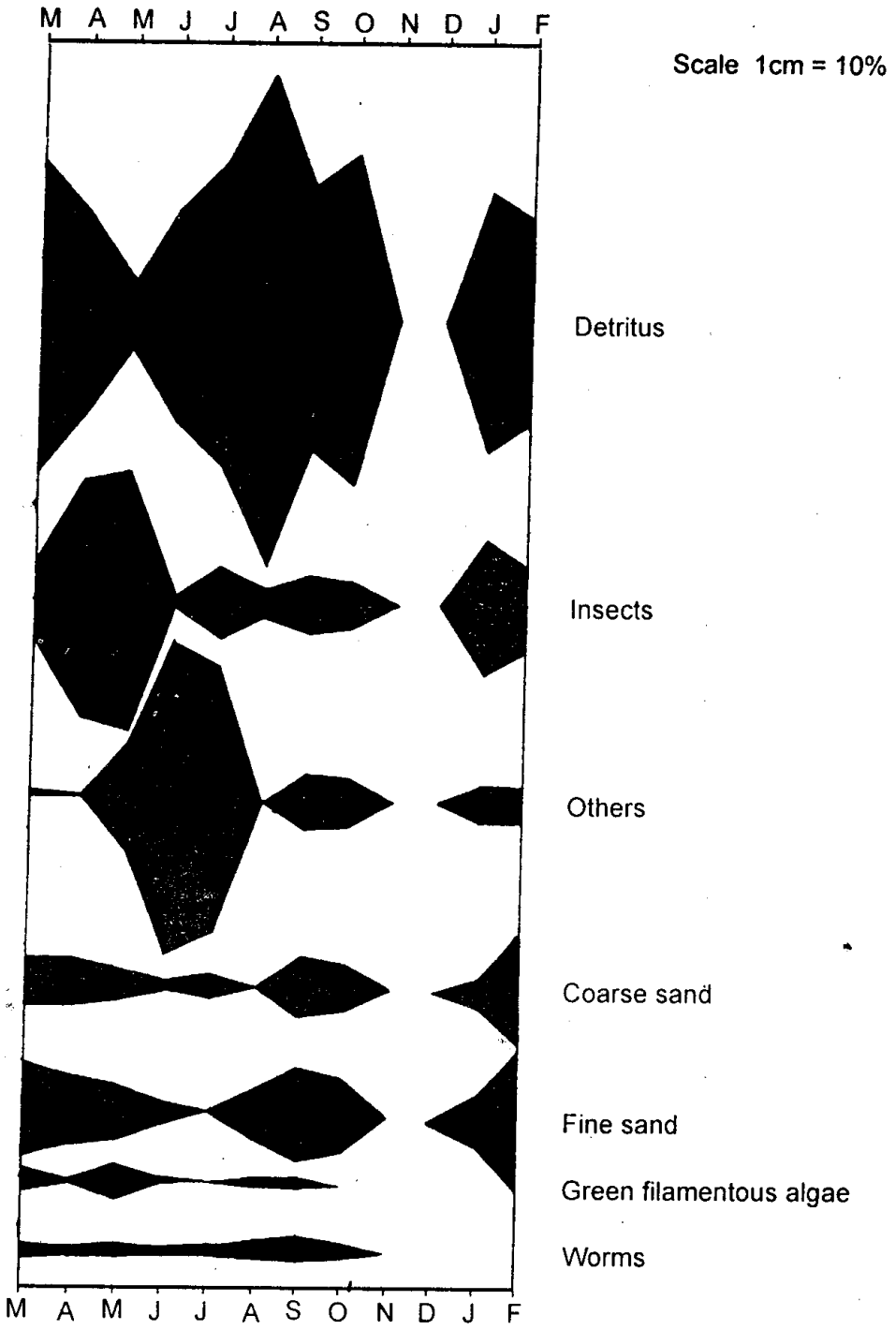

Fig. 5: The monthly relation to feeding habits in *C. nigrodigitatus* using relative percentage points in River Ase, March 1982 - February 1984.

Figure 6 presents the summary of feeding habits in relation to three sized groups in *C. nigrodigitatus* using frequency of occurrence. Detritus was an important food item in the three sized groups accounting for 66.67, 80.77 and 80.00% for small, medium and large sized groups respectively.

Blue green algae were consumed more by small and large sized groups than by medium sized group. Desmids were consumed by medium and large size groups only. Diatoms accounted for 51.43% in the large sized group, but their occurrence

were relatively low in small and medium sized groups contributing to 22.22% and 19.23% respectively. Fruits and seeds were not consumed by the small sized group but were eaten by other sized groups.

Rotifers were absent in the small and large sized groups but, only accounted for 3.45% in the medium sized group. Worms were not consumed by the small sized group, but were of importance in the medium and large sized groups contributing to 46.15% and 62.86% respectively. Crayfish (2.56%) was only eaten by the large sized group. Cladocera, important in the diet of small sized group accounted for 56.56%, but its occurrence was relatively low in the medium (10.34%) and large (10.26%) sized groups. Copepoda were important food in the small sized group (88.89%), but its ingestion was low in the medium (12.85%) and large (15.71%) sized groups. Ostracods were consumed only by the medium (7.69%) and large (11.43%) sized groups.

Pentaneura larvae occurred in considerable importance in small, medium and large sized groups accounting for 55.56%, 51.72% and 66.67% respectively. Only odonatan nymphs and coleopteran larvae were ingested by the small size group, while ephemeropteran nymphs, adult hemipterans, trichopteran, *Chironomus* larvae and *Chaoborus* larvae were absent in the diet of the medium sized group. All insect food, except insect eggs were ingested by the larvae sized group. Fish was not eaten by the small sized group but was recorded in the medium and large sized groups.

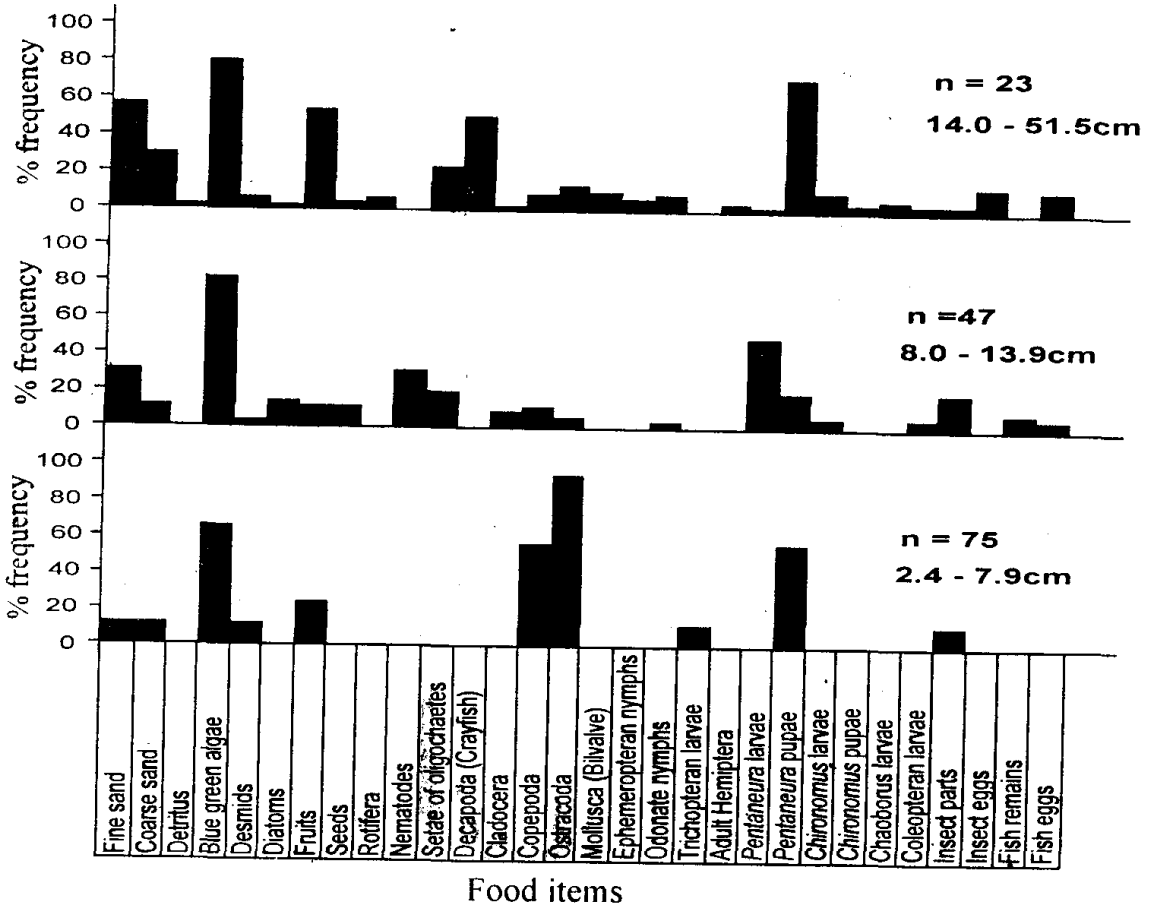

Fig. 6: Feeding habits in relation to sized group in *C nigrodigitatus* using frequency occurrence method in Rriver Ase, March 1982 - February 1984.

The mean points gained per fish was low between 0600 and 1800(h) but the percentage empty stomachs decreased progressively during this period (Fig. 7). Between 1800 and 2100(h) the mean points gained per fish increased and the number of empty stomachs also increased. Between 2100 and 0300(h), the mean points gained per fish were high and the percentage empty stomachs were low. However, the number of fish caught during this period were low. The low mean points recorded between 0300 and 0600(h) was because of only one fish with food being caught during this period.

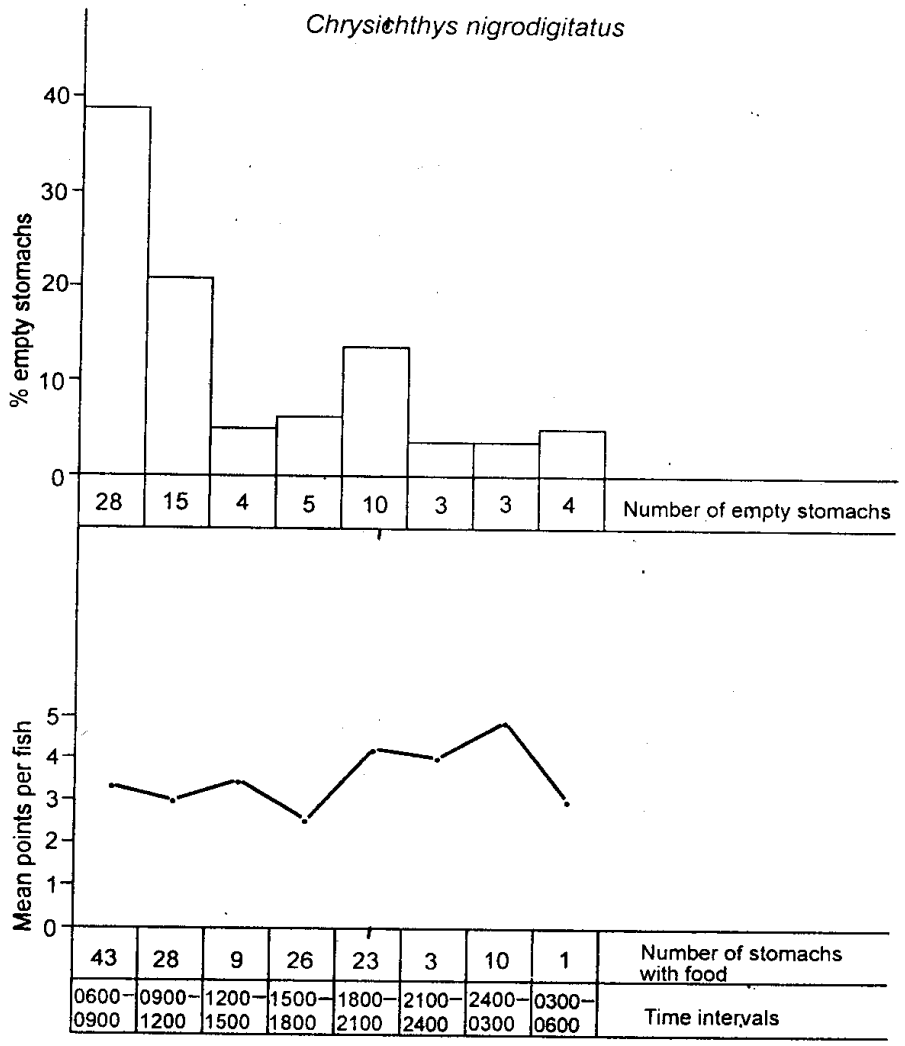

Fig. 7: Diel variations in feeding intensity of *C. nigrodigitatus* showing mean points gained and the percentage of all empty stomachs at different time intervals in River Ase, March 1982 - February 1984.

Figure 8 presents the monthly variation in feeding intensity. Feeding occurred throughout the year except in November and December. The highest mean points gained per fish was obtained in January while the lowest was in August, but the number of fish caught was low during this period. In general, more fish were caught

in the rainy season. The mean points gained per fish fluctuated widely during this period. Monthly mean points per fish were relatively high in April and May after which the number of empty stomachs increased and the mean points per fish were low. More empty stomachs were observed in the rainy season than in the dry season.

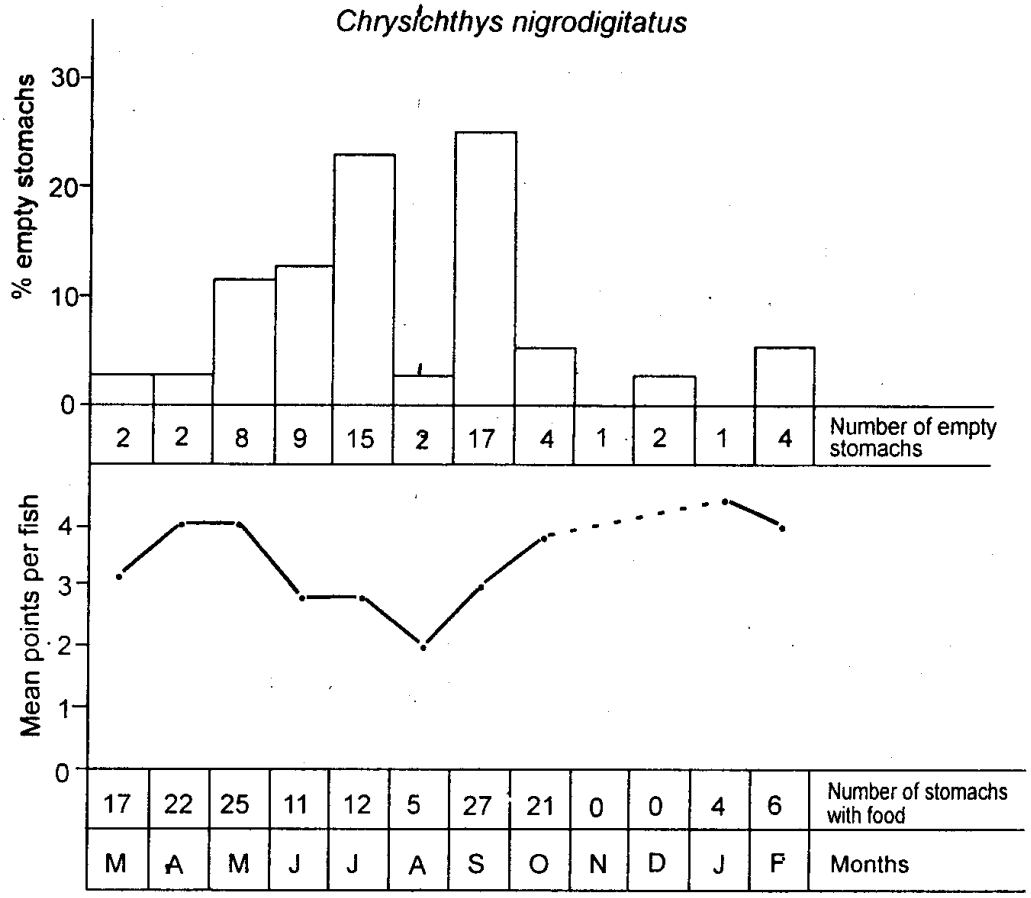

Fig. 8: Monthly variations in feeding intensity of *C. nigrodigitatus* showing mean points gained and the percentage of all empty stomachs during different months in River Ase, March 1982 - February 1984.

The monthly mean condition factors for the study period ranged from 1.2 - 3.9 (Table 8). The highest mean condition factor was recorded in February, 1983 while the lowest was in January of the same year. The small sized group had the highest mean condition factor while the large sized group recorded the lowest. (Table 9).

C. furcatus Günther, 1864

Out of the total of 22 stomachs examined, only five had food. Table 5 summarizes the food composition in these stomachs. Detritus was the most frequently occurring food item amounting to 100.00%. Other food items occurred in the range of 20 - 40%.

By numerical and points methods, detritus was the major food item accounting for 75.73% and 34.04% respectively.

TABLE 5
Analysis of the stomach contents of *Chrysicthys furcatus*

Food Items	Occurrence method		Numerical method		Points method	
	Freq-uency	%	Numbers	%	Points	%
Fine sand	2	40.00	-	-	8	8.51
Coarse sand	1	20.00	-	-	5	5.32
Detritus	5	100.00	6,047	75.73	32	34.04
Blue green algae	1	20.00	45	0.56	1	1.06
Blue filamentous algae	1	20.00	110	1.38	2	2.13
Nematodes	2	40.00	350	4.38	4	4.26
INSECTA						
Pentaneura larvae	2	40.00	1,269	15.89	2	2.13
Chironomus pupae	2	40.00	109	1.37	2	2.13
Coleopteran larvae	1	20.00	55	0.69	18	19.15

The monthly mean condition factors ranged from 1.4 - 2.7 (Table 8). The medium sized group had a higher mean condition factor than the large sized group (Table 9).

Clarotes laticeps (Rüppel, 1829)

Table 6 presents the food items found in the stomachs of nine specimens. By frequency of occurrence and numerical methods, detritus was the most important food item accounting for 66.67% and 89.06% respectively while by points method, *Chrysichthys* sp. accounted for 33.07% as the most prominent food item. Fish were the major food items. Detritus and prawns were also important in the diet.

The lowest and highest mean condition factors were recorded in May, 1983 and October, 1982 respectively (Table 8). The medium and large size fish had the same mean condition factor.

TABLE 6
Analysis of the stomach contents of *Clarotes laticeps*

Food Items	Occurrence Method		Numerical Method		Points Method	
	Frequency	%	Numbers	%	Points	%
Detritus	6	66.67	350	89.06	5	1.95
Decapoda (crayfish)	2	22.22	4	1.02	10	3.89
Prawns	1	11.11	1	025	14	5.45
FISH						
Chrysichthys spp.	4	44.44	6	1.53	85	33.07
Cichlids	3	33.33	4	1.02	35	13.62
Unidentified fish	5	55.56	7	1.78	79	30.74
Bones	2	22.22	14	3.56	21	8.17
Scales	3	33.33	7	1.78	8	3.11

Auchenoglanis occidentalis (Cuvier and Valenciennes, 1840)

Table 7 shows the summary of the food composition. By frequency of occurrence, numerical and points methods detritus constituted 100%, 89.54% and 25.45% respectively as the most important food item.

The lowest and highest mean condition factors were obtained in July, 1982 and August, 1983 respectively (Table 8)

TABLE 7

Analysis of the stomach contents of *A. occidentalis*

Food Items	Occurrence Method		Numerical Method		Points Method	
	Freq-uency	%	Numbers	%	Points	%
Fine sand	7	87.5	-	-	9	16.36
Detritus	8	100	10,754	89.54	14	25.45
Green filamentous algae	2	25.00	342	2.85	2	3.64
Desmids	1	12.50	90	0.75	1	1.82
Worms						
Nematodes	3	37.5	252	2.10	4	7.27
Setae of Oligochaetes	4	50.00	360	3.00	3	5.45
INSECTA						
Ephemeropteran nymphs	6	75.00	6	0.05	7	12.73
Pentaneura larvae	6	75.00	200	1.67	4	7.27
Coleopteran larvae	3	37.50	4	0.03	5	9.09
Isoptera (Termites)	3	37.50	2	0.02	6	10.91

TABLE 8

Monthly mean condition factors (kf) of bagrid species from March, 1982 - February, 1984.

	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Bagrus bayad macropterus	1.1	1.3	1.3	-	1.4	1.4	-	-	1.2	-	1.2	1.3	-	-	-	0.9	-	-	-	1.3	-	0.7	-	-
B. domac niger	1.0	-	1.4	-	-	-	-	-	-	-	1.8	-	-	-	-	-	1.8	-	-	-	-	-	-	-
Chryscicthys auratus longifilis	2.3	2.4	2.9	2.5	2.0	2.6	2.5	2.3	2.2	2.3	2.4	2.9	2.4	1.9	3.0	2.3	2.4	2.7	2.4	2.4	2.4	2.4	2.1	2.5
C. nigrodigitatus	1.9	2.2	2.2	1.9	2.0	2.0	2.2	2.2	2.0	1.8	1.2	3.9	2.0	2.3	1.6	2.2	2.6	2.1	2.1	2.2	2.3	1.8	1.3	2.3
C. Furcatus	2.1	-	-	2.2	-	-	-	-	-	-	-	2.7	2.5	-	-	1.9	2.2	2.0	1.4	-	-	-	-	2.0
Clarotes laticeps	1.9	1.8	-	1.7	-	-	-	3.0	-	-	2.0	2.6	2.1	1.7	1.4	1.7	2.5	-	2.9	-	-	-	1.9	2.5
C. Macrocephalus	-	-	-	2.1	2.0	-	-	-	-	2.5	-	2.6	-	-	-	2.2	2.2	-	-	-	-	2.4	-	-
Auchenoglanis biscutatus	2.1	-	-	-	-	-	-	-	-	-	2.2	-	-	-	-	-	2.0	-	-	-	-	-	-	-
A. Occidentalis	2.0	2.2	2.2	-	1.6	2.8	-	-	-	-	2.5	-	2.0	2.1	2.2	-	1.8	1.8	2.9	-	-	-	2.5	-

TABLE 9
Mean condition factors for different sized groups of bagrid species.

	Small sized group	Medium sized group	Large sized group
Bagrus bayad macropterus	-	-	1.0
B. domac niger	-	-	1.6
Chrysichthys auratus longifilis	2.5	3.1	0.3
C. nigrodigitatus	3.7	2.7	1.3
C. furcatus	-	3.0	2.1
Clarotes laticeps	-	2.2	2.2
C. macrocephalus	-	2.3	2.6
Auchenoglanis biscutatus	-	-	2.2
A. occidentalis	-	-	1.3

DISCUSSION

In River Ase, *Bagrus bayad macropterus* fed mostly on fish (*Chrysichthys* spp. and *Synodontis* spp.) and decapod crustaceans. Insects were also important in the diet. Bakare (1968), Imevbore and Bakare (1970) reported that the diet of *B. bayad* in River Niger mainly composed of young fish, prawns and vegetable matter while Ajayi (1972) recorded *C. auratus, Tilapia* spp. *Alestes* spp. and mayfly nymphs as important food items in Lake Kainji. Based on their studies in River Nile, Sandon and Tayib (1953) classified *B. bayad* as a piscivore, feeding on *Alestes*, small *Chrysichthys* and prawns. All above findings inclusive of the present study indicate that *B. bayad macropterus* is predominantly piscivorous in diet.

The food of *B. docmac niger* has earlier been studied in detail. In River Niger, fish and insect larvae were the main food items (Imevbore & Bakare, 1970). Welman (1948) reported that prawns, insect larvae and mud formed a significant proportion of its diet in River Kaduna. In Lake Kainji, Ajayi (1972) classified *B. docmac niger* as a carnivore, feeding on fish (*C. auratus longifilis; Tilapia* spp; *Synodontis* spp), prawns and benthic insects and similar feeding habits have also been reported for this species in River Ogun (Adebisi, 1981). In rivers in Ghana, fish eggs, fry, adult fish, bivalves, snails and insect larvae were the main food items (Irvine, 1947). Sandon and Tayib (1953) recorded odonate nymphs, pieces of onion, adult insects, fish remains of *Alestes* and *Synodontis* species, sorghum, plants and seeds as the food eaten in River Nile. In Lake Edward, juveniles of *Haplochromis* and *Chironomid* larvae were the food items (Verbeke, 1959). In Lake Victoria, Albert and Kyoga, *B. docmac niger* was piscivorous (Graham, 1929; Worthington, 1929; Corbet, 1961).

In the present study, *B. docmac niger* fed mainly on decapod crustaceans and fish (*Chrysichthys* spp; *Synodontis* spp). This finding is in general agreement with the above investigators. It is clear that *B. docmac niger*, although predominantly a piscivore, is capable of switching to invertebrate diet when fish food is scarce in its natural environment.

In River Ase, the food of *Chrysichthys auratus longifilis* covered a wide variety of food items. Insects, detritus, worms and filamentous green algae were the main food consumed. The findings of this study agree with those of Ajayi (1972) in Lake Kainji. *C. auratus* has been described as a bottom feeder, feeding on bivalves,

trichopteran larvae and sand in River Niger (Bakare, 1968; Imevbore and Bakare, 1970). Pekkola (1919) found that in River Nile, young fish and vegetable matter formed its food while Sandon and Tayib (1953) recorded chironomid larvae, bivalves and scales of *Tilapia* and *Alestes* as the main food items in the same river.

All above results from different researchers confirm that *C. longifilis* is an omnivorous bottom feeder which consumes what is available on the substratum at any given time. Ajayi (1972) is of the opinion that this fish can also move to the surface to feed when food is scarce in the bottom. The presence of zooplankton in the diet of this species in River Ase supports this view.

Variations in food items of dry and rainy seasons were not remarkable. This shows that most food items were available during both seasons and *C. auratus longifilis* was capable of exploiting these resources throughout the year.

In Lekki Lagoon, Ikusemiju (1973), Ikusemiju and Olaniyan (1977) reported that differences occurred in the feeding habits of different size groups of catfish. This supports the findings for *C. auratus longifilis* in River Ase where the large fish consumed a wide variety of food items. This also shows that the large fish were more efficient in utilizing the available food resources than the small fish.

Diel variations observed in this study showed that *C. auratus longifilis* fed both during day and night. Therefore, light is not an important factor influencing the feeding habits. Ajayi (1972) reported that *C. auratus longifilis* used its sense of smell and barbels to detect its food. He, however, observed that it fed mostly during nights under laboratory conditions.

Variations in the abundance of food in the habitat could be responsible for the monthly variations in feeding habits. As stated earlier, food items consumed were not remarkably different in dry and rainy seasons, but the low mean points per fish gained during the rainy season months could be due to moderate availability of food items which augmented intraspecific competition.

The mean monthly condition factor of the fish was relatively high throughout the study period indicating that they were in good condition. The condition factor of the medium size fish was the highest signifying that this size group was in better condition than the other size groups. The large fish were in poor condition (kf = 0.3). This is difficult to explain especially, when the large fish had more variety of food available to them than the small fish.

The food of *Chrysichthys nigrodigitatus* has been a subject of varying opinions ranging from filter feeding to predation (Welcomme, 1979). In this study, detritus, insects, fine sand and worms were the major food items. Ajayi (1972) observed that this species fed on a wide variety of food items, but the dominant items were detritus, bivalves and trichopteran larvae in Lake Kainji. Gastropods, ostracods and cladocerans were the major food items in Lekki Lagoon (Ikusemiju, 1973; Ikusemiju & Olaniyan, 1977), while bivalves dominated its diet in Lagos Lagoon (Fagade & Olaniyan, 1972). *C. nigrodigitatus* fed mainly on algae, detritus, sand and insects in the Ikpoba River (Brown, 1985). In River Ase, the main food items eaten by this species indicate that it is undoubtedly a bottom feeder and the wide range of food items incorporated in its diet show that it is an omnivore. The present conclusion is identical with the view of Ajayi (1972) who classified *C. nigrodigitatus* as an omnivore in Lake Kainji.

The availability of food items in the environment could be responsible for the seasonal variation in the feeding habits of *C. nigrodigitatus*. The main food items were

consumed in both seasons showing that such food items were available throughout the year.

All three sized groups consumed detritus as the main food item. However, relatively less quantities of sand and stones were found in the diet of small sized group thus indicating that bottom feeding is not the predominant method. This view is further confirmed by the absence of benthic organisms and relatively high quantities of zooplankton food in the diet of small sized fish. The detritus consumed by the small fish need not have been taken from the substratum but was probably obtained from the seston. The medium and large sized *C. nigrodigitatus* fed on a wide variety of food items with high quantities of benthic organisms. It appears that after a particular size range (circa 8.0 cm), this fish becomes a predominant benthic feeder. The inclusion of zooplankton in the diet of medium and large size fish, although in small amounts shows the ability to obtain food from the water column.

The diel variations in feeding habits of *C. nigrodigitatus* indicate feeding was both during day and night, with feeding intensity higher between 1800 and 0300(h) , than during other time intervals. This shows that *C. nigrodigitatus* is capable of feeding in the dark and the mechanisms employed are probably similar to those discussed for *C. auratus longifilis*.

Monthly variations in feeding intensity could be related to the abundance of food items in the habitat although this fact cannot be substantaited from the stomach contents examined during the dry and rainy months. However, there appears to be a general inverse relationship between the mean points gained per fish and percentage empty stomachs. When the mean points were high, the percentage empty stomachs of *C. nigrodigitatus* were low and vice versa. This relationship could be explained by intraspecific competition among the individuals of the population of the available food resources. In *C. nigrodigitatus*, the percentage empty stomachs were high during the rainy season months with the exception of August and so, it appears that the competition is likely to be more intense during these months than during other months.

The mean monthly condition factors were above 1.0 throughout the study period indicating that the fish were in good condition. The condition factors of the smaller fish were more than those of the larger ones and this show that the smaller fish were not limited by the food availability although the larger fish fed on a wide variety of food items.

Chrysichthys furcatus fed mainly on algae, mud and a few pebbles in River Niger and it was earlier described as a bottom feeder (Bakare, 1968; Imevbore and Bakare, 1970). In River Ase, detritus, insect larvae and algae were the food items and this finding confirms the bottom feeding nature of this species. The smaller *C. furcatus* were in better condition than the larger ones thus indicating their ability to exploit the food resources in the habitat more efficiently.

In River Ase, *Clarotes laticeps* fed on fish and detritus. Prawns and crayfish were also consumed occasionally in small quantities. In River Niger, small fish, insect larvae and prawns were recorded as the main food of *C. laticeps*. Fish, molluscs, insect larvae, cladocerans and detritus were the main food items eaten by this species in Lake Kainji (Ajayi, 1972). Sandon and Tayib (1953) reported fish remains, prawns, Hemiptera, snails and leaves as its main food items in River Nile. These findings did not contrast the results obtained during this study. The small and large *C. laticeps* had similar condition factors, an indication that both size groups were utilizing the available food resources well.

In River Niger, the main food items of *Auchenoglanis occidentalis* were mud, lamellibranch molluscs, copepods, cladocerans, ostracods and insect larvae (Monod, 1949; Bakare, 1968; Imevbore and Bakare, 1970). Ajayi (1972) described *A. occidentalis* as a bottom feeder consuming detritus, insect larvae, nymphs and molluscs in Lake Kainji. In this study, detritus and insects were the major food items. The presence of nematodes and setae of oligochaetes supports the bottom feeding characteristic of this species. Food items like allochthonous termites, suggest that *A. occidentalis* is also capable of feeding at the surface. Only large specimens were caught and their mean condition factor was above 1.0 showing that they were in good condition.

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