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O. A. AYINLA

ABSTRACT:

Food and feeding habit of *Clarias gariepinus* (Burchell 1822)was studdied using numerical, frequency of occurence and volumetric analysis. The three different stages of development of *C.gariepinus* collected from Olupanna Reservoir in Oyo State of Nigeria were investigated. Phytoplankton was the most important food item of *C. gariepinus* fingerling, juvenile and adult on th basis of numerical and frequency of occurence methods while insect and insect remains ranked next by both methods. Volumetrically insects and insect parts were the most important in the diet of fingerling while the volumes for both phytoplankton and fish remains were similar. Fish and fish remains were more important in the diet of juvenile *C. gariepinus* than the other food items by the volumetric method. Also fish and fish remains, insect and insect part contributed equally to the diets of *C. gariepinus* adult and were more important than phytoplankton.

INTRODUCTION:

The biology of *C. gariepinus*. had been studied by Bollock and Koura (1960), Ejike *et al* (1982) and Olatunde (1983) investigated the food and feeding habit of juvenile *C. gariepinus* but information is lacking on the other stages of development. In view of the commercial importance of the fish there is a need for an in–depth biological study of this fish.

The study of food and feeding habits reported in this study is important in guiding fish culturists in the choice of feedstuffs to be used in compounding the artificial diets of the fish to maximise its production under intensive culture system. This study is therefore designed to investigate the food and feeding habits of *C . gariepinus* at the 3 different stages of development i.e. fingerling , juvenile and adult.

MATERIALS AND METHODS

Collection of the Fish samples

Specimens of *c. gariepinus* were caught with cast net on monthly basis at Oluponna reservoir (Oyo State in Nigeria), from May to August, 1984 a period which coincided with the rainy season. A total of 708 specimens were examined comprising 187 fingerlings , 132 juvenile and 333 adult with the standard length of 10.0 15.9cm, 16.19.9cm and 20cm and above respectively. (Classification according to the scheme of Hunter and Depree (1984).

Stomach content analysis

The analysis of the stomach contents of the fish specimens was undertaken using Hynes (1950) methods of numerical, frequency of occurence, and volumetric. specimens were preserved in 70% formaldehyde immediately after catch, to prevent posthumous deterioration . The three methods of analysis were used to have the basis of comparison of the predominance or otherwise of the various food items of the fish.

RESULTS:

The summary of combined food contents of the fingerlings, juvenile and adult fish is presented in Table 1.

The summary of the food and feeding habits of the fish at the 3 different stages is presented in Table 1. Phytoplankton occurred in 95.2% of the stomachs and accounted for 61.8% of the food in fingerlings by numerical method and 10.7% by volume for all the fish specimens examined. insect and insect stages occurred in 43.0% of the stomachs and accounted for 59.4% and was 14.3% by number and volume respectively. Fish and fish remaisns were 10.4% numerically and occurred in 9.6% of the stomach and 6.1% volumetrically. Phytoplankton was the most important food item on the basis of numerical and frequency of occurrence methods. While insect and insect remains ranked next by both methods. With volumetric method insect and insect remains were the most important, while phytoplankton and fish and fish remains were equally important volumetrically. In summary phytoplankton was the most important food item in all the fingerlings examined.

Table 1 Summary of the Food Items of 708 Clarias gariepinus caught at Oluponna Fish Farm Reservoir

Food Items	Numerical Method		Volumetric Method		Frequency of Occurrence	
Insects	Number	%	Volume	%	Number	%
Orthoptera	75	1.59	5	0.06	64	9.04
Hemiptera	82	1.82	3	0.005	70	9.9
Dictyoptera	163	1.64	10	0.006	35	4.9
Coleoptera	36	1.5	5	0.004	47	6.6
Unidentified insect	26	1.36	32	0.170	69	9.7
Insect stage						
Chironomid larvae	635	3.41	2	0.007	86	12.12
Chironomid pupae	128	1.59	1.5	0;004	82	11.6
Fish						
Fish remains	426	9.46	155	8.230	199	28.1
Fish scales	175	2.46	25	1.230	173	24.4
Phytoplankton						
Polycystis	23	0.6	0.26	0.006	23	3.2
Protococcus	44	0.9	0.35	0.005	29	4.1
Pediastrum	62	0.4	0.9	0.020	20	2.8
Closterium	26	1.3	0.06	0.004	36	5.1
Cosmaria	15	1.1	0.03	0.006	24	3.4
Spirogyra	35	1.4	0.6	0.004	21	3.0
Volvocales	25	1.2	0.04	0.001	27	3.8
Diatoms	340	6.8	2.2	5.25	234	32.9
Flagellates	380	18.18	1.5	4.62	285	40.25
Others						
Unidentified Items	178	2.5	30	8.64	78	11.0
Bottom deposit	-	-	220	12.35	260	36.7

The analysis of the juvenile stomachs showed that phytoplankton accounted for 84.6% of the food numerically and occurred in 79.5% of the stomachs examined nd was 9.0% volumetrically. Insect and insect stages accounted for 56.05% of the food numerically and occurred in 47.0% of the stomach and was 16.7% volumetrically. Fish and fish parts occurred in 67.4% of the stomachs and accounted for 42.2% by numerical method, and 19.9% by volume. Phytoplankton was also the most important food item in juvenile *C. gariepinus*. It is obvious from this study that by numerical and frequency of occurrence methods phytoplankton was the most important food item in the juvenile fish while insect and insect parts were the second with numerical method. Fish ad fish remains were second most important food item with frequency of occurrence method. Fish and fish remains were the most important food item considering volumetric method followed by insect and insect parts while phytoplankton was least in importance by this method. With *C. gariepinus* juvenile fish and fish remains became more important food item than in the fingerlings. This is understandable because of the tiny size of phytoplankton. However the volumetric method may not be used to assess the relative importance of the food items because the bigger sized food items which occupied large volume may not necessarily be of nutritive importance than phytoplankton which is tiny in size.

In adult *C. gariepinus* phytoplankton accounted for 52.9% of food items numericaly while it occurred in 83.3% of the stomach and was 9.43% by volume. Insect and insect stages accounted for 55.2% by number and 82.86% by frequency of occurrence and 11.78% in volume. Fish and fish parts accounted for 17.88% numerically, occurred in 69.2% of the stomach and was 7.55% by volume. Phytoplankton and insect and insect parts were equally important in the food of adult *C. gariepinus*.

There were unidentified food items in all the groups and they were important in the food items of *C. gariepinus*. *Histogram of stomach contents* of the fingerling, juvenile and adult fish are present in figure 1 to 3.

The summary of the combined total number of full and empty stommachs of the 3 stages of the fish is presented in Table 2. Out of the 708 specimens examined, 73 (10.3%) had empty stomachs.

The analysis of the 3 stages combined (table 3) by numerical method has shown that insect and insect stages constituted 14.9% of the food items found in the stomach of fish while it occurred in 72.86% of the stomachs examined. Insect and insect stages were 0.257% by volume. Fish and fish remains were about 12% by numerical method and 9.49% by volume. They occurred in 23.72% of the stomachs examined. Phytoplankton was 31.88% by numerical method, 9.92% by volume and occurred in 99% of thestomachs examined. This finding has therefore shown that by numerical method phytoplankton were the most important food item in the diet of C. *gariepinus* caught from the wild followed by insect and insect stages. Phytoplankton was also the most important food item on the basis of frequency of occurrence method. Phytoplankton occurred in almost all the stomachs examined while insect and insect stages occurred in 72.86% of the samples. On the basis of volumetric method, phytoplankton and fish and fish remains were equally important in te diet of *C. gariepinus*. The summary of the three methods has therefore suggested that phytoplankton was the most important food of *C. gariepinus* followed by insect and insect stages and then fish and fish remains (see table 3)

Table 2

Monthly Percentage Analyss of C. gariepinus full And Empty Stomahc from the wild

Stomach Analysis of C. gariepinus collected from the wild May to August 1987

Monthly	No. of Stomach Examined	No. of Stomach with food	% of Stomach with food	No. of Empty Stomach	% of Empty Stomach
May	172	161	93.6	11	6.4
June	177	170	96.0	7	4.0
July	175	159	85.1	26	14.9
August	186	155	84.2	29	15.8
Total	708	635	89.7	73	10.3

Table 3

Summary of the food items of fingerlings Juvenile and adult *c. gariepinus* from the wild.

Size Group No. of Fish Examined No. of Empty Stomachs	Fingerling 10. 3 – 14.5cm 187 15			Juvenile 14.5 – 18.5cm 132 12			Adult 18. 5 – 35cm 383 46		
Insect	N%	V%	F%	N%	V%	F%	V%	N%	F%
Othorptera	0.96	0.45	2.14	5.4	1.2	9.2	6.4	1.5	11.7
Hemiptera	0.87	0.32	3.2	3.5	0.85	6.1	6.7	1.2	14.6
Dictyoptera	2.8	0.36	1.1	1.8	0.03	3.8	2.5	0.08	9.9
Coleoptera	0.86	1.5	0.58	4.6	0.96	0.03	2.7	1.2	10.0
Unidentified Insect Parts	2.26	9.46	1.1	7.5	1.24	5.3	8.2	1.2	15.7
Insect Stages									
Chironomid larvae	20.7	6.7	16.042	18.4	6.7	10.6	9.6	2.8	10.96
Chironomid pupea	28.4	4.5	18.7	14.3	5.7	9.1	15.2	3.8	9.1
Fish									
Fish remains	3.87	2.5	5.3	28.4	15.3	40.9	14.3	6.25	35.3
Fish scales	6.5	3.6	4.3	16.8	3.7	26.5	3.58	1.30	33.9
Phytoplankton									
Polycystic	0.36	0.08	1.6	2.6	0.88	1.5	3.4	1.2	4.6
Protococcus	0.48	0.36	1.1	3.7	1.4	5.3	3.6	1.3	5.2
Pediastrus	1.04	0.37	1.6	3.5	0.86	3.8	3.2	1.2	3.1
Closterium	3.36	1.45	2.1	3.8	0.45	6.1	3.4	0.8	6.5
Cosmeria	1.45	0.89	1.6	1.5	0.04	6.1	1.3	0.05	3.4
Insect									
Spirogyra	1.86	0.96	1.6	1.6	0.05	3.8	1.4	0.06	3.4
Volyocales	1.45	0.75	0.5	0.68	0.03	3.03	1.4	0.02	5.7
Diatoms	22.36	2.35	34.8	24.86	2.45	44.7	18.4	2.2	28.7
Flagellates	28.45	3.45	50.8	32.5	2.86	49.2	16.8	2.6	32.7
Others									
Unidentified Items	7.8	2.8	2.78	5.8	2.7	18.9	2.68	0.86	32.6
Bottom deposits	18.7	5.4	46.3	26.7	6.9	56.8	25.8	6.4	30.8

N = n

N = Numerical
V = Volumetric
F = Frequency of Occurrence.

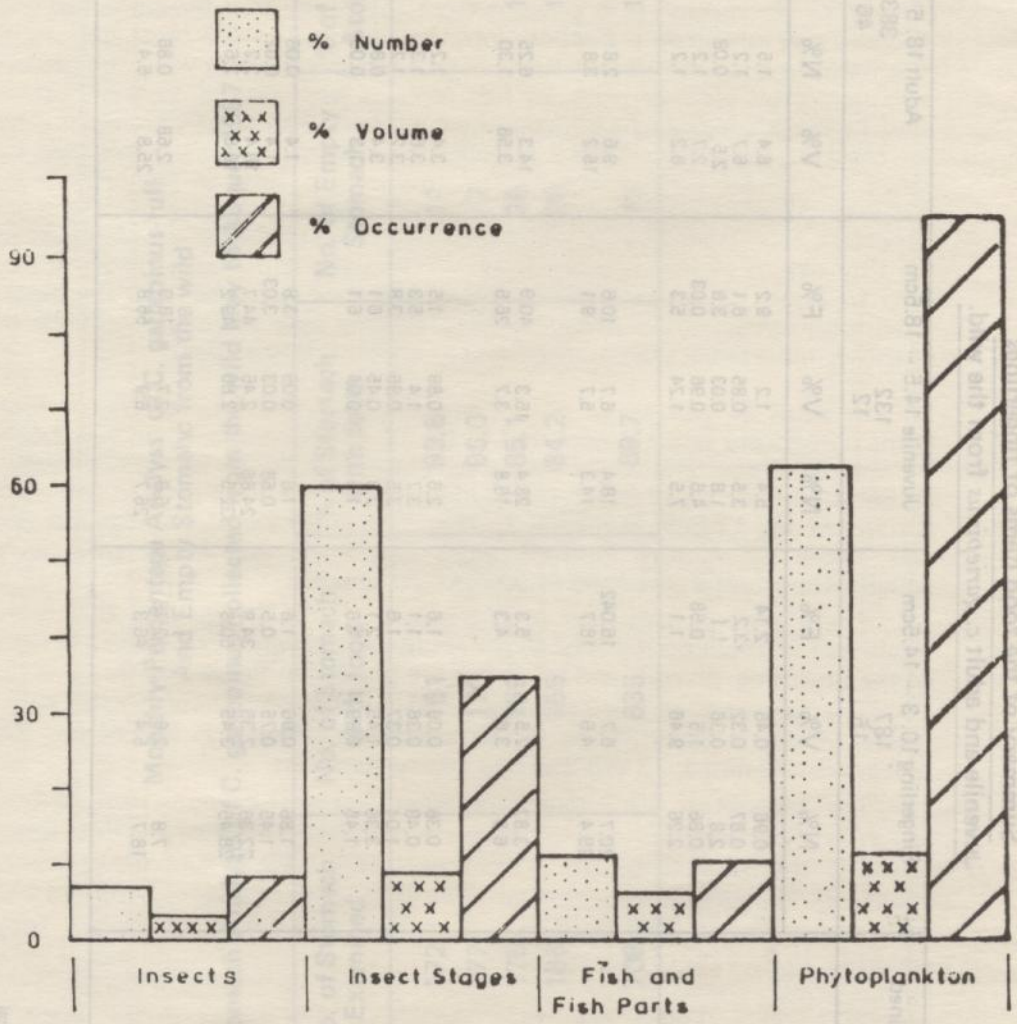

Fig. 1 Stomach Contents of Clarias gariepinus fingerlings.

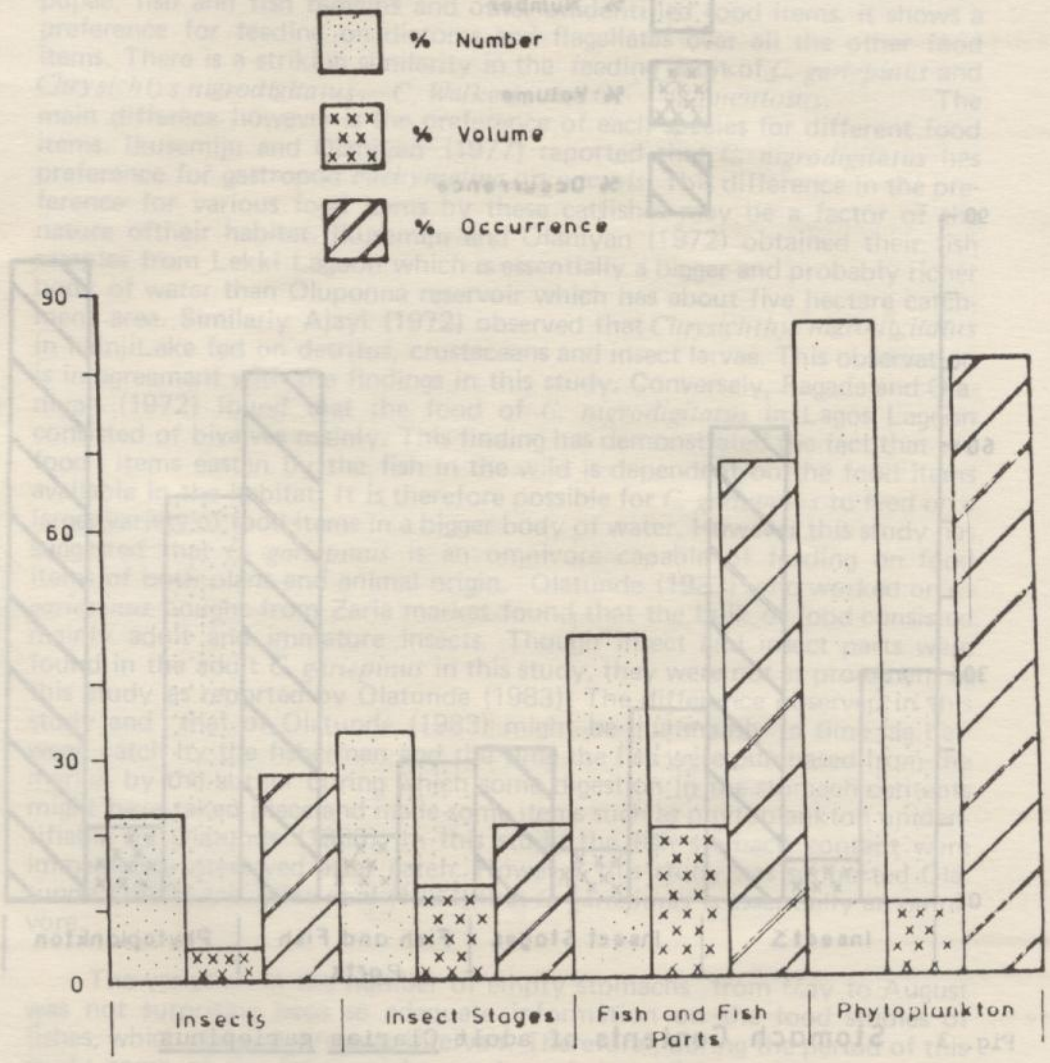

Fig. -2 Stomach Contents of juvenile Clarias gariepinus

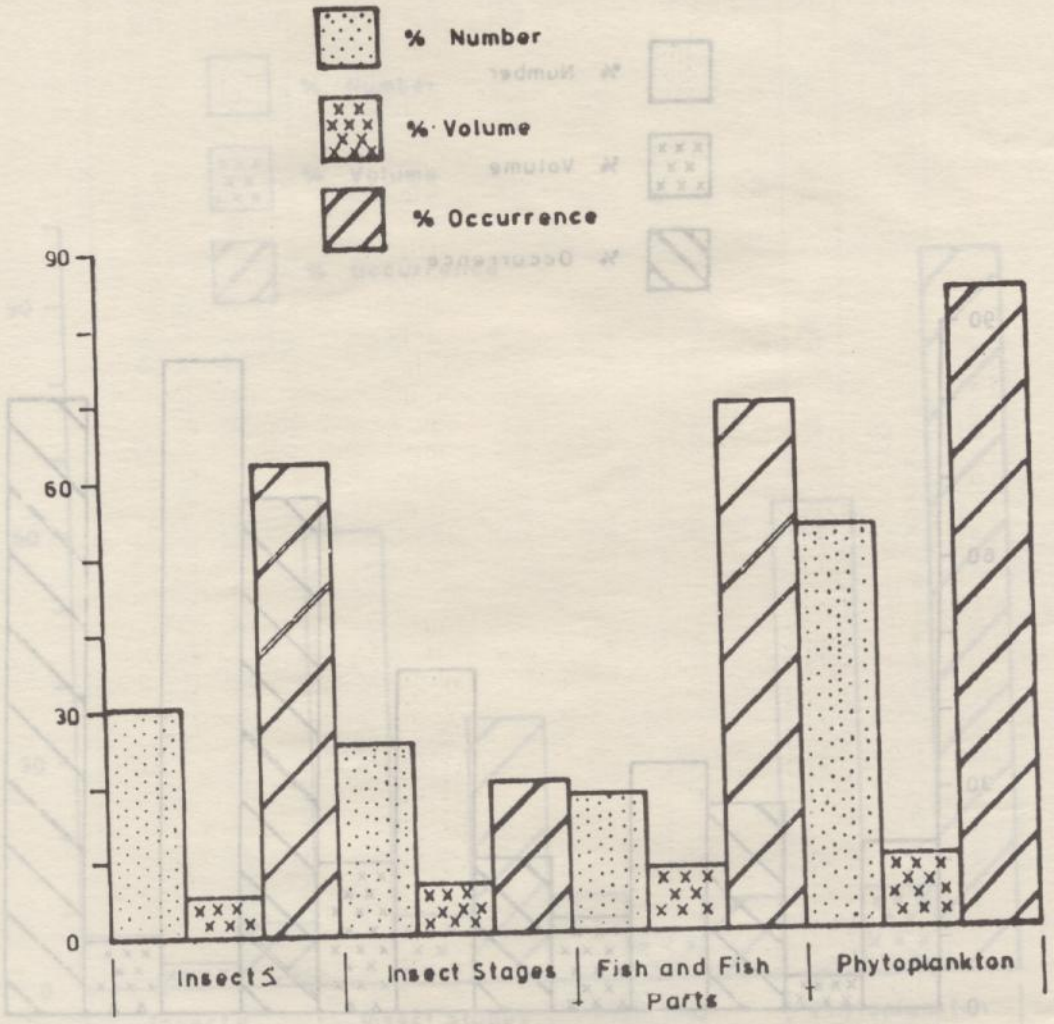

Fig. 3 Stomach Contents of adult Clarias gariepinus

DISCUSSION:

C. gariepinus is an ominivore with preference for plankton diet. It also feeds on other types of food items such as insect and insect larvae and pupae, fish and fish remains and other unidentified food items. it shows a preference for feeding on diatoms and flagellates over all the other food items. There is a striking similarity in the feeding habit of *C. gariepinus* and *Chrysichtys nigrodigitatus*, *C. Walkeri* and *C. filamentosus*. The main difference however is the preference of each species for different food items. Ikusemiju and Olaniyan (1977) reported that *C. nigrodigitatus* has preference for gastropod *Pachymelina bryonensis*. This difference in the preference for various food items by these catfishes may be a factor of the nature oftheir habitat. Ikusemiju and Olaniyan (1972) obtained their fish samples from Lekki Lagoon which is essentially a bigger and probably richer body of water than Oluponna reservoir which has about five hectare catchment area. Similarly Ajayi (1972) observed that *Chrysichthys nigrodigitatus* in kainjiLake fed on detritus, crustaceans and insect larvae. This observation is in agreement with the findings in this study. Conversely, Fagade and Olaniyan (1972) found that the food of *C. nigrodigitatus* in Lagos Lagoon consisted of bivalves mainly. This finding has demonstrated the fact that the food items easten by the fish in the wild is dependent on the food items available in the habitat. It is therefore possible for *C. gariepinus* to feed on a larger variety of food items in a bigger body of water. However this study has suggested that *C. gariepinus* is an omnivore capable of feeding on food items of both plant and animal origin. Olatunde (1983) who worked on *C. gariepinus* bought from Zaria market found that the bulk of food consisted mainly adult and immature insects. Though insect and insect parts were found in the adult *C. gariepinus* in this study, they were not as prominent in this study as reported by Olatunde (1983). The difference observed in this study and that of Olatunde (1983) might be due mainly to time lag between catch by the fishermen and the time the fish were purchased from the market by the author during which some digestion in the stomach contents might have taken place and made some items such as phytoplankton unidentifiable by Olatunde (1983). In this study the fish stomach content were immediately preserved after catch. However this study has supported Olatunde (1983) and Ejike et al (1982) that *C. gariepinus* is essentially an omnivore.

The variation in the number of empty stomachs from May to August was not surprising beca se adequate information on the food studies of fishes, which occur at irregular interva!s. Therefore , during the period of this study some of the fishes might not have fed at all hence the number of empty stomachs encountere.d. Moreover, the rate of digestion of food materials occur at different levels. and animal materials digest faster than plants, hence the identification of such animal materials depends so much on the presence of hard parts such as bones, scales etc. This factor was responsible for identifying some of the food materials as fish and insect remains therefore suggesting that the species consume insects and fishes. This also might have contribution to the classification of some of the items as unidentified items because probably some of them were digested beyond recognition for possible classification.

Essentially all the same food items were observed in fingerlings, juvenile and adult *C. gariepinus*. This study has shown that fish and fish remains are more important in the diet of juvenile and adult *C. gariepinus*, than in the diet of the fingerlings. This finding is in agreement with Fagade and Olaniyan (1972) who noted quantitative differences in the diet of *Ethmalosa fimbriata* relative to size. It also agrees with Marcus (1982) who reported that large *Ilisha africana* fed on larger food items such as fish and fish larvae, shrimp mantis, shrimps and sepia while smaller fishes feed on calanoids, amphipods, cyclopoids, crustacean larvae. Similarly insect larvae and pupae, diatoms, and flagellates which are small food items are more important in the diets of fingerlings of *C. gariepinus*. The reason according to Fagade and Olaniyan (1972) why larger fish are able to feed on larger food items is due to the inceased gill rakers which enabled the filteration of more water. Okera (1973) on the other hand suggested that rather than by filteration, the larger food items of clupeids were eaten by acts of direct seizure with jaws followed by gulping with the smaller plankton were obtained by filter feeding. The investigator agreed with Okera (1973) in that the *C. gariepinus* juveniles and adults have better ability of seizing and gulping since they possess better developed jaws than the fingerlings, while fingerlings, juvenile and adult all have the ability for filter feeding as was obserdved that phytoplankton was equally important in their diets. This is also in agreement with the fact that the gill rakers of adult and juvenile *C. gariepinus* are better structurally developed.

Frequency of occurrence and numerical methods are more reliable methods in assessing the relative importance of the food items. The use of volumetric method in assessing the importance of phytoplankton in the diet of adult and juvenile *C. gariepinus* undermined its nutritive importance since it does not occupy as much space as even fish scale that is not much of nutritive value.

There is however a clear indication that fish and fish parts, insect and insect remains were of more importance with adult and juvenile *C. gariepinus* than the fingerling stage.

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