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FILTER-FEEDING HABIT OF THE AFRICAN CATFISH *CLARIAS GARIEPINUS* BURCHELL, 1822 (PISCES: CLARIIDAE) IN LAKE CHAMO, ETHIOPIA

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ABSTRACT: The feeding habit of the African catfish *Clarias gariepinus* (Burchell) was studied by assessing the stomach contents of 419 fish (287 juveniles - 17.1-44.7 cm TL and 132 adults - 55.2-109.0 cm TL) collected between February 2003 and January 2004 in Lake Chamo. Different kinds of food items were found in the stomachs such as zooplankton, insects, fish scales, fish and detritus. Zooplankton occurred in 75.4% of the stomachs and accounted for 83.1% of the total volume of food consumed. Detritus occurred in 33.7% of the stomachs and contributed 10.9% of the total volume of food items. Fish (*O. niloticus*) occurred in 15.5% of the stomachs and accounted for 4.2% of the total volume of the food organisms. Fish scales were found in 20.5% of the stomachs and contributed 1.2% of the total volume of food items. Insects occurred in 27.2% of the stomachs but their volumetric contribution was relatively low accounting for only 0.6% of the total volume. Generally juvenile fish tended to feed on relatively higher proportion of insects and detritus while adults tended to feed more on zooplankton.

Key words/phrases: *Clarias gariepinus*, Filter-feeding, Lake Chamo.

INTRODUCTION

The African catfish *Clarias gariepinus* (Burchell, 1822) is widely distributed in African freshwaters in the Niger and Nile River systems, extending to southern Africa, in the Limpopo, Orange-Vall, Okavango River systems and most of the East African rift lakes (de Moor and Bruton, 1988). The species is one of the most important individual commercial freshwater fish species in many parts of Africa (Willoughby and Tweddle, 1978; Bruton, 1979; Clay, 1979; Tesfaye Wudneh, 1998; Elias Dadebo, 2000; Lemma Abera, 2007). There is considerable knowledge of the biology of the fish in other parts of Africa. However, little has been done on the basic biology of the species in Ethiopia. Such area-specific information is needed for proper management and utilization.

In tropical swamps, rivers and lakes, the low solubility of oxygen at high temperatures and the decomposition of organic matter can often combine to produce low concentration of oxygen, particularly during the dry season. To

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increase the availability of oxygen, the catfish has developed tree-like chambers on top of the gill cavity. Because of this respiratory organ, the catfish is able to live in stagnant, warm waters with very low dissolved oxygen (Payne, 1986). Due to this, *C. gariepinus* is able to survive in desiccated environments (Donnelly, 1973; Viveen *et al*., 1986) or even in highly polluted bodies of water (Groenewald, 1964).

Various workers have studied feeding habits of *C. gariepinus* in some African water bodies (Willoughby and Tweddle, 1978; Tesfaye Wundeh, 1998; Elias Dadebo, 2000; Zerihun Desta *et al*., 2007; Lemma Abera, 2007). The available information indicates that *C. gariepinus* utilizes a wide variety of food items, including terrestrial and aquatic insects, snails, zooplankton and several benthic organisms and fish. In some eutrophic water bodies of Africa *C. gariepinus* was found to shift to ram-feeding mode and filters large quantities of zooplankton using its long and compact gill rakers (Murray, 1975).

In Ethiopia, the lakes and the river systems have great potential for the production of *C. gariepinus*. In fact it is one of the commercially important fish species in Ethiopia. It is also of considerable importance in the traditional fishery of Lake Chamo. Since it is a fast growing fish (Van der Waal, 1974; Willoughby and Tweddle, 1978; Clay, 1979) and an indiscriminate feeder (Bruton, 1978, 1979; Spataru *et al*., 1987; Tesfaye Wudneh, 1998; Elias Dadebo, 2000; Yalcin, 2001; Lemma Abera, 2007), it can be used to produce large quantities of inexpensive animal protein to meet the demand for the growing population. In spite of its importance, very few studies have been conducted on its biology in this country. This paper deals with the filter feeding habits of *C. gariepinus* in Lake Chamo, which is not very much reported in the literature previously.

MATERIALS AND METHODS

Description of the study area

Lake Chamo ($5^0 42´$-$5^0 58´$ N; $37^0 27´$-$37^0 38´$ E) has a surface area of approximately 551 km^2, a maximum depth of 16 m and lies at an altitude of 1,108 m (Amha Belay and Wood, 1982) (Fig. 1). The lake lies to the east of the Precambrian block of the Amaro Mountains within the less intensely faulted basin (Mohr, 1962). The surrounding region receives two rainy seasons per year, March-May (heavy rains) and September-October (little rains). The mean annual rainfall of the area is about 1000 mm (Daniel Gamachu, 1977). During the past several decades the water level of the lake has declined considerably and this resulted in significant shrinkage of the lake's surface area.

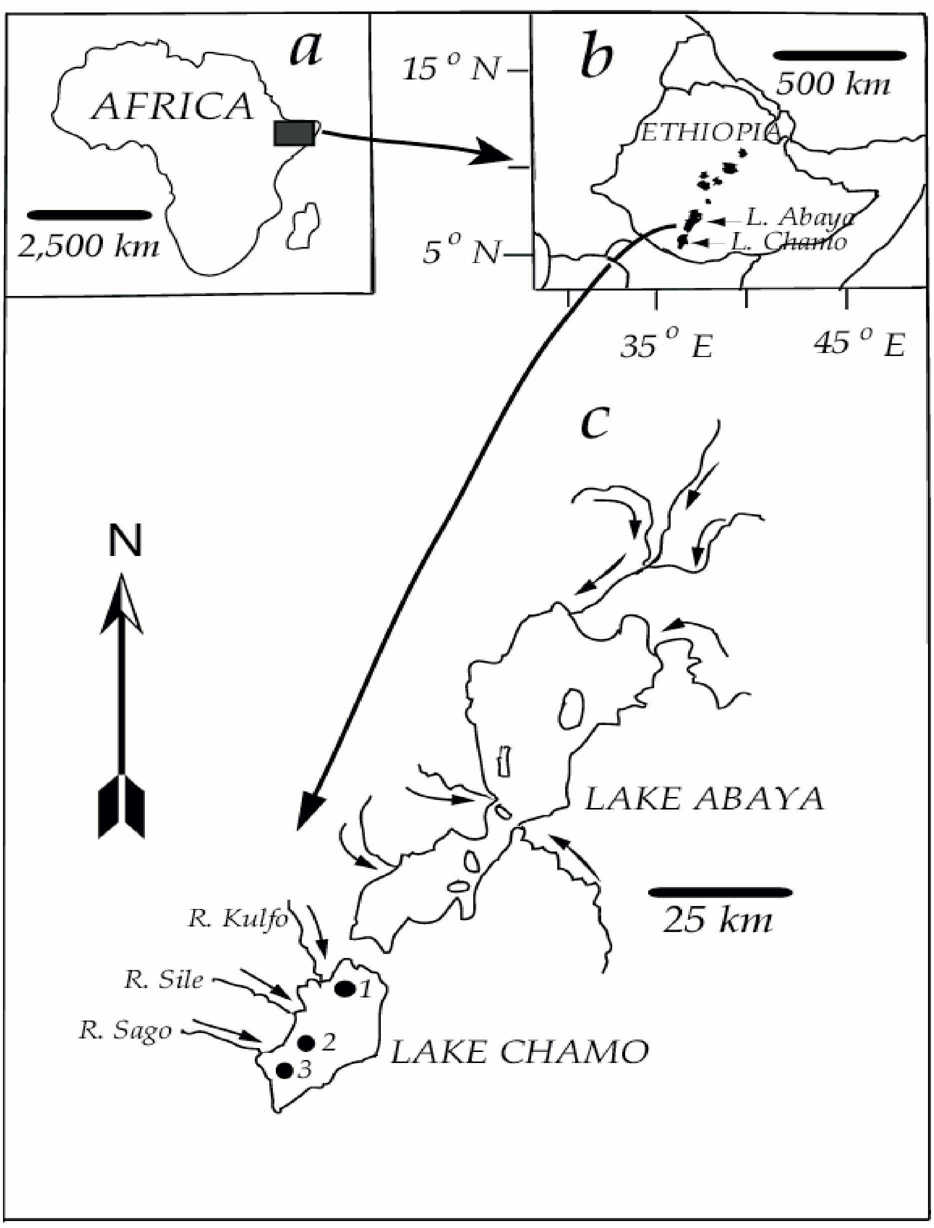

Fig.1. Map of Africa with the relative position of the Horn of Africa highlighted (a), map of Ethiopia with the relative position of the Ethiopian rift valley lakes indicated (b) and map of Lakes Abaya and Chamo with the sampling stations in Lake Chamo indicated (c) (1-Deset, 2-Bedena, and 3-Bole).

The ichthyo-fauna of Lake Chamo, and also that of the neighboring Lake Abaya, is Soudanian species (Beadle, 1981). The fish species are more diverse than those of the other rift valley lakes of the country probably as a result of the northward migration of the Soudanian species when the lake was in contact with the Nile system in the recent past (Beadle, 1981). There are more than 20 fish species in Lake Chamo and the inflowing rivers (Getachew Teferra, 1993). The commercially important species are *Oreochromis niloticus* (L.), *Labeo horie* (Heckel), *Bagrus docmak* (Forskål) and *Clarias gariepinus* (Burchell). Capture of *Lates niloticus* (L.) has been banned for more than a decade now, as a result of sharp decline of the stock due to over-fishing.

Sampling

This work was based on 631 individuals of *C. gariepinus* that were collected between February 2003 and January 2004 using gillnets at three sites in the pelagic area of the lake (Figure 1c). In addition, beach seine and small hook and line gear were used to obtain juvenile fish from the shallow littoral area. The gillnets were usually set during the afternoon and lifted the following morning. TL of all fish was measured to the nearest millimeter immediately after capture. TW and eviscerated weight (EW) of fish under 1,000 g were weighed to the nearest gram whereas those between 1,000 g and 2,000 g were weighed to the nearest five grams. Larger specimens were weighed to the nearest 25 g.

Stomach content analysis

Identification of stomach contents was done visually for the large food items, but a dissecting microscope was used for smaller organisms. The relative importance of food items was investigated using frequency of occurrence, numerical analysis and volumetric analysis. In frequency of occurrence method, the number of stomachs in which a given category of food item occurs is expressed as a percentage of the total number of non-empty stomachs examined (Windell and Bowen, 1978). This method provides information on the proportion of the population that fed on that particular food item.

In numerical analysis the number of food items of a given type that were found in all samples examined was expressed as a percentage of all food items (Windell and Bowen, 1978). This estimated the relative abundance of that food item in the diet.

In volumetric analysis food items that were found in the stomachs were sorted into different taxonomic categories and the volume of items in each category was measured (Bowen, 1983). The relative importance of a food category was then expressed as a percentage of all the categories of food items present in the samples. In assessing the importance of different food items for different size classes, the fish were categorized into six size classes (I- 15.0-29.9 cm, II- 30.0-44.9 cm, III- 45.0-59.9 cm, IV- 60.0-74.9 cm, V- 75.0-89.9 cm, and VI- >90.0 cm) and the total volume of food in each size class was determined. Volumetric contribution of each category of food items was then expressed as a percentage of total volume of food consumed in each size class.

An index of relative importance (IRI) value for each food item was calculated as follows:

$$IRI = \%F \times (\%N + \%V) \quad (1)$$

where %N is the number of each prey item as a percentage of the total number of prey items identified, %V is the percentage in volume of each prey item, and %F is the frequency of occurrence for each prey item in the total number of stomachs examined.

The IRI of each prey item was standardized to %IRI:

$$\%IRI = 100 \times IRI_i / \Sigma IRI_i$$

Dietary overlap between different length-classes was calculated as percentage overlap using Schoener Diet Overlap Index (SDOI) (Schoener, 1968; Wallace, 1981) based on the following formula:

$$\alpha = 1 - 0.5\left(\sum_{i=1}^{n} |Pai - Pbi|\right) \quad (2)$$

where α is percentage overlap, SDOI, between size group *a* and *b*, *Pai* and *Pbi* are proportions of food category (type) *i* used by size group *a* and *b*, and *n* is the total number of food categories.

Diet overlap in the index is generally considered to be biologically significant when α value exceeds 0.60 (Zaret and Rand, 1971; Mathur, 1977).

RESULTS

Six hundred and thirty one stomachs were collected during the period of investigation, of which 212 (33.6%) were completely empty. Out of the remaining 419 (66.4%) stomachs, 287 were collected from juvenile catfish (17.1-44.7 cm TL) caught by beach seine and small hook and line gear. *C. gariepinus* in Lake Chamo feeds on different kinds of food items such as zooplankton, insects, fish scales, fish and detritus. Zooplankton occurred in 75.4% of the stomachs and accounted for 83.1% of the total volume of food consumed (Fig. 2). Since zooplankton were small in size and numerous in numbers, other relatively large prey contributed only about 0.01% of the total number of food items. Detritus occurred in 33.7% of the stomachs and contributed 10.9% of the total volume of food items (Table 1, Fig. 2). Fish (*O. niloticus*) occurred in 15.5% of the stomachs and accounted for 4.2% of the total volume the food organisms (Table 1, Fig.2). Fish scales were found in 20.5% of the stomachs and contributed 1.2% of the total volume of food items. Insects occurred in 27.2% of the stomachs but their volumetric contribution was relatively low accounting for only 0.6% of the total volume.

Table 1. Occurrence, numerical and volumetric index values and the corresponding IRI and %IRI values of various food items in the diet of 419 *C. gariepinus* (17.1-109 cm TL) from Lake Chamo.

Food items	Frequency of occurrence		Numerical analysis		Volumetric analysis		IRI	% IRI
	Number	%	Number	%	Vol. (ml)	%		
Copepods								
Thermocyclops	301	71.8	$2.12x10^7$	73.40	3,537.8	62.10	9,728.90	80.52
Mesocyclops	168	40.1	$4.99x10^6$	17.20	906.4	15.90	1327.30	10.99
Cladocera								
Moina	154	36.8	$1.47x10^6$	5.10	244.7	4.30	345.9	2.86
Ceriodaphnia	140	33.4	$7.27x10^5$	2.50	24.2	0.42	97.5	0.81
Diaphanosoma	23	5.5	$8.56x10^4$	0.30	14.3	0.25	80.0	0.66
Daphnia	12	2.9	$4.51x10^3$	0.02	2.3	0.04	0.17	0.00
Rotifera								
Brachionus	86	20.5	$4.31x10^5$	1.50	10.8	0.19	34.65	0.29
Insects								
Chironomidae larvae	109	26.0	$3.58x10^3$	0.01	17.9	0.31	8.32	0.07
Ephemeroptera	21	5.0	$4.52x10^2$	0.00	2.1	0.04	0.20	0.00
Anisoptera	17	4.1	$5.90x10^1$	0.00	3.8	0.07	0.29	0.01
Hemiptera	26	6.2	$8.70x10^2$	0.00	2.7	0.05	0.31	0.00
Coleoptera	13	3.1	$3.78x10^2$	0.00	0.8	0.01	0.03	0.00
Ranatra	6	1.4	$9.00x10^0$	0.00	1.2	0.02	0.03	0.00
Fish scales	86	20.5	$7.52x10^2$	0.00	70.9	1.24	25.42	0.21
Fish	65	15.1	$2.30x10^2$	0.00	245.0	4.30	64.93	0.54
Detritus	139	33.2	-	-	631.7	11.10	368.52	3.05

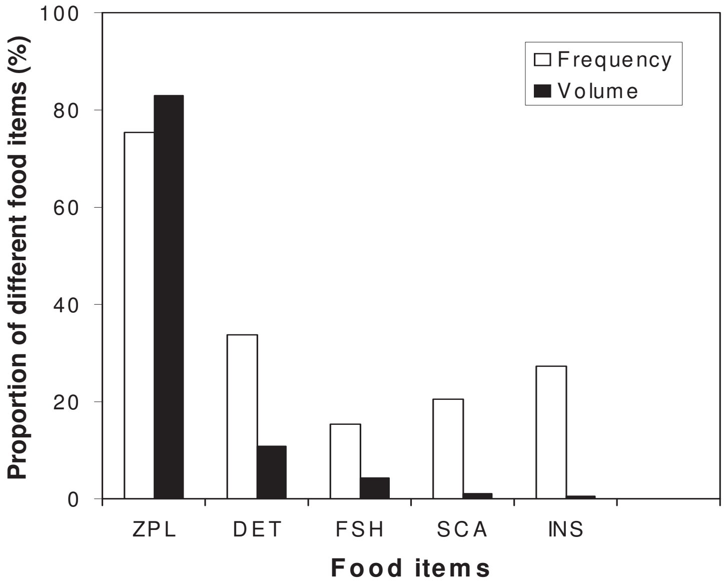

Fig. 2. The percentage contribution of prey organisms consumed by *C. gariepinus* in Lake Chamo using frequency of occurrence and volumetric methods of analysis (ZPL-Zooplankton, DET-Detritus, FSH-Fish, SCA-Fish scales, INS-Insects).

Copepods (*Thermocyclops* and *Mesocyclops*) were the most important food items found in the stomachs of *C. gariepinus* (Table 1). *Thermocyclops* occurred in 71.8% of the stomachs examined and accounted for 73.4% of the total number of food items. Volumetrically *Thermocyclops* contributed 62.1% of the total volume of food items. *Mesocyclops* occurred in 40.1% of the stomachs, accounted for 17.2% numerically and contributed 11% of the total volume of food items (Table 1).

Compared to the copepods, the frequency of occurrence as well as the volume of Cladoceran zooplankton was low. Among the Cladocera, *Moin*a occurred in 36.8% of the stomachs examined, accounted for 5.1% of the total number of food organisms and contributed 4.3% of the total volume of food consumed (Table 1). Other Cladocerans including, *Ceriodaphnia*, *Diaphanosoma* and *Daphnia* were less frequently consumed contributing only 0.91% of the total volume of the food consumed (Table1). The contribution of Rotifera (*Brachionus*) was the lowest among the zooplankton groups where it occurred in 20.5% of the stomachs, constituted 1.5% numerically and accounted for 0.19 % of the total volume of food (Table1).

The contribution of insects to the diet of *Clarias* was low. Chironomidae larvae was more frequently consumed and accounted for relatively higher volume among the insect groups. It occurred in 26.0% of the stomachs, accounted for 0.01% numerically and constituted 0.31% volumetrically (Table 1). All other groups of insects contributed only 0.19% of the total volume of the food consumed by *Claria*s.

Fish scales occurred in 20.5% of the stomachs and accounted for 1.24% of the total volume of the food items, while fish fry (*O. niloticus*) occurred in 15.1% of the stomachs and contributed 4.3% of the total volume of food consumed (Table 1). Detritus occurred in 33.2% of the stomachs and accounted for 11.1% of the total volume of food items (Table 1).

IRI (%IRI) values for different food items were given in Table 1. According to this index *Thermocyclop*s (9,728.9) (80.5%) were the most important food items followed by *Mesocyclops* (1,327.3) (11%). The %IRI values of all other food items combined were less than 10% (Table 1).

An attempt was made to investigate the difference in the diet of juvenile (17.1-44.7 cm TL) and adults (55.2-109.0 cm TL) (Tables 2 and 3). Generally juvenile fish tended to feed relatively higher proportion of insects and detritus while adults tended to feed more on zooplankton. *Thermocyclops* occurred in 62.4% of the stomachs, accounted for 60.8% numerically and contributed 29.5% volumetrically in the diet of juveniles (Table 2). In the case of adults *Thermocyclops* occurred in 92.4% of the stomachs, constituted 75.1% of the total number of food items and accounted for 70.6% of the total volume of food items (Table 3). The contributions of other zooplankton groups were also higher in the case adults than the juvenile fish (Tables 2 and 3).

Volumetric contribution of all insect groups added up to 2.2% of the total volume of food items of juveniles, while the contribution of insects was negligible in the diets of adults (Tables 2 and 3). Fish scales and fish contributed 3.1% and 6.4%, respectively of the total volume of food of the juveniles while their contribution to the total volume of food of the adults was 0.8% and 3.7%, respectively (Tables 2 and 3).

Detritus was an important source of food for the juveniles occurring in 41.4% of the stomachs and accounting for 41.3% of the total volume of food items while its contribution in the diet of adults was 15.9% by the frequency of occurrence method and 2.9% volumetrically (Tables 2 and 3).

Table 2. Occurrence, numerical and volumetric index values and the corresponding IRI and %IRI values of various food items in the diet of 287 juvenile (17.1-44.8 cm TL) *C. gariepinus* from Lake Chamo.

Food items	Frequency of occurrence		Numerical analysis		Volumetric analysis		IRI	% IRI
	Number	%	Number	%	Vol. (ml)	%		
Copepods								
Thermocyclops	179	62.4	$2.14x10^6$	60.8	357.3	29.5	5634.7	59.8
Mesocyclops	105	36.6	$7.19x10^5$	20.4	143.7	11.9	1328.6	14.1
Cladocera								
Moina	67	23.3	$3.33x10^5$	9.50	55.5	4.60	328.5	3.5
Ceriodaphnia	69	24.0	$2.12x10^5$	6.10	7.20	0.60	160.8	1.7
Diaphanosoma	17	5.9	$1.80x10^4$	0.51	3.00	0.25	4.5	0.05
Daphnia	5	1.7	$1.09x10^2$	0.00	0.06	0.05	0.9	0.00
Rotifera								
Brachionus	37	12.9	$8.91x10^4$	2.53	2.23	0.20	35.20	0.40
Insects								
Chironomidae larvae	103	35.9	$3.47x10^3$	0.10	17.4	1.4	53.9	0.57
Ephemeroptera	17	5.9	$3.79x10^2$	0.01	1.8	0.15	0.90	0.01
Anisoptera	13	4.5	5.90x101	0.00	3.8	0.30	1.4	0.01
Hemiptera	21	7.3	$8.70x10^2$	0.02	2.7	0.20	1.6	0.02
Coleoptera	10	3.5	$3.78x10^2$	0.00	0.8	0.07	0.20	0.00
Ranatra	5	1.7	$9.00x10^0$	0.00	1.2	0.10	0.17	0.00
Fish scales	71	24.7	$5.47x10^2$	0.00	37.1	3.10	76.60	0.80
Fish	38	13.2	$1.02x10^2$	0.00	77.6	6.40	84.5	0.90
Detritus	118	41.4	-	-	500.2	41.3	1709.8	18.1

Table 3. Occurrence, numerical and volumetric index values and the corresponding IRI and %IRI values of various food items in the diet of 132 adult (55.2-109.0 cm TL) *C. gariepinus* from Lake Chamo.

Food items	Frequency of occurrence		Numerical analysis		Volumetric analysis		IRI	% IRI
	Number	%	Number	%	Vol. (ml)	%		
Copepods								
Thermocyclops	122	92.4	$1.91x10^7$	75.10	3,180.50	70.60	13, 462.70	84.50
Mesocyclops	63	47.7	$4.27x10^6$	16.80	762.7	16.90	1,607.50	10.10
Cladocera								
Moina	87	65.9	$1.14x10^6$	4.5	189.2	4.20	573.3	3.60
Ceriodaphnia	71	53.8	$5.15x10^5$	2.00	17.0	0.40	129.1	0.80
Diaphanosoma	6	4.6	$6.76x10^4$	1.30	11.3	0.30	7.4	0.10
Daphnia	7	5.3	$4.40x10^3$	0.02	2.2	0.10	0.6	0.00
Rotifera								
Brachionus	49	37.1	$3.42x10^5$	0.27	8.6	0.20	17.4	0.00
Insects								
Chironomidae larvae	6	4.5	$1.10x10^2$	0.00	0.5	0.00	0.0	0.00
Ephemeroptera	4	3	$7.30x10^1$	0.00	0.3	0.00	0.0	0.00
Anisoptera	4	3	0	0.00	0.0	0.00	0.0	0.00
Hemiptera	5	3.9	0	0.00	0.0	0.00	0.0	0.00
Coleoptera	3	2.3	0	0.00	0.0	0.00	0.0	0.00
Ranatra	1	0.8	0	0.00	0.0	0.00	0.0	0.00
Fish scales	15	11.4	$2.05x10^2$	0.00	33.8	0.80	9.1	0.10
Fish	27	20.5	$1.28x10^2$	0.00	167.4	3.70	77.9	0.50
Detritus	21	15.9	-	-	131.5	2.90	46.1	0.30

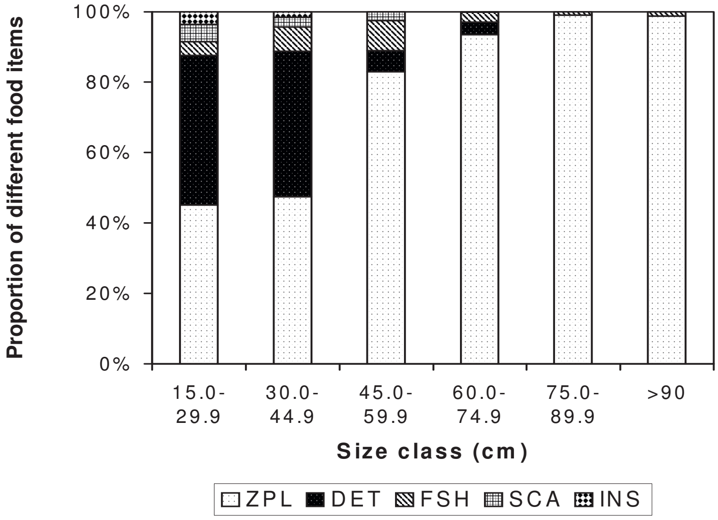

Fig. 3. The percentage volumetric contribution of prey organisms consumed by *C. gariepinus* at different size classes in Lake Chamo (ZPL-Zooplankton, DET-Detritus, FSH-Fish, SCA-Fish scales, INS-Insects

There was no significant difference in the diets of individuals in the size classes I & II, III & IV, III & V, III &VI and IV & V, IV & VI and V & VI (SDOI >0.6) (Table 4). Significant differences in the diets of individuals were observed in the size classes I & III, I & IV, I&V, I & VI, II & III, II & IV, II & V, and II & VI (SDOI <0.6 marked by an * in Table 4).

Table 4. Schoener Diet Overlap Index (SDOI) in six size classes of *C. gariepinus* from Lake Chamo, Ethiopia.

Size classes	SDOI (%)
I and II	93.8
I and III	57.6*
I and IV	51.7*
I and V	46.7*
I and VI	46.1*
II and III	58.7*
II and IV	54.1*
II and V	48.5*
II and VI	48.7*
III and IV	89.8
III and V	84.6
III and VI	84.1
IV and V	94.5
IV and VI	94.7
V and VI	98.0

DISCUSSION

From the results of stomach content analysis, it is evident that *C. gariepinus* uses ram feeding to filter large quantities of zooplankton in Lake Chamo. Since the fish has morphological adaptation for piscivorous feeding habit (big mouth, marginal and pharyngeal teeth, tough and muscular stomach and short intestine) and filter feeding (long, numerous and compact gill rakers) it can shift from one kind of feeding habit to the other depending on the availability and emergence of some food organisms. Various authors have studied the feeding habits of *C. gariepinus* in different parts of Africa and reported its poly-phagus nature of feeding (Willoughby and Tweddle, 1978; Clay, 1979; Viveen *et al*., 1986; Tesfaye Wudneh, 1998; Elias Dadebo, 2000; Yalçin *et al*., 2001; Lemma Abera, 2007; Zerihun Desta *et al*., 2007).

Spataru *et al*. (1987) studying *C. gariepinus*, in Lake Kinneret (Israel) and Elias (2000) working with the same fish in Lake Awassa (Ethiopia), both reported the importance of fish in the diets of *Clarias*. As a carnivore *C. gariepinus* also utilizes a variety of food items, other than fish, including zooplankton, terrestrial and aquatic insects, snails and other benthic invertebrates (Willoughby and Tweddle, 1978; Clay, 1979; Viveen *et al*., 1986; Elias Dadebo, 2000). Bruton (1979) reported that *C. gariepinus* fed on offshore fish and invertebrates at high lake level, but it shifted its feeding to littoral fishes and invertebrates when these became abundant. Yalçin *et al*. (2001) and Lemma Abera (2007) indicated the importance of Dipteran larvae in River Asi (Turkey) and Lake Babogaya (Ethiopia).

The results of this study showed that the most frequent food component was zooplankton (75.4%). This food component also comprised 83.1% of the total volume of food items consumed by *C. gariepinus* in Lake Chamo. Even though filter feeding of *Clarias* on zooplankton is well known from other studies (Schoonbee, 1969; Murray, 1975; Yalçin *et al*., 2001) such a high level of zooplankton consumption has not been reported in natural environments. Murray (1975) observed ram feeding of *C. gariepinus* in Lake Mcllwaine, (an eutrophic South African reservoir) close to the surface of the water. Schoonbee (1969) stated that zooplankton were the dominant food items of *C. gariepinus* in Lake Barbespan, Western Transvaal, South Africa. High productivity of the water body that results in peak production of zooplankton in certain seasons of the year could be the main reason initiating *C. gariepinus* to shift to zooplankton filtering. Clay (1979) stated that juvenile *C. gariepinus* below 30 cm in length did not filter feed in Lake McIIwaine, but when given the opportunity of high zooplankton concentration under laboratory conditions the fish did successfully filter feed. According to Yalçin *et al*. (2001) microscopic food organisms including zooplankton, ostracods and phytoplankton were more abundant in the diet of *C. gariepinus* in the summer than in other seasons. On the other hand, Dögeloh (1994) reported that zooplankton (Cladocera and Copepoda) were consumed mainly in autumn and spring. In Lake Chamo water temperature is high throughout the year and seasonal variation is low (25-28^{0}C) (Demeke Admassu, 1998; Zenebe Tadesse, 1998). Even though seasonal variation in zooplankton production has not been studied in Lake Chamo, *C. gariepinus* was found to feed on zooplankton throughout the year. A study conducted in Lake Awassa (another rift valley lake 250 km to the north of Lake Chamo) indicated that the production of the major zooplankton groups remained high throughout the year with a slight peak at the end of the rainy season (Seyoum Mengistou and Fernando, 1991). Bruton (1979) reported that crustaceans contributed the highest weight of the prey in spring and summer while fish were more abundant in the diet in autumn and winter in Lake Sibaya, South Africa. In another South African clear man-made lake Dögeloh (1994) reported that Micronecta were more important in the diet of *Clarias* in autumn and summer while zooplankton (Cladocera and Copepoda) were more important in autumn and spring.

During the present study consumption of zooplankton by *Clarias* was high in Lake Chamo throughout the year. Several reasons could be forwarded to explain this high consumption of zooplankton throughout the year. First, the eutrophic nature of the lake and high water temperature throughout the year promote high level of phytoplankton, and thus high zooplankton production. As the concentration of zooplankton increases, the catfish may use ram feeding which is more profitable. Second, in the presence of other strong piscivorous fish species in the lake, such as *L. niloticus*, *H. forskahlii*, and *B. docmak*, *C. gariepinus* may not be able to compete for the available prey fish in such an environment. Since *C. gariepinus* has the anatomical adaptations for feeding, that allows it to feed on prey ranging in size from a minute zooplankton to a fish half its own length, it may shift from piscivorous feeding habit to ram feeding depending on the profitability of consuming small-sized food items from the environment

Detritus occurred in considerable quantities in the stomachs of the catfish. Many authors have studied the feeding habits of *Clarias* species in different parts of Africa giving varying interpretations about the diversity of diet. Willoughby and Tweddle (1978) suggested that detritus could be of some nutritional benefit to *C. gariepinus*. Dögeloh (1994) also studied the feeding habit of *C. gariepinus* and described the species as an omnivorous fish feeding on both plants and animals. Clay (1981) attempted to determine the utilization of plant proteins by juvenile *C. gariepinus* fed mixtures of maize, soya-extract and sunflower in different proportions. In this work of Clay (1981), the presence of the enzyme protease in the stomach and anterior intestine of *C. gariepinus* was suggested to be responsible for most protein digestion with little or no specialization to either plant or animal protein. Thomas (1966) produced detailed information on the feeding habits of *C. senegalensis* in a man-made lake in the Ghanaian savanna. He suggested that this fish must be carnivorous since it has no pyloric caeca in which cellulose-digesting organisms could live. Groenewald (1964) also observed that *C. gariepinus* was primarily a predatory fish in its feeding habits.

The relative contribution of detritus was high in juveniles (15.0-29.9 cm TL and 30.0-44.9 cm TL), whereas in the stomachs of adults, zooplankton was the only food item consumed by the majority of fish in Lake Chamo. Various workers studying the feeding habits of *C. gariepinus* in many parts of Africa have reported the presence of large quantities of plant materials (Willoughby and Tweddle, 1978; Clay, 1979; Spataru *et al*., 1987; Dögeloh, 1994; Elias Dadebo, 2000; Yalçin *et al*., 2001). Elias Dadebo (2000) and Yalçin *et al*. (2001) considered the presence of plant materials as accidental intake where the fish can take algal filaments, macrophyte fragments and detritus from the bottom of the water together with insect larvae and other benthic invertebrates. The relative importance of insects, fish scales and fish fry was also high in juveniles than in adults. The difference in the proportion of different food items consumed by juvenile fish and adults could be due to the difference in the habitat they feed. Juveniles are normally confined to the littoral environment where weed-bed fauna, fish fry and decomposing plant materials are found in higher quantities. On the other hand, adults prefer deeper waters where zooplankton concentration is high.

In summary, this study has clearly shown the importance of different food items in the diet of *C. gariepinus* in Lake Chamo. The main components of the diet of juveniles were zooplankton and detritus. Fish scales, fish fry and insects were also of considerable importance for juvenile *C. gariepinus* while zooplankton was the most important food item in the diet of adults. Importance of detritus declined steadily with size of fish while importance of zooplankton increased with size of fish.

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