FOOD PREFERENCES OF THE COMMERCIAL FISHES OF THE VOLTA LAKE

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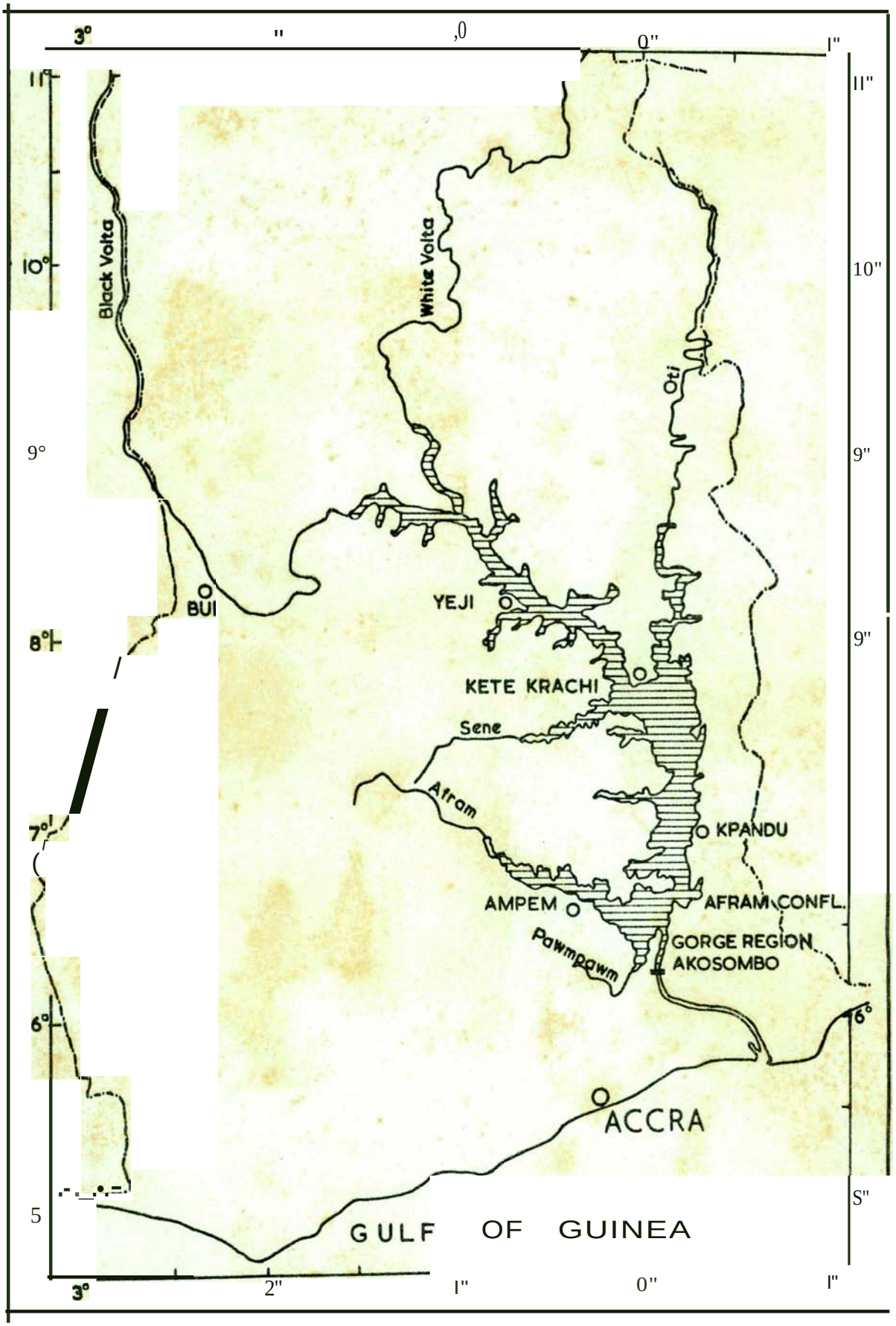
Black Volta
White Volta
Oti
BUI
YEJI
KETE KRACHI
Sene
Afram
KPANDU
AMPEM
AFRAM CONFL.
GORGE REGION
AKOSOMBO
Pawmpawm
ACCRA
GULF OF GUINEA
3°
2"
1"
0"
11°
10°
9°
8°
7°
6°
5

FOOD PREFERENCES OF VOLTA LAKE COMMERCIAL FISH

Introduction

The food of fish of the VoltaLake in Ghana dUring the first two years of its existence has been descrited briefly by PETR (1967). Detailed food analyses are being prepared for publication. This Report attempts to show the degree of importance of particular food types among the 22 most important commercial fish species, without regard to the fish distribution in the Lake. It may help to orientate the further research on the most important hydrobiological problems which are alosely related to the exploitation of the fisheries of the Volta Lake.

Results

Only those species of fish which formed 10 percent or more by number of the total catch are included in this study. The observations on population changes and their feeding habits were startrd in November 1964 at Akosombo. In 1965, and regularly from 1966 sampling was carried Gut in several other important fishing areas of the Lake: Ampem, Kpandu, Kete Krachi, Yeji (see map).

More than 500 specimens belonging to 22 commercial species were analysed for food. On the Volta Lake by far the most frequently used fishing gear is gill nets of $1\frac{1}{2}$, 2, 3, 4, 5 and 6 inches mesh size; much less commonly long lines are used, while in the shallower parts of the Lake fish traps and cast nets are employed. The fisheries activity in the Lake is predominantly in shallow areas and bays. Only rarely are nets set at greater depths.

The results of food analyses have been expressed quantitatively in terms of the percentage occurrence of each particular food item in each species examined. For purpose of this study all food items were grouped into 8 main food types:

1) higher plants - i.e. flooded grass, the leaves of trees, pieces of wood, plant detritus, cassava, Ceratophyllum
2) aquatic insects - larval and pupal forms, adults of Odonata, emerging subimagines of Ephemeroptera, Hemiptera.
3) mud, bottom deposits - including coarse and fine sand and stones.
4) fish - including fish scales.
5) terrestrial insects - predominantly ants, grasshoppers, termites.
6) phytoplankton and planktonic detritus.
7) Aufwuchs (periphyton) - excluding aquatic insect larvae, Crustacea, Oligochaeta.
8) zooplankton.

Table. I shows the food items of those fish species which formed 10% or more of the total catch by number.

TABLE I

Food items of those 22 commercial fish species which form 10% or more of the total catch, by number

	Food	overall % volume
1	higher plants	18.81
2	aquatic insects	18.31
3	mUd, bottom deposits	13.12
4	fish	13.11
5	terrestrial insects	11.33
6	phytoplankton and planktonic detritus	9.21
7	Aufwuchs	2.72
8	zooplankton	1.43

FOOD TYPES:

1. Higher plants.

In the 22 species investigated higher plants formed 18.81% of the total food eaten. In the following species higher plants formed more than 10% of the total food eaten:

Distichodus rostratus andD.engycephalus	61.5%
Tilapia zilii and T.melanopleura	61.4
Alestes macrolepidotus	61.0
Synodontis spp.	58.2
Citharinus citharus	29.9
Alestes dentex and A.baremose	21.2
Labeo coubie	13.9

Aquatic plant material was found only in Tlistichodus, the stomachs and guts of which were often found fully stuffed, with Ceratophyllum and in Alestes, with cassava and grass seeds also present. All species contained predominantly grass leaves, grass seeds, the dead parts of twigs, the leaves of trees and fine plant detritus. The composition of food suggests that they were feeding predominantly on plant material from flooded areas and were avoiding aquatic plants.

This food item occurred in 19 species of the fish examined.

2. Aquatic insects

In the 22 species investigated aquatic insects formed 18.31% of the total food eaten. In the following species aquatic insects formed more than 10% of the total food eaten:

Synodoritis sorex	100.0%
Synodontis nigrita	73.3
Chrysichthys nigrodigitata	65.8
Eutropius niloticus	38.6
Alestes nurse	17.4
Alestes dentex and A.baremose	13.0
Synodontis spp.	10.4

Chironomid larvae were predominant, followed by chaoborid larvae,

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ephemeropteran nymphs and small numbers of trichopteran larvae. The insects clearly originated both from the bottom (with organic sediment and pieces of wood often present), and, from the periphyton of flooded trees, grasses and water plants. The majority of fish species feeding on aquatic plants also readily consumed terrestrial insects.

This food item occurred in 16 species of the fish examined.

3. Mud bottom deposits.

In the 22 species investigated mud and bottom deposits formed 13.12% of the total food eaten. In the following species mud and bottom deposits formed more than 10% of the total food eaten:

Citharinus citharus	70.1%
Labeo coubie	53.3
Heterotis niloticus	45.7
Labeo senegalensis	41.5
Tilapia nilotica	19.2
Tilapia zillii and T.melanopleura	11.3

The first three species consumed great quantities of fine bottom mud, containing organic detritus and algae. Tilapia used this material as a supplementary food. In Heterotis coarse sand and stones were regularly found, serving for mechanical grinding of zooplankton, the preferred food of this fish in the Lake.

This food item occurred in 7 species of the fish examined.

4. Fish.

In the 22 species investigated fosh formed 13.11% of the total food eaten. In the following species fish formed more than 10% of the total food eaten:

Lates niloticus	99.3%
Hemichromis fasciatus	61.8
Alestes dentex and A.baremose	30.7
Schilbe mystus	19.0
Eutropius niloticus	10.0

Lates is almost exclusively predatory on other fish; exceptionally bigger aquatic insects were found in its stomach. Hemichromis is a small predatory cichlid. Both species utilize preferably clupeids and schilbeids, which serve as food also for some other fish.

This food item occurred in 10 speoies of the fish examined.

5. Terrestrial insects.

In the 22 species investigated, terrestrial insects formed 11.33% of the total food eaten. In the following species terrestrial insects formed more than 10% of the total food eaten;

Schilbe Dystus	80.5%
Eutropius niloticus	40.3
Alestes nurse	27.2
Alestes macrolepidotus	27.1
Alestes dentex and A.baremose	25.1

Fish feeding on this food item also readily took aquatic insects and small fish, predominantly clupeids. This suggests that they can show great adaptability to changes in the food supply.

This food item occurred in 10 species of the fish examined.

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6. Phytoplankton, planktonic detritus.

In the 22 species investigated, phytoplankton and planktonic detritus formed 9.21% of the total food eaten. In the following species phytoplankton and planktonic detritus formed more than 10% of the total food eaten:

Tilapia galilaea	96.4%
Tilapia nilotica	64;0
Distichodus rostratus	12.5

All three herbivorous species prefer shallow bays where this type of food is abundant. Occasionally, a substantial part of the plankton and planktonic detritus is formed by Protozoa.

This food item occurred in 7 species of the fish examined.

7. Auf'wuchs (periphyton).

In the 22 species investigated, Aufwuchs formed 2.72% of the total food eaten. In the following species Aufwuchs formed more than 10% of the total food eaten;

Distichodus rostratus	21.2%
Labeocoubie	15.3

Filamentous algae were predominantly found. It was, often very difficult to distinguish periphyton algae from benthic algae, as most of diatoms, blue green and some of other algae form part both of the the benthic flora. It is clear that some of the algae in mud sucking fish originated from Aufwuchs.

This food item occurred in 9 species of the fish examined.

8. Zooplankton.

In the 22 species investigated, zooplankton formed 1.43% of the total food eaten; in only one species (Heterotis niloticus) did it represent more than 10% of the total food eaten, L e. 17.1%.

This food, item occurred in 8 species of the fish examined.

Associations of fish in the Volta Lake after two years.

With the progressive lacustrinization of the Lake, the following associations of fish have been established after two years.

The South of the Lake: Afram shallows at Ampem:

The fish association is dominated by Tilapia nilotica, T.galilaea, with a high frequency of occurrence of T.zillii, Hemichromis fasciatus, neterotis niloticus, Chrysichthys nigrodigitatus. Fishing is predominantly by gill nets of large mesh size (3-5 in.) but also by fish traps.

Kpandu, shallows:

The fish association is dominated by Tilapia nilotica, T.galilaea, with a high frequency of occurrence of T.zillii, Hemichromis fasciatus, Heterotis niloticils, Chrysichthys nigrodigitatus, Auchenoglanis occidentalis, Pelmatochromis guntheri. Fishing is predominantly by fish traps set at the shores.

Kpandu off-shore areas:

Here at the edges of emerging flooded trees and around islands fishing with gill nets of 3-5 in. mesh size yields at a high frequency of occurrence of Alestes macrolepidotus, while at a much lower frequency Alestes dentex, Alestes nurse, Eutropius niloticus, Chrysiohthys nigrodigitatus, Lates niloticus, Citharinus citharus.

In the North the fish are establishing theoselves in peroanently flooded plains. The fish associations are formed by the following species.

Kete Krachi:

Labeo coubie, Lates niloticlls, Distichodus rostratus, Synodontis gambiensis, Citharinus citharus, Alestes baremose, Eutropius niloticus, Alestes macrolepidotus, Tilapia galilaea. Gill nets of different mesh sizes are the fishing gear most commonly in use.

Yeji:

Numerous fishermen use exclusively 1½ in. gill nets set in the flood plains. The fish association is dominated by lUestes baremose, Eutropius niloticus, while less common are Schilbe mystus, Alestes nurse and Alestes macrolepidotus.

3-5 in. gill nets set partly in flood plain, partly in the free or deeper water yield/association of fish: Citharinus Githarus, Synodontis gambiensis, Synodontis oeobranaceus, Synodontis sorex, Lates niloticus, Tilapia galilaea, Schilbe mystus, Chrysichthys nigrodigitatus, Hyarocynus spp., Distichiodus rostratus, Labeo senegalensis. The abundance of some of these speciesa vries, reflecting their migratory movements. /the following

In the South of the Lake the herbivoroes greatly predominate, with Tilapia spp. as the commonest fish in catches. Predators are represented by Hemichromis, zooplankton feeders by Heterotis, insectivores by Chrysichthys and Hemichromis. At Kpandu where the fish associatidn shows a great similarity to that at Ampem, there also occur Auchenoglanis and Pelmatochromis which predooinantly feed on aquatic insects.

At Kete Krachi Labeo and Citharinus are mud suckers, Lates is a predator, Distichodus rostratus and Alestes macrolepidotus are herbivorous fish feeding on higher plants, Tilapia galilaea is a phytoplankton feeder. The other species: Synodontis gambiensis, Alestes baremose, Eutropius niloticus feed predoninantly on aquatic insects, but the latter two also feed on other fish.

At Yeji the fish association recorded from 1½ in. gill nets is highly dominated by insectivores: Alestes baremose, Eutropius niloticus, Schilbe oystus, Alestes nurse and Alestes dentex. Alestes macrolepidotus isa herbivore. In the group of bigger fish from 3-5 in. gill nets mud suckers such as Citharinus citharus, Synodontis membranaceus, Labeo senegalensis predominate and omnivorous Synodontis gambiensis and Synodontis sorex are coomon. Predators are represented by Lates and Hydrocynus spp., herbivores by Distichodus, phytoplankton feeders by TEapia galilaea, and the insocti- vorous Schilbe and Chrysichthys also coomonly occur.

The cooDosition of the fish associations in areas under observation seen to have stabilized to a certain extent during the third year (1966-1967), when only seasonal changes in the abundance of some species as a result of spawning migrations were recorded.

Figure I represent diagramatically for the different species those items of food which fomed 4% or more of the food volume; the main food items are indicated by heavy lines ending in circles. Most of the commercial fish can feed on three or more different types of food, though some of them such as Tilapia galilaea, Lates niloticus, Synodontis sorex, prefer one food type, while Hemichroois fasciatus, Citharinus citharus, Labeo senegalensis, Schilbe mystus and Synodontis nigrita prefer only two. None of the species seem to have been forced to the change their previous feeding habits as a result of the lack of sooe particular type of food in the Volta Lake. It is to be expected that those species with a wide range/acceptable food /of items would have been less influenced by the sudden change in the environment than those with a narrow feeding spectrum. On the other hand, an abundance of food does not mean that all the originally riverine fish species were able easily to establish themselves in the Lake, as has been shovm already for the oormyrids (PETR, in press).

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Discussion

In the original riverine conditions during the floods the oajority of the fish invaded the flood plains for spawning, and there fed upon flooded vegetation, while the aquatic insects which periodically developed in this temporary habitat supplied the fish with additional food. Both food sources were in great abundance and evidently consumed by preference, especially by young fish. This situation is reflected by the feeding regime of the Volta Lake fishes after the first two years of perQanent inundation. New areas flooded by the Lake can be considered as representing during this period a large flood plain which the fish enter and where they find optimal conditions for their life. In contrast with previous conditions, they are not forced to retreat into the river channel by a decrease in the water level during the dry season. In comparison with the oscillation of water level between the dry and wet seasons in the old rivers, the draw-down during first /the two years in the Volta Lake was very small, the area of the exposed land was negligible; and extensive low lying areas are still waiting to be flooded.

As most of the area had not being cleared before the Lake was established, the flooding of trees and bushes markedly influenced the hydrobiology of the Lake in two ways. By their decay they greatly reduced the oxygen content of the water and for most months of the year there was a total depletion of oxygen in the deeper water, especially during first two years. Secondly, the persistance of flooded vegetation provided new surfaces for the establishemen.t of a rich Aufwuchs (periphyton) and for aquatic invertebrates, associated with and utilizing this habitat.

Fish previously feeding on the benthic and littoral fauna readily started to exploit invertebrates inhabiting these surfaces. With the development of an abundant aquatic invertebrate population in the Lake, dominated by a few species in extremely great numbers, the fish species which under riverine conditions had fed predominant on terrestrial insects, started to feed on the emerging stages of aquatic insects. This can be illustrated by the following example: the areas of occurrence of Schilbe mystus and Eutropius niloticus seep directly to depend on the presence and the population density of the mayfly Povilla adusta. In regions of the Volta Lake where this insect has not yet established a strong population both fish species are very scarce. This shows that some species, with a relatively wide feeding spectrum but with a preference for a particular type of food, will avoid areas where the preferred food is absent, even though there is in these areas a great surplus of the food items which were utilized by them under the more /of stressful riverine conditions.

This illustrates the elaboration in a fish species of a food preference which seems to go so far that the fish avoid places where the preferred item is missing or not abundant.

The organic matter contained in the mud, with a predominance of plant detritus, may be expected to become of increasing importance in the Lake, where in the South it is consumed predominantly by Tilapia. Typical mud suckers such as Labeo and Citharinus are in retreat in more lacustrine areas, possibly because of an irreversible anadromous migration.

The wide distribution of small pelagic fishes, Pelonulla afzeliusi and Physailia pellucida, supply the big and small predators with abundance of food. Both Lates (the dominant predator in the North) and Hemichromis (the dominant predator in the South) greatly prefer Pellonula as prey. Lates seems to have been unable to restablish its population in the South, though the food supply there is good.

Fish feeding in the Volta Lake on phytoplankton are restricted to the shallows where the density of phytoplankton increases towards the shores.

Tilapia greatly favours such areas and has established there a strong population. There is no evidence that any ofLfish in the Lake have been able, even /the as juveniles, to utilize the phytoplankton of the extensive off-shore regions.

Heterotis, the only zooplankton feeder in the Lake, has also greatly increased its popUlation. It is the fastest growing fish of the Lake. Zooplankton, as a food source, is most probably of great importance for the juveniles of sooe fish, but this problem has not yet been studied.

The picture of the food preference of Volta Lake commercial fish is not complete, as the feeding habits of almost no juveniles have been studied. Acontinuation of the study on food of fish is essential and should be concentrated on changes in the feeding habits of the most important fish during their development, with seasonal changes and in different areas of the Lake.

References

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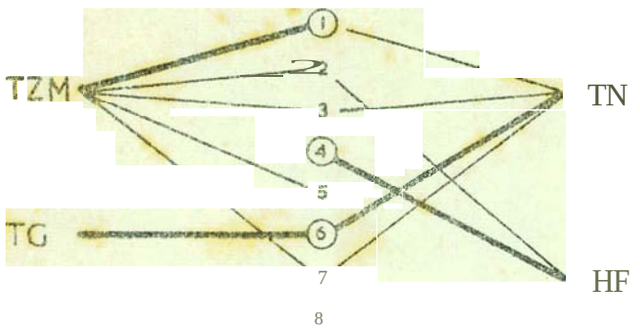
CICHLIDAE

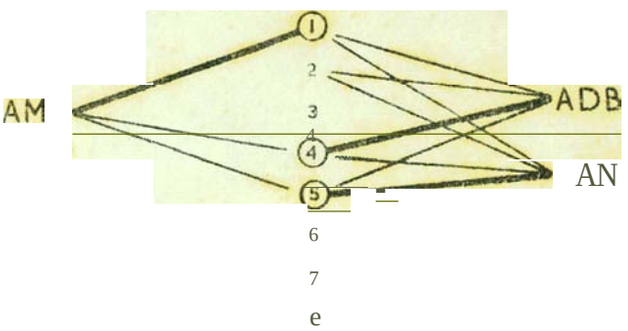
Food items which form 4 % or more of the volume



TZM — Tilapia tiilii + melanopleura
TG - T. galliaea
TN — T. nilotica
HF — Hemichromis fasciatus

CHARACIDAE

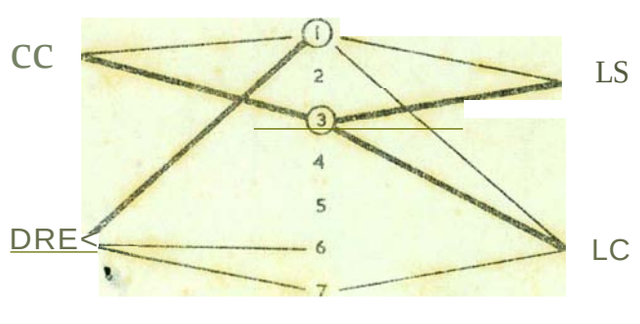
Food items which form 4 % or more of the volume



AM - Alestes macrolepidotus
ADB - Alestes dentex and A. baremose
AN — Alestes nurse

CiTHARINIDAE, CYPRINIDAE

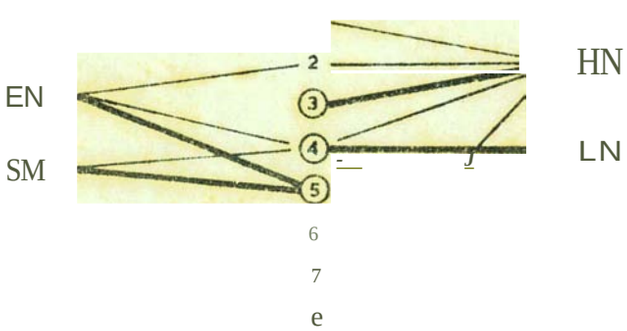
Food items which form 4 % or more of the volume



CC _. Citharinus citharus
DRE .. Distichodus rostratus + D. engycephalus
LS — Labeo senegalensis
LC - Labeo coubi

SCHILBEIDAE, OSTEOGLOSSIDAE SERRANIDAE

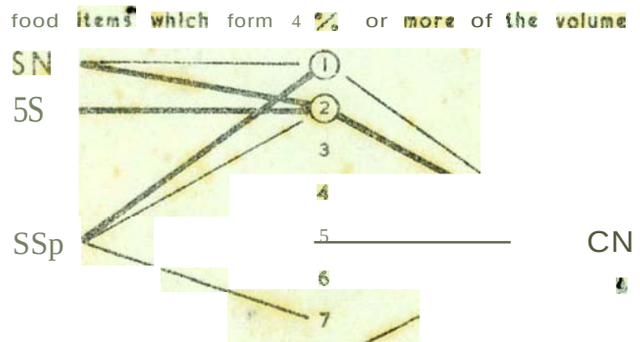
Food items which form 4 % or more of the volume



EN - Eutropius nilotlcus
SM - Schllbe mystus
HN - Heterotis nilotlcus
LN - Lates niloticus

MOCHOCIDAE, BAGRIDAE

food items which form 4 % or more of the volume



SN — Synodontis nlgrlta
SS — Synodontis sorz
SSp - Synodontis spp.
eN — Chrysichthys nlgrodigltatus

KEY TO MAJOR FOOD CATEGORIES

1 Higher plants
2 Aquatfc Insects
3 MUd, bottom deposits
4 Fish
5 Terrestrial Insects
6 Phytoplankton and pianktonlc detrltUi
7 Aufwuchs
8 Zoopiankton •

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