Food Habits of Family Cichlidae in the Riverine Area of South Western Nigeria

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ABSTRACT

Studies of gut content analysis of fish are essential for understanding the food habits and trophic levels of fish and how they interact with their environment. One hundred and fifteen (115) individuals of cichlids which comprise of 6 species namely: *Hemichromis fasciatus, Hemichromis bimaculatus, Oreochromis niloticus* ¸ *Oreochromis aureus, Sarotherodon galilaeus and Tylochromis sudanensis* were studied between December 2020 and May 2021. The frequency of occurrence (FO), number method (Cn) and volumetric method (Cv) of food items analysis and viscera-somatic index (VSI) were used in this study. The food items in the stomach of *H. fasciatus, H. bimaculatus, O. niloticus, O.* aureus and *T. galilaeus* showed that these fishes found in this study were euryphagous thus, they feed on a wide range of food items. *T sudanensis* was the only species found to be stenophagous thus, feeding on a limited variety of food items. *T. sudanensis* had the least numbers recorded of the fishes caught. This is related to its observed food habit in this study, therefore its abundance is related to food availability. The viscero-somatic index of all 115 individuals varied between average of 3.79 and 5.09 which indicates all species examined have higher weight of flesh than weight of viscera. The result from this study proved that cichlids in Nigeria are of good culture potential except *T. sudanensis.*

Keywords: Fish: Ecology; Gut content; Viscera-somatic index; Euryphagous; Stenophagous

Introduction

Fishes are sources of food for human beings and other animals,. They are rich in protein and vitamins. Statistics have shown that fish accounts for more than forty percent of the protein diet of two-thirds of the global population (FAO, 2018). Fish is a resource mostly exploited by man and is linked to the trophic chain in its entire environment where they are commonly found (Craig et al., 2004) Fish populations need resources to survive and one of the most fundamental questions in ecology is what resources a particular species requires to exist (Litvaitis, 2000). Therefore, it is necessary to identify the resources used by fishes and document the availability of those resources. In fish ecology, documentation of gut content is critical in efforts to preserve endangered species and manage exploited populations (Manly et al., 2002).

Knowledge of natural diet in a fish species is generally essential in order to know the nutritional habits of fish and to understand its trophic, material and energy dynamics and to model outcomes for their ecosystems (Cutwa and Turingana 2000, Jordan et al., 2006, Navia et al., 2010). Stomach content analysis is a very important part of the food habit study, feeding ecology and, in general terms, a necessary step in research focused on fish ecology. Data on feeding ecology can be used to construct food webs and predict possible changes in food chains and material and energy transfer between and within ecosystems (Nakano and Murakami 2001; Baxter et al. 2004, 2005, Rezende et al., 2008). Fish stomach contents can therefore be used to identify differences in fish feeding strategies, fish health, habitat related food availability, as well as to gather information regarding the trophic relationships in aquatic communities. The knowledge of diet composition and feeding habits is, therefore, an important introduction to the natural history of any species (Ahlbeck et al., 2012; Litvaitis 2000).

Stomach content analysis is used to understand many aspects of the ecology of fishes at the individual, population, community and ecosystem levels. Gut content analysis also gives information on seasonal and life history changes of fish because the types and magnitude of food available as well as the season it occurs plays an important role in the evolutionary history of fishes (Akinwumi, 2003).

Viscero-somatic index is used to evaluate the dress out percentage of a fish after processing which is an indicator of fish quality. It helps to determine how much food fish is left for fish to consume after the visceral mass has been removed. Viscera means the visceral organs in the fish like the intestine. Viscero-somatic index is basically used to investigate how much materials is deposited in the viscera rather than in the muscle (the edible part of the fish) that is the ratio of the viscera mass to the body mass of the fish. The structure, length and conformation of the intestines are closely related to the diet of the fish (Miller and Harley, 2002). Therefore, understanding this relationship is important to predict the diet of fishes, how fishes feed and the mechanism of feeding (Malami et al., 2007). As a group, cichlids exhibit a similar diversity of body shapes, ranging from strongly laterally compressed species (such as *Altolamprologus, Pterophyllum,* and *Symphysodon*) to species that are cylindrical and highly elongated (such as *Julidochromis, Teleogramma, Teleocichla, Crenicichla*, and *Gobiocichla*). Generally, however, cichlids tend to be of medium size, ovate in shape, and slightly laterally compressed, and generally similar to the North American sunfishes in morphology, behaviour, and ecology (Helfam et al., 1997). Cichlids are efficient and often highly specialized feeders that capture and process a very wide variety of food items. This is assumed to be one reason why they are so diverse. Various species have morphological adaptations for specific food sources (*Kullander 2019*) but most cichlids consume a wider variety of foods based on availability. Therefore, this study was conducted in order to determine the gut content and viscerosomatic index of family *Cichlidae* in Nigeria to harness its culture potential.

Materials and Methods

Study Area

The study area is in the riverine area, River Igbokoda of western Nigeria in West Africa. It has coordinates of North (Latitude 6 °21′12″) and East (Longitude 4°47′58″) with land elevation of 40 meters above sea level and with a population of 71,027. Ondo State coastal waters are parallel to South-western coastline of Nigeria and are characterized by extensive lagoons and river delta systems. The area is subject to tidal fluctuations with salt water incursion, two to ten months of the year. The study area is separated from the open ocean by a strip of sandy land which varies in width from about 2-16 kilometres. The area is highly low lying and highly susceptible to tidal fluctuations. The rivers and creeks overflow their banks during the rainy season, thus isolating most farming communities and settlements. There are three subzones which are freshwater (< 30 ppt), brackish water (30 ppt – 33 ppt), saltwater (> 33 ppt) bordering the coastal swamps and creeks. There are two hydrological cycles in the area i.e the wet and dry seasons. The wet seasons spans May to October while the dry season spans November to April. The area is highly susceptible to climate change. The rivers and creeks overflow their banks during the rainy season, thus isolating most farming communities and settlements. The river serves as means of transportation to other states like Lagos, Ogun and Delta States among others.

It is longest territorial water in Nigeria and has fishing terminal. Babatunde (2010) reported that 80% of the population of the study area engage in fishing and that the area records the bulk production in Ondo state. Each of the male fishermen is also likely to be married to two or more wives who are also engage in different stages of fish processing so that all of them can combine their businesses along the stages of fishing. Their level of education is lower than the national average, especially for women.

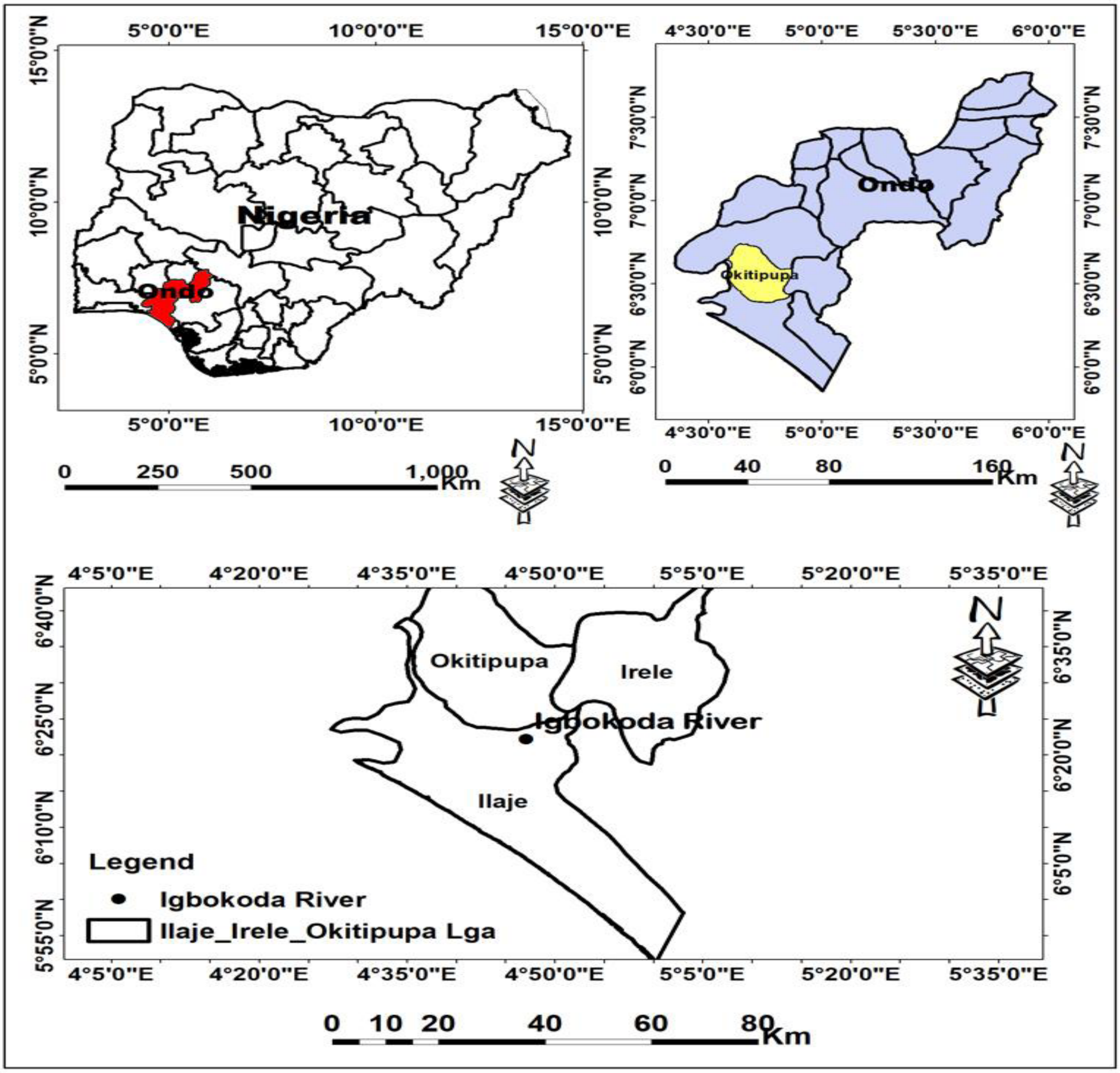


Figure 1: Map of Nigeria showing Ondo state with the study area, Igbokoda River highlighted.

Fish Collection and Identification

A total of one hundred and fifteen (115) samples of cichlids were collected from Igbokoda river in Ilaje with the assistance of fishermen using non-return valve trap from the period of December 2020 to May 2021. The fishes were transported in containers with openings to The Federal University of Technology, Akure obakekere limnology laboratory for analysis. The fish samples were sorted into species level based on the taxonomic keys provided on FishBase website, and Adesulu and Sydenham (2007). Assistance of the head Laboratory Technologist, and experienced fisher folks who provided the local names of the fish species.

Sample Preparation and Examination

The fishes collected were dissected to remove guts and expose the condition of the stomach. The stomach contents were placed in sealed nylon bags with distilled water and refrigerated prior to examination. Stomach samples were mixed with distilled water in a petri-dish for proper separation and easy identification of food materials under a microscope. Each prepared sample was placed on the glass slides, the food items were viewed under light microscope at a magnification of x10 to x20 and captured using photomicrograph at 5, food items were sorted and identified with the aid of taxonomic keys provided by Math/Science Nucleus (2004)

Analysis of Stomach Content

The various items in the fish stomach was analysed using Frequency of Occurrence (FO), Composition by number (C_n) and Index of Relative Importance (IRI).

Number method - The number of individual of each food type in stomach is counted and expressed as a percentage of the total number of food items in the sample studied, or as a percentage of the gut contents of each specimen examined, from which the total percentage composition is estimated.

Frequency of Occurrence, $Oi = \frac{Ni}{N}$ ----Where, Ni is number of fish containing prey i and N is the number of fish with food in their stomach.

Volumetric method - In this method the contents of each sample is considered as unity, the various items being expressed in terms of percentage by volume as estimated by inspection.

In point (volumetric) method, percentage volumes within each subsample are calculated as:

$$\alpha = \frac{number\ of\ points\ allocated\ to\ component\ a}{total\ point\ allocated\ to\ subsample} X\ 100$$

Where α is the percentage volume of the prey (food item) component α

Index of fullness- This is measured as the ratio of food weight to body weight as an index of fullness, which is very widely employed. (The ratio of corresponding volume can also be used.)

$$\text{Fullness index} = \frac{weight\ of\ the\ stomach\ contents\ \boldsymbol{x}\ 100}{weight\ of\ fish}$$

Index of Relative Importance: This index is an integration of measurement of number, volume and frequency of occurrence to assist in evaluating the relationship of the various food items found in the stomach.

Index of relative importance, IRIi = (%Ni + % Vi) %Oi, Where, Ni, Vi and Oi represent numerical, volumetric and frequency of occurence of prey i respectively.

$$\text{Viscero somatic index- VSI} = \frac{weight\ of\ fish\ visceral}{weight\ of\ fish}\ X\ 100$$

Ethics approval and consent to participate –A waiver was approved by The Federal Ministry of Agriculture, Ondo State Nigeria. The fishes used for the experiment were processed and sold off as finished products with the approval of the Centre for Research and Development (CERAD) at The Federal University of Technology, Akure. Nigeria.

Results

A total number of one hundred and fifteen (115) specimens were examined comprising of thirty (30) individuals of *Hemichromis fasciatus*, twenty (20) individuals of *Hemichromis bimaculatus,* twenty-five (25) individuals of *Oreochromis niloticus,* fifteen (15) individuals of *Oreochromis aureus*, twenty (20) individuals of *Sarotherodon galilaeus* and five (5) individuals of *Thylochromis sudanensis.*

Table 1: Summary of stomach contents analysis of *hemichromis fasciatus* in river Ogbokoda, south western Nigeria.

Food Items	Occurrence (% O_i)	Number (% N_i)	Volumetric (% V_i)	Index of relative importance (% N_i+% V_i)% O_i	IRI % (rank)
BACCILLARIOPHYTA					
Naviula spp	48	11.11	17.5	1373.28	20.02 (2)
Thalassisira spp	4	0.92	0.60	6.08	0.09 (17)
Licmophora spp	20	4.62	2.75	183.4	2.67 (7)
Nitzchia spp	32	7.4	1.00	268.8	3.92 (6)
Psuedonitzchia spp	4	0.92	0.25	4.68	0.68 (13)
Guirnadia spp	4	0.92	1.20	8.48	0.12 (16)
Plaurosigma spp	16	3.70	3.50	115.2	1.67 (9)
Cheatoceros spp	16	3.70	8.66	512.67	7.47 (5)
Cyclotella spp	8	1.85	4.95	54.4	0.79 (12)
Striatella spp	34	5.55	4.60	868.02	12.65 (3)
CRUSTACEAN					
Zoea	16	3.70	10.30	609.76	8.88 (4)
DINOFLAGELLATES					
Ceratium spp	16	3.70	3.80	120	1.74 (8)
Dinopyhsis spp	4	0.92	0.5	1.84	0.030 (15)
TENTACULATA					
Ctenophora spp	12	2.77	5.2	95.64	1.39 (10)
COSCINODISCOPHYCEAE					
Coscinodiscus spp	8	1.85	6.50	66.8	0.97 (11)
INSECT					
Insect part	4	0.92	12.5	46	0.67 (14)
FISH					
Fish egg	36	8.33	8.60	609.48	8.88 (4)
OTHERS					
Cysts	76	17.59	7.60	1914.44	27.91 (1)

Table 2: Summary of stomach contents analysis of *hemichromis bimaculatus* in river Igbokoda, Ondo state

Food Items	Vi	Ni	Oi	IR1	IRI% (rank)
BACCILLARIOPHYTA					
Naviula spp	45	15.51	29.36	2019.15	53.86 (1)
Thalassisira spp	5	1.72	0.70	12.1	0.32 (12)
Licmophora spp	10	3.44	4.36	78	2.08 (9)
Nitzchia spp	20	6.89	2.45	186.8	4.98 (5)
Psuedonitzchia spp	5	1.72	0.31	10.15	0.27 (14)
Striatella spp	10	3.44	6.17	96.1	2.56 (8)
CRUSTACEAN					
Zoea	5	1.72	2.39	20.55	0.55 (11)
Dinopyhsis spp	5	1.72	0.50	11.1	0.29 (13)
CHLOROPHYCEAE					
Pediastrum spp	5	1.72	6.05	38.85	1.04 (10)
COSCINODISCOPHYCEAE					
Coscinodiscus spp	10	3.44	8.91	123.5	3.29 (7)
FISH					
Fish egg	20	6.89	13.00	397.8	10.61 (3)
PLANT					
Plant material	10	3.44	9.35	127.9	3.41 (6)
OTHERS					
Cysts	25	8.62	16.45	626.75	16.71 (2)

Table 3: Summary of stomach contents analysis of *oreochromis niloticus* in river Igbokoda, Ondo state

Food Items	Oi	Ni	Vi	IRN	IRN% (rank)
BACCILLARIOPHYTA					
Naviula spp	64	14.41	16.89	2003.2	35.63 (1)
Licmophora spp	12	2.70	5.80	102	1.81 (9)
Guirnadia spp	16	3.60	3.62	115.52	2.06 (7)
Plaurosigma spp	40	9.00	8.50	700	12.45 (3)
Cyclotella spp	8	1.80	1.62	27.36	0.48 (11)
CRUSTACEAN					
Zoea	4	0.90	3.85	19	0.34 (13)
DINOFLAGELLATES					
Ceratium spp	12	2.70	6.79	113.88	2.02 (8)
COSCINODISCOPHYCEAE					
Coscinodiscus spp	28	6.30	7.05	373.8	6.65 (5)
Skeletonema spp	8	1.80	1.25	24.4	0.43 (12)

MEDIOPHYCEAE					
Leptocylindricus spp	8	1.80	1.74	28.32	0.50 (10)
FISH					
Fish egg	12	2.70	8.40	133.2	2.40 (6)
PLANT					
Plant material	24	5.40	19.39	594.96	10.58 (4)
OTHERS					
Cysts	50	11.71	16.00	1385.5	24.65 (2)

Table 4: Summary of stomach contents analysis of *oreochromis aureus* in river Igbokoda, Ondo State

Food Items	Oi	Ni	Vi	IRN	IRN% (rank)
BACCILLARIOPHYTA					
Naviula spp	60	18.00	20.15	2289	49.35 (1)
Guirnadia spp	20	6.00	6.20	244	5.26 (5)
Plaurosigma spp	26.5	8.00	9.69	468.75	10.12 (3)
Cheatoceros spp	13.3	4.00	11.07	200.43	4.32 (6)
COSCINODISCOPHYCEAE					
Coscinodiscus spp	13.3	4.00	4.40	111.72	2.40 (7)
Skeletonema spp	6.5	2.00	6.00	52	1.12 (9)
FISH					
Fish egg	6.5	2.00	8.60	68.9	1.49 (8)
PLANT					
Plant material	13.3	4.00	15.55	260.01	5.60 (4)
OTHERS					
Cysts	33.3	10.00	18.34	943.72	20.35 (2)

BACCILLARIOPHYTA					
Naviula spp	35	5.64	31.17	1288.35	32.89 (2)
Licmophora spp	20	3.22	1.61	96.6	2.46 (8)
Nitzchia spp	10	1.61	0.50	21.1	0.54 (12)
Psuedonitzchia spp	20	3.22	1.95	103.4	2.64 (7)
Guirnadia spp	10	1.61	7.45	90.6	2.31 (9)
Plaurosigma spp	10	1.61	3.19	48	1.23 (11)
Cheatoceros spp	20	3.22	12.20	308.2	7.87 (3)
CRUSTACEAN					
Zoea	15	2.41	9.00	171.15	4.37 (6)
DINOFLAGELLATES					
Ceratium spp	15	2.41	1.55	59.4	1.52 (10)
COSCINODISCOPHYCEAE					
Coscinodiscus spp	25	4.03	4.40	210.75	5.38 (5)
ZYGNEMATOPHYCEAE					
Closterium spp	5	0.80	0.25	5.25	0.13 (13)
FISH					
Fish egg	20	3.22	8.00	224.4	5.73 (4)
OTHERS					
Cysts	50	8.06	17.73	1289.5	32.92 (1)

Table 5: Summary of stomach contents analysis of *tilapia galileus* in river Igbokoda, Ondo State

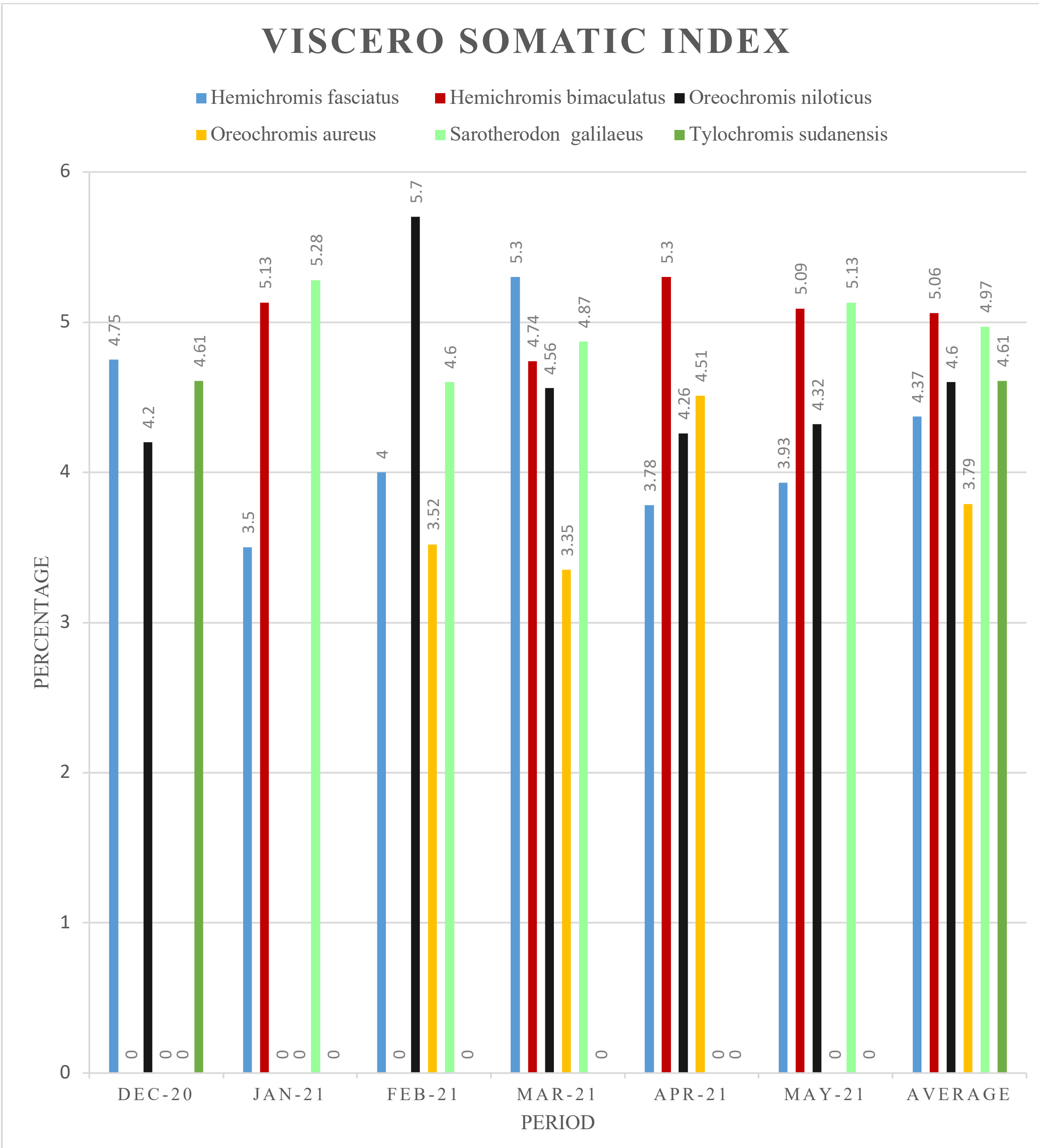
Food Items	Oi	Ni	Vi	IRI	IRN% (rank)
BACCILLARIOPHYTA					
Naviula spp	35	5.64	31.17	1288.35	32.89 (2)
Licmophora spp	20	3.22	1.61	96.6	2.46 (8)
Nitzchia spp	10	1.61	0.50	21.1	0.54 (12)
Psuedonitzchia spp	20	3.22	1.95	103.4	2.64 (7)
Guirnadia spp	10	1.61	7.45	90.6	2.31 (9)
Plaurosigma spp	10	1.61	3.19	48	1.23 (11)
Cheatoceros spp	20	3.22	12.20	308.2	7.87 (3)
CRUSTACEAN					
Zoea	15	2.41	9.00	171.15	4.37 (6)
DINOFLAGELLATES					
Ceratium spp	15	2.41	1.55	59.4	1.52 (10)
COSCINODISCOPHYCEAE					
Coscinodiscus spp	25	4.03	4.40	210.75	5.38 (5)
ZYGNEMATOPHYCEAE					
Closterium spp	5	0.80	0.25	5.25	0.13 (13)
FISH					
Fish egg	20	3.22	8.00	224.4	5.73 (4)
OTHERS					
Cysts	50	8.06	17.73	1289.5	32.92 (1)

Table 6: Summary of stomach contents analysis of *tylochromis sudanensis* in river Igbokoda, Ondo State

Food Items	Oi	Ni	Vi	IRN	IRN% (rank)
BACCILLARIOPHYTA					
Licmophora spp	40	12.5	19.28	1271.2	32.40 (2)
Nitzchia spp	40	12.5	7.35	794	20.24 (3)
Psuedonitzchia spp	20	6.25	15.37	432.4	11.02 (4)
Skeletonema spp	20	6.25	65.00	1425	36.32 (1)

Table 7: Summary Of Stomach Fullness During The Period Of Study.

Species	No	Empty	%	¼ full	%	half-full	%	¾full	%	Full	%
H.fasciatus	30	0	0	14	46.66	12	40.00	4	13.33	0	0
H.bimaculatus	20	0	0	4	20	9	45	5	25	2	10
O.niloticus	25	0	0	9	36	15	60	1	4	0	0
O.aureus	15	0	0	7	46.66	6	40	1	6.67	1	6.67
T.galileus	20	0	0	4	20	11	55	4	20	1	5
T.sudanensis	5	0	0	1	20	3	60	1	20	0	0
Total	115	0	0%	39	31.55%	58	50%	16	14.83%	4	3.61%



DISCUSSION

Figure 2: Viscero-somatic index of samples during the period of study

Gut Content Analysis

A summary of food items that constituted the diet of *Hemichromis fasciatus* is given in Table.1. *Navicular spp*, Zoea, *Thallasiosira spp*, insect parts, *Nitzchia spp, Pseudonitzchia spp, Guinardia spp, Cyclotella spp, Stritella spp, Ceratium spp, Dinopyhsis, Coscinodiscus spp, Ctenophora spp,* and *Cheatoceros spp,* cysts and fish eggs were present in the stomach samples collected. Indicating that the fish is omnivorous, this result is similar to results of studies by (Oribhabor *et al.,* 2019) who reported that *H. fasciatus* found in Qua Iboe River in Akwa Ibom State, Nigeria fed on benthic invertebrates and occasionally on species of fish, but this species was found to feed also on plant materials and also agrees with studies by (Oronsaye, 2009) who reported that *H.fasciatus* found in Ikpoba dam Benin city, Nigeria feeds on insects, fish, plankton and plant materials

A summary of the food items that constituted the diet of *Hemichromis bimaculatus* from River Igbokoda is given in Table.2. *Navicula spp*, plant material, *Nitzchia spp, Striatella spp, cysts, Coscinodiscus spp*, fish egg, *Licmophora spp Thalassiosira spp, Zoea, Psuedonitzchia spp, Dinophysis spp,* and *Pediastrum spp* were present in the stomach of samples collected. Indicating that the fish was omnivorous, this result is similar to results studied by Ayoade and Ikulala (2007) who reported *H.bimaculatus* from Eleiyele Lake in southwestern Nigeria fed mainly on algae, crustaceans, diatoms, plant materials and fish egg.

A summary of the food items that constituted the diet of *Oreochromis niloticus* is given in Table.3 *Navicular spp, Pluarosigma spp*, cysts *Conscinodiscus spp*, plant material, fish egg, *Leptocylindricus spp*, *Ceratium spp*, *Striatella spp*, *Skeletonema spp*, *Cyclotella spp* and *Guinardia spp* were present in the stomach of samples collected. Indicating that the fish is omnivorous but feeding mainly on Bacillariophyceae, this result corresponds to results of studies by (Mohsen 2003) who stated that Bacillariophyceae were dominant in the stomach of cichlids cultivated in a pond in Egypt. Also, Abidemi-Iromini (2019) reported that Bacillariophyceae constituted 38.22% of the food items thus the most prevailing food items in the stomach of *Oreochromis niloticus* found in the Lagos lagoon.

A summary of the food items that constituted the diet of *Oreochromis aureus* is given in table.4. *Navicula* spp, *Guinardia spp, Cheatocerus spp, Plaurosigma spp, Conscinodiscus spp, Skeletonema spp*, fish egg, plant material and cysts. Indicating that this fish species is omnivorous which is in corresponds with results of studies by Horsfall et al., (2004) who reported that *S.galilaeus* found in Sombriero River Cross River, Nigeria fed mainly on plant food substances such as phytoplankton, plant parts, leaf parts and some percentages of animal food include insect pupae, insect larva and protozoa.

A summary of the food items that constituted the diet of *Sarotherodon galilaeus* is given in table.5. N*aicula spp, Licmophora spp, Nitzchia spp, Psuedonitzchia spp, Guinardia spp, Plaurosigma spp, Cheatoceros spp*, zoea, *Conscinodiscus spp*, *Closterium spp, Ceratium spp* were present in the stomach of samples collected. This indicates that it is omnivorous. A summary of the food items that constituted the diets of *Tylocromis sudanensis* is given in Table 6, *Licmophora spp*, *Nitzchia spp, Psuedonitzchia spp* and *Skeletonema spp* were present in the stomach of samples collected. Indicating that this fish species is planktivorous feeding exclusively on planktons which is in contrast with (Konan 2011) who reported that *Tylochromis spp* found in Ebrie Lagoon, Ivory coast fed on benthic invertebrates, insects larvae, zooplankton, and terrestrial plants.

Stomach Fullness

The summary of the stomach fullness of samples during the period of study is shown in Table7. A total number of 115 samples were examined 0 (0%) had empty stomachs, 39 (31.55%) had ¼ full stomachs, 58 (50%) had half-full stomachs, 16 (14.83%) had ¾ full stomachs and 4 (3.61%) had full stomachs. 56% of *Hemichromis fasciatus* had ¼ full stomachs, 28% of sample had half full stomachs and 16% had ¾ full stomachs, with majority (56%) having ¼ full stomachs. This result agrees with results of studies by Oribhabor et al., (2019) with reported that *H. fasciatus* found Qua Iboe River in Akwa Ibom State, Nigeria had 100% of stomachs had a food item inside. Table.7 shows the stomach fullness of *Hemichromis bimaculatus* during the period of study. 20% of the sample had ¼ full stomachs, 45% of sample had half-full stomachs, 25% had ¾ full stomachs and 10% having full stomachs, with majority(45%) having half-full stomachs, indicating that 100% of samples had food in their stomachs. This result agrees with Oribhabor *et al.,* (2019) who reported that *H. bimaculatus* found in Qua Iboe River in Akwa Ibom State, Nigeria had 100% of stomachs with food items inside them. Also, results of studies by Ayoade & Ikulala (2007) showed that 74.2% of *H.bimaculatus* from Eleiyele Lake in southwestern Nigeria examined had food in their stomachs. 36% of *Oreochromis niloticus* had ¼ full stomachs, 60% of sample had half full stomachs and 4% had ¾ full stomachs, with majority (60%) having half full stomachs indicating that 100% of samples had food in their stomachs. Similarly Oso *et al.,* (2017) also reported that *O.niloticus* found in Ero dam Ekiti, Nigeria had 90.5% stomachs containing food items.

20% of *Sarotherodon galilaeus* had ¼ full stomachs, 55% of sample had half full stomachs, 20% had ¾ full stomachs and 5% had full stomachs, with majority (55%) having half-full stomachs indicating that 100% of samples had food in their stomachs. This result is similar to results of studies Gbaguidi *et al.,* (2016) who reported that *S. galilaeus* found in a man-made lake in Benin Republic had 99.60% of stomach with food inside them. 20% of *Tylochromis sudanensis* had ¼ full stomachs, 60% of sample had half full stomachs and 20% had ¾ full stomachs, with majority (60%) having half-full stomachs.

Viscero-Somatic Index

Figure 2. shows the average percentage of viscera weight in average total fish weight for *Hemichromis fasciatus* during the period of study was 4.37 percent which indicates that the weight of fish before dressing out is higher than the weight of fish after dressing out. The average percentage of viscera weight in average total fish weight for *Hemichromis bimaculatus* and *Oreochromis niloticus* during the period of study indicates that the weight of fish before dressing out is higher than the weight of fish after dressing out. This result tallies with (Araujo *et al*., 2020) who reported the viscero somatic index of *Oreochromis niloticus* found in rivers in Brazil to vary between 2.70 and 8.36 indicating that the weight of fish flesh is higher than fish visceral. *Oreochromis aureus* had the lowest average values for VSI and this is an indication that *Hemichromis bimaculatus* which recorded the highest value has more fillet for consumption than *Oreochromis aureus* in relation to total body mass. *Sarotherodon galilaeus, Tylochromis sudanensis* also followed the same trend. The visceral somatic index of all samples collected varied between averages of 3.79 and 5.03 indicating that species have more weight in ratio of fish flesh to fish visceral. With respect to this study, the fishes studied are good fishes for consumption because of its rich fillet quality.

Conclusion

Based on the findings of this research, it has been established that *Hemichromis fasciatus* is found to be omnivorous, *Hemichromis bimaculatus* is herbivorous, *Oreochromis niloticus* is omnivorous, *Oreochromis aureus* is herbivorous, *Tilapia galileus* is omnivorous and *Tylochromis sudanensis* is herbivorous. There was no obvious seasonality in the abundance of food items consumed generally in all species examined, because the fishes fed mainly on the same food items during the period of study, although at varying quantities and intensities. *Tylochromis sudanensis* was the only species reported to be strictly planktivorous and stenophagous. *Tylochromis sudanensis* was the least occurring species amongst the fish species examined. It is therefore implied that the food habit of this species is relative to its abundance in the water body. The viscero-somatic indices for all the species indicated that every fish species examined has more flesh than viscera organs. The average percentage of viscera in average total body weight of *Hemichromis fasciatus, Hemichromis bimaculatus, Oreochromis niloticus, Oreochromis aureus, Sarotherodon galilaeus* and *Tylochromis sudanensis* indicates that the weight of fish before dressing out is higher than the weight of fish after dressing out. It also established that all the examined fish species are omnivores except *Tylochromis sudanensis* which is a planktivore. This implies that all the examined species except *Tylochromis sudanensis* have good aquaculture potential in relation to feeding.

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