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Food and Feeding Habit of Silverside Fish (*Alestes baremoze*) in The Nun River Around Odi, Bayelsa State, Nigeria

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ABSTRACT

The food and feeding habit of Alestes baremoze in the Nun River around Odi, Bayelsa State was investigated between September and October, 2021. Fish species were procured from fishers using gill nets, cast nets, traps, hooks and lines. Specimens were chilled with iced blocks at the point of collection and transported to the laboratory. A total of 65 fish specimens were examined and their stomach contents analyzed using numerical and frequency of occurrence methods. The results revealed that 23.1% had full stomach, and 13.8% empty stomach with the highest in the month of September (32.3%) and lowest in November (10.8%). This study showed that Alestes baremoze is an omnivore, as the stomach contents revealed the presence of more zooplankton such as Copepod naupluis (295), Diaptomus (190), Cypria spp (56), Macrothrix spinose (102) and Metopus (55), some phytoplankton such as Paramecium (28) and Spirogyra (16) as well as other materials which include fish scales (placoid), shrimp antannae and unidentified materials (20). Copepod nauplius (295) was the most abundant food item in the stomach, followed by Diaptomus (190) and Spirogyra the least abundant. The animal origin foods were the most dominant food item in the stomach.

Keywords: Feeding Habit, Food, Silverside Fish, Batelsa State, Nigeria, Freshwater, Odi, Nun River

1. INTRODUCTION

Silverside fish (Alestes baremoze) is one of the most abundant specie from the family Alestidae. They are a clade of morphologically distinctive freshwater fishes. These species are widely distributed across the continent, occurring in the upper and lower Niger, Benue, Chad, Upper Nile in Egypt, White and Blue Lakes in Sudan, Uganda, Vilta, Senegal and so on. It has a lateral (fusiform) body shape, with an oval sub section. They are typically scaly fishes. Alestes baremoze are usually found in the inshore zones of lakes. They are mainly diurnal i.e active during the day and shows benthopelagic behavior. They are majorly omnivores, feeding almost entirely on phytoplankton and zooplankton (Gosse and Coenen, 1990). Alestes baremoze are extensively used in aquaculture in most African countries such as Uganda, Senegal, Ethiopia etc. on account of their good qualities (Satia, 1990).

Good adaptation to climate changes, ability to support high population densities, ability to feed on phytoplankton and zooplankton in ponds and popularity among the consumers. Alestes baremoze is of considerable socio-economic importance, as they constitute a highly valued, but increasingly over exploited component of artisanal and commercial fisheries across the continent. The study of food and feeding habits of freshwater fish species is a subject of continuous research. This is because it makes up a basis for the development of a successful management program on fish capture and culture (Shalloof and Khalifa, 2009). Moreover, studies on natural feeding of fish enable us to identify the trophic relationships present in aquatic ecosystems, identifying feeding composition, structure and stability of food webs in the ecosystem (Adeyemi, 2009; Otieno et al., 2014). The information is also vital for management of the fish in the controlled environment and for formulation of the appropriate diet given to the fish in aquaculture (Adeyemi, 2009). Therefore, understanding of food and feeding behaviour of Alestes barmoze is a key factor to its successful culture in a controlled environment (Shalloof and Khalifa, 2009).

Information about the food and feeding habits of fishes is used in defining predator-prey relationship (Saa et al., 1997, Anibeze, 2001) and the creation of trophic models as a tool to understanding complete ecosystem (Lopez-perata and Arcila, 2002; Bachok et al.,2004). It also guides the choice of feed stuff needed for artificial diet of cultured species for optimal production (Ketoye, 2007). A good knowledge of food and feeding habits of fish species is very vital in fish culture (Njoku et al., 2009) with regard to evolution (Collar, et al., 2009), selection of prey, predation etc (Allison and Sikoki, 2013).

Justification of the Study

Alestes baremoze (Plate 1) is an economically important fish species in the Niger Delta Region. Hence, the knowledge of the ecology and biology of the fish in relation to its food and feeding habit is essential towards proper planning and implementing thorough management strategies for the fish species (Alestes baremoze). In as much as this fish species is among one of the most abundant and widely consumed fishes by the inhabitants of the study area. Notwithstanding the economic importance of this fish in the study area, there is little or no literature on the food and feeding habit of the silverside fish Alestes baremoze in the Nun River around Odi, Bayelsa State.

Plate 1: Photograph of silverside fish (Alestes baremoze)

This research is therefore, expected to bridge that gap. It is proper to understand the relationship between body structures and fish diet which will enable fish biologist and fisheries scientists to predict their diet, how they feed and the mechanics of feeding of the fish species. Consequently, the information that will be obtained from this research, will contribute useful information on the food and feeding habit of Alestes baremoze in the Nun River, around Odi community, Bayelsa State, Nigeria.

2. MATERIALS AND METHODS

Study Area

This study was carried out at the Nun River, in Odi community in Kolokuma/Opokuma Local Government Area of Bayelsa State, Niger Delta region, Nigeria. This River is formed when the Niger River splits into two, forming River Nun and Furtado's River. Its geographical coordinates are 5º34' 0'' North, 5º43' 0'' South. It is located at about 281ml or (452km) South of Abuja the Nation's capital. The topography is characterized by a maze of affluent, creeks and swamps crossing the low-lying plains of the Niger Delta in varying dimensions. Much of the area is predominantly water-logged. Settlement pattern is a clustered type and people are confined to families and compounds. Crop farming and fishing are two major occupations engaged by the inhabitants of the community.

Sample Collection

A total of 65 fish specimens of Alestes baremoze were bought twice monthly for a period of three months between September and November, 2023 at the landing sites in Odi Community in Kolokuma/Opokuma Local Government Area in Bayelsa State, Nigeria. The samples were kept in plastic containers immediately after buying, chilled in ice block in order to reduce post mortem digestion and immediately carried to the wet laboratory of the Department of Fisheries, Niger Delta University for further analysis of the food content.

Laboratory Examination of the Specimen

The total lengths of fish specimens were measured using a measuring board (meter rule) in centimeter and weight using accurate digital scale in grams. The fish body cavity was opened using a pair of scissors, starting from the anus (vent) to the mouth ventrally, the entire visceral and intestines were removed and put into plastic containers (dish), where the liver, fat and other organs that are attached to the intestine and stomachs were gently removed and the length and weight of stomach was measured and recorded. The stomach contents of all the specimens were preserved in 4% formalin solution to avoid deterioration and contamination for later analysis. Fractions of the food contents were placed on glass slides and observed under varying magnifications of the electronic microscope. The food items were identified based on the keys of Jeje and Fernando (1986).

Stomach Content Analysis

The stomach contents were emptied into a petri-dish to which 10% saline water was added to disperse the contents after which they were observed under an electronic microscope. Thereafter, the food items were identified and sorted into different categories. The analysis was carried out using the frequency of occurrence method and the numerical method.

Frequency of Occurrence

This is the number of stomach in which each food item occurs and expressed as percentage of the total number of fish stomachs examined.

This is expressed as % number of food items

= Total number of stomach with particular food X 100 (Yem and Abubakar, 2013).
Total number of all food items

Numerical Method

This method involves counting the number of each food item present in the stomach of the fish and summing up these numbers to obtain the grand total number of all the food items found in the stomach.

This is expressed as % number of food items

= Total number of particular food X 100 (Yem and Abubakar, 2013).
Total number of all food items

Food Analysis Indices

In other to reduce bias, dietary importance of food item was determined using the relative importance (RI) index (George and Hadley, 1979, Hyslop, 1980). Food items with RI > 5.0% was considered major or important food items.

RII = % (frequency × Numerical x 0.01)..... (Simenstad et al., 1991)

Statistical Analysis

All the data obtained were subjected to descriptive analysis and presented in form of tables and graphs.

3. RESULTS

Degree of Fullness of Stomach

Table 1 presents the analysis of degree of fullness of stomach of Alestes baremoze examined in the study area. Out of the 65 fish specimens of Alestes baremoze examined, 63.1% of their stomach were full with food items, 23.1% were half full and 13.8% were with empty stomachs. The percentage of stomach fullness was higher in the month of September (32.3%), followed by October (20.0%) and lowest in November (10.8%).

Table 1: Analysis of Degree of fullness of stomach of Alestes baremoze in the Nun River, around Odi in Bayelsa State

Month	No. of specimen examined	No. of full stomach	%	No. of half stomach	%	No. of empty stomach	%
September	33	21	32.3	5	7,7	13	4.6
October	20	13	20.0	7	10.8	13	4.6
November	12	7	10.8	3	4.6	3	4.6
Total	**65**	**41**	**63.1**	**15**	**23.1**	**9**	**13.8**

Source: Field Survey, 2022.

Assessment of Food Items

The food items present in the stomach of Alestes baremoze by the numerical method is presented in Table 4. The total length of the specimens ranged from 5-25cm. The results revealed that Copepod nauplius (295) was the most abundant food item in the stomach, followed by Diaptomus (190), Macrothrix spinosa (102), Shrimp antennae (57) Cypria (56), fish scales (55), Metopus (55), Paramecium (28), unidentified materials (20) while the lowest was Spirogyra (16). In the frequency of occurrence method, as shown in Table 3, Copepod nauplius (33), still had the highest number of occurrence, followed by Diaptomus (23), fish scales (12) and shrimp antennae (12) had the lowest number respectively.

Table 2: Numerical analysis and percentages of items in the stomach of Alestes barmoze in River around Odi Bayelsa State

Size Range (cm)	No. of fish	%	Diaptomus	%	cypria	%	Fish scales (placoid)	%	Macrothrix spinosa	%	Metopus	%	paramecium	%	Unidentified materials	%	Shrimp antennae	%	Spirogyra	%	Copepod nauplius	%
5-10	10	15.4	45	23.7	8	14.3	5	9.1	48	47.1	12	30.7	10	35.7	6	30.0	9	15.8	6	37.5	30	10.2
11-15	18	27.7	50	26.3	13	23.2	18	32.7	23	22.5	10	21.4	6	21.4	4	20.0	8	14.0	4	25.0	89	30.2
16-20	16	24.6	40	21.1	17	30.4	12	21.8	19	21.4	4	17.9	5	17.9	3	15.0	15	26.3	4	25.0	80	27.1
> 20	20	32,3	55	28.9	18	32.1	20	36.4	12	11.8	7	25.0	7	25.0	7	35.0	25	43.9	2	12.5	96	32.5
Total	**65**	**100.0**	**190**	**100.0**	**56**	**100.0**	**55**	**100.0**	**102**	**100.0**	**33**	**100.0**	**28**	**100.0**	**20**	**100.0**	**57**	**100.0**	**16**	**100.0**	**295**	**100.0**

Source: Field Survey, 2022.

Table 3: Frequency of occurrence (F) and percentages of items in the stomach of Alestes Baremoze in River Nun around Odi Bayelsa State

Size Range (cm)	No. of fish	%	Diaptomus	%	Cypria	%	Fish scales (placoid)	%	Macrothrix spinosa	%	Metopus	%	paramecium	%	Unidentified materials	%	Shrimp antennae	%	Spirogyra	%	Copepod nauplius	%
5-10	10	15.4	3	13.0	2	10.0	3	25.0	6	35.3	6	40.0	6	37.5	3	21.4	2	16.7	6	40.0	4	12.1
11-15	18	27.7	6	26.1	6	30.0	2	16.7	4	23.5	4	26.7	4	25.0	5	35.7	3	25.0	4	26.7	10	30.3
16-20	16	24.6	4	17.4	5	25.0	3	25.0	5	29.4	2	13.3	2	12.5	2	14.3	3	25.0	3	20.0	6	18.2
> 20	20	32.3	10	43.5	7	35.0	4	33.3	2	11.8	3	20.0	4	25.0	4	28.6	4	33.3	2	13.3	13	39.4
Total	**65**	**100.0**	**23**	**100.0**	**20**	**100.0**	**12**	**100.0**	**17**	**100.0**	**15**	**100.0**	**16**	**100.0**	**14**	**100.0**	**12**	**100.0**	**15**	**100.0**	**33**	**100.0**

Source: Field Survey, 2022.

The percentage of composition of numerical and frequency of occurrence of food items in the stomachs of Alestes baremoze examined are shown in Table 4.4. By the numerical composition of the food items, zooplankton constituting of Diaptomus, Cypria, Macrothrix spinosa, Metopus, Copepod nauplius were prominent (79.3%), followed by other materials constituting of fish scales (6.5%), unidentified materials (2.3%) and shrimp antennae (6.7%), while phytoplankton such as paramecium (3.3%) and spirogyra (1.9%) were the least of the number of food items in the stomachs examined. For the percentage of frequency of occurrence of the food items zooplanktons (79.3%) and other materials such as fish scales, unidentified materials and shrimp antannae (15.5%) were the dominant food items while the least dominant was phytoplankton (5.2%).

Table 4: Food items in the stomach of Alestes Baremoze in the Nun River around Odi Bayelsa State

Food items	Numerical method	%	Frequency of occurrence	%
Zooplankton				
Dioptomus spp.	190	22.3	23	13.0
Cypria spp.	56	6.6	23	11.3
Macrothrix spinosa	102	11.9	17	9.6
Metopus spp.	33	3.9	15	8.5
Copepod nauplus	295	34.6	33	18.6
		79.3		**61.0**
Phytoplankton				
Paramecium	28	3.3	16	9.0
Spirogyra	16	1.9	15	8.5
		5.2		**17.5**
Other Materials				
Fish scales	55	6.5	53	6.8
Unidentified materials	20	2.3	50	7.9
Shrimp antannae	57	6.7	30	6.86.8
Total	**852**	**100.0**	**177**	**100.0**

Source: Field Survey, 2022.

Important food item(s) found in the stomach of the specimens is depicted in Table 5. The results show that Copepod naupluis (6.4) is the most important food item found in the stomach of Alestes baremoze while Spirogyra (0.2) and unidentified materials (0.2) were the least important food items in the stomach of Alestes baremoze.

Table 5: Relative important indices of food items in the specimen.

Food item	Important Relative Index
Diaptomus spp.	2.9
Cyrpia spp.	0.7
Macrothrix spinosa	1.1
Metopus spp.	0.3
Copepod nauplus	6.4
Paramecium	0.3
Spirogyra	0.2
Fish scales	0.4
Unidentified materials	0.2
Shrimp antannae	0.5

Source: Field Survey, 2022.

3. DISCUSSION

The stomach contents of many African in-land water fishes have been studied with a view to understanding their dietary requirements in their natural habitats and biotic environments (Adebisi, 1981). Umaru et al. (2014) stated that the primary problems posed in the study of fish feeding habits, is to have a broad knowledge of the different species of prey in order to understand qualitative and quantitative bridge between fish and their food organisms. The high degree of specimens with full stomach, could be due to the nature of food consumed by this species which comprised almost the types of natural food available in the aquatic system. The high percentage of guts with food is generally attributed to a successful feeding strategy abducted by the specimens (Nwani, 2004) and additionally benefiting from good food abundance during the sampling season.

The half-filled stomachs were also many but less than fully filled stomachs. This could be due to the digestion of food consumed, when they were captured by the fishing gear. Therefore, within this period some of the food items could have been digested and absorbed, thereby reducing the food contents of the stomach. In contrast, low percentage of empty stomachs were encountered, this is an indication that there is high availability of food of this species because it exploits most of the natural food. It indicates that the Nun River is productive and less oligotrophic. Abari et al. (2015) also observed low percentages of empty stomachs in Alestes barmoze at Doma Dam in Nassarawa State and attributed it to the low oligotrophic nature of the area sampled.

However, the low percentage of empty stomachs could be due to their feeding behaviour or must have used up the food items consumed. The size ranges of specimens used in this study showed variations in their body sizes within the population examined. This observation is similar to those of previous studies of Oso et al. (2006), Abariet al. (2015) and Abidemi-Iromini and Ige (2017) who reported that the body sizes of fish to a large extent determines the spectrum of food items it will consume. Understanding the relationship between body size and fish food is therefore important in interpreting the fish's diet and feeding mechanisms. Hence, the type of food available in an area influences the distribution, abundance and rate of growth (size) of the fish as reported by Ogheneochuko (2007).

The major food items of Alestes barmoze in the Nun River were mainly Copepod naupluis, Diaptomus, Macrothrix spinosa, Sypria, Mesopus, shrimp antannae etc. The feeding habit was similar to those reported by Fagade and Olaniyan (1972) in the Lagos Lagoon; Adeyemi et al. (2009) in Lake Gbedikere, Kogi State, Oso et al. (2006) in Ero Reservoir in Ekiti State, Abariet al. (2015) in Doma Dam, Nasarawa State, Abidemi-Iromini and Ige (2017) from Lagos Lagoon. Apart from the major food items, they also picked a variety of other food items. Nwani (2004) stated that Mormyrids including Cichlids were able to exploit more than one source of food. This ability to exploit different varieties of food makes A. barmoze to be omnivorous. Examination of the diet of this species showed that there was high percentage of mud and detritus in the stomach. This is an indication that this species is a bottom grazer. The food and feeding habits of A. baremoze in the Nun River as reported in the present study is in agreement with earlier reports for this fish species found in some other water bodies.

For instance, Abidemi-Iromini and Ige (2017) noted that interspecific competition occurred among six Alestes species in Lekki Lagoon. Also, Nwani (2004) further reported that this fish species fed mainly on zooplankton and other plankton materials in Ikpoba River, Oso et al. (2006). It was observed that more food items were recorded in the month of September. This could be attributed to the fact that more food items were available in the month of September than any other months during the sampling period.

4. CONCLUSION

The results obtained in this study showed that only few of Alestes baremoze examined had empty stomach. The reason for this may be due to the fact that the food items in their stomach may have been regurgitated or digested as the fish struggled to escape from the traps and gill nets used in capturing them. The species also showed high level of trophic flexibility. The different variety of food items found in the individual stomach of A. baremoze indicated that the fish is an omnivore and a pelagic fish as well as the stomach contents revealed the presence of more zooplankton such as Copepod naupluis, diaptomus, Cypria spp, Macrothrix spinosa and metopus, some phytoplankton such as paramecium and spirogyra as well as other materials which include fish scales (placoid), shrimp antannae and unidentified materials. Furthermore, the knowledge on the feeding habits of this species resulting from this study should be of benefit in the formulation of supplementary diets necessary for mass production of the species. This will help to meet up local demands as well as to generate foreign exchange for the country. It will as well serve as a baseline for further studies especially on the plankton species which constituted the bulk of the diet of Alestes baremoze.

REFERENCES

Abari, M. A., Usman, M. and Yusuf, K. (2015). Food and Feeding Habit of Nile Tilapia (Oreochromis niloticus) in Doma Dam, Nasarawa State, Nigeria. International Journal of Fisheries and Aquatic Studies; 11 (1): 67-74.

Abdel-Tawwab, M. (2001). Food and feeding habit of Oreochromis niloticus under the effect of inorganic fertilizer with different N: P: K ratios in Abbssa fish ponds. Egypt Agric. Res. 78 (1): 437-448.

Abidemi-Iromini, A. and Ige, O. O. (2017). Gut content composition of Oreochromis niloticus (Trewawas, 1982) from Lagos Lagoon, Nigeria. In: K. E. Lelei (Ed.). Proceedings of the 32nd Annual National National Conference of the Fisheries Society of Nigeria (FISON) 23rd – 28th October, Anambra State. Pp. 320 – 322.

Adebisi, A. (1981). Analysis of the stomach contents of the Piscivorus fishes of the Upper Ogun River in Nigeria. Hydrobiology, 79: 167-177.

Adeyemi S. O. (2009). Food and feeding habits of some commercially important fish species in Gbedikere Lake, Bassa, Kogi State, Nigeria. International Journal of Lake & River. 2009; 2:31-36.

Adeyemi, S. O., Akombu, P.M. and Toluhi, O.O. (2009). Food and feeding habits of Oreochromis niloticus in Lake Gbedikere, Bassa, Kogi State. Continental Journal of Animal and Veterinary Research; 1: 25 – 30.

Agi, P. I. (1995). Vesical Schistosomiasis at OdauVillage in Ahoada Local Government Area, Rivers State, Nigeria West African Journal of Medicine 14 (1): 6-10.

Agumassie, T. and Mathewos, T. (2018). Food and feeding habits of Nile tilapia Oreochromis niloticus (L.) in Ethiopian water bodies: A review. International Journal of Fisheries and Aquatic Studies; 6(1): 43-47.

Akinwumi, F. O. (2003). Food and feeding habits of Tilapia zillii (Pisces; Chichildae) in Ondo State University fish farm (Dept. of Environmental Biology and fisheries). Proc. 16th Ann. Conf. Fish. Soc. Nig., (FISON), pp: 195-198.

Alagoa, E. J. (1999). The land and people of Bayelsa State: Central Niger Delta: Onyoma Research Publications, Port Harcourt, Nigeria 167 p.

Allison, M. E. and Sikoki, F. D. (2013). Food and Feeding Habits of Parailia pellucid (Boulenger, 1901) (Schilbeidae) in the Freshwater Reaches of the Nun River of the Niger Delta, Nigeria. Int 'I. J.of Adv. Fish. and Aquatic Sci. Vol. 1(I): 1-14.

Allison, M. E. and Youdubagha, S. E. (2013). Preliminary studies on the food and feeding habits of Synodontis membranaceous from Ogobiri River, Nigeria. In: P.E. Ndimele (Ed.). Proceedings of the 28th Annual Conference of the Fisheries Society of Nigeria (FISON) Nov. 25th-30th, Abuja. Pp. 233-236.

Anibeze, C. I. P. (1995). Aspect of ecobiology of Heterobranchus longifilis (Valenciennces, 1840) in Idodo River Basin (Nigeria) and their application of aquaculture. University of Nigeria, Nsukka. Ph.D. Thesis. 153p.

Anibeze, C. I. P. (2001). Stomach length and food preference of tree Tilapia species (Osteichthyes: Cichlidae) in Agulu Lake basin, Nigeria J. Aquatic Sciences, 16:57-60.

Aoyiola and Fatureti (1990). The food and feeding habits of mud catfish, Clarias gariepinus caught from the wild. J. West African Fisheries 5: 249-255.

Bachok, Z., Mansor, M. I. and Noordin, R. M. (2004). Diet composition and food Habits of Demersal and Pelagic Marine Fishes from Terengganu Water, East Coast of Peninsular, Malaysia, NAGA, Vol. 27: 3.

Bagenal, T. B. and F. W. Tesch (1978). Age Growth in Method of Assessment of Fish Production in Fresh Waters, (Ed. T. Bagenal). Oxford Blackwell Scientific Publication. Pp. 101-136

Balarin, J. D. (1979). Tilapia. A guide to their biology and culture in Africa. University of Stirling Uk174pp. Bardach, J. F., Ryther, J. H. and Mclarny, W. D. (1972). Aquaculture. The farming and husbandry of fresh water and marine organism. Wiley Interscience, London. Pp 91-270.

Canonico G. C, Arthington A. and Thieme M. L. (2005). The effects of introduced tilapias on native biodiversity. Aquatic Conservation: Marine and Freshwater Ecosystem; 15:463-483.

Collar, D. C., O'Meara, B. C., Wainwright, P. C., and Near, T. J. (2009). Piscivory limits diversification of feeding morphology in Centrarchid fishes. Evolution 63: 1557-1573.

Fagade, S. O. and Olaniyan, C.I.O. (1972). Food and feeding inter-relationship of fishes in Lagos Lagoon, J. fish Biol. 5:203-225.

Gift R.U, (2021). A project proposal on the Food and feeding habit of Galeoides decadactylus in the Brass River, Bayelsa State. Submitted to the department of Fisheries, Niger Delta University. (B.Agric) pp 1-36

Houlihan D, Boujard T, Jobling M. (2001). Food Intake in Fish. Blackwell Science, Oxford, UK, 130-143.

Hynes, H. B. N. (1965). The Food of Freshwater Sticklebacks (Gasterosteus acculealus and Pygoteuspungistis) with review of methods used in studies of the food of fishes. Journal of Animal Eco. 19:36-58p

Hyslop, E. J. (1980). Stomach content analysis. A review of methods and their application. Journal of Fish Biology; 17: 411- 429.

Inyang, W. M. and Nwani, C. D. (2004). Food and feeding habits of Distichodus spp. (OsteichthyesDistichodontidae) in Anambra River. J. of Bio. Res. Technol. 4: 34-43.

Jeje, C. Y. and Fernando, C. H. (1986). A practical guide to the identification of Nigeria Zooplankton (Cladocera, cpepods and rotifer). A publication of Kainji Lake Research Institutes (KLRI), New Bussa. Pp. 1-141.

Kamal, M., Kurt, A. and Michael L. B. (2010). Tilapia Profile and Economic Importance South Dakota Cooperative Extension Service USDA Doc. Retrieved form: http://pubstorage.sdstate.edu/

Ketoye, E. M. (2007). Ecology of nutrient deficient inter surface zone of Lake Nabugabo, Uganda. African Journal of Ecology, 45 (3): 282-284.

Kwen, K. and Yem, I. Y. (2016). Food and feeding habit of Synodontis membranaceous in the Upper Nun River, Bayelsa State, Nigeria. International Journal of Agricultural Innovations, Volume 6, Number 1: 80-86.

Lopez-peralta, R. H. and Arcila, T. (2002). Diet composition of fish species from southern continental shelf of Colombia. NAGA World fish cent. Quart. 25: 23-29.

Njoku, D. C., Keke, I. R. and Allison, M. E. (2009). Food and Feeding habits of Distichodus engycephalus of Lake Oguta: Search for a sustainable Aquaculture in the New Millennium. The Zoology; 7: 122-129.

Northcott, M. E., M. C. M. Beveridge and L. G. Ross. (1991). A laboratory investigation of the filtration and the ingestion rate of Tilapia (Oreochromis niloticus), feeding on two species of blue green algae. Environ. Biol. Fishes, 31:75-85.

Nwani, C. D. (2004). Aspect of the biology of Mormyrids in Anambra River, Nigeria. Ph.DThesis University of Nigeria, Nsukka. Pp. 194.

Odun, O. and Anuta, M. (2001). Food and feeding habits of Musansorgi (Boulenger) from Warri Rivers. Nigerian Journal of Aquatic Sciences; 21: 16-18.

Ogbheneochuko, O. S. (2007). Food and feeding habit of Heterotis niloticus, swim up advance fry from the Kainji Freshwater Reservoir. Department of Fisheries, Niger. J. Fish. Sci. Technol. 1: 89-92.

Ohammed, E. Y., Uraguchi Z. B. (2013). Impacts of climate change on fisheries: implications for food security in SubSaharan Africa. In: Hanjra, M. A. (Eds.) Global Food Security, Nova Science Publishers, 114-135.

Olojo, E. A., Olurin, K. B. and Osikoya, O. J. (2003). Food and feeding Habits of Synodontis nigritafrom the Osun River, SW Nigeria NAGA, World fish center quarterly, volume 26, Number, A Pp 21 – 24.

Oso, J. A., Ayodele, I. A. and Fagbuaro, O. (2006). Food and Feeding Habits of Oreochromis niloticus (L.) and Sarotherodon galilaeus (L.) in a Tropical Reservoir. World Journal of Zoology 1 (2): 118-121.

Otieno, O. N., Kitaka, N. and Njiru, J. M. (2014). Length-weight relationship, condition factor, length at first maturity and sex ratio of Nile tilapia, Oreochromis niloticus in Lake Naivasha, Kenya. International Journal of Fisheries & Aquatic Studies. 2014; 2:67-72.

Saa, P. M., Palomares, L. and Pauly, D. (1997). The food items table. In: Fish Base1997.CD-ROM, ICLARM, Manila, Philippines. 98p.

Shalloof, K. and Khalifa, N. (2009). Stomach Contents and Feeding Habits of Oreochromis niloticus (L.) From AbuZabal Lakes, Egypt. World Applied Journal of Science; 6:01-05.

Shinkafi, B. A. and Ipinjolu, J. K. (2001). Food and feeding habits of Catfish (Synodontis clarias Linnaeus) in River Rima, Nigeria. Journal of Agriculture and Environment, 2 (1): 113-120.

Trewavas, E. (1983). Tilapia species of the Genera Sarotherodon, Oreochromis and Danakila. London British Museum (Natural History) Publication No. 583. Unecia Ltd, Jinja Uganda.

Tudorancea, C.C.H., Fernando and J.C. Pagi. (1988). Food and feeding habits of Oreochromis niloticus (Linnaeus, 1957) juveniles in Lake Awassa(Ethiopia) Arch. Hydrobiol. Suppl, 79: 267-289.

Ugwumba, A. A. A. and Ugwumba, O. A. (2007). Food and Feeding Ecology of Fishes in Nigeria. Crystal Publishers, Lagos 97pp

Umaru, J. A., Annune, P. A. and Cheikyula, J. O. (2014). Food and feeding habit of some selected fish species in Doma Dam, Nasarawa State, Nigeria. In: S. G. Solomon (Ed.). Proceedings of the 29th Annual Conference of the Fisheries Society of Nigeria (FISON) 24th – 28th November, Makurdi, Benue State. Pp 158-164.

Welcomme, R. L. (2001). Inland Fisheries: Ecology and Management. Food and Agriculture Organization/Blackwell Science Publications, 358p

Whisky E. (2019). Project work on the food and feeding habit of Oreochromis niloticus in Ogobiri River, around Amassoma Community, Bayelsa Staate. Submitted to the department of Fisheries, Niger Delta University. (B.Agric) pp 1-39.

Yem I. Y. and Abubakar I. (2013). Aspects of Practical Fish Biology. Okaeme A. N., Nnaji J. C., Olufeagba S. I. and Abubakar I. In Introduction to Freshwater Fisheries, Espatek Nigeria Limited New Bussa, Niger State. 357p

Yi, Y., Lin, C.K and Diana, J. S. (1996). Influence of (Distichodus brivipinnis) stocking Density on their Growth and yield in cages and ponds containing the cages. Aquaculture, 146:205 – 215.