The Zoologist Vol. 7: 21-29 (2009)

DIEL VARIATIONS IN THE FISH SPECIES COMPOSITION OF RIVER OROGODO, SOUTHERN NIGERIA

[*1]Meye, J. A. and [2]Ikomi, R. B.

[1] *Department of Fisheries Technology, Delta State Polytechnic, Ozoro.*
[2]*Department of Animal and Environmental Biology, Delta State University, Abraka.*

Abstract

An investigation to assess the diel distribution of fish species in River Orogodo was carried out between January 2006 and December 2007. Fish sampling was conducted monthly for the 24 months based on day and night sampling effort in three different stations of the river. A total of 5,153 (55.83%) and 4,076 (44.17%) individuals were caught during the day and night respectively. Of the 37 species, only 2 species (*Gnathonemus petersii* and *Gymnarchus niloticus*) were restricted to day time catch only, while one species (*Mastacembellus leonbergii*) was restricted to night catch. The remaining 34 species occurred during both day and night. The dominant day time catch were *Clarias gariepinus*, *Chromidotilapia guentheri*, *Malapterurus electricus* and *Erpetoichthys calabaricus*, while the dominant night catch include *Clarias macromystax*, *Auchenoglanis occidentalis* and *A. biscutatus*. The results of the study showed that diel variations of fish composition and abundance in River Orogodo was related to the activity pattern of the fish during different times, as more fish were caught when active. The diel variations in fish species composition/distribution of River Orogodo were discussed and compared with the findings of earlier studies conducted elsewhere.

Keywords: Diel variation, fish species, River Orogodo, Nigeria.

Introduction

Nigeria is rich in marine and freshwater fisheries resources fauna in over 800km coastline, extensive brackish water, lagoons and creeks, rivers, lakes, ponds and swamps. All are potential sources of fish food for her peoples (Otobo, 1977). Ironically, despite this high fisheries potential of the country, Nigeria not only eats up all her yearly fish production but imports fish to supplement this yearly production because the annual fish production is well below demand. In order to ensure better management of the fisheries resources of the country and for sustainable productivity, detailed studies on the diel variations of the fish communities in these water bodies is not only desirable but compelling (Idodo-Umeh, 2004).

River fisheries is the most neglected area of fisheries research in Africa, yet it contributes about 40% of the fish caught in the freshwaters of the continent each year (Welcomme, 1976). In Nigeria, it contributes more than 60% of fish yield by capture fisheries (FDF, 1984). Despite this, programme of studies of Nigeria freshwater fish and fisheries are restricted to only the major rivers (Niger,

***Corresponding author:**
E-mail: meyeja@yahoo.com

Benue, Sokoto), natural lakes (Chad, Oguta, Aze) and man-made lakes (Kainji, Tiga and Bakolori). In addition, most of those studies in the past were concerned only with the fish composition, distribution and abundance in these water bodies (Lelek and El-Zarka, 1973; Akintunde, 1976; Olatunde, 1977; Tuegels *et al*, 1992; Meye and Ikomi, 2007) while neglecting the temporal (diel) distribution of these species. Few studies on the temporal variations in fish species were mainly restricted to a particular family (Ajayi, 1972; Otobo, 1977; Olatunde, 1979) or genus (Arawomo, 1972; Willoughby, 1974). Documented work on the diel variations in fish species composition in the Niger Delta includes that of Idodo-Umeh (2004) in River Ase and Meye and Ikomi (2008) in Urie Creek. However, the effect of photo period (daylight) on the distribution and abundance of fish species cannot be overemphasized. Therefore, in describing the fish community of a water body, it is important to consider not only the spatial, but also the diel distribution of species as well. This is because such knowledge can be used by fishermen to predict fish abundance in these water bodies (Araoye, 2005).

This paper presents a comprehensive study based on a two-year sampling survey on the diel variations of the 37 fish species recovered from River Orogodo, Southern Nigeria.

Materials and methods

Study area

River Orogodo (5°10′ – 6°20′N and 6°10′ – 6°6′E) (Fig. 1) is located in the Mid-Western Niger Delta area of Nigeria. It is an oligotrophic freshwater river with its origin at Mbiri, where it is fed principally by ground seepage from aquifer and secondarily by precipitation, municipal and surface run-off from the riparian communities. It flows south-westerly for about 45km through Agbor and Abavo, both in Ika South Local Government Area to Obazagbon-Nugu and Evboesi, both in Orhionmwon L.G.A, Edo State, and finally empties into a swamp near Abraka in Delta State. During the wet season months, the swamp normally overflows to the nearby Ethiope River, but during the dry season months, this lower course dries up.

In this study area, two climatic seasons prevailed, namely the wet season (May-October) and the dry season (November-April). Some key physicochemical variables of the river during the wet and dry seasons are: water temperature (20.1-32.7°C), dissolved oxygen (3.8-9.4 mgl^{-1}), conductivity (18-200.3 $mscm^{-1}$), transparency (40.0-124.1cm) and BOD_5 (1.4-14.4 mgl^{-1}). The study stretch was demarcated into three sampling stations namely; Station I (upstream), Station II (midstream) and Station III (downstream) (Fig. 1).

Station I was located at Mbiri, the source of the river. It covers a distance of about 5km with an average width and depth of 3.5m and 0.37m respectively. Dominant riparian vegetations are *Panicum repens, Vossial cuspidate, Echinochlea pyramidalis, Commelina* and *Nymphaea spp.* The flow velocity in this stretch is relatively high with an average of 25-40cm/s.

Station II, called the midstream of the study stretch, spans from Agbor municipal to Owa-Ofie, about 2km downstream of Station I. The average width of the river here is about 4.5 and a depth of about 0.57m. This section of the river has numerous abattoirs located along the stretch which discharge their wastes into the river. The station, for most of its length is sparsely vegetated – the marginal vegetation is composed of grasses such as *Panicum sp* and ferns. There are also sparse population of floating macrophytes such as *Pistia stratiotes* and *Azolla africana*. The current velocity is about 22 – 35cm/s.

Station III was located at Abavo about 11km downstream of Station II. It is heavily shaded and bordered by marginal vegetations such as bamboo trees (*Bambusa sp*) and raffia palms. Average width and depth measured 6m and 0.70m respectively. The mid-channel of the river in this station is mostly open, and the current velocity is relatively slow (about 13 – 28cm/s). The substratum is predominantly sand and salt. Relevant human activities in the river include fishing, cow slaughtering, commercial sand dredging and discharge of domestic effluents.

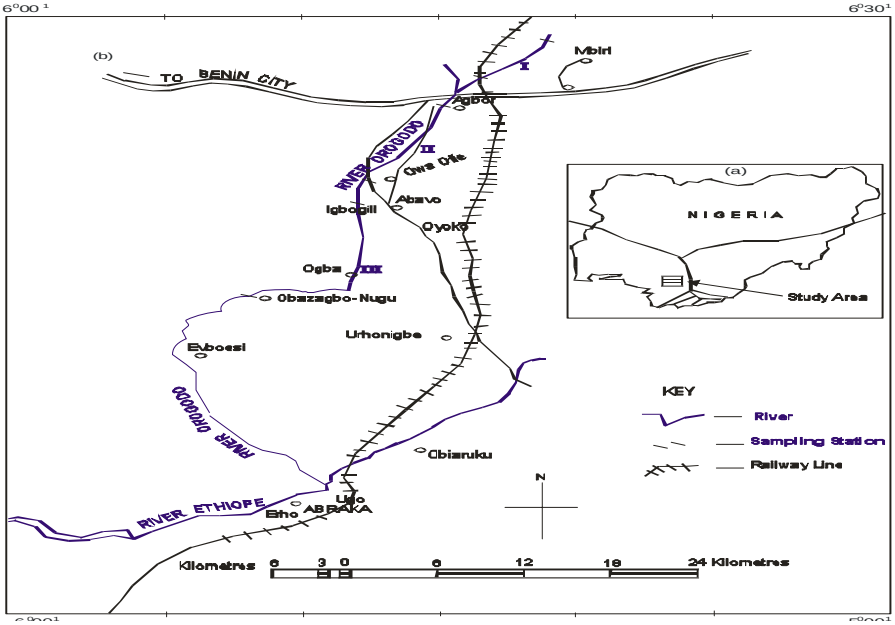

Fig.1. The study area. (a) Nigeria showing the location of Agbor
(b) Study station showing the location of the sampling stations
Source: Directorate of Lands and Surveys, Governors Office, Asaba (2000).

Fish sampling and identification

Monthly fish sampling was conducted day and night and during dry and wet seasons from River Orogodo at the three stations from January 2006 to December 2007. Sampling was conducted using set gill nets (22 – 70mm stretched mesh size), drag net (10mm stretched mesh size) and a hand net of 0.5mm between 9.00 – 12.00 hours in the day and 21.00 – 24.00 hours at night. Fishes were captured and preserved in 10% formalin prior to laboratory examination. In the laboratory, the specimens were sorted, identified, counted and labeled in appropriate containers.

Fish samples were identified using the taxonomic keys as provided by Olaosebikan and Raji (1998) and Idodo-Umeh (2003). The standard and total lengths were measured to the accuracy of 0.1mm, and weighed to the nearest 0.1g using an electronic weighing balance.

Data analysis

Chi-square test (X^2) ($P<0.05$) was used to test for significance difference between the fish abundance in day and night samples. The relative abundance score (%) of each species was calculated as in Ogbeibu (2005).

Results

Diel variations

The variations in day and night catches for the individual species in River Orogodo during the

period of study are presented in Table 1. A total of 5,153 individuals representing 55.83% were captured during the day time while 4,076 individuals or 44.17% were caught during the night. Chi-square test computed indicated a significant difference (X^2=125.68, P<0.05) between the day and night catches in the river. Out of a total of 37 species recorded in the entire study period, 2 species (*Gnathonomus petersii* and *Gymnarchus niloticus*) were restricted to the day catches while only one species (*Mastacembellus leonbergii*) was restricted to night time. The remaining 34 species were caught during both day and night times. The table showed a general trend of more catches in the day time for most species than in the night.

Figure 2 shows the variation in percentage of day and night catches of the three dominant families in River Orogodo. The family bagridae recorded 295 individuals or 27.70% during the day time and 770 or 72.03% during the night. There was a significant difference (X^2 = 211.9, P<0.05) between the day and night catches in the family. The family clariidae had 880 individuals representing 50.96% caught during the day while 847 or 49.04% were caught at night. There was no significant difference (X^2 = 0.631, P>0.05) between the day and night catch of this family. Similarly, the family cichlidae recorded 1,155 individuals or 64.89% during the day and 625 or 35.11% at night. This showed a significant difference (X^2 = 146.12, P<0.05) between the day and night catch in the family.

The diel variations in catch among the individual species in the three dominant families are presented in Table 2 and trends are described below.

Bagridae

Auchenoglanis biscutatus recorded 47 individuals representing 28.21% in the day time and 374 or 71.79% in the night. Chi-square test carried out showed a significant difference (X^2 = 253.99, P<0.05) between the day and night catch.

Auchenoglanis occidentalis had 148 individuals or 27.20% caught during the day while 396 individuals or 72.80% were recorded in the night. The night time catch were also significantly higher (X^2 = 113.06, P<0.05) than the day time catch.

Clariidae

Out of a total of 798 individuals of *Clarias gariepinus* caught during the study period, 502 or 62.91% was recorded in the day while 296 or 32.06% was recorded in the night. Chi-square test showed a significant difference (X^2 = 53.18, P<0.05) between the day and night records. For *Clarias auguillaris*, 194 or 59.88% individuals were recorded during the day while 130 individuals representing 40.12% were caught in the night. The day time catch was also statistically different (X^2 = 12.64, P<0.05) from the night time catch. *Clarias macromystax* had more catches in the night (421 or 69.59%) than the day which had 184 individuals representing 30.41%.

Cichlidae

Chromidotilapia guentheri had a total of 416 individuals (81.73%) in the day time catch and 93 individuals (18.27%) in the night. This showed a significant difference (X^2 = 102.48, P<0.05) in the number of individuals caught during the two different sampling periods.

Out of a total of 570 individuals of *Hemichromis fasciatus* caught in this study, 353 or 61.93% were recorded in the night while 217 or 38.07% individuals occurred in the day time catch. Chi-square test indicates a significant difference (X^2 = 32.45, P<0.05) between the abundance of this species in day and night time.

The diel variations in the catch of *Oreochromis aureus, O. niloticus, Sarotherodon macrocephala* and *Tilapia dageti* were not significantly different (P>0.05). A total of 250 individuals of *Tilapia mariae* were caught out of which 227 or 90.80% was recorded in the day while the remaining 23 or 9.20% were caught at

night. The day time catch was significantly higher ($X^2 = 166.5$, $P<0.05$) than the night catch.

The total number of individuals of *Tilapia zilli* caught during the study period was 253. Out of the number, 201 or 79.45% were recorded in the day time while only 53 individuals representing 20.55% was recorded in the night.

Table 1. Diel Variations in fish abundance in River Orogodo, Nigeria from January 2006 to December 2007

S/N	Fish Species	Total N	Day n_1	%	Night n_2	%
1	*Erpetoichthys calabaricus*	593	375	7.22	218	5.35
2	*Pantodon bucholzi*	225	180	3.49	45	1.10
3	*Papyrocranus afer*	40	78	0.54	12	0.29
4	*Xenomystus nigiri*	291	169	3.28	122	2.99
5	*Brienomyrus branchistius*	244	174	3.38	70	1.72
6	*Hyperopisus bebe occidentalis*	223	47	0.91	176	4.32
7	*Isichthys henryii*	78	21	0.41	57	1.40
8	*Gnathonemus petersii*	7	7	0.14	-	-
9	*Phractolaemus ansorgei*	421	200	3.88	221	5.42
10	*Brycinus longipinnis*	135	105	2.04	30	0.74
11	*Hepsetus odoe*	64	15	0.29	49	1.20
12	*Barbus callipterus*	217	147	2.85	70	1.72
13	*Auchenoglanis biscutatus*	521	147	2.85	374	9.18
14	*Auchenoglanis occidentalis*	544	148	2.87	396	9.72
15	*Schilbe intermedius*	55	15	0.29	40	0.98
16	*Clarias gariepinus*	798	502	9.74	296	7.26
17	*Clarias anguillaris*	324	194	3.76	130	3.19
18	*Clarias macromystax*	605	184	3.57	421	10.33
19	*Epiplatys sexfasciatus*	131	99	1.92	32	0.79
20	*Parachanna africana*	364	171	3.32	193	4.74
21	*Parachanna obscura*	177	111	2.15	66	1.62
22	*Malapterurus electricus*	519	377	7.32	142	3.48
23	*Polycentrysis abbreviata*	282	200	3.88	82	2.01
24	*Chromidotilapia guentheri*	509	416	8.07	93	2.28
25	*Hemichromis bimaculatus*	134	96	1.86	38	0.93
26	*Hemichromis fasciatus*	570	217	4.21	353	8.66
27	*Oreochromis aureus*	128	58	1.13	70	1.72
28	*Oreochromis niloticus*	11	7	0.14	4	0.10
29	*Sarotherodon macrocephala*	13	9	0.18	4	0.10
30	*Tilapia dageti*	46	20	0.39	26	0.64
31	*Tilapia mariae*	250	227	4.41	23	0.56
32	*Tilapia zillii*	253	201	3.90	52	1.28
33	*Mastacembellus leonbegii*	3	-	-	3	0.07
34	*Ctenopoma kingsleyae*	272	183	3.55	89	2.18
35	*Ctenopoma petherici*	175	97	1.88	78	1.91
36	*Gymnarchus niloticus*	2	2	0.04	-	-
37	*Ilisha africana*	5	4	0.08	1	0.03
	Total	9229	5153		4076	
	Relative abundance %		55.83		44.17	

Table 2. Variations in the day and night catches of major fish families or species in River Orogodo, Nigeria

Fish Families/Species	Day	Night	X^2 (P = 0.05)
Bagridae			
Auchenoglamis biscutatus	147	374	98.9*
A. occidentalis	148	396	113.06*
Total	295	770	
Claridae			
Clarias gariepinus	502	296	53.18*
C. anguillaris	194	130	12.64*
C. macromystax	184	421	92.84*
Total	880	847	
Cichlidae			
Chromidotilapia guentheri	416	93	204.96*
Hemichromis fasciatus	217	352	32.44*
Oreochromis aureus	58	70	1.13
Oreochromis niloticus	7	4	0.82
Sarotherodon macrocephala			
T. dageti	9	4	1.92
T. mariae	20	26	0.78
Tilapia zillii	227	23	166.46*
Total	201	52	87.76*
	1155	625	

* indicates significance

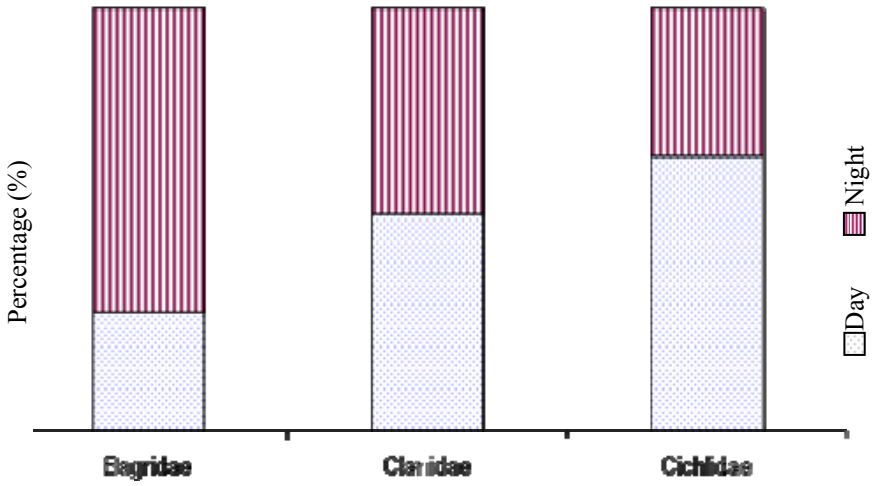

Fig. 2. Percentage variation of day and night catch of dominant fish families in River Orogodo, Nigeria

Discussion

The fish species composition of River Orogodo has shown distinct dissimilarity between day and night time as more individuals captured in the day implies higher activities during the day. This finding is similar to that recorded by Motwani and Kanwai (1970); Allison *et al*, (1997), Idodo-Umeh (2004) and Meye and Ikomi (2008). On the other hand, Ikusemiju (1973) reported more individuals in night catch than in day catch and attributed this to the ability of the fish to avoid fishing gear during the day. This observation seemed to support the view of Lagler *et al*, (1977) that large numbers of fish species are negatively phototrophic and therefore there is bound to be a considerable reduction in the number of fish caught during daylight. Arawomo (1972) observed that the diel variations in the number of fish were caused by gear selectivity.

In River Orogodo however, the types of fishing gear used were the same for both day and night sampling and so gear selectivity cannot be considered as a valid reason for the differences observed. It appears that more species as well as more individuals are active during the day and are hence vulnerable to the day time fishing activity. In terms of number of species, 36 species were caught in the night. Though there was no significant difference between the number of species in both day and night, the general trend was high catch for each species in the day time than night time. Brown (1985) recorded more of *Brycinus longipinnis* in Ikpoba River in the day time while Ikomi *et al*, (2005) reported more of *Thysia ansorgei* in Ethiope River during the day. As Motwani and Kanwai (1970) pointed out, the diel habits of the different species are likely to influence the species composition of day and night catch.

The family bagridae had a significantly higher abundance in the night than in the day. The two species, *Auchenoglanis biscutatus* and *A. occidentalis*, appears to be active during the night. Previous studies in the past have reported a greater activity at night of some fish species (Arawomo, 1972; Idodo-Umeh, 2004). Moreover, many catfish species have been reported to be capable of non-visual feeding (Zaret, 1980) and this probably account for the high numbers of these two species of bagridae in the night.

The three species of the family clariidae appears to be active at both day and night as there was no significant difference between the day and night catch for the species combined. This could be an adaptation to search for food at all times in the face of inter and intra-specific competition for resources in the habitat. It could also confirm that light is not a limiting factor in the search for food/mate by members of this family. However, individual species for *Clarias gariepinus* and *C. anguillaris* had greater number in the day time than in the night while *C. macromystax* occurred more in the night than the day. The family cichlidae recorded significantly higher number in the day than the night, though the diel variation in abundance varies among the species of this family. *Chromidotilapia guentheri*, *Tilapia mariae* and *Tilapia zilli* were caught more in the day than the night while *Hemichromis fasciatus* had higher abundance in the night catch than the day. The remaining species, e.g., *Oreochromis aureus*, *O. niloticus, Sarotherodon macrocephala* and *Tilapia dageti* did not fit either into day or night category. Therefore it is difficult to generalize the diel activity patterns of this family of fishes in River

Orogodo into distinct groups. This however is of adaptive advantage as differences in time of movement/activity of closely related species would help to keep them seasonally distinct and thereby reducing inter-specific competition (Lowe-McConnel, 1975 and Idodo-Umeh, 2004). Variations in diel activity patterns could be an effective method for resource partitioning and avoidance of competition among different species of fish inhabiting the same stretch of the river.

The results of this investigation have shown that the fish species composition and abundance in River Orogodo varied between day and night time. These variations appear to be related to the activity pattern of the fish species during different times of the day as more fish samples were caught when active.

Acknowledgements

We are grateful to the two institutions: Delta State University, Abraka and Delta State Polytechnic, Ozoro, for providing the necessary facilities for this research work.

References

Ajayi, O. (1972). The Biological Studies of the Family Bagridae (Pisces, Siluroidei) in Lake Kainji, Nigeria. M. Phil. Thesis, University of Ife, Nigeria, 155pp.

Akintunde, E.A. (1976). The Biology of *Tilapia* and *Sarotherodon* species of Kainji Lake, Nigeria, with Special Reference to *Sarotherodon galilaeus*. M.Sc. Thesis, University of Ife, Nigeria, 200pp.

Allison, M.E., Gabriel, U.U., Inko-Tariah, M.B., Davies, O.A. and Udeme-Naa, B. (1997). The Fish Assemblage of Elechi Creek, River State, Nigeria, Niger Delta. *Biologia*, 2(1): 90 – 96.

Araoye, P.A. (2005). Relationship Between Rainfall, Water Levels, Flooding and Fish Supply from Asa Dam, Ilorin, Nigeria. Proc. Of the 20th Annual Conf. of the Fisheries Society of Nigeria (FISON), Port Harcourt, 14 – 18 November, 2005.

Arawomo, G.O. (1972). The Ecology of Fish Genera, *Citharinus* and *Distichodus* in Lake Kainji, Nigeria. M. Phil. Thesis, University of Ife, Nigeria, 129pp.

Brown, C.A. (1985). The Food and Feeding Relationship of Non-Cichlid Fishes of Ikpoba River, Downstream of the Dam. M.Sc. Thesis, University of Benin, Benin City, Nigeria.

FDF (1984). Federal Department of Fisheries Annual Report 58pp.

Idodo-Umeh (2003). Freshwater Fishes of Nigeria. (Taxonomy, Ecological notes, diet and utilization). Idodo-Umeh Pub. Benin City, Nig. Pp332.

Idodo-Umeh, G. (2004). Diel Variations in the Fish Species of River Ase, Niger Delta, Nigeria. *Tropical Freshwater Biology,* 12/13: 63 – 76.

Ikomi, R.B., Arimoro, F.O. and Abake, E.F. (2005). Some Aspects of the Biology of *Thysia ansorgii* (Boulenger) (Cichlidae) in River Ethiope, Delta State, Nigeria. *Journal of Tropical Biosciences*, 5(2): 1 – 7.

Lagler, K.F., Bardach, J.E., Miller, R.R. (1977). Ichthyology: The Study of Fishes. John Wiley and Sons Inc. New York and London. 545pp.

Lelek, A. and El-Zarka, S. (1973). Ecological Comparison of Pre-Impounded Fish Fauna of River Niger and Kainji Lake, Nigeria. *Geophysical Monograph,* 17: 655 – 660.

Lowe-McConnel, R.H. (1975). Fish Communities in Tropical Waters: Their

Distribution, Ecology and Evolution. 1st Edition, Longman, London. 378pp.

Meye, J.A. and Ikomi, R.B. (2008). A Study of the Fish Fauna of Urie Creek at Igbide, Niger Delta. *The Zoologist*, 6: 69 – 80.

Meye, J.A. and Ikomi, R.B. (2007). Observations on Some Aspects of the Ecology of Cichlid Fishes in Urie Creek, Niger Delta, Nigeria. *Journal of Agric. Res. and Policies*, 2(2): 39 – 45.

Motwani, M.P. and Kanwai, Y. (1970). Fish and Fisheries of the Coffer-dammed Right Channel of the River Niger at Kainji. In Visser, S.A. (ed) Kainji Studies in Ecology, Ibadan University Press, Ibadan. 346pp.

Ogbeibu, A.E. (2005). Biostatistics. A Practical Approach to Research and Data Handling. Mindex Press, Benin City. 264pp.

Olaosebikan, B.D. and Raji, A. (1998). Field Guide to Nigeria Freshwater Fishes. Federal College of Freshwater Fisheries Technology, New Bussa. 106pp.

Olatunde, A.A. (1977). The Distribution, Abundance and Trend in the Establishment of the Family Schilbeidae (Osteichthys, Siluriformes) in Lake Kainji, Nigeria. *Hydrobiologia*, 56: 69 – 80.

Olatunde, A.A. (1979). The Biology of the Family Schilbeidae (Osteichthys, Siluriformes) in Lake Kainji. In: Proceedings of the International Conference on Lake Kainji and River Basin Development in Africa, Ibadan, 11 – 17 December, 1977, Kainji Lake Research Institute Publications, New Bussa. 2: 393 – 412.

Otobo, F.O. (1977). The Biology of Clupeid Fishes in Lake Kainji, Nigeria. Ph.D. Thesis, University of Ife, Nigeria. 272pp.

Tuegels, G.G., Reid, G.M. and Kings, R.P. (1992). Fishes of the Cross River Basin (Cameroon-Nigeria). Taxonomy, Zoogeography, Ecology and Conservation Musee Royal De L'Afrique Centrale Tervaren, Belgique, *Annals Sciences Zoologiques*, Vol. 266.

Welcome, R.L. (1976). The Fisheries Ecology of African Flood Plains. *CIFA Tech. Pap.*, 3: 1 – 51.

Willoughby, N.G. (1974). The Ecology of the genus *Synodontis* (Pisces, Siluroidei) in Lake Kainji, Nigeria. Ph.D. Thesis, University of Southampton. 242pp.

Zaret, T.M. (1980). Predation and Freshwater Communities. Yale University Press, New Haven, 187pp.