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Composition, Abundance and Distribution of Fishes in Onah Lake, Asaba, Nigeria

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ABSTRACT: A comprehensive survey of the itchyofauna of Onah Lake was undertaken to provide data on the composition, abundance, distribution, diversity and ecological structure of this perennial freshwater body, located west of the River Niger flood plain. Fish sampling was conducted monthly between January 2000 and December 2001. A total number of 2,682 specimens belonging to 35 genera, 25 families and 46 species, were encountered. Spatial variation in fish catch revealed that station 'A' recorded 880 specimens; station 'B' recorded 793 specimens while station 'C' recorded 1009 specimens. The least number of taxa (36) and specimens (793) were encountered in station 'B' which also showed the poorest richness (9.46) in species composition. The ponderal index revealed that Citharinus citharus and Sarotherodon galilaeus contributed 16.1%; 13.4% and 10.3%; 10.1% respectively of the total fish catch by number and by biomass. They were the most dominant species. Four out of the nine rare species recorded were restricted to station 'C' while the other members of this group were encountered in two or three stations; the rare species contributed 19.6% by number and 1.37% by biomass. The analysis of variance revealed that fish abundance varied significantly ($P < 0.05$) among the stations across the months. Fish catch was significantly higher ($P < 0.05$) in the dry season (1452 ± 67.07) than the rainy season (1230 ± 46.33).

Keywords: *Citharinus citharus,* Ponderal index; Fish composition; Onah Lake.

Introduction

Onah Lake and its environs in recent times, has been receiving increased attention as a recreational centre for the new capital city of the newly created Delta State, Nigeria. Physical development and other human activities common in cities are making incursions into the hitherto unperturbed and serene environment. Man's activities are known to modify the physical, biological and socio-economic environment (Roggeri, 1995), such that the fauna can be altered as a result of changes affecting the flora and habitat of the area. Such modification results to ecological change via trophic relations. These activities have made it mandatory to protect the ecological integrity of the ecosystem. Of primary concern is the sustenance, management and protection of its naturally occurring ecosystem especially its fish population.

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There is a global rise in the interest of researchers, to maintain biological and genetic diversity which will be of benefit to future generation. Dugan (2003) stated that long term sustainable use of African lake fisheries will require better governance and significant improvement in the management of land and water use in the catchment's basins.

Scientific studies on African lakes whose size range between 2,003 and 75,000km^2 abounds. Amongst them, are Tchad, Victoria, Kainji and Volta lakes, (Dugan, 2003).

Onah Lake is a small natural freshwater body in Oshimili South Local Government Area of Delta State. Like other freshwater bodies in Nigeria, this lake has been undergoing steady exploitation. The only scientific work carried out so far in the lake, was a one-month fish fauna survey by Aikoriogie, (1988). This study was therefore the first comprehensive documented ecological assessment of the lake geared towards providing data on species composition, abundance, distribution, and diversity with which future faunal changes resulting from man's interventions in the environment may be assessed and managed.

Materials and Methods

Description of study area.

Onah Lake is a perennial freshwater body located west of the River Niger flood plain. It lies between longitude 6^{o}41' to 6^{o}43' East and latitude 6^{o}41' to 16^{o}18' North of the equator. The lake is found in the rain forest zone, about 8.0km from Asaba town in Oshimili South Local Government Area of Delta State. Its substratum is made of a deep layer of clay and an ad-mixture of silt and decomposing organic matter surrounding a lake area of ten kilometer square (10.00km^2). The lake is believed to be an offshoot of the Niger River judging by their nearness and semblance of substratum.

The lake, which is in the Asaba- Ogwashi rock formation, has a gentle slope west of its bank. This permits an influx of surface run-off and organic matter derived from the surrounding vegetation contributing to its allochthonous nutrient input. The headwaters of the lake are rivers Iyiocha-Uno and Odo-Ogolo which join north of Ugbolu town (fig. 1). From this confluence, the river flows eastwards as Oto-Oshushu river before flowing southwards as river Uto into the lake. Two adjoining water bodies (Niger and Anwai rivers) derived only during the rainy season peak and flood, inundates the adjoining and adjacent land making the lake appear as a single body of water covering a greater land area. However, at the onset of the dry season, as the flood recedes, the lake assumes its original smaller surface area forming three clearly demarcated compartments known by the indigenes as Obabala, Ogbu and Ododo Onah designated as stations A, B and C.

The upstream station 'A' has a maximum length of about 3731m, a water depth of roughly 4m and a maximum width 472m. The region was infested with submergent vegetation including *Ceratophylum demersum*, *Utricularia* sp. and a fern *Diaplazium* sp. Other vegetations were *Azolla pinnata* and *Pistia stratiotes*. The midstream station 'B' had a maximium length of 3067m, a depth of 6m and a maximum width of 112m. Its fringing vegetation included *Panaicum subalbidium, Terminalia ivorensis, Raphia nitida* and *Dialium guirensis*. There was also a floating macrophyte *Azolla pinatta*.

The downstream station 'C' has a maximum length of 3201m, a water depth of 5m and a maximum width of 174m. Its bottom was characterized by pockets of depressions and its vegetation included *Pistia stratiotes, Nymphaea lotus, N. micrantha* and *Ipomoea aquatica*. All macrophytes were identified using the key illustrations of Akubundu and Agyakwa (1998).

Active farming was observed on the flood plain of the lake at stations 'A' and 'B' during the dry season. The farmers cultivate groundnut, yam and an improved cassava variety that matures within six months. All crops are harvested just as the flood set in.

Fish collection

The sampling programme spanned through January 2000 to December 2001, when routine sampling was conducted once a month. The gears used were set over night at 1800hrs and tended twice a day between 0700hrs to 1000hrs and 1600hrs to1800hrs. Fish capture was conducted with the assistance of two boatmen, operating at each station. Ten sets of gill nets measuring 25m stretched and three meters deep, were set at the bottom/water column. A cast net with 0.64m pocket stretched mesh with a diameter of six meters was used in each station. Ten trigger traps and baskets of different shapes and sizes were pitched at the demersal region. Ten sets of foul-hooked long line, measuring 35m, were pitched along the fringing vegetation at each station. When the water level in the lake was low during the dry season, a fish aggregating device called 'Bangana' was used for fish capture. All harvested specimens were packed in an ice chest and transported to the laboratory where they were sorted, measured and identified according to key and description of Idodo-Umeh, (2003).

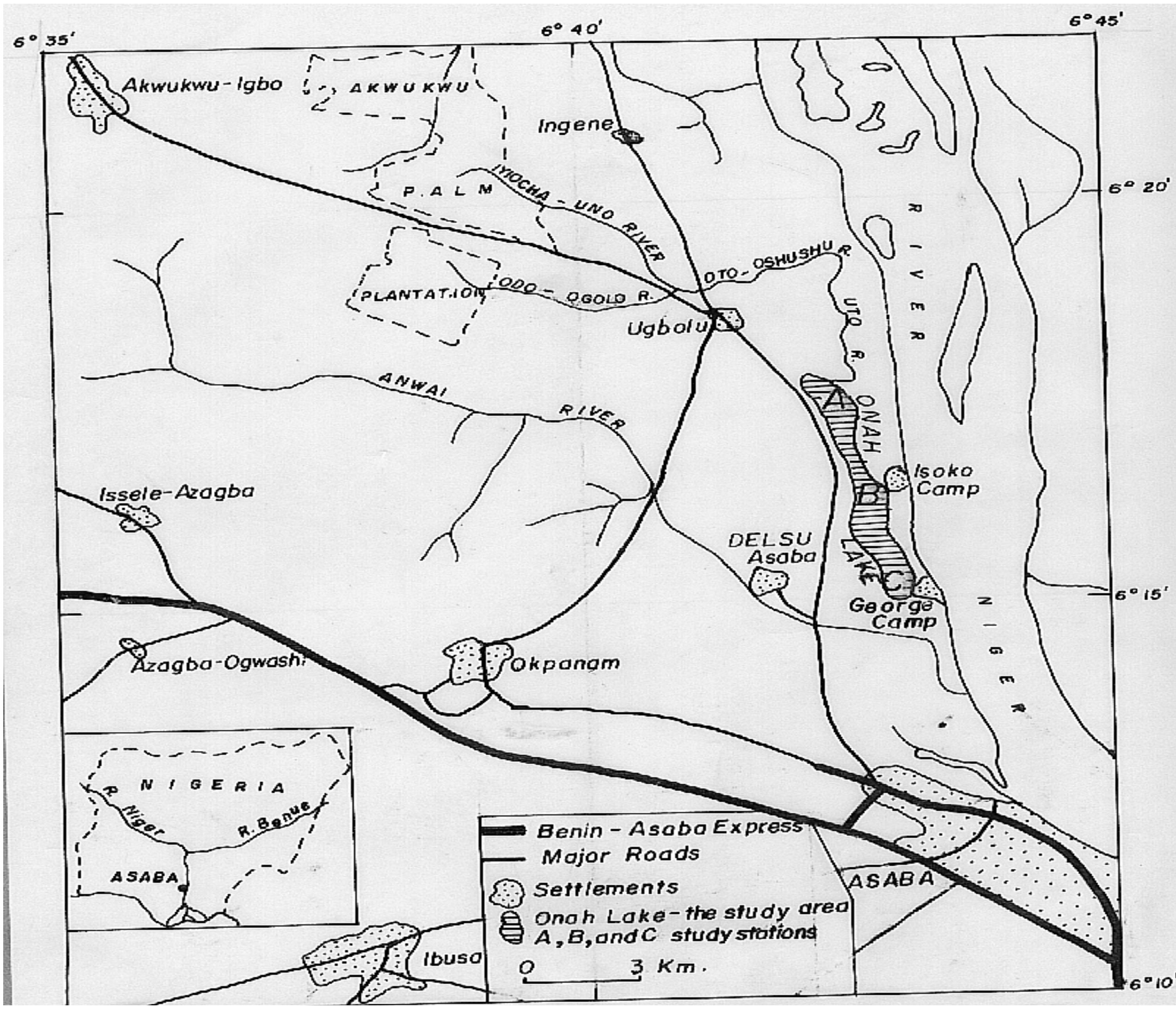

Fig 1: Map of Asaba and environ showing the study area (Onah Lake) and study stations A, B and C.

Data analysis.

Fish species were analysed using fish diversity indices as follows: Mergalef Index for species richness (M) Shannon-Wiener Index (H) for general diversity and species Evenness Index (E), (Zar, 1984). The ponderal index (PI) was used to analyze the fish sampled by number, and by biomass and expressed in percentage. Fish species with a ponderal index of 1-9% was regarded as a 'permanent' occupant of the lake

(Lauzanne, 1983). A ‘dominant’ fish species was that accounting for 10% or more both by number and by biomass. Contributions between 0.5-0.9percent were the value ascribed to a ‘present’ member, while a value below 0.5% was recorded as a ‘rare’ member of the lake. Analysis of variance and Duncan New Multiple Range Test (Steele and Torrie, 1960) were used to test for significant differences among the stations and mean comparisons respectively.

Results and Discussion

Fish composition and distribution

The total number of specimens caught during the twenty four months of sampling was 2,682. This number is made up of 35 genera, 25 families and 46 species (Table 1). Station ‘B’ contributed the least (793 specimens), followed by station ‘A’ with 880 specimens. The highest number of specimens caught (1009), was recorded in station ‘C’. When the ponderal index was used to determine abundance and biomass, situations arose where a fish species made up of few specimens became weightier than the combined weights of more specimens of smaller sizes. This was the reason why *Parachanna obscurus* which was a ‘permanent’ occupant when percentage by number was used in the ponderal index, became a ‘present’ occupant when percentage by biomass was applied. Similarly, *Distichodus engycephalus* which was a ‘present’ occupant when percentage by number was used became a ‘permanent’ occupant when percentage by biomass was applied.

The fish fauna was dominated by two species, namely *Citharinus citharus* and *Sarotherodon galilaeus* contributing 16.1%; 13.4% and 10.3%; 10.1% respectively of the total fish catch by number and by biomass (Table 1). *Citharinus citharus* was the most dominant species in the lake, irrespective of number and biomass. This species was ubiquitous, occurring at all times. The ‘permanent’ species were represented by 27 taxa contributing 66.0% by number and 70.23% by biomass. The ‘present’ species which were seven in number contributed 5.6% by number and 4.9% by biomass. The ‘rare’ species totaling nine, contributed 1.96% by number and 1.37% by biomass. These observations were in agreement with those reported in Kainji Lake (Arawomo, 1972). Aikoriogie, (1988) had earlier reported only two fish species after one mouth survey of the lake. This observation contrasts with that of the present study. The increased number of species is attributed primarily to greater sampling duration and intensity, use of varied gears and greater attention to detailed identification (Idodo-Umeh 2001). Again more species may have migrated from the adjoining rivers either for breeding, feeding or during the flood (Lauzanne, 1983, and Idodo-Umeh, 2001).

Table 1: Spatial distribution and relative abundance by number, by biomass and percentage distributions of fishes in Onah Lake during the study period.

Taxa	**No. of Specimen Caught in Stations**			**Total specimen caught.**	**% by Number**	**Index of Abundance by number**	**% biomass**	**Index of biomass**
	A	**B**	**C**					
ANABANTIDAE								
Ctenopoma kinsleyae(Gunther 1896)	12	-	8	20	0.8	. .	0.4	.
BAGRIDAE								

Taxa	**No. of Specimen Caught in Stations**			**Total specimen caught.**	**% by Number**	**Index of Abundance by number**	**% biomass**	**Index of biomass**
	A	**B**	**C**					
Auchenoglanis bisculatus	19	45	33	97	3.6	. . .	1.3	. . .
Auchenoglanis occidentalis	11	32	14	57	2.1	. . .	1.2	. . .
Bagrus bayad	11	38	24	73	2.7	. . .	1.8	. . .
Bagrus filamentosus	18	39	31	88	3.3	. . .	1.2	. . .
Chrysichthys auratus longifilis(Geoffery St Hilaire,1809)	28	14	19	61	2.3	. . .	1.5	. . .
CENTROPOMIDAE								
Lates niloticus (Linnaeus, 1962)	06	03	04	13	0.5	. .	0.6	. .
CHANNIDAE								
Parachanna obscura (Gunther, 1861)	23	-	18	41	1.5	. . .	0.9	. .
CHARACIDAE								
Brycinus nurse (Ruppel, 1832)	28	13	21	62	2.3	. . .	1.7	. . .
Brycinus macrolepidotus	10	06	14	30	1.1	. . .	0.3	.
Hydrocynus lineatus	17	-	22	39	1.4	. . .	0.8	. .
CICHLIDAE								
Oreochromis niloticus (Linnaeus 1757)	11	08	26	45	1.7	. . .	2.4	. . .
Sarotherodon galilaeus (Artedi, 1757)	90	83	102	275	10.3	. . . .	10.1	. . . .
CITHARINIDAE								
Citharinus citharus (Geoffrey St Hilaire, 1809)	130	128	174	432	16.1	. . . .	13.4	. . . .
Citharinus latus	49	70	55	174	6.5	. . .	8.0	. . .
CLARIIDAE								
Clarias anguillaris (Daget, 1960)	35	20	45	100	3.7	. . .	5.8	. . .
Clarias gariepinus (Cuvier and Valenciennes, 1864)	60	46	69	175	6.5	. . .	8.5	. . .
Heterobranchus bidorsalis	22	24	30	76	2.8	. . .	3.9	. . .
Heterobranchus longifilis (Cuvier and Valenciennes, 1864)	31	11	25	67	2.5	. . .	3.5	. . .
CYPRINODONTIDAE								
Epiplatys sexfasciatus	01	-	06	07	0.3	.	0.03	.
CYPRINIDAE								
Labeo coubie (Ruppel, 1832)	10	20	18	48	1.8	. . .	1.37	. . .
DISTICHODONTIDAE								
Distichodus engycephalus (Gunther ,1864)	13	-	11	24	0.9	. .	1.1	. . .
Distichodus rostratus	02	04	05	11	0.4	.	0.6	. .
GYMNARCHIDAE								
Gymnarchus niloticus (Cuvier, 1829)	06	01	03	10	0.4	.	5.5	. . .
HEPSETIDAE								
Hepsetus odoe (Block, 1865)	06	-	09	15	0.6	. .	1.1	. . .
ICHTHYBORIDAE								
Phago loricatus Gunther, 1965	11	01	03	15	0.6	. .	0.1	.
Phago ornatus Gunther, 1965	-	-	01	01	0.04	.	0.002	.
Garra waterloti (Daget, 1960)	-	-	01	01	0.04	.	0.004	.

Taxa	No. of Specimen Caught in Stations			Total specimen caught.	% by Number	Index of Abundance by number	% biomass	Index of biomass
	A	B	C					
LEPIDOSIRENIDAE								
Protopterus annectens (Owens, 1939)	02	02	06	10	0.4	.	3.2	...
MALAPTERURIDAE								
Malapterurus electricus (Gmeli, 1789)	08	14	12	34	1.3	...	1.3	...
MASTACEMBALIDAE								
Mastacembelus loennbergi	09	10	13	32	1.2	...	0.5	..
MOCHOKIDAE								
Synodontis clarias	13	07	20	40	1.2	...	1.4	...
Synodontis nigrita Cuvier and Valenciennes, 1864	08	07	11	26	1.0	...	1.7	...
Synodontis sorex (Gunther, 1864)	07	03	03	13	0.5	..	1.3	...
MORMYRIDAE								
Gnathonemus abadii (Boulenger, 1901)	18	08	12	38	1.4	...	1.7	...
Gnathonemus petersii	15	05	05	25	0.9	..	1.0	...
Hyperopisus bebe occidentalis (Lacepede 1803)	10	03	16	29	1.1	...	0.9	..
Mormyrus deliciosus	04	02	02	08	0.3	..	1.2	...
NOTOPTERIDAE								
Papyrocranus afer (Gunther 1868)	39	10	18	67	2.5	...	2.36	...
Xenomystus nigri (Gunther 1968)	07	06	08	21	0.8	..	0.3	.
OSTEOGLOSSIDAE								
Heterotis niloticus (Ehrenberg, 1829)	08	08	11	27	1.0	...	1.8	...
PHRACTOLAEMIDAE								
Phractolaemus ansorgei (Boulenger, 1901)	-	-	01	01	0.04	.	0.2	.
POLYPTERIDAE								
Erpetoichthys calabaricus (Smith, 1866)	22	31	24	77	2.9	...	2.9	...
SCHILBEIDAE								
Eutropius niloticus (Ruppel, 1872)	27	12	25	64	2.4	...	0.6	..
Schilbe mystus (Linneaus, 1762)	23	59	30	112	4.2	...	2.3	...
TETRAODONTIDAE								
Tetraodon fahaka (Linnaeus, 1762)	-	-	01	01	0.04	.	0.03	.
TOTAL	880	793	1009	2682	100%		100%	

Key:

. Rare species ≤ 0.5% , **..** Present species ≥ 0.5% -0.9%,
. . . Permanent species ≥ 1.0% -9.0% **....** Dominant species ≥ 10.0%

The analysis of variance (ANOVA) revealed significant differences ($p < 0.05$) in total fish catch with respect to spatio-temporal distributions (fig 2). Each station showed a zenith value in fish catch in at least one month. Thus station ‘B’ which consistently recorded the lowest catch in seven months showed the highest catch in December. Stations ‘A’ which generally appeared to be intermediate, (for seven months) recorded the highest specimens in April, August, September and October. Station ‘C’ recorded the highest catches in the remainder of the seven months of the year, which were particularly pronounced in November.

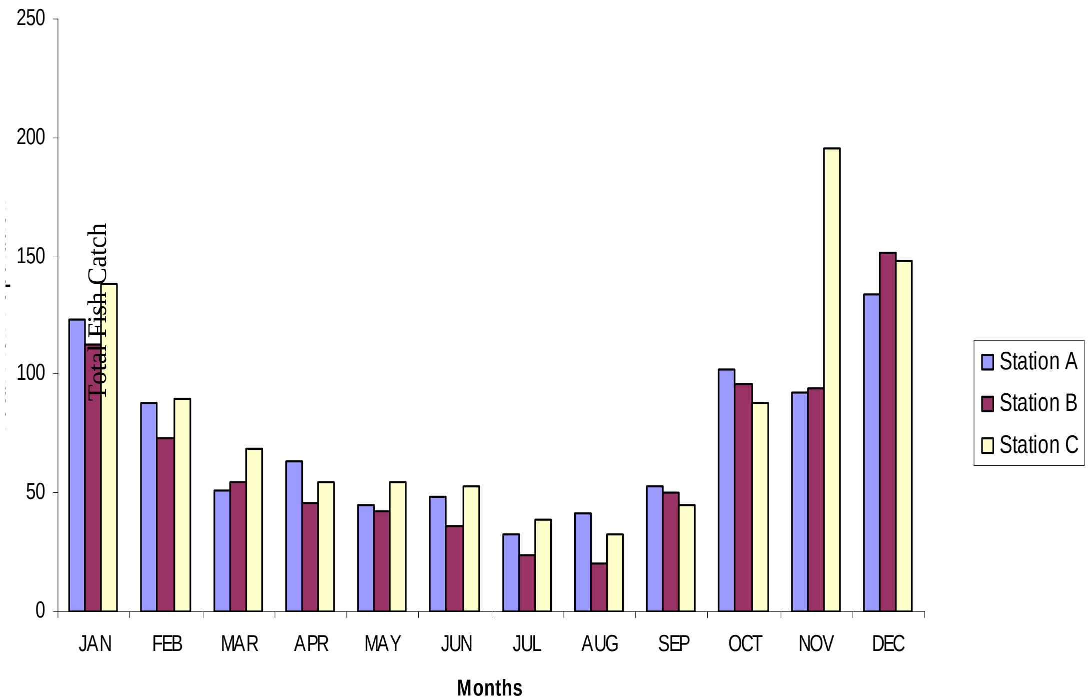

Fig 2: Spatio-temporal variation in mean fish catch.

Fish diversity in flood plains, adjacent to rivers or lakes poses special problems. According to Baijot *et al.* (1997) flooding drastically alters the faunal composition of water bodies and the communities are always changing their species composition with changes in water level. Fishes are mobile and the resident community in any area may be affected by the migratory activities connected with breeding and feeding during flooding. Fish movements are controlled by ecological conditions and the diversity of a community in one area could be affected by changes in the adjacent area. Hence diversity becomes a product of an all dynamic spatial and temporal changes affecting the community (Baijot *et al.*, 1997 and Idodo-Umeh, 2001).

The mean comparison in fish abundance during the months was conducted using Duncan Multiple Range Test (DMRT). It revealed that the highest number in total fish catch was recorded in December (144.3 $\pm$ 9.07) followed by catches in the month of November (127.0 $\pm$ 58.89) and January (124.7 $\pm$ 13.01) which were statistically similar. The least abundance was recorded in July (32.0 $\pm$ 7.55) and August (31.3 $\pm$ 10.60) (Table 2) which corresponded with the period of the wet season.

The mean fish catch varied remarkably from month to month. Apart from the catch in October which was described as intermediate, it will be concluded that the dry season months (October to February) recorded high catches while the rainy season months (March to September) revealed low catches. This may be due to the dry season draw down of water occasioned by evaporation and receding flood. This lead to fish concentrated in a small volume of water, facilitating their catch. The reverse was the case during the rains. Baijot *et al.* (1997) and Idodo-Umeh (2001) reported similar observations in Burkina-Faso and Anumage Fadama.

Table 2: Temporal variation in total fish catch in both years combined.

Months	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Mean ±SD	124.7^{b} ±13.01	83.7^{d} ±10.12	58.3^{e} ±9.30	54.7^{e} ±9.50	47.3^{f} ±7.10	45.7^{g} ±8.74	32.0^{h} ±7.55	31.3^{h} ±10.60	49.3^{f} ±4.04	95.3^{c} ±7.51	127.0^{b} ±58.89	1443^{b} ±9.07

Means with different alphabetical superscripts are significantly different at 5% level of probability.

Fish diversity

Forty-six fish taxa were identified in the lake. Station 'C' recorded the highest number of taxa (46). Station 'A' was intermediate (42) while station 'B' was the least (36), (Table 3).

Table 3: Fish diversity indices of Onah Lake.

Diversity indices	STATION		
	A	B	C
Number of specimens	880	793	1009
Fish taxa	42	36	46
Mergalef Index (M)	10.77	9.46	11.82
Shannon Wiener Index (H)	0.03	0.10	0.00
Evenness Index (E)	0.16	0.89	0.15

Mergalef Index described the species richness on station by station evaluation. The value increased from 9.46 in station 'B' to 10.77 in stations 'A' and 11.82 in stations 'C'. Station 'B' which recorded the least richness was the poorest in species diversity.

Shannon Wiener index revealed intermediate fish diversity in station 'A' (0.03). The highest diversity (0.00) was recorded in station 'C' while the lowest diversity was recorded in station B (0.10). Values close to or equal to zero indicates the station with the highest species diversity (Table 3). The evenness index which measured diversity based on how even or uneven the species occur in the stations revealed that station 'C' was the least even with a value of (0.15), while station 'B' was the most even with a value of (0.89) in that order (Table 3). The observed trend in species diversity revealed that station 'B' recorded the poorest richness (9.46) and the lowest diversity 0.10 in species composition, but was the most even station in regard to fish distribution (0.89). Stations 'C' where the highest numbers of specimens (1009) were caught recorded the least even distribution (0.15). These observations are in agreement with the species diversity model of Zar (1984).

Fish family status

The Citharinidae and Cichlidae families each contributed 22.6% and 12.0% of the total fish catch respectively, leaving the remaining 23 families with 65.40% contribution in this study. A comparison of fish catch at the family level in Nigeria revealed that the highest number was encountered in Onah Lake (Table 4). Four lakes (Oguta, Kainji, Ofonitorubuo and Anumagie/Ake Fadama) recorded over 50 fish taxa and over 18 families. Lower numbers (in total fish taxa and fish family) were recorded in the remaining three lakes (Asejire, Tatabu and Eleiyele). Onah Lake which incidentally recorded 46 taxa, encountered the highest fish families (25) amongst the lakes. Of particular note are three families (Lutjaniidae, Ophiocephalidae and Pantodontidae) which were not caught in the study area. Eleiyele lake accounted for the lowest (taxa and family) while Oguta Lake recorded the highest taxa but intermediate family. However, when considered on the bases of taxa richness, Onah Lake recorded more richness (46) than Eleiyele (13), Tatabu (18) and Asejire (43). This observation is attributed to the difference in water bodies and gears used, (Van der Knaap *et al*., 1991). Ruwet (1961) reported that it was difficult to compare fish families of different lakes. Difference in lake surface area (Bernacsek, 1984; Baijot *et al*., 1997) and unregulated fishing activities are probable reasons for the observed differences in family composition of lake systems. Fish species have their preference for the type of water in which to live. While some prefer still and quite water, others favor fast flowing turbulent and well oxygenated water. Even in a single body of water, fishes select the niche in which to live since the inland water systems are usually more or less isolated from each other, by land mass. Thus a small occasional connection between normally separate water systems could allow many fishes to pass from one area into another during flood. This is a probable reason for the highest fish family composition of Onah Lake, when compared with composition in bigger lakes as Kainji that does not occasionally join other bodies of water. This opinion was also expressed by (Baijot *et al*., 1997). Again, the increased number in fish family's reported during the present study may have resulted from the power of dispersal by the fish fauna during the flood when rivers Niger and Anwai join with the lake, forming a single sheet of water body for at least one and half months. This ensured that fishes move from one region into another.

Table 4: Comparison in fish families diversity Nigerian lakes.

Fish families	OFONITORUBUO LAKE(1984-85) Alfred-Ockiya and Otobo (1990)	ASEJIRE LAKE Akinyemi *et al (1985)*	TATABU LAKE Daddy and Awojoodu(1991)	KAINJI LAKE Daget (1961)	ANUMAGIE and AKE FADAMA. Idodo-Umeh and Victor (1960)	OGUTA LAK6E Ita (1983)	ELEIYELE LAKE Akinyemi *et al* (1985)	ONAH LAKE (This study)
Anabantidae	X	X	-	X	-	X		X
Bagridae	X	X	X	X	X	X	X	X
Centropomidae	X	-	-	X	X	X		X
Channidae	X	X	-	X	X	X	X	X
Characidae	X	X	X	X	X	X		X
Cichlidae	X	X	X	X	X	X	X	X
Citharinidae	X	X	X	X	X	X	-	X
Clariidae	X	X	-	X	X	X	-	X
Cyprinidae	X	-	X	X	X	X	-	X
Cyprinodontidae	X	-	-	X	X	X	-	X
Distichodontidae	-	X	X	X	X	X	-	X
Gymnarchidae	X	X	X	X	X	X	-	X
Hepsetidae	-	X	X	X	X	X	-	X
Ichthyboridae	-	-	-	-	-	-	-	X
Lepidosirenidae	X	-	X	X	X	X	-	X
Lutjanidae	-	-	-	X	-	-	-	-
Malapteruridae	X	X	-	X	X	X	X	X
Mastacembelidae	X	-	-	X	-	X	-	X
Mochochidae	X	X	X	X	-	X	X	X
Mormyridae	X	X	X	X	X	X	X	X
Notopteridae	X	X	-	X	X	X	-	X
Ophiocephalidae	-	X	X	-	-	X	-	-
Osteoglossidae	X	X	X	X	X	X	X	X
Pantoduntidae	X	-	-	-	-	-	-	-
Phractolaemidae	-	-	-	-	X	-	-	X
Polypteridae	X	-	X	-	-	-	-	X
Schilbeidae	X	X	X	X	X	X	X	X
Tetraodontidae	X	-	-	X	-	-	-	X
Total	22	16	15	23	19	22	8	25
Taxa richness	80	43	18	92	58	101	13	46

Conclusion

The study has accumulated information relating to fish species composition, relative abundance, temporal and spatial variations. This will be useful in multi-species management of the lake so as to sustain the lake fishery for the fisher folks in particular and the nation in general.

Recommendations

Routine monitoring of the lake is recommended in order to asses the ecological changes that may occur over time. Fish restocking should be carried out because the only known activity of the lake presently is over fishing accomplished through the use of indiscriminate fishing gears by the fisher folks.

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