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Studies on the Physico-Chemical Parameters and Plankton Abundance in Relation to Fish Productivity in Four Natural Lakes in Anambra State, Nigeria, Southeastern Nigeria

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Abstract:-Studies on the physico-chemical parameters and plankton abundance in relation to fish productivity were carried out on four natural lakes in the four agricultural zones in Anambra State, Southeastern Nigeria. Data were collected during two seasons (wet and dry) and statistically analyzed. Emerging results obtained from the study revealed an inverse relationship between phytoplankton and zooplanktonabundance. In all the four lakes, plankton density as well as physico-chemical parameters varied with the seasons, being more abundant in the rainy season. Four major families of phytoplankton viz: Chlorophyceae, Baccillariophyceae, Euglenophyceae and Cyanophyceae were identified in the course of the study. Four major classes of zooplankton viz: Cladocera, Copepoda, Ciliata and Rotifera were also identified in the four lakes.Low densities of plankton were recorded in February and March while high densities were recorded in August and September. Generally, the phytoplankton out-number the zooplankton. Fifteen families of fish were identified viz: Osteoglossidae, Cichlidae, Characidae, Hepsetidae, Citharinidae, Distichodontidae, Cyprinidae, Centropomidae, Clariidae, Bagridae, malapteruridae, Channidae, Pantodontidae, Mochokidae and Schilbeidae. Agbu lake had the highest fish productivity followed by Obutu Lake and Agulu lake. There was no evidence of fisheries activities in Nwangene Lake. Fish species encountered in Nwangene Lake were of no commercial importance. Potential fish yield in Agulu Lake (mean depth 5.50m) was 2.32%; 3.40% from Agbu Lake (mean depth: 3.50m); 3.80% for Obutu (mean depth: 3.20m) and 9.86% for Nwangene (mean depth: 1.25m). Thus there existed a general trend of increasing productivity with decreasing with decreasing depth which is an illustration of the principle that biomass is not necessarily correlated with rate of production.

Keywords: Natural Lakes, Physico-Chemical Parameters, Plankton Abundance, Fish Productivity.

I. INTRODUCTION

Anambra State has a network of streams, rivers, man-made impoundment and natural lakes which are home to numerous fish species of commercial value (Nwosu, 2003; Nwosu *et al*., 2012). It is situated between Longitude 5° 45' E and 7° 21' E and Latitude 6° 36' N and 7° 08' N. There is, however, a dearth of information on many water bodies in Nigeria and other developing countries (Udoidiong and King, 2000).

Water quality parameters interact with their biotic components and affect the productive potential of fish species (Kemdirim, 1993; Aguigwo, 1997; kemdirim, 2000 and Nwosu, 2003). The fish carrying capacity of aquatic ecosystems is a function of the biology of a particulars species and its interaction with its environment and other species (Robinson, 2007 and Nwosu *et al*., 2012).

This study, therefore, provides new and hitherto unavailable information on the lacustrine fish species of the southeastern Nigeria. The interplay of the physico-chemical characteristics and their biotic components gives a vivid picture of the complexity of the ecosystems studied.

II. MATERIALS AND METHODS

Four natural lakes (Agulu lake in Anaocha Local Area, Obutu Lake in Ndikelionwu in Orumba North Local Government Area, Nwangene Lake in Onitsha South Local Government Area, and Agbu Lake in Anyamelum Local Government Area) were studied (Plates 1-4).

ISSN No: - 2456 – 2165

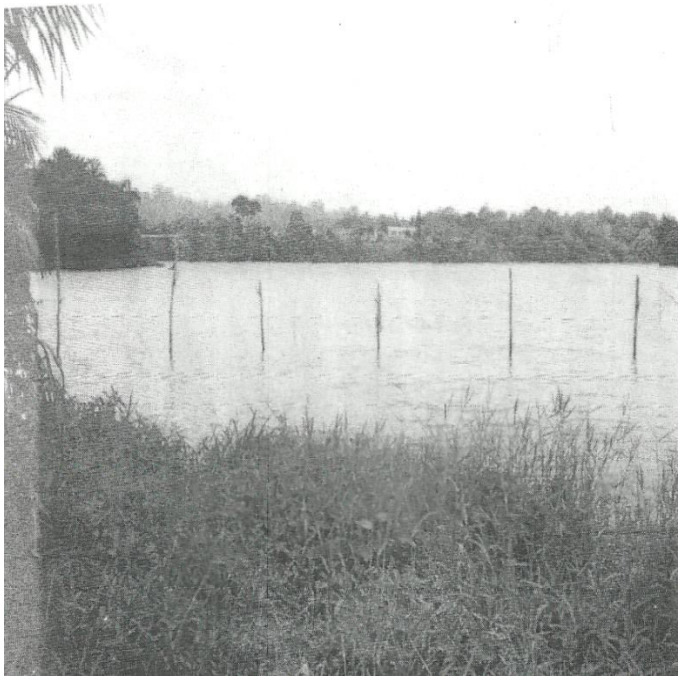

Fig. 1: Agulu Lake: A Cross Sectional View

Fig. 2: Agbu Lake: a cross sectional view

Fig. 3: Nwangene Lake: A Cross Sectional View

Fig. 4: Obotu Lake: A Cross Sectional View

ISSN No: - 2456 – 2165

The four lakes were selected for the study based on the four agricultural zones in Anambra State, Nigeria. Anambra State lies within the following geographical locations: 5° 35'E to 7° 08'. It is bordered on the West by Delta State; on the North by Kogi State; on the East by Enugu State and in the South by Imo State.

All four lakes lie within the tropical rain forest belt with climatic conditions characterized by a dry season (November – March) and a rainy season (April – October). The tropical rainforest is characterized by a complex vegetation, however, the riparian and littoral vegetation has been reduced to a secondary vegetation largely as a result of anthropogenic activities (Nwosu *et al*., 2017) the littoral vegetation of the lakes consist of assorted macrophytes dominated by *Raphia* and *Musa* species and the ubiquitous *Elaesis guineesis*. The marginal flora includes the true rooted aquatics, such as the water lily (*Nymphaea* and *Nuphar*) with leaves and flowers above water, *Potamogeton* and the arrowhead (*Sagittaria*). Others include free-floating algae. All four lakes lie within the Anambra basin with a depocentre of clastic materials. There is no evidence of magmatic activity (Egboka, 1993).

A. Collection of Samples and Laboratory Analysis
Biotic Parameters

Water samples were collected by means of a 70µm plankton net and a modified Clarke-Bumpus sampler (Aguigwo, 1997 and Nwosu, 2003).
The water samples collected were fixed with Lugol Solution to precipitate and preserve the phytoplankton and further concentrated to 10ml by centrifugation and the numerical estimates done by methods adopted by Boyd (1979), Aguigwo 91997) and Nwosu *et al*. (2013).
100ml of the water sample was fixed with 4% formalin for analysis and analysis (Aguigwo, 1997 and Nwosu *et al*., 2013).
Nitrate-nitrogen concentration and phosphate-phosphorus concentration were determined spectrophotometrically.

B. Plankton Identification

This was done according to the key of key and Whipple (1959) Wetzel (1975) and Aguigwo, 1997).
Fish identification was done using with reference to Holden and Reed (1992).

C. Physico-Chemical Parameters

a). Transparency and pH: Transparency was measured fortnightly with the aid of a 20cm Secchi Disc. Temperature and pH values were measured with aid of a portable pH/Temperature meter (YSI model 51). Dissolved oxygen (DO) values were determined by the Winkler method.

b). Electrical Conductivity: This was determined with the aid of a conductivity meter (Model EBA/10).

c). Alkalinity: This was determined titrimetrically using phenol disulphonic acid Boyd (1979) and Aguigwo (1997), and Nwosu (2003).

D. Statistical Analysis

This was done using one-way analysis of Variance and the least significant difference (LSD test at 5% level of significance).

III. RESULTS

A. Physico-Chemical Parameters

Mean Values of physico-chemical parameters (pH, Dissolved Oxygen, Conductivity, Temperature, Alkalinity, Transparency, Nitrate-Nitrogen and Phosphate-Phosphorus concentration are presented in Table 1. For each physico-chemical parameter there was a high and a low phase.

ISSN No: - 2456 – 2165

Physico-chemical parameters	Lake	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Phophate-phophorus conc. (mg/l)	Agulu Lake	0.45	0.60	0.61	0.65	0.65	0.75	0.82	0.86	0.90	0.80	0.61	0.59
	Nwangene Lake	0.35	0.45	0.63	0.71	0.83	0.91	0.92	0.81	0.91	0.61	0.59	0.55
	Obutu Lake	0.51	0.52	0.55	0.66	0.75	0.82	0.95	0.96	0.81	0.72	0.62	0.55
	Agbu Lake	0.49	0.53	0.55	0.60	0.71	0.83	0.83	0.85	0.70	0.65	0.61	0.58
Nitrate-nitrogen conc. (mg/l)	Agulu Lake	0.51	0.60	0.61	0.71	0.82	0.83	0.81	0.75	0.91	0.71	0.65	0.55
	Nwangene Lake	0.54	0.59	0.61	0.87	0.95	0.96	0.95	0.98	0.90	0.71	0.82	0.72
	Obutu Lake	0.55	0.61	0.63	0.72	0.85	0.86	0.86	0.83	0.87	0.75	0.83	0.61
	Agbu Lake	0.51	0.60	0.55	0.65	0.71	0.75	0.76	0.76	0.78	0.81	0.73	0.62
Nitrate-nitrogen conc. (mg/l)	Agulu Lake	26.70	27.00	28.00	25.00	26.00	24.00	23.03	25.00	23.00	26.00	22.00	25.70
	Nwangene Lake	27.50	28.00	28.00	27.05	32.00	24.60	25.00	25.10	24.00	27.00	26.00	28.50
	Obutu Lake	28.00	28.00	27.00	29.00	31.00	23.10	23.20	24.00	23.00	26.00	28.00	27.00
	Agbu Lake	26.00	27.00	28.00	28.10	29.50	23.00	24.00	22.00	24.00	27.00	26.00	30.00
pH	Agulu Lake	9.00	8.75	9.00	9.01	8.00	9.30	9.50	10.00	10.92	9.00	9.00	9.02
	Nwangene Lake	10.00	10.04	10.25	13.05	10.00	9.10	9.20	9.00	10.00	11.98	12.00	9.20
	Obutu Lake	9.00	7.00	7.20	8.02	8.00	8.00	8.00	8.00	9.00	8.00	10.00	10.20
	Agbu Lake	9.02	7.00	7.85	8.20	9.00	10.00	8.50	7.00	8.00	8.01	8.20	9.01
Transparency (ml)	Agulu Lake	0.81	0.80	0.90	1.20	1.30	0.90	0.92	1.00	1.20	1.40	1.50	0.90
	Nwangene Lake	0.50	0.60	0.62	0.40	0.50	0.30	0.20	0.21	0.36	0.50	0.40	0.50
	Obutu Lake	1.20	2.90	0.80	0.80	0.80	1.20	1.00	0.60	0.50	0.80	0.50	1.50
	Agbu Lake	1.30	2.50	1.40	1.30	1.20	1.35	0.80	0.60	0.70	1.20	0.80	0.90
Electrical conductivity (mhos/cm)	Agulu Lake	40.00	39.00	41.00	42.00	43.00	49.00	65.00	65.10	62.00	55.00	47.00	47.50
	Nwangene Lake	38.00	37.00	38.00	43.00	47.00	48.00	51.00	52.00	52.10	50.00	43.00	41.00
	Obutu Lake	41.00	38.00	40.00	46.00	52.00	61.00	71.00	56.00	48.00	48.00	45.00	38.01
	Agbu Lake	39.00	41.00	40.00	42.00	46.00	50.00	75.00	78.00	76.00	51.00	45.00	44.50
Alkalinity (ppm)	Agulu Lake	8.00	12.00	12.05	13.00	20.00	25.00	24.00	23.00	21.50	29.00	21.00	13.00
	Nwangene Lake	10.90	10.00	18.00	18.50	25.00	21.00	37.00	41.00	29.00	25.00	28.00	15.00
	Obutu Lake	11.00	9.00	10.00	12.00	22.00	23.00	28.00	35.00	28.00	21.00	19.00	12.00
	Agbu Lake	9.00	8.00	10.00	13.00	16.00	18.00	20.00	29.00	25.00	26.00	22.00	17.00
Dissolved oxygen (mg/l)	Agulu Lake	4.30	4.50	5.20	5.10	3.90	4.02	5.00	3.70	4.00	5.00	6.10	5.90
	Nwangene Lake	4.00	3.90	3.00	4.02	4.82	4.01	3.80	3.95	5.02	4.25	4.00	5.27
	Obutu Lake	5.31	3.70	5.35	5.45	5.54	5.05	5.70	5.70	6.20	6.10	5.65	5.01
	Agbu Lake	5.00	6.05	6.10	4.05	4.60	4.00	5.01	5.00	3.90	6.20	6.00	5.05

Table 1: Means Monthly Variation of Physico-Chemical Parameters in the Four Lakes

In Obutu Lake mean values of Temperature ranged from 23°C in September to 31°C in May; mean values of Dissolved Oxygen ranged from 3.70mg/l in February to 6.20mg/l in September, mean values of Conductivity ranged from 38 mhos/cm in February to 71mhos/cm in July, mean values of pH ranged from 7 in February to 10.20 in December, mean values alkalinity ranged from 9ppm in February to 35ppm in August, mean values of nitrate-nitrogen concentration ranged from 0.56mg/L in January to 0.87mg/L in September, phosphate-phosphorus concentration ranged from 0.51mg/L in January to 0.96mg/L in August while mean values of

ISSN No: - 2456 – 2165

transparency ranged from 0.60m in August to 2.90m in February.

In Agulu lake mean values of Temperature ranged from 23°C in September to 28°C in March, mean values of dissolved oxygen ranged 3.90mg/L in March to 6.10mg/L in November, mean values of conductivity ranged from 39mhos/cm in February to 65.10mhos/cm in August, mean values of pH ranged from 8.00 in May to 10.92 in September, mean values of Alkalinity ranged from 8ppm in January to 29ppm in October, mean values of nitrate-nitrogen concentration ranged from 0.51mg/L in January to 0.91mg/L in September, mean values of phosphate-phosphorus concentration ranged from 0.45mg/l in January to 0.90mg/L in September while mean values of transparency ranged from 0.80 in February to 1.50m in November.

In Agbu Lake, mean values of Temperature ranged from 22°C in August to 28.50°C in December, mean values of dissolved oxygen ranged from 3.90mg/L in September to 6.20mg/L in October mean values of conductivity ranged from 39mhos/cm in September to 6.20mg/c in October; mean values of Conductivity ranged from 39mhos/cm in January to 78mhos/cm in August. Mean values of pH ranged from 7 in February to 10 in June; mean values of alkalinity ranged from 8ppm in February to 29ppm in August; mean values of Nitrate-nitrogen concentration ranged from 0.51mg/l in January to 0.81mg/l in October; mean values of phosphate-phosphorus concentration ranged from 0.49mg/l in January to 0.85mg/l in August while mean values of transparency ranged from 0.70m in September to 2.50m in February,In Nwangene Lake mean values of Temperature ranged from 24°C in September to 28.50°C in December mean values of dissolved oxygen ranged from 3mg/L in March to 5.27mg/l in December mean values of conductivity ranged from 37mhos/cm in February to 52.10mhos/cm in September.

Mean values of pH ranged from 9 in August to 13.05 in April; mean values of alkalinity ranged from 10ppm in February to 41ppm in August.

Nitrate-nitrogen concentration ranged from 0.54mg/L in January to 0.98mg/L in August; phosphate-phosphorus concentration ranged from 0.35mg/L in January to 0.92mg/L in Julywhile mean values of transparency ranged from 0.20m in July to 0.62m in March.
In all the four lakes studied the mean values of physico-chemical parameters varied significantly ($P<0.05$).

B. Plankton Abundance

Plankton abundancein the four lakes is shown in Table 2.

S/No	Plankton	Agulu Lake	Nwagene Lake	Obutu Lake	Agbu Lake
(a)	Number of phytoplankton	7248	5646	8533	7917
(b)	Number of zooplankton	1434	2683	2234	1972
(c)	Total number of plankters	8682	8329	10767	9889
(d)	Percentage of phytoplankters (%)	83.48	67.79	79.25	80.06
(e)	Percentage of zooplankters (%)	16.52	32.21	20.75	19.94

Table 2: Percentage occurrence of Phytoplankton and Zooplankton in the Lakes

Four major families of phytoplankton (Chlorophyceae, Baccilliariophyceae, Euglenophyceae and Cyanophyceae)and four Classes of Zooplankton (Cladocera, Copepoda, Ciliate and Rotifera) were identified.

In Agulu Lake Plankton abundance was 5646.In Obutu Lake plankton abundance was 8533; 7917 in Agbu Lake; 7248 in Agulu Lake and 5646 in Nwangene lake (Table 2).An inverse relationship was also observed between phytoplankton and zooplankton abundance r=-0.99; r=-0.86; r=-94 and r=-0.78 in Obutu Lake Agulu Lake, Agbu Lake and Nwangene respect lively (Fig. 2).

In all the four lakes studied monthly plankton abundance varied significantly ($P<0.05$) with larger cell numbers of plankton occurring during the rainy season.

C. Fish yield

Mean of fish yield in the lakes are presentation in Table 3. Mean fish yield were 0.28, 0.39 and 0.0.50 metric tonnesper year in Agulu, Obutu, and Agbu Lakes respectively.Statistical analysis, however, showed no significant difference ($P>0.05$)in fish yield in the four lakes.

ISSN No: - 2456 – 2165

Lakes	T_1	T_2	T_3	T_4	Mean
Agulu	0.32	0.25	0.36	0.20	0.28
Obutu	0.42	0.31	0.40	0.45	0.33
Agbu	0.65	0.28	0.38	0.70	0.50
Nwangene	0.46	0.28	0.37	0.45	-
P >0.05					

Table 3: Means of Fish Yield (Metric Tonnes/Year) In the Lakes

T_1, T_2, T_3, T_4: fish landing sites.

The families, genera and species of fish encountered in the lakes are presentation in Tables 4-6.

In Agulu Lake the Cichlids had a relative abundance of 33.20% followed by the Clariids (25.701%)Osteoglossids (12.60%)Citharinids ``(6.10%)Synodontids (4.30%)`Characids (1.60%)Malapterurids (1.20%)Distichoclontide (1.10%) and Channids(0.60%).

Family	Species	Number of individuals in family	% of individuals in the family	% relevance abundance of individuals in total sample
Channidae	Channa obscura	35	100	
	Total	35		0.80
Cichlidae	Sarotherodon niloticus	750	54.70	18.20
	Tilapia zili	620	45.20	15.00
	Total	1370		33.20
Clariidae	Clarias anguilaris	610	57.40	14.80
	Heterobranchus bidorsalis	452	42.50	10.90
	Total	1062		25.70
Citharinidae	Citharinus citherus	250	100	
	Total	250		6.10
Bagridae	Chrysichthys nigrodigitatus	205	100	
	Total	250		6.10
Characidae	Hydrocynus lineatus	65	100	
	Total	65		1.60
Hepsetidae	Hepsetus odoe	235	100	
	Total	235		5.70
Mochokidae	Synodontis clarias	175	100	
	Total	175		4.30
Distichodontidae	Distichodus brevipinus	45	100	
	Total	45		1.10
Malapteruridae	Malapterurus electricus	50	100	
	Total	50		1.20
Osteoglossidae	Heterotis niloticus	520	100	
	Total	250		12.60
	Grand total	4120		

Table 4: Percentage Occurrence of the Various, Families, Genera and Species of Fish in Agulu Lake

ISSN No: - 2456 – 2165

In Obutu Lake the Cichlideshad a relative abundance of 45.80%; Clariids, 34.50%; osteoglossids, 9.30%; Characids, 4.80%; Hepsetids, 1.10%; Bagrids, 1.10%; Citharinids, 1.10%; Distichodontids, 0.80%; Synodontids, 0.50%; Malapterurids, 0.30% and Schilbeids, 0.30%.

Family	Species	Number of individuals in the family	% of individuals in the family	% relative abundance of individuals in total sample
Cyrinidae	Labeo pseudocoubie	28	100	
	Total	28		0.60
Cichlidae	Sarotherodon niloticus	1050	52	23.90
	Tilapia zilii	962	47	21.90
	Total	2012		45.80
Clariidae	Claria anguillaris	1001	65.80	22.70
	Heterobranchus bidorsalis	520	34.10	11.80
	Total	1521		34.50
Characidae	Hepsetus odoe	50	100	4.80
	Total	50		1.10
Mochokidae	Synodontis batensoda	15	58.20	0.40
	Synodontis clarias	7	31.80	0.10
	Total	22		0.50
Malapteridae	Malapterurus electricus	12	100	
	Total	12		0.30
Schilbeidae	Schilbe mystus	5	41.60	0.10
	Eutropius niloticus	7	58.30	0.20
	Total	12		0.30
Distichodontidae	Distichodus brevipinus	35	100	0.30
	Total	35		0.80
Bagridae	Chrystichthys nigrodigitatus	50	100	
	Total	50		1.10
Citharinidae	Citharinus citherus	35	100	
	Total	35		0.80
Osteoglossidae	Heterotis niloticus	413	100	
	Total	413		9.30
	Grand total	4400		

Table 5: Percentage Occurrence of the Various Genera, Families and Species of Fish in Obutu Lake

In Agbu lake, the Cichlids has a relative abundance of 47.50%; Clariids, 27.80%, Osteoglossids 9.30%; Bagrids, 4.60%, Hepsetids, Channids, 2.70%, 3.30%; Citharinids, 1.40% Cyprinids, 1.10% and Centropomids, 0.10%.

ISSN No: - 2456 – 2165

Family	Species	Number of individuals in the family	% of individuals in the family	% relative abundance of individuals in total sample
Osteoglossidae	Heterotis niloticus	420	100	
	Total	420		9.30
Clariidae	Claria anguillaris	620	49.20	13.60
	Clarias anguillaris	230	18.20	5.00
	Clarias submarginatus	10	7.90	0.20
	Heterobranchus bidorsalis	350	27.70	7.70
	Heterobranchus longifilis	150	11.90	3.30
	Total	1260		27.80
Characidae	Hydrocynus lineatus	100	100	
	Total	100		2.20
Hepsetidae	Hepsetus odoe	150		
	Total	150		3.30
Citharinidae	Citharinus citherus	50	76.90	1.10
	Citharinus distichodoides	15	23.00	0.30
	Total	65		1.40
Bagridae	Chrystichthys nigrodigitatus	210	100	
	Total	210		4.60
Centropomidae	Lates niloticus	5	100	
	Total	5		0.10
Cichliose	Sarotherodon niloticus	730	33.90	16.10
	Tilapia zilli	1420	66.0	31.40
	Total	2150		47.50
Cyprinidae	Barbus occidentalis	35	70	0.80
	Barbus stigmatopygus	15	30	0.30
	Total	50		1.10
Channidae	Channa obscura	120	100	
	Total		120	2.70
	Grand total	4530		

Table 6: Percentage Occurrence of the Various Genera, Families and Species of Fish in Agbu Lake

D. Potential Fish Yield (PFY)

Log f = Log MEI

$$PFY = \frac{TDS}{2}$$

where MEI = Morpho-edaphic index

TDS = Total dissolved solids (conductivity) (Wetzel, 1975).

IV. DISCUSSION

The physico-chemical parameters, nutrient levels and plankton abundance varied with the seasons in all the lakes. Mean monthly temperature values were high during the dry months but low in the rainy (wet) months. The low temperature phase corresponded with the rainy months which affected the temperature regime by lowering the solar heat radiation during the cloudy rainy months (April to October). Wetzel (1983), Aguigwo (1997) D'Croze *et al*. (1998) Franks (2001) and Nwosu *et al*. (2013) have reported similar phenomena with respect to the importance of such changes in temperature in lacustrine ecosystems. The researchers all observed that these temperature gradient were accompanied by little seasonal changes in temperature at any depth.

Temperature reductions may also be due to accumulation of surface run offs into the lakes (Aguigwo, 1997; Callieri *et al*., 1999; Swedish EPA, 2001). Weak temperature gradients were most pronounced in Nwangene Lake. This was probably due to the relatively shallow nature of the lake which resulted from anthropogenic eutrophication and lake filling.

The oligomictic conditions in Nwangene Lake may have resulted, in part, from thermal stability and the shallow nature of the lake. This agrees with Odum (1971), Harris 1980, Voros *et al*. (1998) and Stockner *et al*. (2000).Such changes during lake mixing may affect phypolimnetic dissolved oxygen. This condition might have adversely affected available fish habitats as well as primary productivity in the lake. The latter,

However, does not explain the absence of fish species of commercial value in the lake during the period of the study. Harris (1980), and Nwosu *et al*. (2013) observed that the pelagic ecosystem and community structure are modulated by intrinsic factors, such as basin morphometry, thermal structure and the seasons. Thus the destruction of fish habitats in Nwangene Lake as a result of human activity coupled with the dynamics of physico-chemical and biotic factors might explain the absence of fisheries activities in the lake.

The development of stratification during the warm months on the other hand, might have increased primary productivity in Agbu, Agulu and Abutu Lakes by maintaining algae for longer periods within the euphotic zone (Odum, 1971; Wetzel, 1983; Stockner and Shortreed, 1991; Nwosu, 2003 and Nwosu *et al*., 2013).

Generally the lakes were all heavily influenced by fluxes of chemical and organic matter from their agricultural catchment areas in contrast to Nwangene lake which has a catchment area which in the main, comprises residential houses, markets and grassland areas littered with human and animal refuse and industrial effluents.

High phytoplankton abundance (79.25%) in Agulu lake might have accounted for the preponderance of plankt ivorous fish species such as the Cichlides in the lake. The presence of predators such as crocodiles (in Agulu Lake) would tend to bring down fish populations while restricted and/or regulated fishing in Agbu Lake would tend to conserve fish stock. These probably explain the relatively higher quantity of fish recorded in Agbu Lake when compared with Agulu and Obutu Lakes.

From the analysis of seasonal data set of this study emerges characteristic patterns in temporal changed of the natural plankton and Ichthyofaunal assemblages of the lakes. These seasonal changes are related to the dynamics of the biotic and physico-chemical paramters (Callieri and Stockner, 2000 & Nwosu, 2003). How the biotic exploit the environmental variability is the result of evolutionary mechanisms and their interaction with others of their kind.

The values for potential fish yield in the lakes (Agulu, 2.32%; Agbu 3.40%; Obutu 3.80% and Nwangene 9.86%), depicts a general trend of increasing productivity with decreasing depth. This is also an illustrations of the principle that biomass is not necessarily correlated with the rate of production (Odum, 1971, Nwosu, 2003).The low number of fish species encountered during the study might be due in part to the short study period. Perhaps, further investigation might reveal more fish species.

V. CONCLUSION

Most inland water bodies in Nigeria including Lake Lainji have, however, been over fished. The non enforcement of inland and fisheries laws and regulations has led to the fast depletion of the natural stock. Another problem exacerbating the situation is cultural eutrophication which entails a drastic reduction in the number of plant and animal species in the water bodies. This problem demands urgent attention.

Efforts should also be as a matter of urgency to correct the imbalance between fish demand and supply by adopting several methods and strategies of fish production systems especially those that depend less on foreign inputs. Strident efforts should also be made to encourage research work on our aquatic resources so as to diversify our agro-statistical data base to improve the indigenous fishery.

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