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Fish Introduction into Lakes: A Case for Oguta Lake, Imo State, Nigeria.

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Abstract

The objective of this paper is to propose fish introduction into Lake Oguta as a project for enhancement of fisheries production. Focusing on finfish introductions as a plausible fisheries management strategy in inland freshwater lakes, the case is made for the need to predicate this operation on a *sine qua* non- a good amount of rather holistic database of the target lake. Thus, the knowledge on Lake Oguta in Imo State Nigeria, has herein been recapitulated as the basis of advocation of introduction of some fish species, into the Lake, to exploit some apparently "vacant' ecological niches identified, in order to boost the fisheries production. The Clupeid freshwater sardines *Pellonulla leonensis,* the Cichlidae *Sarotherodon galileus,* the Citharinid (moonfishes, *Citharinus* and the "upside –down" Bagrid catfish *Hemisynodontis membranaceus)* are the fish species suggested for this proposed introduction. The use of a well-developed fish hatchery facility in Oguta, built by Imo State Government, can be used to generate "fish seeds" needed. Funding and assemblage of experts as limiting factors are discussed.

Keywords: Fish introduction, a scientific case for Lake Oguta, Imo State, Nigeria.

1. Introduction

Inland fresh water fisheries is primarily an economic endeavour of man aimed at sustainably exploiting the aquatic fauna or its biota *(sensu lato*) for its cheap protein food needs. In a country like ours (Nigeria), a considerable surface area covered by fresh waters – lakes, rivers, flood plain lakes and associated flood ponds, etc. with enormous fish and fisheries potential (Ita, Sado, Balogun & Pandogari, 1985), if seriously scientifically and sustainably managed. The subsidiary, "back-of-the same coin" – Aquaculture developes *pari – parsu*, to supplement fish and fisheries production by man's intervention to avoid the tedium of wildlife *in situ* natural water body fish production or fisheries *sensu stricto.*

To achieve the maximum potential of fisheries production of a natural water body, an effective, management template has to be developed scientifically, not by guess work or arbitrariness as to avoid disastrous consequence (Ogutu – Ohwayo, 1992). Aquatic resources management for inland fresh water fisheries involves a retinue of strategies – control of fishing techniques, prevention of over fishing and stock depletion, netting mesh sizes, fishers population densities, pollution and the drainage basin anthropogenic activities,

use of poisons to catch fish, etc., all of these to be encapsulated in appropriate administrative and legal frameworks. In all of these, the management template to be developed and put in use, based on a holistic or selected data base – a *sine qua non* for inland water fisheries development (Nwadiaro, 2009). It is almost impossible for any fisheries scientist to manage a water body without any limnological knowledge of it – at least, the population status – biomass, species composition and dynamics of its biological resources.

Fish introduction into a lake or any water body is one of the well-known fisheries management options, but can only be employed predicated on a sound data base. As well introduced by Ogutu – Ohwayo (1992). "Fish introductions have been used to enhance fish production by filling a less utilized ecological niche, for aquaculture; sport and recreation, ornamental purposes and to control disease vectors and weeds. "Oguta – Ohwayo (*op. cit*.) opined that at least 50 fish species that have been introduced into and between different countries in Africa, the *raison d'etre* (Table, 1) for the introduction and species used. It is based on the above that this author was shocked at a non-scientific fish introduction of possibly some Clariid Siluroid catfishes into Lake Abadaba, near Etiti, Imo State of Nigeria, sometimes last year, funded by a zealous Senator and ceremonially over seen by officials of the Ministries of Agriculture (Federal and State) or their representatives. This paper directs itself to Oguta Lake in Oguta, Oguta LGA, Imo State of Nigeria and makes a case for appropriate, data based fish introduction into the lake.

Table 1. A list of reported fish introductions into and within Africa and the purpose of the introductions (compiled from FAO/CIFA, 1985).

Names of species	Name of species
Astatoreochromis alluaudi (5)	*Limnothrissa moidon (5)*
Astronotus ocellatus(1)	*Micropterus dolomieu (2)*
Basilichthys bonarienses (1)	*Micropterus punctulatus (2)*
Bargus meridionalis (2)	*Micropterus salmoides (15)*
Barbus barbus (1)	*Oreochromis andersoni (1)*
Barbus kimberlevensis (1)	*Oreochromis aureus (1)*
Barbus natalensis (1)	*Oreochromis esculentus (1)*
Carassius carassius (1)	*Oreochromis bornorum (1)*
Carassius auratus (3)	*Oreochromis leucostictus (3)*
Catla catla (2)	*Oreochromis macrochir (13)*
Cichla ocellaris (1)	*Oreochromismossambicus (5)*
Clarias lazera (5)	*Oreochromis niloticus (11)*
Ctenopharyngodom idella (6)	*Oreochromis shiranus (1)*
Cyprinus carpo (16)	*Oreochromis spilurus (6)*
Esox lucius (3)	*Osphronemus gouramy (6)*
Etroplus suratensis (1)	*Poecilia reticulate (3)*
Gambusia affinis (7)	*Salmo gairdneri (16)*
Heterotis niloticus (6)	*Salmo trutta (7)*
Hypophthalmichthys molitrix (3)	*Salvelinus fontinalis (2)*
Ictalurus puntatus (1)	*Serranochromis robustus (1)*
Labeo rohita (1)	*Stolothrissa tenganicae (5)*
Lates niloticus (2)	*Tilapia rendalli (12)*
Lepomis cynanellu (8)	*Tilapia zilli (7)*
Lepomis gibbossus (2)	*Tinca tinca (4)*
Lepomis macrochirus (8)	*Xiphophorus maculates (1)*
Lepomis microlophus	

The figures in brackets show the number of countries to which each species has been introduced and the frequency of each reason for introduction (taken from Ogutu-Ohwayo, 1992)

The reasons for the introduction are summarized as follows: Aquaculture (72), spot (angling and recreation) (26), fill vacant niche and create commercial fishery (23), forage for other fish (especially bass) (9), Control (6), Control mosquitoes (6), Control snails (2), Ornamental purposes (1), Accidental transfer (1), No reason given (24).

2. Lake Oguta

In our efforts so far to develop a fisheries template for L. Oguta and in obedience to our avowed commitment to generating an inland water data base as a *sine qua non*, a series of studies has been conducted. These are summarized as follows:

2.1. Physical Feature

Odigi and Nwadiaro (1988) gave the geographical and related physical limnology thus: Lake Oguta is a relatively small, shallow fresh water body (flood season maximum surface area = 2.48km^2, maximum depth=9.30m) but the largest natural lentic system in southeastern Nigeria. The maximum water depth, surface water temperature, Secchi-disc-transparency and conductivity, varied seasonally with rainfall. These parameters had ranges of 7.0-9.3m, 24.0-31.0^{0}C, 0.61-400m and 8.6-16.5µS.cm^{-1} respectively. Weak, unstable thermal stratification develop towards midday in the warmer months (April-August). The sedimentological data show that variation in the lake's particle size distribution; with coarse sandy shores, and fine, silty clay at the deep, open area. The sediment particle size variation is related to relief, transportation and depositional processes. The lake basin is a low energy, aqueous continental depositional environment. The origin of the lake is related to the Quaternary/Holocene Eurasian glaciations which correlate with the pluvial in the tropics. Associated with the sedimentological features, the heavy minerals of the surficial sediments have been documented for the lake basin (Odigi & Nwadiaro, 1993). The chemistry of the bottom sediments with respect to the cations, trace and heavy metals by Nwadiaro and Odigi (1991) and summarized as follows:

The concentration of the major cations and selected metals in the sediments on lake Oguta, a small tropical lake in West Africa, is given based on dry season samples, given the fact that the lake receives little or no industrial or anthrogenic impact now, the concentration determined can be considered as "background" for the area, against which any future changes can be evaluated, in decreasing order of concentrations, Mg, K, Na and Ca has respective mean values of 421.4,258.3,100 and 75µg/g dry weight. Aluminum and Iron were the most abundant of the other metals with mean levels of 21.73 and 13.10 x 10^{3}µg/g respectively. The contamination ranking for the trace metals was Cu>Zn>Pb>Mn>Ni>Cr>Co>Cd.

2.2. Chemical features of the water are well documented (Nwadiaro and Umeham, 1985) and Nwadiaro (1993) as abstracted below.

Some aspects of the chemical hydrology of Oguta Lake, the largest natural lake in the Southeastern Nigeria, have been studied over a 12 month period (May, 1982 to April, 1983). The means and ranges in the hydrogen ionic concentration, conductivity and alkalinity were

respectively 5.78(5.1 – 6.4), 11.39µS cm^{-1} (8.6 – 16.5µS cm^{-1}) at 25^0C and 11.83 $mg1^{-1}$ $CaCO_3$(7.5 – 28.75). The total ionic concentration was generally very low. Total Phosphorous, orthophosphate phosphorus, nitrate nitrogen, nitrate nitrogen and silica had concentrations and ranges 0.01-0.83mgl^{-1}, 0.12 – 2.24mgl-1, 0.01 – 0.20mgl^{-1} and 2.76 – 0.83mgl^{-1}. Apart from the orthophosphate, the concentration of the other nutrient ions were generally adequate and comparable to those of other Nigerian waters for which information is available. Biochemical oxygen demand, dissolved oxygen concentration and percentage oxygen saturation were in the rages 0.1-2.71 mgl^{-1}, 3.4 – 6.95 mgl^{-1} and 42-87% respectively. There were significant differences in the monthly concentrations of these chemical parameters but none when site variations were considered. The chemical hydrology of the lake is intimately related to the rainfall regime and water level. Monthly changes in the depth profiles of some chemical characteristic were studied for Oguta Lake, the largest natural lake in the Southeastern region of Nigeria. The investigations were conducted from May, 1982, to April, 1983. Hydrogen ion concentration, salinity and alkalinity did not show significant variation with depth. Nitrate-nitrogen showed no definite pattern but in February, October and November, distinct metalimnetic nitrate maxima occurred. Silica was approximately homogeneously distributed with slight negative heterograde curves in February and October. Total phosphorus levels were relatively lower in the bottom water but the most distinct discontinuity occurred in November when a metalimnetic maximum co-occurred with a nitrate-nitrogen maximum. Dissolved oxygen concentration showed a consistent clinograde profile typical of thermally stratified eutrophic water. Biochemical oxygen demand values followed the dissolved oxygen pattern very closely.

2.3. Biological attributes

Phytoplankton and associated algae: In a comprehensive survey of the primary net phytoplankoton producers Ziller and Econonmou-Amilii (1998) catalogued the species composition of this community for not only Oguta lake but several other but associated floodplain lakes in the Lower Niger Delta freshwater areas in Imo State of Nigeria. They showed the rich and high species diversity of algal flora of Oguta in particular. The peculiarity and distinctiveness of the algal community's phytoplankton had been highlighted by Nwadiaro and Oji (1986) thus:

2.3.1. The phytoplankton productivity and chlorophyll-a concentration of Oguta Lake, the largest natural lake in southeastern Nigeria, are presented (December, 1983-November, 1984). The gross productivity ranged from 1.3 to 3.77$gC.m^{-2}$ day^{-1} for the water column, dropped during the period of heavy rainfall and varied with depth. The chlorophyll-a concentration had monthly means from 2.31 to 4.00$mg.m^{-3}$ with a drop during the rains, but little depth variation. Both productivity and chlorophyll-a showed non-significant correlation with the physic-chemical features of the water. The values of these biological parameter showed the lake as mesotrophic. The values are compared with those of other African lakes. A more remarkable biological feature of Oguta Lake is in its "unusual algal jellies" as opined by Nwadiaro(1989a). Preliminary observations were made between October, 1982 and May, 1983 on the nature, taxonomic composition, spatial distribution, buoyancy behavior and nutrient requirements of some unusual planktonic algal "jellies" in Oguta Lake in southeastern Nigeria. There "jellies" are macroscopic, blue-green algal masses whose excessive mucilage of high consistency act as substrata for other epiphytic components viz. diatoms and green algae. They are more abundant in the lentic areas of the lake, undergo diurnal vertical movements and have their growth enhanced by spikes of nitrogen and

phosphors salt into their aquatic medium. The effects of these “jellies” on the ecology and general water use of the lake are discussed. Speculations of the reason of their occurrence are given and possible control measures outlined. Other algal community studies are Nwadiaro and Oji (1986), and Nwadiaro and Idabor (1990)

2.3.2. Zooplankton: First and foremost, Oguta Lake exhibits another fisheries-related positive peculiarity in the high population of its major plankter – the giant Calanoid Copepod *Tropodiaptomus lateralis* Kiefer 1932 (Maas *et al,* 1992). *T. lateralis* fist described in 1932 from the River Niger at Say in Niger republic, has been reported in a lake in Botou on the Burkina-Fasso/Niger Republic boarder, Toumodi in Cote d’Ivoire, at River Niger at Gao (in Mali) by Kiefer (1933), Niamey by Dussart (1981) and also from the River Niger at Ani-Eze (Maas *et al*, 1992). This only Calanoid constituted an incredible large numerical proportion of the limnetic zooplankton of Lake Oguta that literally and logically suggests the near absence of pelagic zooplankton feeding finfishes like the young-of-the-year moonfishes(the Citharinidae *Citharinus,* the upside-down catfish *Hemisynodontis membranaceus* and the freshwater sardine-a clupeid *Pellonula leonensis* which equates, in terms of ecological niche, to *Limnothrisa miodon* and its introduction into Lake Tanganyika in east Africa(Spliethoff *et al*, 1993). Maas *et al* (1992) opine that *T.lateralis together* with the Cladoceran *Diaphanosoma exicum* thereby forms the crucial link between the primary producers and the pelagial fish and logically reason that thus, the vertebrate pressure on the zooplankton, while not entirely eliminated, has lessened and this may be the biotic factor which has permitted *T.lateralis* to build up large populations in the lake. The exceptional standing of this Calanoid copepod in the Zooplankton in terms of numbers, density and biomass, prompted work on the biology of *T.lateralis* as initiated by DeClerck *et al* (2018). The calanoid copepod co-occurs with two species of Cyclopoida-Copepoda: *Thermocyclops neglectus* (Sars, 1909) and *Mesocyclops major* Sars, 1927 but these had smaller numerical representation than the Calanoida –Copepoda

2.3.3. The Rotifer plankton of Lake Oguta restates the ‘wealth’ of the Zooplankton community with its high species richness and biodiversity (Segers 1993, Segers *et.al*; *1993).* The lake, with its associated floodplain. Lakes (over 44) are rated as either the most or nearly the most speciose rotifer community in any freshwater lentic biotope, competing probably with South America’s Amazon inland waters. Before this paper creates the impression that the only faunal plankters of Lake Oguta, are the above, mention must be made of the Cladocera *Diaphanosoma excisum* Sars, the *Branchionus* speices (Rotifera, and larvae of the bloodworms o insects *Chaoborus* the later occasionally preying on the Copepodid instars of the Calanoida. While the Nigerian floodplain Lake Iyi-Efi recorded an incredible species numbers of 136 (about the World’s highest per water body, Lake Oguta followed up with 124 (Nwadiaro *et al*., 2008).

2.3.4. The Branchiopoda/Cladocera showed up prominently in the zooplankton with the families Sididae *(Diaphanosoma excisum* (*Bosmina longirostris* (O.F. Muller, 1853) Chydoridae (*Kurzia longirostris* (Daday, 1898). Thus, Oguta Lake has a very rich zooplankton fauna taxonomically and numerically with biomass that need to be converted to finfishable stock.

2.3.5. Finfish Composition, Biology and Fisheries: The taxonomic composition of the finfish fauna and some aspect of the fisheries have been published by Nwadiaro (1989b), Dumont *et al* 1994, and Nwadiaro *et al* 2018, in press). The lake has a rich ichthyofaunal taxonomic

composition represented by 28 families and over 91 species. The large diversity is easily attributed to the lakes close association with its major influent rivers (Njaba, Awbana and Utu), Orashi River and River Niger via the Ndoni creek linking Niger to the Orashi. The gill net fin fisheries are represented by 19 families with only four families constituting over 90% in number and biomass. The order of dominance to the artisanal net fish catch is Citharinidae > Cichlidae > Characidae > Bagridae. The bottom long line ("unchu waya", "mari-mari") produced mostly Bagrid catfishes but this is declining due to the reduced number of fishers with requisite expertise. Due to the predominance of the Bagrid catfish *Chrysichthys filamentous* some aspects of thisspecies have been studied with respect to its biometrics, length/weight relationships and condition factors (Nwadiaro and Okorie, 1985), reproductive biology (Nwadiaro and Okorie, 1986 and feeding strategies (Nwadiaro and Okorie, 1987).

2.4. Availability and presence of usable facility: At about the middle Awbana River in front, just before Senator Francis Arthur Nzeribe entrance there is a well-built fish hatchery built years ago by the Imo State Government of Nigeria. This facility can with requisite clearance, approval and authorization be used to develop and produce fish seeds to be introduced into Oguta lake on a before the next flood period.

2.5. Funding and stakeholder participation. As always, funding is an indisputable, indispensable and initial take-off point for any project no matter how small or cursory. Like any endeavor, the feasibility is a stakeholder issue – the stakeholder groups – their commitment, desire and prioritization. The FISON Society of Nigeria (FISON), Federal, State and Local Governments and MDA with statutory or non-statutory mandates for inland fresh water fisheries development must be sensitized into being coerced or persuaded to show interest. The case with East African Great Lakes is an example(McConell *et al*, 1992).

2.6. Possible candidate fish to use: Given the points recapitulated and canvassed so far, the target fish, fish species that can be used must be zooplanktivorous species (Lauzanne,1974). Possible candidates fish seeds to be sourced for and introduced into Lake Oguta, are the young of the year moonfishes (Citharinidae), the (CIupeidae *Pellonula leonensis*), The Cichlidae *Oreochiomis zilli, Sarotherodon galileus 0*and the Mochokidae *Hemisynodontis membranaceus* (The upside-down-cat fish).

3. Conclusions and Recommendations

It is the belief of the author of this paper that a case has been attemptably canvassed and made for a fish 'seed' introduction to Oguta lake.

(i) It is recommended as a special project to be undertaken by the Fisheries Department of the Imo State Ministry of Agriculture as Fisheries production enhancement is their primary statutory responsibility.

(ii) The funds for the project can be appropriated from the Ministry's budget and that of either Federal Ministry of Agriculture, Imo River Basin Authority, FAO via FISON request or any International donor agencies or even any enthusiastic private/public partnership.

(iii) The project can be contracted to FUTO's Department of Fisheries & Aquaculture Technology as capable experts are in good numbers there to execute the project.

(iv) The Fisheries Society of Nigeria (FISON), now chartered, should champion such an advocated project in the same way as the United States of America Fisheries Society did with exotic species FISON should be more involved in searching for funds to develop ecosystem (lake and river basin) fisheries development.

(v) Nigeria's Fisheries Scientists should engage more in holistic ecosystem fisheries studies in order to provide management templates to Governments Agriculture/Fisheries Ministries.

References

Anderson, A. M., 1961: Further observations concerning the proposed introduction of the Nile perch into Lake Victoria – *E. Afr. Agric. J.* 26, 195-201.

Balon, E. K. & Bruton, M. N. (1986). Introduction of alien species or why scientific advice is not heeded. *Env. Biol. Fish*. 16, 225 – 230.

Barel, C. D. N., Dorit, R., Greenwood, P. H., Fryer, G., Hughes, N., Jackson, P. B. N., Kawanabe W., Low-Mcconnell, R. H., Nagoshi, M., Ribbink, A. J., Trewavas, E., Witte, F. & Yamaoka, K. (1985). Destruction of Fisheries in Africa's Lakes. *Nature* 15 (6014), 19 – 20.

Benda, R. S., 1979: Analysis of catch data from 1968 to 1976 from 9 fish landings in the Kenyan waters of Lake Victoria. *J. Fish Biol*. 15, 395 – 397.

Declerck, S., Nwadiaro, C. S. and Dumont H.J. (2006). The influence of flow regulation of the River Niger by the Kainji reservoir/dam on the biodiversity and fish production of Lake Oguta, Lower Niger Delta Nigeria, Imo State. *Proc. of the 21st Annual Conference/30th Anniversary celebrations of the Fisheries Society of Nigeria* (FISON) Calabar, Nigeria. 13th – 17th Nov. 2006.

Dumont, H., Nwadiaro, C. S., Miracle, M.R. and Econmou – Amilli, A. (1994); Floodplain Lake Management of the Lower Niger Delta in Nigeria – Ecology, stock assessment and improvement of exploitation. Project TS2 – A – 287. Report *to the European Union's Science & Technology unit, Brussels, Belgium, 224.*

Dussart, B.H. (1981). *T.lateralis* Kiefer 1932 (Copepoda –Calanoida) in Niamey (Niger) *In*: Maas, S., Nwadiaro, C.S. and Dumont, H. J. (1992). *T.lateralis* in Lake Oguta, Nigeria. Hydrobiologia 239:163-170

FAO/CIFA (1985). Introduction of species and conservation of genetic resources. Committee for Inland Fisheries of Africa (CIFA), 6th session, Lusaka, Zambia, 7-11 October 1985. CIFA/85/13. FAO, Rome, Italy, 18pp.

Ita, E.O., Sado, E.K., Balogun, J.K. & Pandogari, K. (1985). Inventory survey of Nigeria's inland waters and their fisheries resources – A preliminary checklist of the water bodies with special reference to ponds, lakes reservoirs and major rivers. Kainji Lake Research Institutes's Technical Report No. 14, New Bussa, Nigeria. 51.

Kiefer, F. (1933). The calanoid copedod *Tropodiaptomus lateralis* in Botou (Niger). Toumodi (Cote d' Ivoire) and River Niger at Gao (Mali) *In*: Maas, S., Nwadiaro, C.S. and Dumont, H. J. (1992). *T.lateralis* in Lake Oguta, Nigeria. Hydrobiologia 239, 163-170

Lauzanne, L. (1988). Les habitudes alimentaires des poissons d'eau douce Africaines. In: C. Leveque, M. N. Bruton and Sentougo, S.(eds). Biology and Ecology of African Freshwater-fishes ORSTOM and IFAN. 221-222

Mass, S., Nwadiaro C. S. & Dumont, H.J. (1992). *Tropodiaptomus lateralis* Kiefer 1932 (Copedoda: Calanoida) in Oguta Lake, South-Eastern Nigeria. *Hydrobiologia,* 293, 193 – 170.

McCann, J. A. (1984). Involvement of American Fisheries Society with exotic species. – In: W.R. Courtney & J. R. Stauffer (eds): Distribution, biology, and management of exotic fishes: 1969 – 1982. Baltimore: John Hopkins University Press.

McConnell, R. H., Crul, R. C. M. & Roest. F. C. (1992). Symposium on Resource use and conservation of the African Great Lakes held at Bujumbura in 1989. *Mitt,. Internet. Verein. Limnol*, 23, 128 + 46 figs. + 18 tables.

Nwadiaro, C. S. (1987). Depth variations in the chemistry of Oguta Lake, Imo State, Nigeria. *Hydrobiological Bulletin*. 21 (2), 133 – 140.

Nwadiaro, C. S. (1989a). Preliminary observations on the nature, taxonomic composition, distribution, behaviour and nutrient requirements of the "unusual alga jellies; of Lake Oguta in South Eastern Nigeria. *Int. Rev. Ges. Hydrobiol.* 74, 633 – 642.

Nwadiaro, C. S. (1989b). Ichthyofauna of Lake Oguta, a shallow lake in the south-eastern Niger. *Arch. Hydrobiol*. 115(3), 463 – 475.

Nwadiaro, C. S. (2009). Inland water database a *sine qua non* for freshwater fisheries development in Nigeria. 12th Inaugural Lecture of the Federal University of technology, Owerri, Imo State Nigeria

Nwadiaro, C. S. & Oji, E. O. (1986). Phytoplankton productivity and chlorophyll-a concentration of Oguta Lake, Imo State, Nigeria. *Hydrobiol. Bull*. 19 (2), 123 – 131.

Nwadiaro, C. S. & Idabor, P. (1990). Proximate composition and nutrient elements of the "unusual algal jellies" of Lake Oguta, South-Eastern Nigeria. *Int. Rev. Ges. Hydrobiol*. 75(3), 413 – 420.

Nwadiaro, C. S. & Okorie, P. U. (1986). Some aspects of the reproductive biology of *Chrysichthys filamentous* (Teleostei: Bagridae) In Oguta Lake, Nigeria. *Rev. Zool, Afr.* 99(3), 233 – 241.

Nwadiaro, C. S. & Okorie, P. U. (1985). Biometric characteristics, length/weight relationship and condition factors in *Chrysichthys filamentous* (Pisces: Bagridae) from Oguta Lake, Imo State of Nigeria. *Biologia Africana*. 2(1), 48 – 57.

Nwadiaro, C. S. & Okorie, P. U. (1987). Food and feeding habits of the African bagrid fish, *Chrysichtys filamentosus* in Oguta Lake, South-Eastern Nigeria. *Jap. J. Ichthyol*. 33(4), 375 – 383.

Nwadiaro, C.S. & Odigi, M.N. (1991). Sediment of Lake Oguta, Imo State, South-Eastern Nigeria. Cations and trace/heavy metals. Archives fur Hydrobiologie. 121(3), 365-371

Nwadiaro, C.S., Maas, S. & Dumont, H. J. (2008). Copepoda and Cladocera of Oguta Lake and some associated floodplain lakes in the upper section of the Lower River Niger delta in Imo State, South-Eastern Nigeria. African Journal of Applied Zoology and Environmental Biology. 10:1-10.

Nwadiaro, C. S. & Umeham, S.N. (1985). The chemical hydrology of Oguta Lake, Imo State, south-eastern Nigeria. *Arch. Hydrobiol.* 105, 251 – 371.

Nwadiaro, C. S., Miracle, M. R., Vincente, E. & Dumont, H.J. (2018). Comparative Limnology and fisheries of some Lower Niger Delta foodplain Lakes and a non-floodplain lake in South-Eastern Nigeria. *Proc. of the 33rd Annual Confidence of the Fisheries Society of Nigeria (FISON), Ikorudou, Lagos, Nigeria 28th October -2nd November 2018.*

Nwadiaro, C.S., Maas, S. & Dumont, H.J. (2002). Copepoda and Cladocera I of the Zooplankton community) of Lake Oguta and some associated floodplain lakes of the upper section (Imo State) of the Lower River Niger delta in Nigeria. *African Journal of Applied Zoology* and *Environmental Biology.* 10, 1-10.

Odigi, M. I. & Nwadiaro C. S. (1988). Geophysical Limnology of Lake Oguta (in Imo State, South-Eastern Nigeria) with notes on its possible origin. *Hydrobiol Bull*. 22(2), 113 – 126.

Odigi, M.N. & Nwadiaro, C.S.(1993). Heavy minerals in the surficial sediment of Lake Oguta in South-Eastern Nigeria. *Limnologica.* 23(2), 171-176.

Ogutu –Ohwayo (1960). The decline of the native fishes of lakes Victoria and Kyoga (East Africa) and the impact of introduced species, especially the Nile perch, *Lates niloticus*, and the Nile tilapia, *Oreochromis niloticus*.– *Environ. Biol. Fish*. 27, 81 – 96.

Segers, H. (1993). Rotifera of some lakes in the flood plain of the River Niger (in Imo State, Nigeria). – New species and some other taxonomic considerations. *Hydrobiologia.* 250, 39-61.

Segers, H., Nwadiaro, C. S. & Dumont, H.J. (1993). Rotifera of some lakes in the floodplain of the River Niger (Imo State). II – Faunal composition and diversity. *Hydrobiologia.* 250, 63 – 71.

Spliethoff, P. C., Long, H. H. & Frank, V. C. (1983). Success of the introduction of the fresh water clupeid, *Limnothrissa moidon* (Boulenger) in Lake Kivu. – *Fish. Manag*. 14, 17 – 31.

Ziller, S. & Economou – Amilli, A. (1998). Freshwater algae from lakes in the Lower Niger Delta system in Nigeria. *Hydrobiologia* 368 (1/3), 217 – 229.