ASSESSMENT OF FISH STOCK AND PLANKTON OF OLI RIVER, KAINJI LAKE NATIONAL PARK, NIGERIA

***ABIODUN J. A., YEM, Y. I. & AJAYI, O.**
National Institute for Freshwater Fisheries Research, P. M. B. 6006, New Bussa, Niger State, Nigeria.
*Corresponding author: jaabiodun1@yahoo.com

Abstract
Fish stock, Physico-chemical parameters and primary productivity of Oli River were determined using experimental gill-net, standard limnological procedures and depth strata techniques. Thirty six (36) different fish species from 15 families were recorded from the river during the survey. The catches were dominated by Schilbeids with Schilbe mystus dominating the over-all catch composition. The yield estimate from the river based on experimental gill net sampling was 30.27 kg/1000 m^2, which translates to an average fish production of 48 kg/ha. Eighteen (18) and fourteen(14) species of phytoplankton and zooplankton respectively were recorded from the river. This is quite high and it is an indication that the river has abundant natural fish food. Using the Morpho-Edaphic Index (MEI) that is based on the river conductivity and mean depth, the potential fish yield of the river was 57.38 kg/ha. This yield which is higher than the actual production indicates and strengthens the need for proper management of the river to improve its current fish production.
Keywords: Fishery, conservation, fish stock assessment, species composition.

Introduction

Oli River is the longest river flowing in the Kainji Lake National Park (KLNP) traversing the park along a north-south axis. By virtue of being mostly in the park, the river is a prime protected environment. During the dry season, water holes scattered in the park dry up. Also the terrestrial grasses usually get burnt and not available as forage to the herbivores, which are in greater abundance in the park. Within this period, Oli River provides the source of water and green vegetation on its banks for animals, which cluster along the channel. The importance of this seasonal phenomenon for conservation and management of the park is well recognized. For one, it guarantees the survival of the large animals, which are primarily targeted for conservation, over the long dry seasons. Secondly it provides good game viewing scenario for tourists.

The Kainji Lake National Park being the first of its kind in Nigeria could be described as being fairly studied. These include the geology and soil (Valette, 1973), Vegetation (Child, 1974), bush fire and its ecological significance (Afolayan, 1978). Child (1973) reported the occurrence of 60 species of wild animals, 24 species of amphibian and 350 species of game birds. Other studies include the habitat utilization by elephants and the biology of guinea fowls in the park (Ayeni, 1977). However, very little work has been done on the fish stock assessment of the Oli River, which traverses the park. Also knowledge of the plankton, benthos and aquatic macrophytes is completely lacking.

This study tends to obtain baseline information on the fish stock, limnology and fish potential yield of Oli River complex, which will fill the gap in knowledge and also help in the management and development of the fishery of the River for conservation and tourism.

Study Site

Oil River lies between latitudes 10° 30'N and longitudes 4° 20'and 4° 26'E. It has its source from "Pocket Ecotum" (Fadama area) in Benin Republic and enters the Kainji Lake National Park at Gulubi village in Yashikira District of Kwara State. It flows out of the Park at Kali, near Gada Oli and empty into River Niger at New Awuru near Kainji Dam. The rivers, which include Uffa, Ka, Nanu and Isi are seasonal and flow into Oli River at different points within the park. Its length within the park is about 142 km and is located between Kwara and Niger States of Nigeria. River Oli forms pools of water during the dry season when the water level is very low and some of the pools are inhabited by a pod (group) of hippopotamus.

Materials and Method

For the purpose of these studies, six main sites were used as sampling stations. These include site A which is located at about 3 km from the main camp; site B is located at about 5 km from the main camp; site C is located at about 8 km from the main camp; Gilbert child site is located 3.5 km upper part of the main camp; Adjacent camp site is located 1.5km from the main camp and main camp site is located 0.02km opposite the main camp. The instruments used for site selection include accessibility, biological and shoreline characteristics. Fleets of experimental gill nets were used for the fish stock assessment.

These consist of nine nets each measuring 50 meters long and 3 meters deep with meshes ranging from 25 mm to 175 mm (i.e. 1″, 1½″, 2″, 2½″, 3″, 3½″, 4″, 5″ and 7″). The nets were set to cover shoreline, surface and bottom of the water body. Malian traps and long lines were also used in addition to the fleets of gill nets. The fishing gears were checked early in the morning by 6.00 am for night catches and 5.30 pm in the evening for day catches. The nets, long lines and Malian traps were packed and reset at other stations. In order to determine Physico-chemical parameters of the river, water temperature was measured at each sampling station with a mercury thermometer and standard limnological procedures were followed (APHA *et al.*, 2005). Depth strata techniques were used to determine the primary productivity of the river (Karlman, 1973). These were done for periods of low and high water levels of the river.

Results

Fish Species Composition

Thirty-six (36) different species from 15 families were recorded from the river during the survey. The species occurrence, their relative abundance and the percentage weight of each species caught are shown in Table 1. The study revealed eleven (11) carnivorous fish in the river - *Hydrocynus forskalii*, *Bagrus bayad*, *Bagrus docmac*, *Hepsetus odoe*, *Heterobranchus bidorsalis*, *Malapterurus electricus*, *Gymnarchus niloticus*, *Schilbe intermedius*, *Heterobranchus longifilis*, *Clarotes laticeps* and *Lates niloticus* and twenty-five (25) forage fish species.

Mesh Size Selectivity

Table 2 shows fish species caught by each mesh size of the experimental gill net. Mesh sizes 2″ and 2½″ had the highest diversity of twenty (20) species, followed by 3″ with fourteen (14), while the least was 7″ with only one (1) species. In terms of number of fish caught by each mesh size, 2″ had the highest catch with one hundred and eighty-three (183) followed by 2½″with ninety-nine (99), 1″ with ninety-two (92), 3″ with forty-five (45) then 3½″ with eighteen (18), 4″ with seventeen (17), 1½″ with five (5) and 5″ with two (2) while the least was 7″ with only one (1) species. The table also shows that catch by mesh size with 1″accounting for 19.9% and 3.2% by number and weight respectively; 1½″ with 1.1% and 0.7%, 2″ with 39.6% and 29.5%, while 7″, which is the lowest accounted for 0.3% and 1.4% by number and weight respectively. *Heterobranchus longifilis* was caught in hook number 11, *Malapterurus electricus*, *Heterobranchus longifilis* and *Brycinus macrolepidotus* were caught by hook number 12 while *Heterobranchus bidorsalis* and *Brycinus macrolepidotus* were caught in hook number 13.

Fish Yield Estimates

The yield estimates from the river based on the experimental catch data for the sampling periods was 30.27 kg/ 1000 m^2. This translate to an average fish production of 48 kg/ha and the potential fish yield (PFY) for the river was calculated to be 57.38 kg/ha.

Fish Productivity

Table 3 shows the mean physico-chemical parameter of Oli River. The ttemperature (both air and water) was on average of 26.96^{o}C and 28.4^{o}C respectively, while the pH and dissolved oxygen mean values were 6.82 and 6.58mg/l respectively. Table 4 shows phytoplankton and zooplankton recorded in Oli River. Eighteen (18) species of phytoplankton and fourteen (14) species of zooplankton were recorded during the survey.

Table 1: Fish species composition (%) in gillnet based on number and weight in Oli River.

Family / Species	Number	% Number	Weight	% Weight
Mochokidae				
Synodontis membranaceus	3	0.58	1950	3.20
Synodonits schall	39	7.59	6460	10.63
Synodontis filamentosus	6	1.17	460	0.75
Synodontis ocellifer	17	3.31	1050	1.72
Synodontis sorex	4	0.78	1190	1.95
Synodontis gambiensis	6	1.17	1650	2.71
Mormyridae				
Mormyrus rume	2	0.39	1410	2.31
Mormyrops deliciosus (now *M. anguilloides*)	6	1.17	2800	4.60
Mormyrus hasselquisti	9	1.75	1150	1.88
Pectrocephalus bane	43	8.37	650	1.06
Hippopotamyrus pictus	3	0.58	110	0.17
Hyperopisus babe	1	0.19	60	0.10
Gnathonemus abadii	1	0.19	150	0.25
Alestidae				
Hydrocynus forskalii	55	10.70	5095	8.38
Brycinus nurse	4	0.78	140	0.22
Brycinus macrolepidotus	14	2.72	2370	3.90
Cyprinidae				
Barbus bynni occidentalis	1	0.19	1800	2.95
Raiamas senegalensis	5	0.98	270	0.44
Claroteidae				
Clarotes laticeps	9	1.75	1850	3.04
Chrysichthys auratus	1	0.19	40	0.07
Auchenoglanis occidentalis	10	1.95	2850	4.68
Bagridae				
Bagrus bayad	1	0.19	500	0.82
Bagrus docmac	2	0.39	240	0.40
Schilbeidae				
Schilbe intermedius	13	2.53	815	1.33
Eutropius niloticus (now *Schilbe mystus*)	225	43.77	14090	23.20
Citharinidiae				
Citharinus citharus	1	0.19	150	0.25
Distichodontidae				
Distichodus rostratus	2	0.39	3450	5.65
Malapteruridae				
Malapterurus electricus	1	0.19	600	0.98
Clariidae				
Heterobranchus longifilis	2	0.39	2600	4.27
Heterobranchus bidorsalis	2	0.39	600	0.98
Clarias gariepinus	1	0.19	50	0.08
Centropomidae				
Lates niloticus	2	0.39	520	0.86
Hepsetidae				
Hepsetus odoe	3	0.58	300	0.49
Cichlidae				
Sarotherodon galilaeus	10	1.95	1200	1.98
Tilapia zillii	5	0.98	610	1.00
Gymnarchidae				
Gymnarchus niloticus	5	0.98	1300	2.14
Total	**514**	**100**	**60710**	**100**

Table 2: Fish species composition in gill net catches based on mesh sizes in Oli River

	Mesh								
Mesh size	1'	1½'	2'	2½'	3'	3½'	4'	5'	7'
Number of fish caught	92	5	183	99	45	18	17	2	1
Number (%)	19.9	1.1	39.6	21.4	9.7	3.9	3.7	0.4	0.3
Weight(g) of fish caught	1627	379	14910	7330	6620	5640	11250	2050	700
Weight (%)	3.2	0.7	29.5	14.5	13.1	11.2	22.3	4.1	1.4

Table 3: Mean physico-chemical parameters of Oli River

Parameter	**Range**	**Mean ± SD**
Depth (m)	0.1-3.0	1.18±1.16
Temperature (ºC)		
Air	24.0-29.2	26.96±2.13
Water	28.0-28.8	28.4±0.36
Ph	6.6-6.9	6.82±0.09
Dissolved Oxygen (mg/l)	5.80-8.00	6.58±0.84
Biochemical Oxygen Demand (mg/l)	6.00-6.80	6.39±0.39
Transparency (m)	0.05-0.18	0.12±0.07
Conductivity (µ/cm)	40.0-62.0	57.6±6.69

Table 4: Plankton composition (phyto and zoo) of Oli River

S/no	**Phytoplankton**	**Zooplankton**
1	*Aphanocapsa elachista*	*Branchionus calyciflorus*
2	*Nitzchia sp.*	*Asplanduna sp.*
3	*Chlorella ellipsoidea*	*Filinia opoliensis*
4	*Navicula digitoradiata*	*Nanplii*
5	*Hormidium sp.*	*Copepodite*
6	*Navicula petersernii*	*Cyclopoid copepod*
7	*Stamastrum rotula*	*Trichocerca cylindrical*
8	*Fragilaria sp.*	*Lecane deapen*
9	*Scenedesmus quadricanda*	*Lecane bulla*
10	*Closterium simplex*	*Diaphanosoma exicusm*
11	*Phacus sp.*	*Polyarthira delicoptera*
12	*Scenedesmus incrassatulus*	*Sycheata sp.*
13	*Diatomella sp.*	*Filinia longiseta*
14	*Melosira granulate*	
15	*Spirulina sp.*	
16	*Volvox tertius*	
17	*Athrospira sp.*	
18	*Pediastrum simplex*	

Discussion

The family Mormyridae had the highest diversity of seven species, followed by Mochokidae with six species, while the families Distichodontidae, Malapteruridae, Centropomidae, Hepsetidae and Gymnarchidae had one species each. *Eutropius niloticus* (now *Schilbe mystus*) had the highest with 43.77% in terms of number. This was followed by *Hydrocynus forskalii* with 10.70%, while *Hyperopisus bebe*, *Barbus bynni occidentalis*, *Chrysichthys auratus*, *Malapterurus electricus*, *Gnathonemus abadii*, *Citharinus citharus*, *Bagrus bayad* and *Clarias gariepinus* had least with 0.19%. *Eutropius niloticus* (now *Schilbe mystus*) still had the highest in weight, which make up 23.20% of the total catch, followed by *Synodontis schall* (10.63%), while the least were *Citharinus citharus*, *Bagrus bayad*, *Chrysichthys auratus*, *Barbus bynni occidentalis*, *Malapterurus electricus*, *Clarias gariepinus*, *Gnathonemus abadii*, *Hyperopisus bebe* (0.25%).

The revelation of eleven (11) carnivorous fish species in the river - *Hydrocynus forskalii*, *Bagrus bayad*, *Bagrus docmac*, *Hepsetus odoe*, *Heterobranchus bidorsalis*, *Malapterurus electricus*, *Gymnarchus niloticus Schilbe intermedius*, *Heterobranchus longifilis*, *Clarotes laticeps* and *Lates niloticus* and twenty-five (25) forage fish species

showed a balance population of carnivore to forage. According to Swingle (1950), the ratio of forage to carnivores (F/C) ranges from 1: 4-10 in a balanced population.

On mesh size selectivity, the higher number of catches in the mesh sizes below the standard recommended for inland water bodies (i.e. 1″, 2″ and 2½″), contributed 47.9% of the total weight while the recommended standard (3″ and above) though less in number contributed 52.1% of the total weight.

The Fish yield estimates from the river based on the experimental catch data for the sampling periods was 30.27 kg/ 1000 $m^2$and this translates to an average fish production of 48 kg/ha. This figure is high when compared to some other similar rivers in Nigeria like Usuma river in Federal Capital Territory with 38.2kg/ha (Abiodun *et al*., 2013); Egbe river in Ekiti State with 39.7 kg/ha (Abiodun *et al*., 2004). The potential fish yield (PFY) estimate is an index of the total annual production of fish expected from an optimum fishery using empirical derived regression equations. These yield models are basically forecasting tools which provide useful information necessary for decision making in fisheries management and development. Using the Morpho-Edaphic Index (MEI) that is based on the river conductivity and mean depth , the PFY for the river was calculated to be 57.38 kg/ha. This yield which is higher than the actual production indicates and strengthens the need for proper management of the river to improve its current production.

The depth range of the river was 0.1m-3.0m with mean of 1.18m. The river is quite shallow compared to Niger River, Benue River, Cross River and Ogun River. The Temperature (both air and water) was on average of 26.96^{o}C and 28.4^{o}C respectively. The pH and dissolved oxygen mean values were 6.82 and 6.58mg/l respectively. These water parameters indicate good productivity of the river. Boyd (1978) reported pH values range of 6.0-8.2 to be good for sustainable aquatic life including fish. The dissolved oxygen is higher than that of Ogun River (4.95-5.9mg/l) and Calabar River (3.4-7.0mg/l) and falls within the range (5.0-9.0mg/l) as reported by Boyd (1981) and Alabaster (1982) for good water quality sustainable for aquatic organisms. Low water transparency observed was due to suspended solids, surface run-offs and the presence of a lot of hippopotamus in the river. These parameters gave a good reflection of production of natural fish food in the river.

Conclusion

The study has given an insight to the fisheries resource of Oli River and opportunities in developing and managing its fish stock to enhance its potential as tourist attraction and for sport fishing. The water quality of the river was found to be within acceptable levels for fish production and safe for aquatic life. The result shows that the river has high diversity both in fish species and planktons communities. The forage to carnivore ratio was 4:1, indicating a balanced fish population.

The need for proper management of this river so as to improve its fish production is strengthened by the current fish yield which was higher than the actual production.

An update of the data on the inventory and a continuous monitoring system for the fauna and flora of the Oli river complex in relation to their biodiversity is recommended.

Acknowledgment

This work was carried out with the sponsorship of the Kainji Lake National Park (KLNP), New Bussa. We are indebted to the Conservator of the Park, Mr. Y. M. Kolo and the following other staff of the Park Mr. M. Enaberu, Mr. A. Issa, Mr. A. Matane, Mr. H. Kolo and Mr. Dayo Oni for supporting the study. We also wish to acknowledge these other staff of National Institute for Freshwater Fisheries Research, New Bussa Mal. Yusuf Tada, Mal. Suleiman Abdulraham and Israel Unogwu for their participation in the study

.**Reference**

Abiodun, J. A., Bankole, N. O., and Yem, Y. I. (2013). Appraisal of the current fish diversity and production at Usuma river, Federal Capital Territory, Abuja, Nigeria. *Internal Journal of Applied Research and Technology*. 2(4): P53-58

Abiodun, J. A., Alamu, S. O., and Miller, J. W. (2004). Preliminary mission report on assessment of Egbe river fisheries in Ekiti State, Nigeria with implication for management. Report submitted to FAO/NSPFS, Abuja. May, 2004. 34p

APHA, AWWA and WEF (2005). Standard methods for examination of water and waste water. *21st ed. APHA, Washinton D.C*

Afolayan, T. A. (1978). The effect of fires on the vegetation in Kainji Lake National Park, Nigeria. Oikos 31: pages 376-382

Alabaster, J. S. (1982). Report of the EIFAC. *Workshop of fish farm effluents*. *Technical Paper 41, FAO, Rome*.

Ayeni, J.S.O. (1977). The Kainji Lake National Game Park; Poaching of Wild-game is the major problem. *Kainji Lake Research Institute Newsletter, Vol.2, No 2, August, 1978*

Bond, C.E. (1979). *Biology of Fishes*. W.B. Saunders Company, London, 514pp. *Philadelphia: W. B. Saunders*.

Boyd, C. E. (1981). Water quality in warm water fish ponds. *Auburn University Publishers, Alabama. p. 353*.

Child, G.S. (1973).The vegetation map of Borgu Game Reserve (unpublished manuscript).

Child, G.S. (1974). An ecological survey of the Borgu Game Reserve, *F.A.O. Rome*

Karlman, S. G. (1973). In Adeniji, 2001: *An evaluation of the primary productivity and potential fish yield of Kainji Lake*. FAO Technical Report series no.3

Swingle, H. S. (1950). Relationships and dynamics of balanced and unbalanced fish populations. *Alabama Polytechnic Institute, Agric Expt. Station Bulletin, No. 274.*

Valette, J. (1973). The reconnaissance soil survey of Mokwa-Kontagora-Kainji area, North- west and Kwara State, Nigeria. *Soil Surv. Bull. (Samaru) 44.*