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FISH DIVERSITY IN TWO RESERVOIRS IN SOUTHWEST NIGERIA

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ABSTRACT

This study investigated the fish diversity of Eko – Ende and Owalla reservoirs, which are within the Osun river system in South West, Nigeria with a view to document biodiversity information needed for conservation and sustainable fisheries. Fish samples were collected monthly from the two reservoirs for one year, using a battery of multifilament gill nets. The data collected from each reservoir was analyzed for fish diversity. Information obtained on the forage / carnivore (F/C) ratio of fishes in each reservoir was used in measuring and comparing the ecological balance of the reservoirs. The results showed that eighteen fish species representing 16 genera and 10 families were identified in Eko – Ende, while 17 fish species in 15 genera and 10 families were identified in Owalla during the period of study. Sixteen species (representing 84.2% of the total number of fish species) were common to both reservoirs and they were both dominated by Cichlids. Eko – Ende Reservoir had greater fish diversity than the Owalla Reservoir. Shannon – Weiner (H') index of fish diversity from Eko – Ende reservoir was 2.37 while that from Owalla reservoir was 2.10. The forage / carnivore (F/C) ratios of the fishes from the two reservoirs showed that Eko – Ende reservoir (F/C = 1.98) is ecologically balanced, while Owalla reservoir (F/C = 0.92) is not Owalla reservoir had a higher population of *Hemichromis fasciatus* (a predatory species). This reservoir also had more intensive fishing activities than the smaller Eko – Ende reservoir. The study concludes on the need for a participatory research to alleviate the problem of ecological imbalance of fish species in Owalla reservoir.

INTRODUCTION

Fishes are important components of aquatic environments. As renewable natural resources, fishes have been exploited for various purposes. These include aesthetics, sports, scientific studies, food, and production of fishmeal and fish oil. In a country like Nigeria, most fish species are of economic importance almost all fishes are eaten irrespective of the size. As such the knowledge of fish diversity is of scientific, ecological and economic importance; as it provides basic indices on the diversity of various aquatic environments. The importance of biodiversity – defined as the variability among living organisms from all sources – cannot be over emphasized. From the ecological point of view, it is well established that all species provide at least one function in an ecosystem. Each function is an integral part of regulating the species balance, species diversity and species health. Biodiversity has intrinsic values for human culture, survival and benefits. These values are the basis for the three main objectives of the convention on biological diversity. These are conservation, sustainable use and the fair and equitable sharing of benefits of utilization (Klopper *et al.*, 2001)

The fauna of inland waters has been widely reported as consisting complex assemblages

of numerous species (Thuok, 1998; Welcomme, 1999; Van der Waal, 2000). This is especially true for tropical countries, leading to increasing advocacy for more research in the 'species-rich, and data poor' tropical countries (Ita, 1993; Wishart and Davies, 1998; King, 2001; and Pullin, 2004). The conservation of biodiversity in aquatic habitats – including reservoirs – has become an increasingly important global challenge in the management of water resources. However, Leveque (1997) emphasized that the starting point for the conservation and sustainable use of any resource is to know how and where the resource exists. Biodiversity is not evenly distributed on earth. There are a variety of objective measures of biodiversity. These include species richness, Simpson index, and Shanmon – Wiener index. These indices are available in computer software such as the Palaeontological Statistics software (Hammer *et al*., 2006). In addition, Helfman *et al*. (1997) recorded three indices used by ecologists. Alpha diversity refers to diversity within a particular area, community or ecosystem. It is measured by counting the number of species within the ecosystem. Beta diversity is species diversity between ecosystems; this involves comparing the number of species that are unique to each of the ecosystems. Gamma diversity is a measure of the overall diversity for different ecosystems within a region.

Nigeria has a vast expanse of inland freshwater. Olaosebikan and Raji (1998) reported that the freshwater fish species of Nigeria is the richest in West Africa with more than two hundred and sixty – eight (268) known species. Many reservoirs in Nigeria have been constructed either for irrigation or water supply, but fisheries is almost always added uses of these reservoirs. As such majority of these reservoirs have been inadequately monitored and studied for their fisheries. The few studies carried out have concentrated on large sized water bodies (Balogun, 2005 and Taiwo, 2008). There are urgent needs for efficient monitoring of the fishes in the various water bodies in Nigeria. In addition to the concerns on the loss or decline of fish diversity, is the concern on fish production and supply in the country. Abban *et al.* (2000) observed that information on the fish fauna of many African countries has been inadequate. This is largely due to rapid changes in the aquatic environment through irresponsible fishing and environmental degradation, resulting from inadequate plans for economic development. The observation made by these authors is suggestive of the possibility of losing vital components of fish diversity before they are well known.

The two reservoirs selected for this study are within the Osun river system. They are relatively small when compared with major reservoirs in Nigeria. They are however quite significant in the land – locked Osun state. The Owalla reservoir is surrounded by many fishing communities for whom fishing constitutes the main economic stay. Fishing activities are more intense on Owalla reservoir than Eko – Ende reservoir where people have other sources of livelihood. There are no pre – impoundment information on these reservoirs. It was however established that they were primarily impounded for portable water supply. While research effort is being focused on the enhancement of inland fisheries in some parts of Nigeria (Neiland and Ladu, 1998), other parts like Osun State still lack baseline data on which fisheries enhancement projects could be based. This study was carried out to document the ecological balance of these reservoirs, while providing additional scientific information for a national biodiversity database.

MATERIALS AND METHODS

The study was carried out in Eko – Ende and Owalla reservoirs located respectively in the Ifelodun and Irepodun Local Government areas of Osun State within

latitude 6° 50′N and 7°59′N and longitude 4° 20′E and 5° 30′E. The two reservoirs are located within the Osun River basin, otherwise described by Ita (1993) as the Western littoral region on the hydrologic map of Nigeria. Eko – Ende reservoir has a surface area of 136.5ha, while Owalla reservoir has a surface area of 1,053ha.

Fish samples were collected from both reservoirs monthly for a period of one year. Samples were collected using a battery of multifilament gill nets (mesh sizes: 15mm, 20mm, 25mm, 30mm, and 40mm) to minimize selectivity of the gill nets used for sampling. The nets were set in the evening around 1800h on each sampling day and were hauled the following morning between 0700h and 0900h. To ensure a complete inventory of the fish fauna of the reservoirs, additional fish samples were obtained from the fisherfolks on the reservoirs (whenever necessary) to augment the catches. Fishes were identified with a combination of identification keys provided by Reed *et al.* (1967), Leveque *et al.* (1990; 1992) and FishBase (2004).

The fish diversity index in each reservoir was computed using the data collected on the monthly relative abundance of fish species using the Palaeontological Statistics software (Hammer *et al*., 2006). The forage / carnivore F / C ratio is a summary description of the relative abundance of non – piscivorous fishes to piscivorous fishes. Values between 1.4 and 10.0 are considered as indicating various levels of ecological balance between the two major trophic groups of fishes. The (F / C) ratio of fishes in each reservoir was calculated according to Abban and Dankwa (2001).

RESULTS

A total of eighteen (18) fish species belonging to sixteen (16) genera and ten (10) families were collected from Eko – Ende reservoir; while seventeen (17) fish species belonging to fifteen (15) genera and ten (10) families were collected from Owalla reservoir during the period of study. A checklist of the fishes collected is presented in Table 1. Analyses of the fish samples show that the fish species compositions of both reservoirs were quite similar. Sixteen of these fishes (representing 84.2% of the total number of fish species) were common to both reservoirs. *Clarias anguillaris* was found only in Owalla reservoir, while *Pollimyrus isidori* and *Clarias gariepinus* were found only in Eko – Ende reservoir.

The two reservoirs were dominated by members of the family Cichlidae. As shown in Table 2, there were seven cichlid species in both reservoirs. The family Mormyridae also had more than one species in both reservoirs. The two reservoirs differ in the number of specimens recorded for each fish species. The cichlids were the dominant group constituting 69.27% and 71.31% of specimens, caught in Eko – Ende and Owalla reservoirs respectively. On the basis of their relative abundance, the fish species from the studied reservoirs could be classified into three groups: rare, common and abundant (Table 3). In Eko – Ende reservoir, six species were in the rare category, forming 3% of the total number of specimens collected while the five species in the common category formed 13.25% of the total catch (Table 3). In the abundant category, were seven species which constituted 83.73% of the total catch. For Owalla reservoir, seven species were in the rare category constituting 3.01% of the total number of fish specimen collected. Five species each in the common and abundant category respectively constituted 13.49% and 83.41% of the total catch in the reservoir. This categorization also shows that the siluriforms – *Chrysichthys nigrodigitatus* and *Schilbe intermedius* together form a significant part – about 19% of the specimens collected in each reservoir.

The forage / carnivore (F/C) ratio of the Eko- Ende reservoir was 1.98, while that of Owalla reservoir was 0.92. These values revealed that the Eko – Ende reservoir is ecologically balanced, while the Owalla reservoir is ecologically imbalanced. Table

4 shows the fish diversity indices as calculated by different methods. 77.78% of the nine indices of diversity showed that Eko – Ende reservoir is more diverse in its fish species composition than Owalla reservoir.

DISCUSSION

The results on the fish species richness of these two reservoirs are comparable to those documented from other reservoirs in Nigeria. The results are similar to those reported by Lamai and Kolo (2003) from Dan – Zaria dam as well as those reported by Mohammed and Omoregei (2004) from Doma Lake. The species richness of the two reservoirs are however less when compared to larger reservoirs in Nigeria like Kainji and Jebba dams reported by Ita (1993). As with many other freshwater systems in Nigeria (Reed *et al*., 1967; Mohammed and Omoregie (2004) and Adesulu and Sydenham, 2007), the fish species composition of Eko – Ende and Owalla reservoirs were dominated by the cichlidae family. Two siluriformes species – *C. nigrodigitatus* and *S. intermedius* – formed a significant portion of the fishes recorded from the two reservoirs. This supports the socio-economic importance attached to these species in the various fishing communities around these reservoirs. It is however noteworthy that the clariid species recorded in these reservoirs were very few in comparison to results from other water bodies in Nigeria. None of the species recorded was endemic to the reservoirs however each species is significant in view of the fish diversity of these reservoirs.

The diversity indices employed in this study showed that Eko – Ende reservoir is more diverse than the Owalla reservoir. Research has shown that a more diverse ecosystem is better able to withstand environmental stress and is consequently more productive than a less diverse ecosystem (Cyrus and Vivier, 2006; Das and Chakrabarty, 2006 and Pattrick and Strydom, 2007). This study also shows that the Eko – Ende reservoir is ecologically balanced while the Owalla reservoir is not. The relatively higher percentage of piscivores – especially *Hemichromis fasciatus* – in Owalla reservoir is a factor responsible for the fewer number of fishes recorded in this reservoir as well as the ecological imbalance in this reservoir. The percentage of *H. fasciatus* is lower in Eko – Ende reservoir. Suarez *et al.* (2001) and Gratwicke *et al.* (2003) reported the presence of predators as one of the major factors that negatively influence fish species richness and abundance. The effect of intense fishing is an additional factor to the poorer status of the fish diversity of Owalla reservoir. This study makes it clear however that there is a threat to the sustainability of fisheries in Owalla reservoir. A participatory research will be required to remove this threat.

REFERENCES

Abban, E. K., Casal, C. M. V., Falk, T. M. and Pullin, R. S. V. (2000). *Biodiversity and Sustainable use of fish in coastal zone.* International Center for Lake and Aquatic Research Management (ICLARM) Conference Proceedings **63**, 71p

Abban, E. K. and Dankwa, H. R. (2001). Amanzuri Conservation and Integrated Development (ACID) Project of Ghana Wildlife society: Fish Biodiversity Baseline study 29p

Adesulu, E. A. and Sydenham, D. H. J. (2007). *The freshwater fishes and fisheries of Nigeria*. Macmillan Nigeria, 397p

Balogun, J. K. (2005). Fish distribution in a small domestic water supply reservoir: a case study of Kangimi Reservoir, Kaduna, Nigeria. *J. Appl. Sci. Environ. Mgt.* **93** (1) 93 - 97

Cyrus, D. and Vivier, L. (2006). Status of the estuarine fish fauna in the St Lucia

Estuarine System, South Africa, after 30 months of mouth closure. *African Journal of Aquatic Science* 31 (1): 71 – 81

Das, S. K. and Chakrabarty, D. (2006). The use of fish community structure as a measure of ecological degradation: A case study in two tropical rivers of India. *Tropical Freshwater Biology* 15: 55 - 69

FishBase (2004). FishBase 2004 CD-ROM. ICLARM, Manila

Gratwicke, B.; Marshall, B. E. and Nhiwatiwa, T. (2003). The distribution and relative abundance of stream fishes in the upper Manyame River, Zimbabwe, in relation to land use, pollution and exotic predators. *African Journal of Aquatic Science* 28 (1): 25 – 34

Hammer, O.; Harper, D. A. T. and Ryan, P. D. (2006). PAST: Palaeontological Statistics software package for education and data analysis, version 1.50. http://folk.uio.no/ohammer/past

Helfman, G. S. Collette, B. B. and Facey, D. E. (1997). *The diversity of fishes*. USA Blackwell Science. 528p

Ita, E. O. (1993). Inland fisheries resources of Nigeria. *CIFA Occasional paper No. 20* Rome FAO 120p

King, N. (2001). Overcoming the taxonomic impediment to sustainable development – Bionet International, the global network for taxonomy. *In*: Klopper, R. R., Smith, G. F. and Chikuni, A. C. (eds.) 2001. The global taxonomic initiative: documenting the biodiversity of Africa. Proceedings of a workshop held at the Kirstenboosch National Botanical Garden, Cape Town, South Africa (27 February – 1 March, 2001). Strelitzia 12, National Botanical Institute, Pretoria pp 63 – 67.

Klopper, R. R., Smith, G. F. and Chikuni, A. C. (eds.) (2001). The global taxonomic initiative: documenting the biodiversity of Africa. Proceedings of a workshop held at the Kirstenboosch National Botanical Garden, Cape Town, South Africa (27 February – 1 March, 2001). Strelitzia 12, National Botanical Institute, Pretoria 204p.

Lamai, S. L. and Kolo, R. J. (2003). Biodiversity and abundance of fish and plankton of Dan – Zaria Dam, Niger State, Nigeria. *Journal of Aquatic Science* 18 (2): 141–148.

Leveque, C. (1997): Biodiversity Dynamics and Conservation: the freshwater fish of tropical Africa. Cambridge University press. 452p

Leveque, C., Paugy, D. and Teugels, G. G. (1990). *The fresh and brackish water fishes of West Africa* vol. 1 & vol. 2. Belgium, Musee Royal de l'Afrique Centrale. 904p

Mohammed, S. U. and Omoregie, E. (2004). A preliminary investigation into the fisheries potentials of Doma Lake, Nasarawa State, Nigeria. *Journal of Aquatic Science* 19 (2): 59 – 64

Neiland, A. E and Ladu, B.M.B. (1998). Enhancement of inland fisheries in Nigeria: the institutional context provided by traditional and modern systems fisheries management In Petr. T. (ed) *Inland Fisheries Enhancement* FAO Technical Paper No 374 pp. 371 – 393

Olaosebikan, B. D. and Raji, A. (1998). Field guide to Nigerian Freshwater fishes, National Institute of Freshwater Fisheries Research (NIFFR), New Bussa, Nigeria 102p

Pattrick, P. and Strydom, N. A. (2007). Composition, abundance, distribution and seasonality of larval fishes in the Mngazi Estuary, South Africa. *African Journal of Aquatic Science* 32 (2): 113 – 123

Pullin, R. S.V. (2004). International concerns on fish biodiversity conservation in Africa. **In** Abban E. K. *et al* (eds.) *Biodiversity, Management and Utilization of West African fishes.* Worldfish Center Contribution No 1718. 53p

Reed, W., Burchard, J., Hopson, A.J., Janness, J. and Yaro, I. (1967). *Fish*

and Fisheries of Northern Nigeria Gaskya, Zaria, Nigeria 226 p

Suarez, Y. R., Petrere, M and Catella, A. C. (2001). Factors determining the structure of fish communities in Pantanal lagoons (MS Brazil). *Fisheries Management and Ecology* 8 (2), 173 – 186

Taiwo, Y. F. (2008). The taxonomy and some ecological aspects of fishes in two reservoirs in Osun State, Nigeria. Ph.D Dissertation Zoology Department, Obafemi Awolowo University, Ile – Ife. 225p

Thuok, N. (1998). Inland fisheries management and enhancement in Cambodia In Peter, T. (ed.) *Inland Fisheries Enhancement* FAO Fisheries Technical Paper. No. 374, Rome. FAO pp. 79 - 90

Van der Waal, B. C. W. (2000). Fish as a resource in a rural river catchment in the Northern Province, South Africa. *African Journal of Aquatic Science* 25: 56 – 70

Welcomme, R. L. (1999). A review of a model for qualitative evaluation of exploitation levels in multi – species fisheries. *Fisheries Management and Ecology* 6(1): 1 – 20.

Wishart, M. J. and B. R. Davies (1998). The increasing divide between first and third Worlds; Science Collaboration and Conservation of third World aquatic ecosystems *Freshwater Biology* 39: 557 – 567

Table 1: Checklist of fish samples collected from the two reservoirs during the period of study

FAMILY	SPECIES
Mormyridae	*Mormyrus rume* Valenciennes, 1847
	Marcusenius senegalensis Steindachner, 1870
	** *Pollimyrus isidori* Valenciennes, 1846
Hepsetidae	*Hepsetus odoe*Bloch, 1794
Alestiidae	*Brycinus longipinnis*Gunther, 1864
Cyprinidae	*Barbus leonensis* Boulenger, 1915
Bagridae	*Chrysichthys nigrodigitatus* Lacepede, 1803
Schilbeidae	*Schilbe intermedius* Ruppell, 1832
Clariidae	** *Clarias gariepinus* Burchell, 1822
	* *Clarias anguillaris* Linnaeus, 1758
Channidae	*Parachanna obscura* Gunther, 1861
Cichlidae	*Chromidotilapia guentheri* Sauvage, 1882
	Hemichromis fasciatus Peters, 1852
	Tilapia mariae Boulenger, 1899
	Tilapia dageti Thys van den Audenaerde, 1971
	Tilapia zillii Gervais, 1848
	Oreochromis niloticus Linnaeus, 1758
	Sarotherodon galilaeus Linnaeus, 1758
Anabantidae	*Ctenopoma nebulosum* Norris and Teugels, 1990

** - Fish species collected only in Eko - Ende reservoir

* - Fish species collected only in Owalla reservoir

Table 2: Relative abundance of fishes caught in the two reservoirs

	EKO ENDE		OWALLA	
SPECIES	**No of Specimen**	**% of Total**	**No of Specimen**	**% of Total**
Mormyrus rume	2	0.30	3	0.46
Marcusenius senegalensis	17	2.56	5	0.77
Pollimyrus isidori	9	1.35		
Hepsetus odoe	16	2.41	3	0.46
Brycinus longipinnis	23	3.46	3	0.46
Barbus leonensis	1	0.15	18	2.79
Chrysichthys nigrodigitatus	61	9.19	103	15.97
Schilbe intermedius	67	10.09	21	3.26
Clarias gariepinus	3	0.45		
Clarias anguillaris			11	1.70
Parachanna obscura	4	0.60	17	2.64
Chromidotilapia guentheri	10	1.51	1	0.15
Hemichromis fasciatus	54	8.13	177	27.44
Tilapia mariae	113	17.02	85	13.18
Tilapia dageti	90	13.55	99	15.35
Tilapia zillii	59	8.88	20	3.10
Sarotherodon galilaeus	112	16.87	74	11.47
Oreochromis niloticus	22	3.31	4	0.62
Ctenopoma nebulosum	1	0.15	1	0.15
Total number of specimens	664	100.00	645	100.00

Table 3: Categorization of fish species based on their relative abundance in the two reservoirs

Category	Eko - Ende Reservoir	Owalla Reservoir
Rare	*Mormyrus rume*	*Mormyrus rume*
	Pollimyrus isidori	*Marcusenius senegalensis*
	Barbus leonensis	*Hepsetus odoe*
	Clarias gariepinus	*Brycinus logipinnis*
	Parachanna obscura	*Chromidotilapia guentheri*
	Ctenopoma nebulosum	*Oreochromis niloticus*
		Ctenopoma nebulosum
Common	*Marcusenius senegalensis*	*Barbus leonensis*
	Hepsetus odoe	*Schilbe intermedius*
	Brycinus logipinnis	*Clarias anguillaris*
	Chromidotilapia guentheri	*Parachanna obscura*
	Oreochromis niloticus	*Tilapia zilli*
Abundant	*Chrysichthys nigrodigitatus*	*Chrysichthys nigrodigitatus*
	Schilbe intermedius	*Hemichromis fasciatus*
	Hemichromis fasciatus	*Tilapia mariae*
	Tilapia mariae	*Tilapia dageti*
	Tilapia dageti	*Sarotherodon galilaeus*
	Tilapia zillii	
	Sarotherodon galilaeus	

rare < 10 specimens,
common = 10 - 50 specimens
abundant > 50 specimens

Table 4: Fish Diversity Indices of the two reservoirs

	Eko - Ende	Owalla
Taxa_S	18	17
Individuals	664	645
Dominance_D	0.1129	0.1588
Shannon_H	2.369	2.099
Simpson_1-D	0.8871	0.8412
Evenness_e^H/S	0.5938	0.4801
Menhinick	0.6985	0.6694
Margalef	2.616	2.473
Equitability_J	0.8197	0.741
Fisher_alpha	3.412	3.201
Berger-Parker	0.1702	0.2744