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Evaluation of the Fisheries Potentials of Egbe Reservoir, Ekiti State, Nigeria

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ABSTRACT

The fish composition and abundance of Egbe Reservoir, Egbe Ekiti, Ekiti State were investigated from September 2005 to December 2006. Fish samples were collected from fishermen using funnel traps, gill nets and cast nets, 75mm mesh size. Five families of fish: Cichlidae, Clariidae, Channidae, Hepsetidae, and Mormyridae consisting of eight species were encountered. Cichlidae dominated the fish population (52.1%) and *Oreochromis niloticus* was the most abundant species. Estimated annual potential fish yield was 413.9 kg/ha/annum while post-calculated fish yield was 126.6kg/ha with 4.8% of the fishery resources exploited. The few species of fish and their abundance encountered in the reservoir indicated that the reservoir is under- exploited and it can support increased fish production if adequately stocked and properly managed to enhance sustainable use of its aquatic resources.

INTRODUCTION

The fish yields of most Nigerian inland waters are generally on the decline (Jamu and Ayinla, 2003). The decline of these fisheries has been attributed to causes ranging from inadequate management of the fisheries resources to environmental degradation of the water bodies. For sustainable exploitation of these fisheries resources, a crucial management tool is to have a comprehensive understanding of the ichthyofaunal composition and distribution of the water bodies.

A lot of studies abound on the composition and abundance of freshwater fish species of Nigeria, some of which include the works of Welman (1948), White (1966) , Reed et al. (1967), Ita et al. (1982), Moses (1987), Ita (1993), Odum (1995), Oso and Fagbuaro (2004), Fapohunda and GodState (2007),Tawari-Fufeyin and Ekaye (2007), Meye and Ikomi (2008) and Offem et al. (2009), to mention a few. However, very few studies are available on the assessment of the sustainable fisheries potentials of these water bodies and many other smaller rivers and reservoirs which contribute significantly to the major fish supply in the country. According to Jackson and Marmulla (2001), tropical and sub-tropical reservoirs are known to be more productive than temperate reservoirs; also shallow smaller reservoirs are generally more productive than large reservoirs due to their high primary production. Marshall and Maes (1994) estimated that yields from tropical shallow reservoirs averaged 30-150kg/ha/year, while deep reservoirs averaged 10-50 kg/ha/year. The estimated yield from African shallow tropical reservoir was far more than that of Asia (Sugunan, 1995).

A lot of limnological parameters including conductivity, total dissolved solids, water quality, phytoplankton and reservoir morphometry have been used to estimate the potential fish yields from reservoirs. The most widely accepted method was the Morpho-Edaphic Index (MEI) developed by Ryder (1965). The MEI is calculated by dividing the value of total dissolved solids (TDS) (Mg/L) by the mean depth (m) of the water body. Reiger et al. (1971), Henderson and Welcome (1974) and Adeniji (1991) had used this method for African lakes with success by substituting with conductivity, which compares favourably well with TDS. Schlesinger and Reiger (1982) also expanded the model to incorporate temperature effects and subsequently enhanced its global applicability. Kantoussau et al. (2007) used this model to evaluate fish yield in two tropical lakes of Mali, West Africa, while Janjua et al. (2008) predicted a high fish production from Shahpur dam, Pakistan, using MEI derived from physicochemical parameters. The simplicity of the MEI and its generally good predictive capabilities has resulted in its application worldwide subject to regional modifications. Generally, MEI demonstrates that as nutrients in the water increase and depth decreases, fish production increases (Kapetsky JM and Petr TO, 1984). Based on this hypothesis, African tropical shallow reservoirs which are known to be highly productive will consequently have high fish yield.

Kester et al. (2007) assessed the fisheries potential of Ero Reservoir in Ekiti State Nigeria. The catch composition of the reservoir showed three different species: *Oreochromis niloticus, Sarotherodon galilaeus* and *Clarias* species, with *O. niloticus* having the highest occurrence by number and weight of 83.6% and 69.2%, respectively. The potential fish yield of the reservoir with a total surface area of 450 ha was predicted to be 652.97 metric tonnes per annum, while the post-calculated annual yield gave a figure of 21.06 metric tonnes per annum. The authors concluded that the reservoir is under-exploited, given the predicted potential fish yield and the post-calculated yield of the fishermen.

Egbe Reservoir is one of the major reservoirs in Ekiti State. It is an important freshwater body for Egbe, Ode- Ekiti and the neighbouring communities in Gbonyin Local Government Area of Ekiti State, Nigeria. It serves as source of drinking water, domestic needs, swimming, artisanal fishing and irrigation of agricultural farms in its vicinity. But very little information is available on the ichthyofauna of the Reservoir. This paper is designed with the aim to investigate the fisheries potentials of Egbe Reservoir.

MATERIALS AND METHOD

Study Area

Egbe reservoir is situated across Egbe River, which is located in the suburb of Egbe Ekiti in Gbonyin Local Government area of Ekiti State in Western Nigeria. The Reservoir takes its source form Kwara State and runs through Ekiti to Ondo State, and eventually empty into the popular Osse river in Ondo-State. The reservoir lies between latitudes $7^0$36N and $7^0$39' North and longitude $5^0$32' E and $5^0$35' East of the equator as shown in Figure 1. The entire length of the reservoir is 26.5 acres and the depth is 64m. The reservoir is located on an undulating plane, surrounded by highlands from which runoffs also feed the reservoir during raining seasons. The reservoir is underlain by metamorphic rocks. Some of the physical and chemical conditions of the river have been investigated in previous studies.

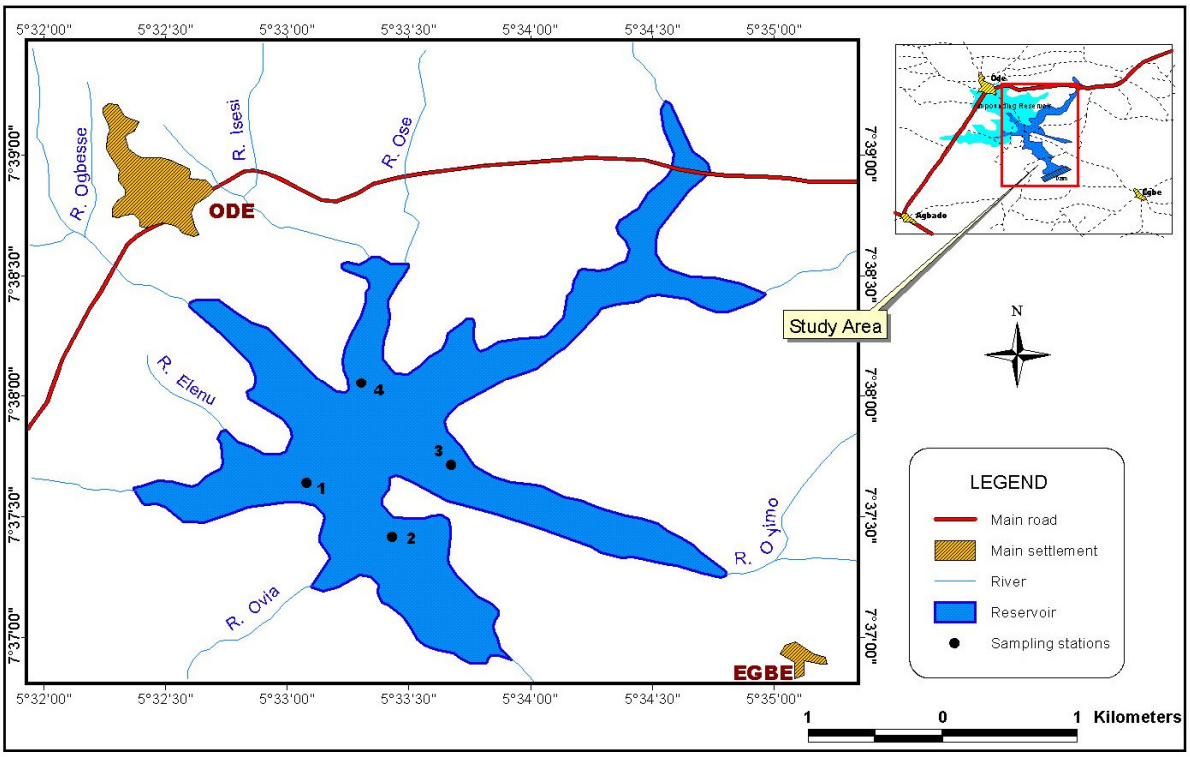

Fig. 1: Map of Egbe reservoir showing sampling stations

Fish Sampling

Fish samples used in this study were collected from the landing sites of the artisanal fishermen every two weeks. Ten out of the 25 artisanal fishermen operating on the study site were available during the study period. Fishing gears in common use in this locality were:

1. Graded hooks of sizes 12, 13, and 14 set at an interval of about 7-10cm in a long line of about 100m. This gear is usually set along the riverbank.
2. Eight wire traps (at each fishing effort) of 5″ and 2″ mesh size and approximate dimension of 65 x 40 x 25 cm with an opening of about 20cm in diameter, usually set along the riverbank.
3. gill nets mainly multifilament of the stretched mesh sizes varying from 2" (50.8mm) – 3" (76.2mm) with the stretched length of about 50meters setting was done as drift nets on the surface of the open water.
4. Cast nets of about 2m in length and spread circumference of about 10m with 75mm mesh size.

The setting of these gears was mostly done in the evenings by 6.00pm and left overnight till 7.00a.m. The catches were sorted into species on the field and collected into an iced cooler and transported to the laboratory where they were preserved in 10% formalin for further examination.

Fish identification

Fish collected from the landing sites of the fishermen were sorted into various species and counted. Identification was done both on the field and in the laboratory using fish identification guides of (Reed et al., 1967; Babatunde and Raji, 1986; Idodo-Umeh, 2003).

Fish Analysis

The mean abundance of each fish species collected at the landing sites of the fishermen was calculated. The percentage composition by number of every fish taxa during dry and rainy seasons as well as for the entire period of study were computed and Paired T-test was also used to determine if there exist significant differences between the rainy and dry season mean total abundance of fish.

The potential fish yield of Egbe Reservoir was estimated as follows:

Fish yield calculations: The potential fish yield in kg/ha/annum was predicted through Morpho-Edaphic Index (MEI) as described by Henderson and Welcome (1974), while the actual annual fish yield in kilogrammes was post-calculated from the result of the selected fishermen.

Potential fish yield: Morpho-Edaphic Index (MEI) was adopted for the prediction of the potential fish yield / annual catch of Egbe Reservoir

$MEI = Cond\ d^{-1}$

Where,
Cond = Conductivity
d = mean depth
$Yield\ (Y) = 23.281 \times MEI^{0.447}$

where,
Y = yield in kg ha^{-1}

Actual (Post-calculated) fish yield: The estimated production per annum of the ten fishermen operating regularly on the reservoir during this period of study was calculated from the sample daily catches of ten of them, with an assumption that the fishermen avoid working during the peak period of rainy season because of flooding and consequently fish for about 264 days a year; their production is calculated as follows:

Total Daily Catches (kg) = No of fishermen x Average Daily Catches (kg). Therefore, Annual Catches (264 days) = Total Daily Catches (kg) x 264

RESULTS

Fish fauna of Egbe Reservoir

A checklist of fish fauna and their percentage composition by number during the period of study was presented in Table 1.

The family Cichlidae was the most abundant fish in the reservoir and constituted 52% of the fish composition of the reservoir (Figure 2). This family was mainly represented by *Oreochromis niloticus* which had the highest abundance of the total composition (18.6%) followed by *Sarotherodon melanopteron* (17.3%). The least abundant cichlid was *Tilapia zillii* (16.2%). Clariidae were next in abundance (20.5%) and was represented by two species, *Clarias gariepinus* and *C. anguillaris*. *C. gariepinus* had higher abundance constituting 11.3% of the total fish number (Table 1).

The snake head, *Parachanna obscurus* (the only species in the family Channidae) contributed 13.3% (Figure 2). Family Hepsetidae was also represented by only one species, *Hepsetus odoe* which was 10.8% of the total number of fish. The least abundant family was Mormyridae, represented by one species, *Heperopisus bebe* which contributed 3.4% to the total number of fish (Table 1).

Seasonal variation in fish abundance

The Cichlidae were the most abundant fish fauna in the reservoir during both rainy and dry seasons, followed by Clariidae, Channidae and Hepsetidae. Mormyridae were the least abundant fish family in the reservoir during both seasons (Table 2). Overall mean abundance of fish was observed to be significantly ($p<0.05$) higher (71.9%) in the rainy season than dry season mean abundance 28.1 % (Table 3).

Table 1: Relative abundance of fish fauna in Egbe Reservoir

Fish species	Total Catch	Relative abundance (%)
Oreochromis niloticus	10,556	18.6
Sarotherodon melanopteron	9,828	17.3
Tilapia zillii	9,176	16.2
Parachanna obscura	7,560	13.3
Clarias gariepinus	6,427	11.3
Clarias anguilaris	5,208	9.2
Hepsetus odoe	6,114	10.8
Heperopisus bebe	1,903	3.4
Total Abundance	56,772	100.00
'D'	0.64	
'H'	2.00	
'J'	0.96	

D = Margalef's diversity index
H = Shamon-Wiener's index
J = Equitability measure

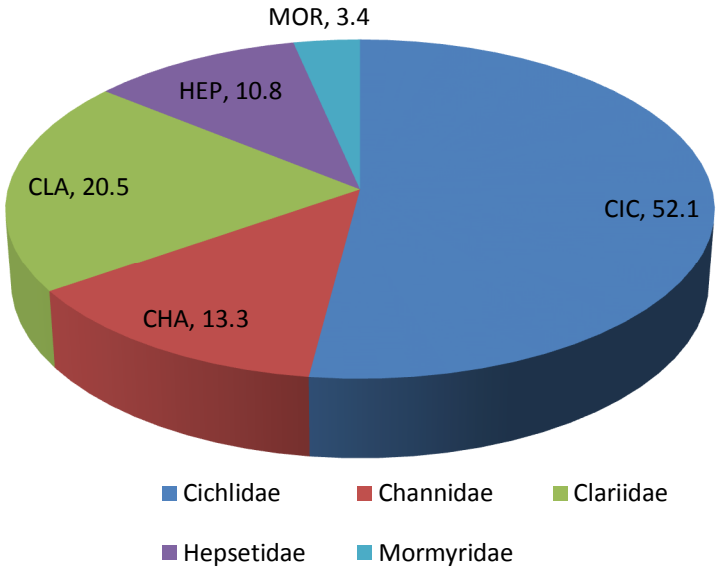

Figure 2: Relative abundance of total fish abundance in Egbe Reservoir during the period of study (Sept. 2005 – Dec. 2006)

Table 2: Abundance and seasonal variation of fish families in Egbe Reservoir

	Rainy Season		Dry Season		Total Abundance	
Species	No	%	No	%	No	%
Cichlidae	21,096	51.6	8,464	53.1	29,560	52.1
Channidae	5,151	12.6	2,409	15.1	7,560	13.3
Clariidae	8,544	21.0	3,091	19.4	11,635	20.5
Hepsetidae	4,378	10.7	1,736	10.9	6,114	10.8
Mormyridae	1,673	4.1	230	1.4	1,903	3.4
Total Abundance	40,842	100	15,930	100	56,772	100
Relative Abundance (%)	71.9		28.1			

Calculation of fisheries potential of Egbe Reservoir

MEI Calculation: The potential fish yield of Egbe Reservoir was predicted through the following calculation.

$$\text{MEI} = \frac{Conductivity\ (\mu S/cm)}{Mean\ \ Depth\,(m)}$$

$$= \frac{231}{5.23} = 44.17$$

Using the prediction value for estimating fish yield;

$$Y = 23.281\ MEI^{0.447}$$
$$= 23.281 \times 44.17^{0.447}$$
$$= 126.58 kg\ ha^{-1}$$

Estimated annual fish yield

= Average fish yield (kg ha^{-1}) for the 16 months study period using conductivity,

Estimated potential fish yield per annum for the reservoir of 272.5ha

$$= \frac{126.58\,kgha^{-1}\ x\ 272.5\,ha\ \ x\ 12}{1000}$$

= 413.9 Metric Tonnes

Post - calculated annual fish yield of Egbe Reservoir

Total daily catch (kg) = 10 x 7.5 = 75kg

75 x 264 = 19800kg = 19.800 metric tones

∴ Annual catches (264 days) = 19.800 metric tones

$$\% \text{ Exploited} = \frac{19.800MT}{413.9MT}\ x\ 100$$

= 4.8 %

% Unexploited = 95.2 %

DISCUSSION

The reservoir is considered to be poor or low in taxa abundance when compared with other tropical inland water bodies. For instance, Awachie and Wolson (1978) recorded 23 fish species in Anambra River, (Adebisi (1988) reported 36 for Ogun River and (Odum (1995) recorded 60 species for Ethiope River. While amongst man-made lakes, Lake Kainji has the highest number of species 101, followed by Jebba with 52 species (Ita, 1993). A much lower number of species, though still richer than that recorded in this present study was encountered in Owena reservoir. Fapohunda and GodState (2007) recorded 14 fish species belonging to seven families in this reservoir. The low fish abundance recorded in Egbe reservoir may be fortuitous.

However, distribution and abundance of fish in tropical water bodies have been variously attributed to several factors but principally depth (Chapman and Kramer, 1991), water temperature (Agremier and Karr, 1983), water transparency, availability of food (Winemiller and Jepsen, 1998) and migratory behaviour of some of the fishes [(Adebisi, 1988). In addition, the prevailing ecological conditions like the nutrient level, current speed and nature of the bottom deposits, may have acted singly or synergistically to influence the present status of fish abundance and distribution observed in Egbe reservoir. Where the bottom sand is fine and hard, such habitats are frequented by *Alestes* (*Brycinus*) and Cichlids (Odum, 1995). This factor may have accounted for the preponderance of the family Cihlidae in Egbe reservoir. They form an important part of the reservoir ichthyofauna, making up more than 50% of the total catch.

The dominance of the members of the family Cichildae in Egbe reservoir goes to confirm that under uncontrolled conditions in most Nigerian Inland waters, the cichlids always dominate (Odum, 1995; Oso and Fagbuaro, 2004; Offem et al., 2009; Awachie and Wolson, 1978; Daddy et al., 1991; Fryer and Iles, 1972). Daddy et al. (1991) also attributed the preponderance of cichlids to their ability to thrive on a wide range of food items and their prolific breeding nature. *Oreochromis niloticus* is by far the most abundant of the cichlidae family. In rank order, the numerical abundance of *O. niloticus* in Egbe Reservoir was close to the observations of other workers (Offem et al., 2009). Next in abundance were the clariids which were known to occur in greater numbers where the bottom is muddy with a relatively low current velocity of 40cm s^{-1}(Daddy et al., 1991). The other species *Parachanna obscurus, Hepsetus odoe*, and *Heperopsisus bebe*, were known to find habitats in areas with floating vegetation and muddy bottoms (Orji and Akobuche, 1989). All these habitat patterns were observed to occur within Egbe Reservoir hence the availability of the various species encountered during the period of study. It therefore goes that if well managed and the necessary resources well harnessed, the reservoir can support sustainable fish production.

The mean depth of Egbe Reservoir, calculated from its volume and area parameters is 5.2 meters. This shallowness explains the moderate productivity of the

water body as established in the estimated annual potential fish yield of 413.9 metric tonnes of the total reservoir area of 272.5ha and the post-calculated (actual) annual fish yield of 126.58 kg ha^{-1}. This finding is in line with the reports of Kapetsky and Petr (1984) that a small or shallow lake with mean depth between 3m and 10m supports high productivity. This also explains the fact that the depth stratum of a shallow lake allows adequate light penetration for the growth of planktonic algae which is fish food (Boyd, 1979). The surface area of the reservoir is also an influencing factor. Out of the seven man-made lakes in Ekiti State, Egbe Reservoir ranks the second largest with a surface area of 272.5ha. Ero Reservoir is the largest with a surface area of 450ha [Kester et al., 2007]. Despite the potential fish production of Egbe Reservoir, only about 4.8% of the fishery resources are exploited. This may be due to ignorance of the nutritive value and palatability of the most abundant cichlids, on the part of the local consumers who believes that the fish is small in size and its all bones, coupled with lack of government interest in the venture. This study thus established that the reservoir is under-exploited giving the predicted potential fish yield (413.9 metric tonnes) and the post-calculated yield (126.58 kg ha^{-1}) of the fishermen and just 4.8 % of the fisheries resources exploited. The reservoir has an enviable potential for fisheries exploitation considering its high total fish abundance.

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