Article

Fish fauna of the Owabi Dam Reservoir in Ghana

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Abstract

This study was carried out to identify fish composition, relative abundance and species diversity of Owabi Dam reservoir located near Kumasi, Ghana. The work was conducted between January-March, 2004. Simpson index was employed to estimate the fish abundance and diversity in the reservoir. Personal observations and interviews were also employed to assess fishery practices in the area. Findings from the studies showed that 19 fish species belonging to fifteen families were present in the reservoir. The family Cichlidae was the most abundant followed by the family Characidae. Other results obtained showed that the species, *Hemichromis fasciatus* was the most abundant followed by *Sarotherodon galilaeaes* and *Hepsetus odoe* in that order.

Keywords fishery; Simpson index; Owabi Dam reservoir; Ghana.

1 Introduction

Around the world, 80-90 million people feed annually on fish. It serves as the most reliable source of protein. The number of people dependent on fisheries as an income has been estimated to be 200 million worldwide. Fish also contributes to the economies of most developing countries through tourism and recreation.

With the growing appreciation that fish is a healthy source of protein, calcium and essential source of fatty acids, fish is increasingly at the mercy of pollutants from human activities. Other human activities such as modification of the environment, harvesting and culture and effects of modernization have contributed to the pollution of water bodies which serve as habitat for fishes (Tiwari, 2011; Zhang et al., 2011).

Available evidence indicates that human activities are eroding biological resources and the biotic components of ecosystems. Habitat changes, reduction of the planets' biodiversity and associated losses of biodiversity are the inevitable prices we pay for over-exploitation of natures resources.

Anthropogenic activities have resulted in damage to the genetic resources of aquatic organisms. That includes modification of environment, harvesting and culturing of aquatic resources for food or other uses (FAO, 1985; Nelson and Soule, 1987).

Environmental modifications to ecosystems may include alterations of physical, chemical or biotic feature of aquatic habitats. Construction of dams, harbors and dredging or filling of waterways are examples of highly

visible alterations of aquatic environments. Siltation of lakes, streams, rivers estuaries and coastal streams as a result of human activities on land often result in drastic alterations of aquatic habitats.

Physical and chemical changes culminate in new environmental conditions that can result in permanent alterations of biological communities (Karr, 1981; Li et al., 1987). The balance of species may change and species not formally abundant may thrive or existing species may be eliminated.

Capture fishery (harvest of aquatic animals from natural populations) has led to dwindling fishery resources and survival. The 3000 or more species that are the world's capture fisheries are at modest risk of losing genetic variation as a consequence of exploitation (FAO, 1985; Nelson and Soule, 1987). Reducing abundance of reproducing individuals results in increased rates of inbreeding and reduced genetic drift and thus increases the potential for further loss (Gall, 1987).

The ever increasing efficiency of fishing technology with modernized gear and new methods to detect fish has led to rapid depletion of stocks and closure of fisheries. In extreme cases, fishery observers have reported the disappearance of entire assemblage such as groups of cichlid species in areas of Lake Malawi (Turner, 1977). Capture fisheries often harvest significant numbers of non-target species thereby exposing them to risk of genetic depletion.

The genetic resources of species have been shaped by natural selection in accordance with its environment. Its' genetic diversity within and among individuals provides resilience to survive environmental change. The rate and scale of change is often beyond the genetic capability of species to resist.

Species diversity (species heterogeneity) is an expression of community structure. A community is said to have high species diversity if many equally or nearly equal abundant species are present. Conversely, if a community is composed of a very few species or if only a few species are abundant, then species diversity is low.

High species diversity indicates a highly complex community, for a greater variety of species allows for a larger array of species interaction. Thus, population interaction involving energy transfer (food webs), predation, competition and niche apportionment are theoretically more complex and varied in a community of high species diversity. High species diversity correlates with community stability; the ability of community structure to be unaffected by disturbance of its components.

The two most common measures of species diversity index are Simpson index and Shannon-Weiner index. The Simpson index is the measure of diversity which takes into account both the number of species and the evenness of occurrence of individuals in the various species. It is an expression of the number of times one would have to take pairs of individuals at random from the entire aggregation to find a pair from the species. Shannon- Weiner Index is a widely employed index. The Shannon index is also an expression of how many equally abundant species would have diversity equal to that in the observed collection. It measures the degree of uncertainty in a sampling event. That is if diversity is low, then the certainty of picking a particular species is high. If diversity is high, then it is difficult to predict the identity of a randomly picked individual.

Establishment and maintenance of ecologically diverse wildlife communities are important objective of contemporary management of wetlands. The catchment of the Owabi Dam is recognized as a wetland of national and international importance in Ghana. It has a very good potential for recreation, aesthetic and fish and wildlife habitats. It serves as a source of fish, water supply, recreation or tourism, wetland habitat for animals, maintenance of water tables, floods and erosion prevention. It is a store of biological diversity and cultural or heritage value. The reservoir besides its primary function of water supply also serves as an inland capture fishery resort. There has been the need for an inventory of the fish fauna of the reservoir to discover their values and reduce the possibility of extinction so that the potential value of the species may be effectively preserved and/or exploited.

The site consists of reed beds and marshland surrounded by woodland and plantation areas. It is also important to resident birds and to various species staging birds during winter. Based on the sites value and its importance, an inventory of the fishes was deemed important to inform decision makers and managers of the Owabi Dam.

This study was carried out to identify the fish composition, relative abundance and species diversity of the reservoir to inform sustainable management of the resource of the Owabi Dam.

2 Materials and Methods

2.1 Location of study area

The study area is the Owabi Wildlife sanctuary, located in the Ashanti Region. It is 19km northwest of Kumasi, the second largest city of Ghana. The sanctuary is the only inland wetland in Ghana. The reservoir was created by the dam. The size is about 22 feet (6.7m) deep and covers an area of 2.03hectares with 7 streams emptying into it. The Owabi sanctuary surrounds the reservoir. A water treatment plant is located on the reservoir and it provides potable water to the Kumasi Metropolis (i.e. estimated to be about 3 million gallons a day).

2.2 Data collection

Frequent visits were paid to the site over a period of time (January to March, 2004). Fish stock in the reservoir was identified with the aid of an identification catalogue (Holden and Reed, 1972) and with the help of local fishermen. Local names were checked with available literature. Interviews were carried out to find out the fish types caught, fishing gear used and the fishing activities at the site. Fishing sampling involved the use of fishing nets used by the local fishermen. Gill nets of mesh sizes used by fishermen include: 2½ inch, 3 inch, 3½, 4inch and 4½ and 5½ inch. Fishes caught by the local fisherman during the study period were sampled, identified and counted. During visits, the number of individual fish species in each catch was assessed and the length and weight measurements were taken using the electronic weighing scale of 300g capacity and a measuring board. Each species was measured from the tip of the snout to the end of the vertebral column (standard length in cm). The data were used as inputs for the calculation of the relative abundance and species diversity.

2.3 Data analysis

The mathematical expression of Simpson index is

$$Ds=1-\Sigma\ (ni(ni-1))/(N(N-1))$$

where Ds=Simpson's index of diversity; N=total number of individuals of all species; ni=total number of individuals of the species i.

To estimate the abundance of fish

1. within a catch, the number of individual species is counted, the species within the largest number is said to be the most abundant
2. within a catch, the individual fishes caught are weighed. The fishes with the largest weight are said to the most abundant.

3 Results

3.1 Species composition of Owabi Reservoir

Nineteen species of fish belonging to thirteen families were identified. Of the nineteen species identified, nine were actually harvested during the study period. Fish belonging to the Cichlidae family were the most

abundant with six species, followed by the family Characidae with two species. Table 1 shows the list of fishes identified, their local names and families.

Table 1 Species of fishes the Owabi Reservoir

Family	Species	Common name	Local name
Channadae	*Channa obscura*	Snakehead	Kuboo (twi)
Clariidae	*Clarias* species	Catfish	Adwene (twi)
Cichlidae	*Hemichromis fasciatus*	-	Tire kokoo (twi)
	H. bimaculatus	Jewel fish	Anglo petuo (twi)
	Oreochromis niliticus	-	Yibo (ewe)
	Tilapia zilli	-	Tibie (twi)
	Sarotherodon galilaeas	-	Apese fufuo (twi)
	Pelmatochromis guentheri	-	-
Characidae	*Alestes species*	-	-
	Hydrocynus vittatus	-	-
Polypteridae	*Ploypterus ansorgei*	-	Nyoti (ewe)
Hepsetidae	*Hepsetus odoe*	-	Lehe (ewe)
Schilbeidae	*Schibei mystus*	-	-
Mormyridae	*Morymyrus macrophthalus*	-	-
Osteoglossidae	*Heterotis niloticus*	Bony tongued fish	Superku (twi)
Claroteidae	*Chrisichthys nigrodigitatus*	-	Lolovi (ewe)
Mochokidae	*Synodontis ocellifer*	-	Akpotokui (ewe)
Malapteruridae	*Malapterurus electricus*	-	Ani (ewe)

3.2 Relative species diversity and abundance

Hemichromis fasciatus is the most abundant species in the reservoir, representing 45.1%. *Sarotherodon galilaeas* and *Hepsetus odoe* followed in that order with 19.2% and 0.7% respectively. Species diversity of nine species was calculated (Table 2).

Table 2 Species abundance recorded during the dry season

Species	No. of individuals	% Abundance	Diversity
Sarotherodon galilaeas	110	18.9	0.315
Hemichromis fasciatus	259	44.4	0.360
H. bimaculatus	46	7.8	0.200
Alestes sp.	9	1.5	0.064
Clarias sp.	18	3.1	0.107
Channa obscura	41	7.0	0.186
Hepsetus odoe	4	0.7	0.034
Tilapia zilli	63	10.8	0.240
Oreochromis niloticus	33	5.7	0.167

3.3 Fisheries at Owabi Reservoir

Fishing was carried out all year round, however fishing is mostly carried out between January-May. Fishermen use dugout canoes and wooden paddles, as fishing activities are on a small scale. In all, 5 dugout canoes were observed at the reservoir. The fish caught were sold to the women folk from Esaase, Akropong, Abuakwa and

Kumasi. The only gear used was the gill net with sizes ranging from 2½-5inch. The gill nets are set at dawn and removed later in the morning.

The only management practice at the site is that Tuesdays are off-days when fishing is prohibited. The fishermen's forebearers instituted this as a management practice to help sustain the resource base. The reservoir is managed by the GWSC and the Ghana Wildfire Department who regulate fishing activities at the site.

Table 3 Length and weight dimensions recorded for various fish species

Species	Length ranges (cm)	Average length (cm)	Weight ranges (g)	Average weight (cm)
Sarotherodon galilaeas	15-16	15.5	142-189.9	165.95
Hemichromis fasciatus	5-15	10.97	4.1-45.2	35.28
H. bimaculatus	11.0-13.0	11.57	43.5-62.5	49.92
Alestes sp.	7.0-8.80	7.82	11.3-23.4	15.93
Clarias sp.	18.5-23.9	21.7	97.3-131.6	103.44
Channa obscura	19.3-25.8	21.06	94.4-138.6	107.83
Hepsetus odoe	9.0-10.2	9.6	19.6-35.4	29.68
Tilapia zilli	13.2-21.3	17.25	31.5-132.4	81.95
Oreochromis niloticus	8.2-16.1	11.2	28.1-162.3	74.46

4 Discussion

4.1 Species composition and abundance

Nineteen species were identified as habiting the reservoir but only nine were reported to be present during the survey. This could be partly as a result of the gear used (gill net). King (1995), reported on selectivity of fishing gears and this may account for the type of fish species caught during the study period. The gill net used by fishermen in the area trapped mainly pelagic fishes. Fishermen attributed total surface area decreases and migration of fishes downstream to low water levels and this affected fishing in the reservoir. This in turn affected the number of fish species harvested during the study period, which was in the dry season.

From an earlier work conducted in 1988, fish species identified were *Clarias* spp. *Hemichromis* sp., *Hepsetus odoe*, *Heterobranchus* sp. *Synodontis occelifer*, *Sarotherodon niloticus* and *Tilapia zilli*. Of the species, Hemichromis sp. was the most abundant. However, this current study recorded *Synodontis ocellifer* and *Herodontis* sp. This could be due to seasonal variations which might have led to low water volumes leading to migration of these species these downstream.

The fishes caught in the reservoir showed that the reservoir consists of most of the fishes in the Lake Volta with the exception of a few species like *Heterotis niloticus. Lates niloticus*, *Labeo* sp., *Gymnarchus niloticus* and *Archinogranus* sp.

4.2 Species diversity

The species diversity of 1.67 indicates a highly complex community, for a greater variety of species allows for a lager array of species interactions. Among ecologists, high species diversity is correlated with community stability; the ability of community structure to be unaffected by disturbance of its components. However, a few maintain that there is no simple relationship between diversity and stability (Mele, unpublished).

4.3 Relative abundance

The relative abundance showed that the cichlidae family was the most abundant with 6 species present. This may be due to its high reproductive potential and its wide distribution in Ghana.

4.4 Fishery at Owabi Reservoir

Fishing practices at the study site were labor intensive with minimal mechanized assistance and total investments in fishing equipment were generally low. This may have accounted for lower fish catch from the reservoir. The catch is usually consumed locally especially by fisher folks and their family. The fishermen use dug-out boats made of wood and paddled. Personal conversations with some selected fishermen reiterated that catches were on the decline and this may be due to over-exploitation of the fish stocks. Decline in fish stock density may have accounted to the small scale nature of the fishing activities at the site.

5 Conclusions and Recommendations

The Owabi Dam reservoir in Ghana is rich in fish diversity. Currently there were about 19 fish species present. The reservoir exhibited a highly complex community structure for a larger array of species interaction. During the study period, the species *Hemichromis fasciatus* was the most abundant with 45.1% and the least species was *Hepsetus odoe* with 0.7%. There was a reduction in the species diversity of the reservoir. This had been attributed to lower water levels, fishing gear selectivity and fishes hiding in the mangroves in the study area.

Fishery resources at the reservoir were being over-exploited and this was evidenced by low catches observed by fishermen during the course of the study. There is the need for regulatory authorities such as the Ghana Water Company Limited (GWCL) and the Wildlife Department (WD) officials to strictly enforce stricter fishery regulations at the site. This may help reduce over-exploitation of the fishery resource base at Owabi dam.

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