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Benthic macro-invertebrates of Asejire reservoir, Southwest Nigeria

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Abstract

A survey of the benthic macro-invertebrate fauna of Asejire Reservoir, Southwest Nigeria was carried out for two years to provide information on the occurrence, distribution and abundance of the benthic macro-invertebrates of the reservoir. Twenty sampling stations were established in the reservoir and sediment samples were collected from each station at bimonthly intervals using an improvised Van-veen grab. Data obtained was subjected to descriptive statistics and various biodiversity indices. A total of 364,351 individual macro-invertebrate specimens were collected. The fauna comprised of twenty-eight species. These was composed of the class Insecta (13 spp), Gastropoda (9 spp) and Bivalvia (2 spp), while Arachnida, Malacostraca, Hirudinea and Gordiadea comprised one species each. *Potadoma moerch* (32.9%), *P. freethi* (18.3%) and *Melanoides tuberculata* (9.0%) were the dominant species accounting for more than 60% of the recorded individuals' species while the least occurring species were *Sphaerium sp* (0.2%) and *Hydracarina sp* (0.4%). Asejire Reservoir can be inferred to be rich quantitatively and qualitatively in benthic macro-invertebrate fauna based on occurrence and abundance of species recorded during this study.

Keywords: Benthic macro-invertebrates, Asejire Reservoir, littoral, species, occurrence

1. Introduction

Sleep The communities of animals that inhabit the bottom of a water basin are called benthic fauna [1]. These animals can be classified either as megafauna, macrofauna, meiofauna and microfauna based on size differences [2]. They are important in the food web of aquatic ecosystems [3, 4]. They also play an important role in aquatic community which includes mineralization, mixing of sediment and flux of oxygen into sediment, cycling organic matters and for assessing the quality of waters [5, 6]. Information on macrobenthic community distribution and structure has been used in environmental monitoring programs and is an important ecological tool to describe spatial and temporal changes in the aquatic ecosystems [7-12]. Appreciable numbers of studies have been carried out on the occurrence, abundance and distribution of benthic macroinvertebrates of freshwater reservoirs in Nigeria. Some of these include the works of [13-15] all on Lake Kainji. The work of [16-24] are all based on reservoirs in the southern part of the country. However, no studies have been conducted on the benthic fauna of Asejire Reservoir which is the biggest reservoir in Southwest Nigeria. Previous studies on Asejire Reservoir were concentrated on the physical, chemical, hydrology, fisheries and plankton communities of the reservoir. These studies include the work of [25-32]. The few studies on the reservoir bottom sediment are limited to the nutrients and heavy metals contents [28, 33]. The present study is the first on the benthic macro-invertebrate fauna of Asejire Reservoir since its impoundment about four decades ago. This study will therefore provide baseline information on the occurrence, distribution and abundance of the benthic macroinvertebrates of the reservoir.

2. Material and Methods

2.1 Study Area

Asejire Reservoir is an impoundment of River Osun created in November 1970 but officially opened in 1972. River Osun catchment basin extends over longitudes 003° 55'E to 005° 05'E and latitudes 06° 35'N to 08° 20'N (Figure 1), while the area of the reservoir is over longitudes 004° 07'017"E to 004° 08'925"E and latitudes 07° 21'48"N to 07° 26'84"N. It was created primarily to supply domestic and industrial water, although some ancillary benefits such as fishing activities have also emerged [3]. The area is typified by an admixture of savanna and high forest trees with palm, indicative of secondary rainforest vegetation.

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The catchment area of the dam is 7,800 km² while the impounded area is 23.42 km² (2,342 hectares). The dam has a normal pool elevation (water level) of 150 a.m.s.l. and maximum flood elevation of 152.4 a.m.s.l. The surface area of the reservoir is about 24km². Its gross storage capacity is approximately 7,403.4 million litres per day while its discharge capacity is 136.26 million litres per day with maximum water capacity of about 675m³.

Fishing, logging and subsistence intense farming activity is prominent around the reservoir, while there are low industrial and commercial activities within the basin catchment area. With the aforementioned enormous significance of the reservoir, no detailed scientific investigation has been carried out on the macro invertebrate benthic fauna of the reservoir which is an important biotic component of the food web and fishery of the reservoir.

Sampling for benthic macroinvertebrate fauna was carried out aboard a hand-dug canoe every two months for twenty four months using an improvised Van Veen grab of 0.04m² (0.2m X 0.2m). The reservoir was divided into three sections (lower reach, mid-basin and upper reach), over which 20 sampling

stations were established. Samples were taken at each of the sampling station, washed through 0.5mm mesh sieve, after which recorded macroinvertebrates were fixed with buffered 40% formalin. Samples of the periphytic macrofauna on rocky substrates were collected by washing them directly into the sieve. In all, a total of three hundred and twenty samples were collected and analysed for this study.

In the laboratory, the samples were washed using 0.5mm and 0.125 mm mesh sieves, then sorted using a X10 scanning lens. Each taxonomic group was placed in a specimen bottle containing 4% formalin and adequately labeled. The identification of the benthic macro-invertebrates collected was based mainly on the keys provided by [34-40]. Description of specimens of taxa was based on scale drawings, photographs and/or microphotography of parts. The taxa richness, diversity and evenness indices were calculated using the Shannon-Wiener, Simpson and Margalef indices.

All the statistical analyses carried out using the Palaeontological Statistics [41], Statistical Package for Social Sciences Software package and Statistical Ecology [42].

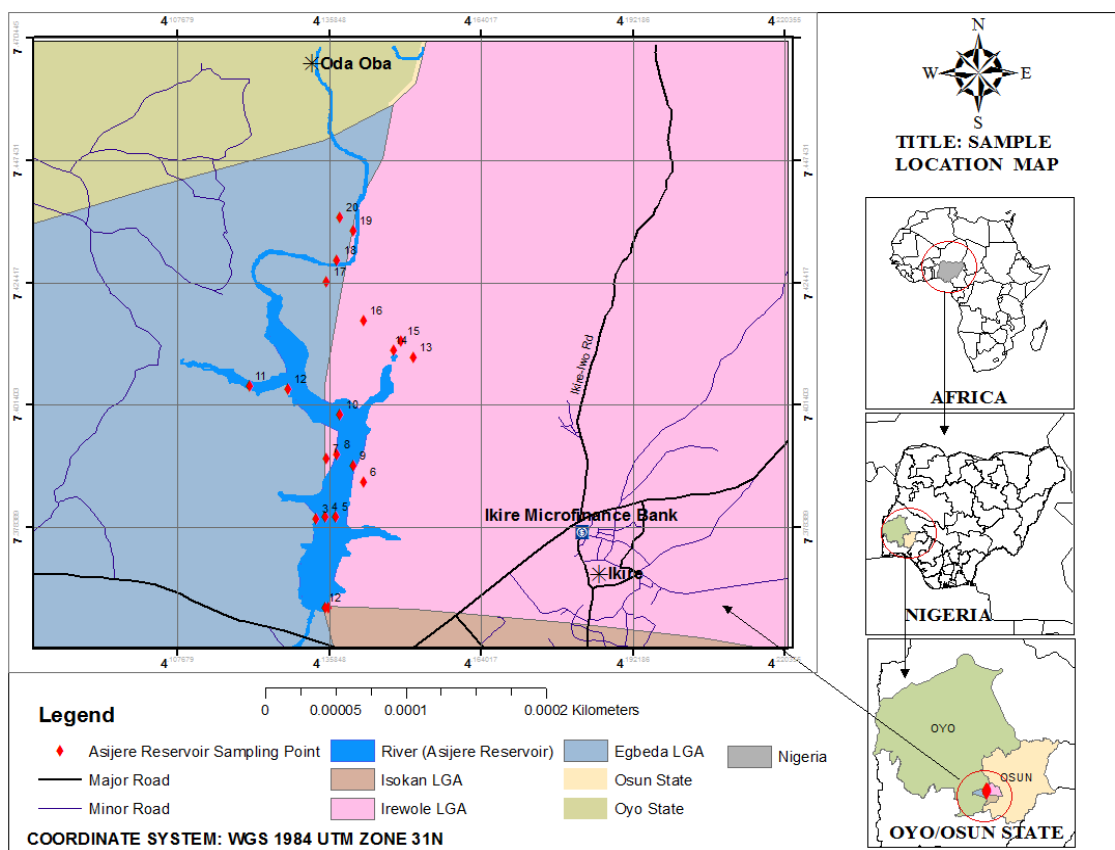


Fig 1: Map of Osun River Basin showing Asejire Reservoir, Catchment basin and Sampling Locations

3. Results and Discussion

A total of twenty-eight benthic macro-invertebrate species were recorded from Asejire Reservoir sediment samples. The fauna is made up of thirteen species of Insecta, nine species of Gastropoda, two species of Bivalva and one species of Arachnida, Malacostraca, Hirudinea and Gordiadea. Information on the distribution and abundance of recorded macro-invertebrate taxa of Asejire Reservoir is given in Tables 1 and 2. The benthic macro-invertebrate taxa were found distributed across all habitats and were highly

interspersed or mixed up between the different ecotypes in the three reaches and the two regions of the reservoir. Many known benthic littoral taxa Odonata (*Sympetrum sp* and *Epicordulia sp*), Ephemeroptera (*Cloeon dipterum* and *Caenis sp*) and Hemiptera (*Belostoma sp*) were also found in the open water region, while some known open water taxa like Dipteran (*Ablablemyia sp*, *Simulium damnosum* and *Chaoborus sp*) were found in the sediment littoral sections of the reservoir.

There were twelve dominant occurring benthic macroinvertebrate taxa (i.e. occurring most frequently) in the reservoir. *Potadoma freethi*, *P. moerchi* and *Melanoides tubaculata* were the three most occurring species (found in all the twenty sampling locations) throughout the sampling period. They were closely followed by *Simulium damnosum* and *Chaoborus* taxa (90% occurrence in the locations). The least occurring taxa was *Hydracarina* sp (10%) followed by *Hydrometra* sp, *Macrobrachium macrobrachium*, *Lymnaea*

natalensis, *Bulinus globosus*, *Gyraulus deflectus* and *Hirudo* sp (15% occurrence). The most abundant taxa was *Potadoma moerchi* (119,985 organism m⁻³) followed by *Potadoma freethi* (32,768 organism m⁻²) and *Melanoides tubaculata* (66,660 organism m⁻²). The least abundant taxa was *Sphaerium* sp (550 organismm⁻²), followed by *Hydracarina* sp (1,350 organism m⁻²) and *Gyraulus deflectus* (1,375 organism m⁻²) as shown in the calculated mean abundance and frequency occurrence of the respective taxa in Table 2.

Table 1: Identified benthic macroinvertebrates species in Asejire Reservoir

Class	Order	Genus	Species
Insecta	Odonata	Libellulidae	<i>Sympetrum</i> sp
		Corduliidae	<i>Epicordulia</i> sp
	Zygoptera	Coenagrionidae	<i>Enallagma desert</i>
	Odonata	Coenagrionidae	<i>Ishnura</i> sp
		Baetidae	<i>Cloen dipterum</i>
	Ephemeroptera	Baetidae	<i>Baetisca</i> sp
		Caenidae	<i>Caenis</i> sp
		Belostomatidae	<i>Belostoma</i> sp
	Hemiptera	Nepidae	<i>Renatra</i> sp
		Hydrometridae	<i>Hydrometra</i> sp
	Diptera	Simuliidae	<i>Simulium damnosum</i>
		Chironomidae	<i>Ablabesmyia</i> sp
		Chaoboridae	<i>Chaoborus</i> sp
Arachnida	Acariformes	Hydrachnidae	<i>Hydracarina</i> sp
Malacostraca	Decapoda	Cambaridae	<i>Macrobrachium macrobrachium</i>
Gastropoda	Basommatophora	Lymnaeidae	<i>Lymnaea natalensis</i>
		Planorbidae	<i>Biomphalaria pfeifferi</i>
		Planorbidae	<i>Bulinus globosus</i>
		Planorbidae	<i>Gyraulus deflectus</i>
		Physidae	<i>Physa gyrina</i>
	Mesogastropoda	Potamididae	<i>Potadoma freethi</i>
		Potamididae	<i>Potadoma moerchi</i>
		Thiaridae	<i>Melanoides tubaculata</i>
		Ampullariidae	<i>Pila ovate</i>
		Sphaeriidae	<i>Sphaerium</i> sp
Bivalvia	Heterodonta	Solenocurtidae	<i>Mutela</i> sp
		Hirudinea	<i>Hirudo</i> sp
Gordiodea	Gordea	Gordiiidae	<i>Paragordius</i> sp

Table 2: Temporal variation in the abundance of total benthic macroinvertebrates (organism/M²) in Asejire Reservoir

Class	Organism	Total Abundance	Total Occurrence	% Frequency Occurrence
Insecta	<i>Sympetrum</i> sp	8450	11	55
	<i>Epicordulia</i> sp	6800	12	60
	<i>Enallagma deserti</i>	5000	9	45
	<i>Ishnura</i> sp	5600	9	45
	<i>Cloen dipterum</i>	7375	11	55
	<i>Baetisca</i> sp	5402	9	45
	<i>Caenis</i> sp	4900	10	50
	<i>Belostoma</i> sp	6677	11	55
	<i>Renatra</i> sp	5375	9	45
	<i>Hydrometra</i> sp	1525	3	15
	<i>Simulium damnosum</i>	23375	18	90
	<i>Ablabesmyia</i> sp	18050	17	85
	<i>Chaoborus</i> sp	13339	18	90
Arachnida	<i>Hydracarina</i> sp	1350	2	10
Malacostraca	<i>Macrobrachium macrobrachium</i>	1500	3	15
Gastropod	<i>Lymnaea natalensis</i>	1575	3	15
	<i>Biomphalaria pfeifferi</i>	9566	10	50
	<i>Bulinus globosus</i>	3200	3	15
	<i>Gyraulus deflectus</i>	1375	3	15
	<i>Physa gyrina</i>	1800	6	30
	<i>Potadoma freethi</i>	66660	20	100
	<i>Potadoma moerchi</i>	119985	20	100
	<i>Melanoides tubaculata</i>	32768	20	100
	<i>Pila ovata</i>	2525	6	30
Bivalvia	<i>Sphaerium simile</i>	550	2	10
	<i>Mutela</i> sp	2852	6	30
Hirudinea	<i>Hirudo</i> sp	1625	3	15
Gordiodea	<i>Paragordius</i> sp	5152	14	70

Taxa distribution and abundance were more pronounced in Stations 6, 19 and 5 (Table 3). Out of the twenty-eight taxa recorded during the sampling period, twenty-seven taxa were recorded in Station 6 while Stations 19 and 5 had twenty-six and twenty-three taxa respectively. Station 9 had the least number of taxa (6) followed by Stations 1 and 8. Taxa

abundance followed similar trend with taxa distribution. Highest taxa abundance was recorded in Station 6 (41,275 organism m⁻²), while Stations 5 and 19 have 30,358 organism m⁻² and 29,890 organism m⁻² respectively. The least abundant station were Stations 8 (4,208 organism m⁻²), 15 (7,575 organism m⁻²) and 2 (7,852 organism m⁻²).

Table 3: Diversity of benthic macroinvertebrates (organism/M²) in Asejire Reservoir

Stn.	No. of species (S)	No. of Individual (N)	Shannon index	Simpson index	Margalef	Reach	Region
1	7	11354	1.72	0.79	0.64	OWR	UR
2	9	9452	1.87	0.83	0.87	OWR	UR
3	11	7852	2.15	0.87	1.12	OWR	UR
4	9	10250	1.5	0.64	0.87	OWR	UR
5	23	30358	2.13	0.77	2.13	Littoral	UR
6	27	41275	2.57	0.86	2.45	Littoral	UR
7	9	15975	1.91	0.82	0.83	Littoral	MR
8	7	10850	1.77	0.81	0.65	OWR	MR
9	6	4208	1.27	0.62	0.6	OWR	MR
10	10	14650	1.62	0.69	0.94	Littoral	MR
11	15	22625	1.68	0.72	1.4	Littoral	MR
12	18	24933	2.39	0.87	1.68	Littoral	MR
13	14	25602	1.65	0.72	1.28	Littoral	MR
14	18	28000	2.13	0.81	1.66	Littoral	LR
15	8	7575	1.87	0.83	0.78	OWR	LR
16	8	8400	1.88	0.83	0.77	OWR	LR
17	13	11827	1.71	0.7	1.28	OWR	LR
18	20	25575	2.33	0.84	1.87	OWR	LR
19	26	29890	2.73	0.88	2.43	Littoral	LR
20	15	23700	2.32	0.87	1.39	Littoral	LR

OWR: open water region; UR: upper region; MR: mid region; LR: lower region

The benthic macro-invertebrate fauna of Asejire reservoir is broadly similar to that of other Nigerian and African inland waters including lake Kanji [15], Eleyele stream [43], Owena Reservoir [19], Opa Reservoir [20], River Galma [44], Ibiokuma River [45], Ikpoba River [46] and Egbe Reservoir [4] especially with respect to species composition. A total of twenty-eight benthic macro-invertebrate animal species made up of the

following animal classes were recorded in the reservoir: class Insecta (13 spp), Gastropoda (9 spp), Bivalvia (2 spp) while Arachnida, Malacostraca, Hirudinea and Gordiadea were made of one species each. While the Insecta were made up of different larva forms, the other species occurs as fully grown adults.

Table 4: Total percentage occurrence and distribution of benthic macroinvertebrates of Asejire Reservoir

Class	Total Abundance	Average Abundance	Total Occurrence	Average Occurrence
Insecta	147	11.3	111868	8601
Arachnida	91	10.1	239454	26606
Malacostraca	14	14	5152	5152
Gastropoda	8	4	3402	1701
Bivalvia	3	3	1625	1625
Hirudinea	3	3	1500	1500
Gordiadea	2	2	1350	1350
TOTAL	268	47.2	364351	46535

Though there is no established checklist of available benthic macroinvertebrate species of Nigerian inland waters [20], most of the recorded species in this study have been identified by other workers. Some of these include the work of [48], who worked on *Bulinus globosus* and concluded that this species has a wide distribution in the Northern and Western regions of Nigeria while [44] concluded that *Bulinus globosus*, *Lymnaea natalensis*, *Lanistes libycus* and *Biomphalaria pfeiferi* are known to occur in most parts of Nigeria. [51; 43] recorded *Potadoma moerchi* in the river bottom of streams in Ile-Ife, while [21] recorded *P. moerchi*, also in Opa river bottom of streams in Ile-Ife. The different larval forms of insects (Anisoptera and Zygoptera) have been recorded in Owena reservoir and Lake Kanji [14] and in Owena Reservoir [19, 20]

worked on Opa Reservoir in Ile-Ife and recorded seven species made up of Molluscs and Insects while [21] worked on different streams flowing into Opa Reservoir and recorded twenty species belonging to Mollusca, Insecta and Annelida.

The dominant species in Asejire reservoir were *Potodoma freethi*, *P. moerchi* and *Melanoides tuberculata* all belonging to the phylum mollusca. This observation agrees with the work of [21] who worked on streams at Ile-Ife and recorded high abundance of *Melanoides tuberculata*, *Bulinus globosus*, *Potadoma moerchi*, *P. freethi* and *Lymnaea natalensis*, while [19, 43, 20] recorded *Biomphalaria pfeiferi* as the dominant species in Owena Reservoir, Ile-Ife streams and Opa Reservoir

The large number of *Potodoma freethi* and *P. moerch*,

recorded in this study compared with the other recorded species was not surprising because it has been reported to be widely distributed in streams and rivers in West and Central Africa rainforest regions ^[55, 49]. While *Potadoma freethi* is commonly found from Ivory Coast to lower Zaire, *P. moerchi* is present from Southeast Ghana to Nigeria ^[50, 36]. *Potadoma freethi* showed strong association with rivers of clear, well oxygenated water flowing over rocks or gravel and lacking aquatic plants.

In comparison to the available studies of inland waters in Nigeria, the macro-invertebrate benthic species recorded in Asejire reservoir can be considered to be rich in species occurrence, distribution and abundance. For instance, in Asejire reservoir twenty-eight species comprising 364,351 individuals were recorded for the two year duration of study, while in Opa reservoir seven species comprising 378 individuals were recorded ^[20], 12,076 individuals in Bindare and Galma Rivers ^[44] and 11,063 individuals from Owena reservoir comprising of thirteen species ^[19]. In Lake Kainji (the largest man-made lake in Nigeria) thirteen species comprising 23,261 individuals were recorded ^[15], forty-one taxa comprising of 4,614 individuals ^[46], eighty-nine taxa comprising 2,535 individuals ^[45].

According to ^[47] an impoverished macro-invertebrate benthic fauna community could be attributed to the physico-chemical and geochemical nature of the sediment (fertility), water depth, sediment type, water current, sediment erosion due to intensive farming and clearing of ground cover which cause silting and adverse effect on the macro-invertebrate benthic community. From available physico-chemical data on the Asejire Reservoir water ^[25-33] it can be inferred that the reservoir is rich in organic carbon and other nutrients. These coupled with the slow currents and thick covering of its shoreline by vegetation provides a good breeding ground and source of food for the benthic macroinvertebrates organisms to thrive.

4. Conclusion

On the basis of benthic macro-invertebrate taxa composition and abundance, Asejire Reservoir can be inferred to be rich in fauna composition when compared to reservoirs of similar sizes in this part of the world. To maintain the pristine nature of the reservoir for sustainable use of the reservoir, there is need for continuous monitoring of not just the reservoir but also rivers and stream flowing into it. Industries and factories within the catchment area should be encouraged to treat and monitor effluent and wastewater before discharging them.

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