Impact of Physicochemical Characteristics on Fishery Status of Eleyele and Asejire Reservoir

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ABSTRACT

Fish are the main resource got from inland water bodies in south west Nigeria, two reservoirs resident in Oyo State, Eleyele and Asejire Reservoirs are investigated. Physicochemical parameters such as water temperature, dissolved oxygen, water transparency, flow rate, pH and fish morphometrics such as gender, weight, length are compared to the parasite diversity in fishes. Results show that physicochemical parameters at both study sites were within national regulated limits set by the National Environmental Standards and Regulations Enforcement Agency (NESREA) while only Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD), went above the limits. Fish morphometrics revealed a low condition factor, with a mean of 0.85 ± .24 for cichlids, and a mean condition factor of 0.73 ± 0.43 for catfishes in Eleyele reservoir. Cichlid fishes in Asejire reservoir had a mean condition factor of 0.90 ± 0.31, while catfishes had a mean condition factor of 0.65 ± 0.14. Parasite diversity in Eleyele reservoir was critically low while in Asejire had higher parasite diversity to Eleyele but was however also low. This study reveals that the two reservoirs are severely impacted by anthropogenic activities while, Eleyele reservoir is greatly impacted and needs intervention to stop the decline of biotic diversity.

Keywords: Asejire; Physicochemical; Irrigation; Electricity generation

INTRODUCTION

Fish is a rich source of animal protein and essential nutrients such as amino acids, fats and vitamins. Nigeria has an inland surface area of 14 million hectares and this supports the artisanal fisheries sector of 90% of domestic fish production in Nigeria. The freshwater fish species of Nigeria is the richest in West Africa with more than 300 known fish species. Reservoirs are impoundments of hydrological basins to provide potable water, irrigation and electricity generation. An unavoidable effect of dams is the shift in fish species composition and abundance. The resulting impact on fish diversity is caused by a multiplicity of factors such as the biota of the ecosystem, dam design, operation of the dam etc. The identification of the sources of impact is not an easy task, because they arise from complex interactions including watershed uses and fish biology. Both Eleyele and Asejire reservoirs are in the southwestern state, Oyo, in Nigeria and are managed by the state government. This study aims to investigate and compare the physicochemical parameters in relation to fishes and parasite abundance [1-4].

MATERIALS AND METHODS

Eleyele reservoir was constructed by the water corporation of the old Western region in 1939, mainly to supply water to Ibadan city by the damming of River Ona. It has a surface area of 152.76 ha and a storage volume of 1550 million gallons with a total depth of 12 m and a mean depth of 6.5 m. Asejire reservoir was constructed by the damming of river Osun. The entire length of the lake is 19.5 km and is enclosed between 07O21' N and 07O33' N. The dam was constructed in 1972

Citation: Akinpelu A, Hassana A (2023) Impact of Physicochemical Characteristics on Fishery Status of Eleyele and Asejire Reservoir. Eur Exp Bio. 13:11.

with a normal pool elevation of 150m and a maximum flood elevation of 152.4 m. Fish and water samples were collected monthly from both reservoirs from December 2014 to May 2015. Fish samples were collected in the morning from artisanal fishers, who caught them the night before, while water samples were collected between 10 am and 1 pm on sampling days. Sampling and laboratory procedure: Three sampling points were chosen where water samples were collected. Physico-chemical parameters such as temperature, transparency, flow rate, dissolved oxygen, biological oxygen demand and pH. Surface water temperature was measured *in-situ*, using a mercury in glass thermometer dipped and read in water at the sampling points. The average was therefore calculated. Water transparency was measured using a 20 cm, weighted seechi-disk. The disk was lowered into the water with a graduated rope until it disappeared from view. The disappearance and appearance points were then noted for the three different sampling points. The flow rate was calculated by placing a float at the beginning of a known distance while determining the time it takes to get to the end of the known point. Dissolved oxygen was measured *in-situ* with a Sper scientific environmental measuring instrument. Water samples for Biological Oxygen Demand (BOD) were stored in dark 300 ml bottles and were measured 5 days later with the environmental measuring instrument. Water samples for pH were collected and stored in clear plastic bottles and measured in the laboratory with a Jenway tabletop pH meter. Fish samples were identified in the laboratory and sorted into different species based on external body features as

described. Gender was determined by the presence of a sexual papilla for the males, while the absence of the sexual papilla signifies a female fish [5-8].

Total and standard lengths of the fishes were determined using a meter rule while the weight of fishes was measured using a Kera weighing balance. The condition factor (k) of the fishes was calculated using the equation:

$$K = \frac{100W}{L^3}$$

Where;

W=Weight of fish;

L=Total length of fish

RESULTS

Temperature and pH values in the Eleyele reservoir were within the National Environmental Standards and Regulations Enforcement Agency (NESREA) limits, however, dissolved oxygen and biological oxygen demand went above the NESREA limits for some months. Asejire reservoirs' physicochemical parameters were within the NESREA limits except for DO and BOD during some months (**Table 1**).

Table 1: Fish morphometrics.

	Fish type		Male	Female	Range	Mean
Eleyele	Tilapia	Length (m)			17-26	21.11 ± 2.435
		Weight (g)	24	12	25-200	82.25 ± 36.136
		CF			.41-1.27	.8506 ± .23610
	Catfish	Length (m)	17	19	19-46	36.60 ± 6.095
		Weight (g)			50-675	355.47 ± 162.13
		CF			.31-2.92	.7317 ± .42638
Asejire	Tilapia	Length (m)	22	14	18-27	21.47 ± 2.569
		Weight (g)			25-325	95.81 ± 61.666
		CF			.43-1.99	.9008 ± .30682
	Catfish	Length (m)	18	18	25-39	32.00 ± 3.538
		Weight (g)			100-350	217.69 ± 71.560
		CF			.37-1.02	.6547 ± .13721

Note: CF=Condition Factor

Physico-chemical parameters of the Eleyele reservoir are shown in **Figure 1**. Transparency in the Eleyele reservoir was high for the first six months with a mode of 1m, the temperature ranged between 26°C-30°C, pH ranged between 5.40-7.84, while DO and BOD ranged 5.10 mg/l to 13.60 mg/l

and 0.10 mg/l to 8.10 mg/l, respectively. Asejire reservoir had a maximum transparency value of 1.1m, the temperature ranged between 22°C-31°C, pH ranged from 6.93-7.13, while DO and BOD were 6 mg/l to 14 mg/l and 0.3 mg/l to 6.60mg/l, respectively (**Figure 2**).
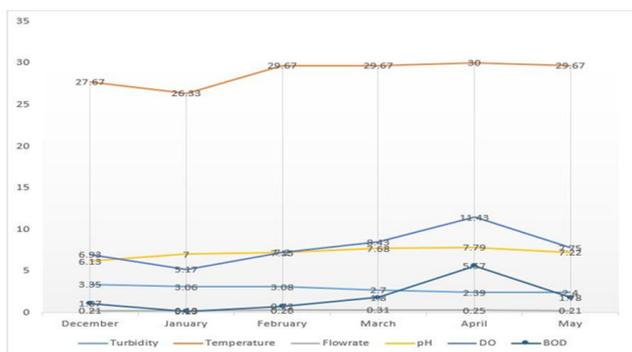
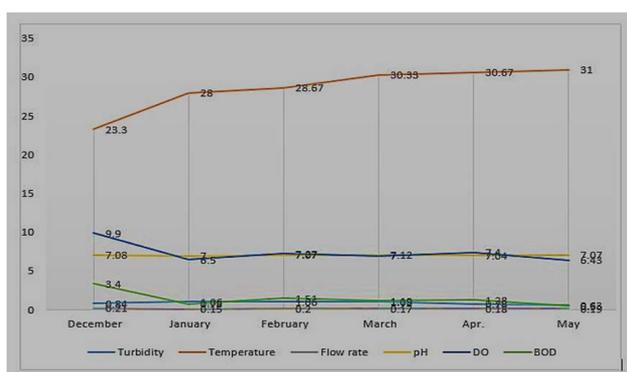**Figure 1:** Physicochemical parameters of Eleyele reservoir.

Figure 2: Physico chemical parameters in Asejire reservoirs.

Fish Morphometrics

A total of 144 fish species were collected from both reservoirs (Eleyele=72, Asejire=72). 81 (56.2%) fishes were male, while 63 (43.8%) fishes were female. Clariid and Cichlid fishes were collected from both reservoirs, the clariid fish comprises only *Clarias gariepinus*, while the Cichlid fishes comprise *Coptodon* (*Tilapia*) *zilli, C. guinensis Oreochromis nilo icus, Sarotherodon melanotheron* and *S. galileaus*. In the Eleyele reservoir, the mean total length of tilapine species was 21.11 cm ± 2.44 cm and the total length of *ilapine* species ranged from 17 cm to 26 cm. The mean weight of tilapias in the reservoir is 82.25 g ± 36.14 g and the minimum and maximum weight of tilapine fishes ranged between 25 g and 200 g. Catfishes in the reservoir had a mean length of 36.60 cm ± 6.10 cm, total lengths ranging from 27 cm to 46 cm. The mean weight of catfishes in the Eleyele reservoir is 355.47 cm ± 162.13 g, the minimum weight being 50 g and a maximum weight of 675 g (**Table 2**). The condition factor of cichlids in the reservoir was as low as 0.41, with a mean of 0.85 ± 0.24. The lowest condition factor for catfishes was 0.31 with a mean of 0.73 ± 0.43. In the Asejire reservoir, the mean total length of tilapias in Asejire reservoir was 21.47 cm ± 2.57 cm, ranging from 18 cm and 27 cm. The mean weight of tilapias is 95.81 g ± 61.67 g, the minimum weight was 25 g and the maximum weight was 325 g. Catfishes had a minimum and maximum length of 25 cm and 39 cm, respectively and a mean length of 32 cm ± 3.54 cm. The mean weight of catfishes is 217.69 g ± 71.56 g, with a minimum weight of 100 g and a maximum of 325 g. The condition factor for fishes in the Asejire reservoir was calculated with Cichlid fishes having a mean condition factor of 0.90 ± 0.31, while catfishes had a mean condition factor of 0.65 ± 0.14 (**Table 3**) [9-13].

Table 2: Overall parasite prevalence.

Fish host		No. examined	No. infected	Species specific prevalence (%)	Overall prevalence (%)
Family	Species type				
Cichlidae	*Coptodon zilli*	33	4	12.12	2.78
	C. guineensis	11	1	9.09	0.69
	Oreochromis niloticus	10	0	-	-
	Sarotherodon melanotheron	12	1	8.33	0.69
	S. galilaeus	6	0	-	-
Clariidae	*Clarias gariepinus*	72	0	-	-
Total		144	6		4.16

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Fish host		Number examined	Number infected	Prevalence
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	C.guineensis	11	1	9.09%
	O. niloticus	10	0	-

	S. melanotheron	12	1	8.33%
	S. galileus	6	0	-
Clariidae	*C. gariepinus*	72	0	-
Total		144	0	4.17%

Parasite Diversity

All fish species examined from Eleyele Lake had no helminth parasites. In Asejire lake, out of the 36 cichlids collected; 6 (16.7%) were infected with *Clinostomum tilapiae*. Out of the 36 clariids observed in Asejire, none was infected, resulting in an overall prevalence of 8.33%. There was a significant difference in the prevalence of parasitic infection in fishes from both Eleyele and Asejire study sites (P<0.05).

DISCUSSION

Data obtained shows that fishes in both Eleyele and Asejire reservoirs possess low parasite prevalence, catfishes, in particular, were devoid of parasites from both reservoirs. Parasite prevalence in fish is dependent on various factors. For example, studies have proven that the prevalence of digeneans in their intermediate and definitive hosts is inversely proportional to the degree of pollution and disturbance of aquatic ecosystems. This inference is accurate, especially for the Eleyele reservoir which resides in an urban area, where the researcher identified several anthropogenic activities less than 10 meters from the reservoir. Varying from cassava processing centers, auto-mechanical workshops and a transportation hub across the reservoir. On the other hand, the Asejire reservoir resides in a rural setting and an area strictly controlled by the Oyo state's water corporation. The major human interaction with the reservoir is through artisanal fishing, therefore, the reservoir is minimally impacted. The interaction between pollutants and parasites usually results in various outcomes for the host, for example, many environmental pollutants may suppress the immune response of organisms, thereby leading to greater parasite infection intensities, finally resulting in host mortality. Recent heavy metal analysis of the Eleyele reservoir has shown that the waterbody had Lead (Pb), Cadmium (Cd), Chromium (Cr) and Manganese (Mn) above the acceptable limits of the USEPA, while Zinc (Zn) and Copper (Cu) were below the limits. Furthermore, the Transfer Factor in the reservoir was high, resulting in fishes having a higher concentration of heavy metals compared to the water body. Condition factor is a measure of the overall wellness of a fish and takes into account the feeding, spawning, habitat status and all other environmental parameters. The mean condition factor of tilapias in Eleyele was below 1.5, while that in Asejire was lower than 2.0. Bagenal and Tesch recommended a condition factor of range (2.9-4.8) as suitable for matured freshwater fish in optimum environmental conditions. This result implies that fishes in both Eleyele reservoir and Asejire reservoir are not conducive environmentally and physiologically for the

fishes that reside in them. Such low condition-factor in fishes have also been reported in freshwater bodies of South-Western Nigeria and this points out that the fishes are stressed. Parasites are an integral part of an ecosystem and the degree of their presence or absence can be an indicator of ecosystem health. Parasites do reflect the biodiversity of their habitat. The link between the diversity of free-living organisms and parasite species richness has long been established in both freshwater and marine systems. Parasites are now used as environmental sentinels to infer environmental conditions in various environmental impact studies. Acanthocephalans are good accumulation indicators of metals in different organisms especially fishes, *Acanthocephalus lucii* was found to accumulate Cadmium (Cd) and Lead (Pb), greater than its fish host, at both larval and adult stages. Digenetic trematodes on their own serve as an effect indicator, majorly because of their complex life cycle moving through various hosts. The first intermediate host is usually a mollusc and a second intermediate host is any of animals such as fish, molluscs, insects, among others, a definite host of trematodes are birds, mammals or amphibians. Poulin investigated the general patterns affecting the distribution of parasites in fish and other vertebrates. He discovered that parasite abundance correlated with body size, however, diet and habitat were not correlated with parasite species richness. He additionally discovered that locally, parasite abundance in fishes is positively related to the number of host species present, but negatively on a larger scale. This could be the reason for the low number of parasites recorded in the Eleyele reservoir than in the Asejire reservoir. As the artisanal fishermen in Eleyele reservoir complained of scarcity of fish in the dam, a result most likely a result of over-fishing, since the Eleyele reservoir is situated in a now urban region of Ibadan.

CONCLUSION

Eleyele reservoir is clearly impacted by anthropogenic activities, a larger and more comprehensive study of both study sites is advised to provide more information on the fishery status using parasites as sentinel species. The case has been made for parasites to be used as sentinels for environmental pollution, as their abundance or lack of it could inform about the deleterious effects of pollutants. Effect indicators (parasites) population and community structure are studied over time and then analyses and the changes interpreted.

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