Available online at http://ajol.info/index.php/ijbcs

Int. J. Biol. Chem. Sci. 8(2): 596-609, April 2014

ISSN 1997-342X (Online), ISSN 1991-8631 (Print)

International Journal of Biological and Chemical Sciences

Original Paper

http://indexmedicus.afro.who.int

Assessment of the water quality parameters in relation to fish community of Osinmo reservoir, Ejigbo, Osun State, Nigeria

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ABSTRACT

Physicochemical indices of water body changed seasonally and this necessitated an investigation to assess the water quality parameters of Osinmo reservoir in relation to its fish species. The water quality parameters were measured using standard methods. Results obtained show that the reservoir is alkaline in nature with dissolved oxygen concentration (1.8-7.2 mgl^{-1}) and alkalinity (64 $CaCO_3$ mgl^{-1}-108 $CaCO_3$ mgl^{-1}) which were within the optimum range for growth and survival of fish. Four families of fish comprising eight species were encountered. The sex-ratio of five species which were statistically different ($P<0.05$) indicated reproductive efficiency populations while other fish species whose sex-ratio differed insignificantly ($P>0.05$) revealed a growing population. The well-being of the fish species was adequate as observed in the least mean condition factor of 0.666±0.057 in *C. gariepinus* and the highest mean of 2.000±0.242 in *S. galilaeus*. The productivity of the reservoir can be improved through proper management of the water body.

Keywords: Water quality, fish abundance, diversity, fish biometrics, sex-ratio, condition factor.

INTRODUCTION

Water is an essential natural resource for life sustenance and healthy functioning of any ecosystem because of its continuous interaction with the surrounding air, land and living things (Wetzel, 2001). Water is also not only the survival resource of all living beings but also the main vector for all developmental activities related to all ecological and societal processes (Rosenblatt, 2005).

The quality of treated and untreated water is typically determined by monitoring microbial presence, especially faecal coliforms, bacteria, phytoplankton, parasites, and the physicochemical properties (WHO, 2001). Management of river and reservoir water quality has become increasingly important due to decline in water quality caused by human activities and run off form catchment basins. Successful implementation of efficient management strategies requires the monitoring of water quality changes (UNEP, 2012). The quality of water should be checked at regular intervals to prevent deterioration of water quality and to maintain healthy aquatic biota (Bhalerao, 2012).

A monitoring program and a preventive and reliable estimation of the quality of the surface waters are necessary, as chemical,

DOI : http://dx.doi.org/10.4314/ijbcs.v8i2.18

physical and biological compositions of surface water are the prime factors on which the suitability of the water for drinking, domestic, industrial or agricultural purpose depends (UNEP, 2012). Abundance, distribution and diversity of fish species in a community are also greatly influenced by water quality parameters (Carol et al., 2006; Cheng et al., 2010). However, the most important factors affecting fish composition and survival differs among waterbodies, ranging from physical properties to water chemistry (Cheng et al., 2010). The present study therefore investigates some of the water quality parameters of a newly impounded reservoir and its relationship to the fish diversity and management strategy.

MATERIALS AND METHODS

Study site

Osinmo reservoir with a catchment area of about 102km^2 was created in 2005 by impounding Ataro river. It has a surface area of about 0.78 sq km with a mean depth of 3.2 meters. The basin extends in width from Longitude 0.4°21.2ˈE to 0.4°21.7ˈE and in length from Latitude 007° 52.8ˈ N to 007°53.2ˈN. The reservoir occupies an undulating terrain with an altitude of 365.8m above the sea level. The vegetation is mainly of lowland rain forest with patchy derived grassland (Keay, 1959). Rainy season in the catchment area is between April and October while the dry season is between November and March annually.

Water sampling and laboratory analysis

Water samples were collected monthly from the reservoir between January and December, 2011. Water temperature was measured *in situ* with a mercury-in-glass bulb thermometer while pH was determined on the field using Gowe® multi-function water quality test monitor. Water transparency was also measured *in situ* using a graduated secchi disc. The samples for the determination of dissolved oxygen (DO) were collected in a 250/125 ml capacity glass reagent bottles, fixed in the field using Winkler's reagents and brought into the laboratory for further processing. Water samples (a total of 36 samples) for the determination of other chemical parameters were collected in two litre polyethylene sample cans. The analysis of the water samples for chemical parameters including acidity, alkalinity, conductivity, and oxygen parameters were all in accordance with standard methods of Golterman et al. (1978) and APHA et al. (1992) as applicable. The conductivity was measured at 25 ºC using Jenway conductivity meter (Model 4071).

Fish sampling and laboratory analysis

Fish species were caught monthly with gill-net 2.54 cm mesh size measuring 100 m long and 3 m deep, set overnight and removed the following morning. Ten funnel-shaped fish traps (made from the plant Eremospathasp) whose entrance has a non-return valve were each baited with ripe palm fruits and set randomly under sedges along the shoreline of the reservoir.

Specimens of fish caught were put in ice-chest box covered with ice and brought to the laboratory, identified (Reed et al., 1967; Paugy et al., 2003; Adesulu and Sydenham, 2007), the total length, standard length and weight of each fish taken and recorded. The lengths of the fish species were measured using meter rule fixed to a measuring board (expressed to the nearest centimeters) while the weights were measured using Denward weighing balance. Fishes were slit open ventrally from the anus to the pectoral fin to determine sex and stage of gonad maturity by visual inspection (Roberts, 1989). The Pondera index (K) (Weatherley, 1972) primarily expresses the condition of a fish in term of well-being and relative robustness.

$$K = \frac{100,000W}{L^3}$$ (William, 2000)

Where W = the weight of fish (g)
L = the length of fish (mm).

Statistical analysis

Data obtained were analysed using relevant statistics including descriptive statistics and multivariate statistics using SPSS software (SPSS16, 2008).

RESULTS

Seasonal variations in the water physicochemical parameters

The results of the physicochemical parameters of water quality in the reservoir are as shown in Table 1. The ambient air temperature varied between a minimum of 16 °C in January, 2011 to a maximum of 26.5 °C in April, 2011 while water temperatures ranged from minimum of 22 °C in December, 2011 to maximum of 29 °C in May, 2011. Water temperature was strongly influenced by the air temperature, increasing with increase in air temperature; hence they both exhibited the same seasonal pattern. The mean water temperature was higher in the rainy season (26.85±1.31 °C) than during the dry season (24.60 ± 1.95 °C) in the reservoir. Likewise, the mean air temperature was higher in the rainy season (24.50 ± 1.22 °C) than during the dry season (20.70 ± 3.52 °C).

The values of dissolved oxygen (DO) in the reservoir ranged from 1.8 $mgl^{-1}$to 7.2 mgl^{-1}. The maximum and minimum values were both recorded in the rainy months of July, 2011 (Mid-rainy season) and April, 2011 (Onset of rainy season). There was no significant ($P > 0.05$) seasonal dissolved oxygen variation with the recorded mean DO of 3.74 ± 1.68 mgl^{-1} and 4.00 ± 0.94 mgl^{-1} in the rainy and dry seasons respectively. Biochemical oxygen demand (BOD_5) of the water samples varied from 0.8 mgl^{-1}in February, 2011 (late dry season) to 2.8 mgl^{-1} in May, July and October, 2011 (rainy months) (Table 1). The Biological oxygen demand also showed low amplitude of variations over the period of study, hence no significant ($P > 0.05$) variation occurred in its seasonal values (mean BOD value of 2.00 ± 0.77 $mgl^{-1}$for the rainy reason and 1.36 ± 0.46 mgl^{-1} recorded for the dry season).

The reservoir acidity fluctuated through the months of sampling with a range of 40$CaCO_3$ mgl^{-1} in October, 2011 (late rainy season) to 66 $CaCO_3$ mgl^{-1} in March, 2011 (Onset of Rainy Season). The seasonal variation as observed in the mean acidity of 46.57 ± 5.00 mgl^{-1} and 51.0 ± 9.00 mgl^{-1} during the rainy and dry seasons respectively were however not statistically significant ($P > 0.05$) while the overall mean acidity was 48.42 ± 7.02 mgl^{-1}. Alkalinity of the reservoir varied between 64 mgl^{-1} in February, 2011 (late dry season) and 108 mgl^{-1} in September, 2011 (late rainy season). There was a significant seasonal variation ($P < 0.05$) in the mean alkalinity over the two seasons (rainy and dry seasons) with a mean of 93.86 ± 10.75 $CaCO_3$ $mgl^{-1}$and 77.20 ± 9.01 $CaCO_3$ mgl^{-1} respectively. The overall mean alkalinity recorded during the period of study was 86.92 ± 12.89 $CaCO_3$ mgl^{-1} (Table 1).

During this study, the pH ranged between 6.60 (September, 2011) and 7.55 (February, 2011). The mean pH in the rainy and dry seasons was 7.07 ± 0.41 and 7.46 ± 0.09 respectively while the overall mean pH was 7.24 ± 0.37. The peak value of conductivity of 153 µScm was recorded during mid-dry season (January, 2011) while the minimum value of 76µScm was observed in July, 2011 (mid-rainy season). ANOVA analysis of conductivity mean values showed seasonal statistical significant ($P < 0.05$ with mean conductivity of 100.86 ± 18.73 µScm and 128.20 ± 22.32 µScm in the rainy and dry seasons respectively and an overall mean conductivity value of 112.25 ± 23.89 µScm.

The transparency of the water in the reservoir also showed statistically significant seasonal variation ($P < 0.05$) with a minimum of 68 cm recorded in August, 2011 and the maximum transparency of 96 cm in February, 2011. The mean transparency of the water in the reservoir was 84.00 ± 2.47 cm.

Fish abundance, diversity, length and weight structure

Four families of fish comprising eight species were caught during the period of study. The family Cichlidae with five species was the most dominant while other families of fish had one species each. The Cichlids constituted about 83% of the population, followed by Hepsetidae 10%, Channidae 4% and Clariidae was 3% respectively. However, *Tilapia zillii* constituted 40% of all fish specimens caught while *Sarotherodon galilaeus* which constituted 20.0% was the second largest specimen caught in the reservoir. Fish length and weight varied with respect to species. The mean standard length and mean weight of each fish shown in Table 2 revealed that relatively bigger specimens of *C. gariepinus*, *P. obscura* and *O. niloticus* were caught in the reservoir during the period of study.

Sex-ratio and condition factor

The lowest sex ratio of fish species of 1:0.2 (male to female) was recorded in *S. galilaeus* while the highest of 1:0.8 (male to female) was recorded for *Oreochromis niloticus*. The sex ratio of male to female in *Tilapia zillii*, *S. galilaeus* and *Hemichromis fasciatus* were statistically significant ($P<0.05$) while for other fish species, the sex ratio were found to be statistically insignificant ($P>0.05$). The range and mean Condition Factor (K) of each fish was as shown in Table 3. *Clarias gariepinus* specimens has the least mean Condition Factor of 0.666±0.057 while the highest mean of 2.004±0.242 was recorded in *S. galileaus* specimens.

Relationship between water quality and fish biometric characteristic

The result of correlation analysis between the water quality and the fish species biometric characteristics (Standard length and weight) is as presented in Tables 4 and 5. Dissolved oxygen, biological oxygen demand and acidity showed positive statistically significant correlation with the body weight of *Sarotherodon galileaus* and *Parachanna obscura* (Table 4) while *Chromidotilapia guntheri* showed zero correlation with conductivity. Acidity also showed positive significant correlation with the standard length of *O. niloticus* while conductivity had a significant negative correlation with both standard length and weight of *O niloticus*. The weight of *T. zillii* also showed a positive correlation with water temperature of the reservoir.

Relationship between water quality and fish catch

The relationship between the physicochemical parameters of water quality and the number of fish caught in the Osinmo reservoir revealed that there was a direct significant ($P < 0.05$) relationship between the numbers of fish caught and water transparency. Conductivity also showed a positive correlation with fish abundance. As shown in Figures 1 and 2, the number of fish caught increases as transparency and conductivity of water in Osinmo reservoir increased. Other water parameters showed no correlation with the fish abundance.

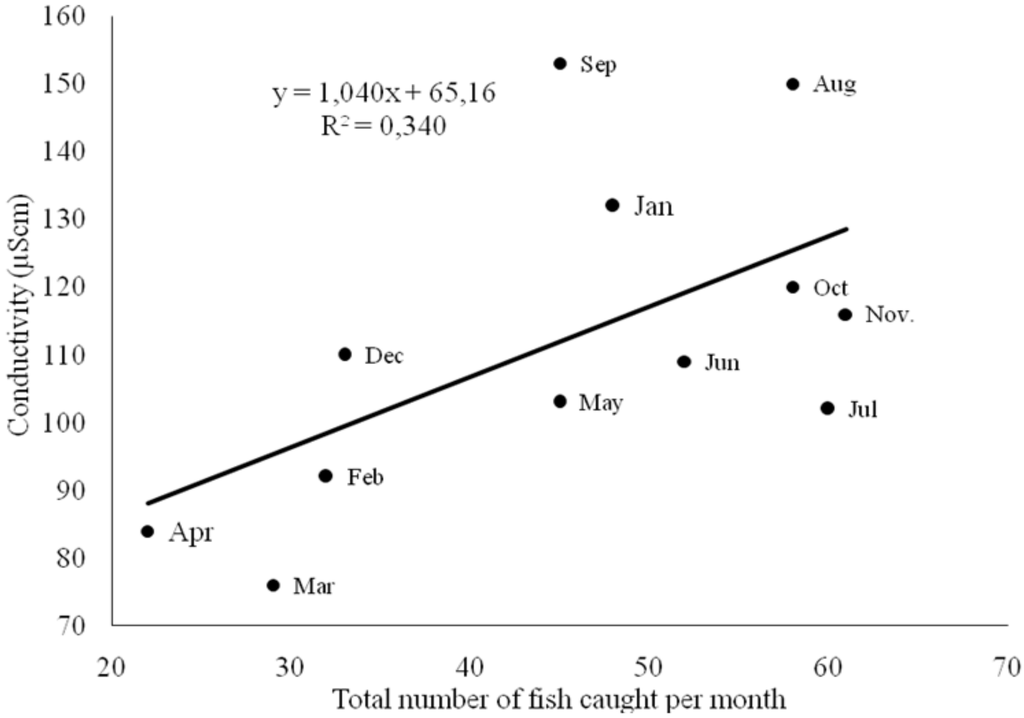

Figure 1: Variation in conductivity (µScm) against total number of fish caught per month.

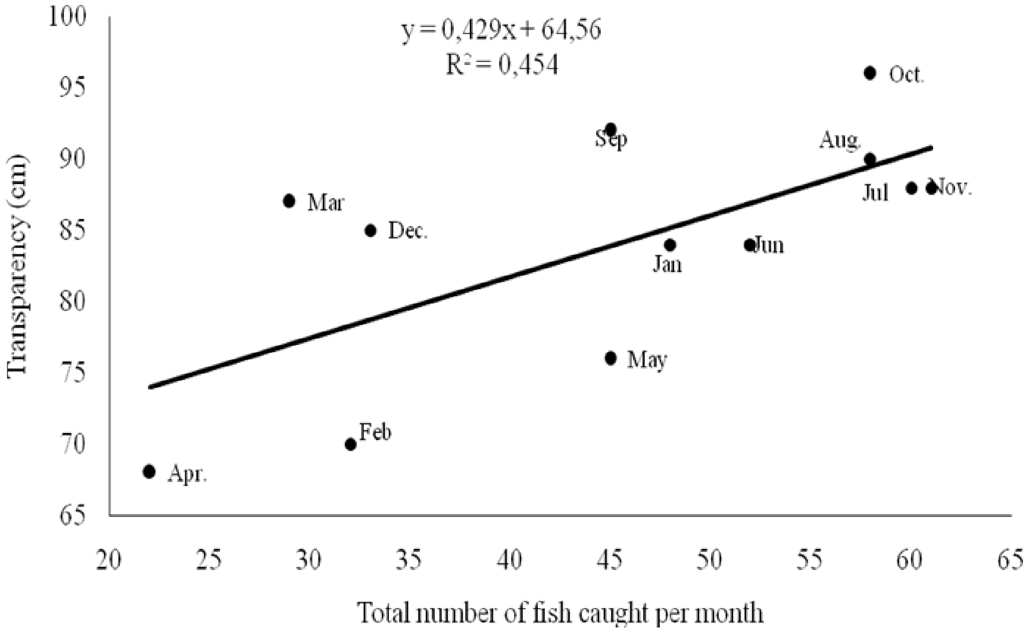

Figure 2: Variation in transparency (cm) against total number of fish caught per month.

Table 1: Seasonal variation in physicochemical parameters of Osinmo reservoir.

Parameters	Rainy season		Dry season		Overall annual range and mean		Anova test	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	F ratio	Probability
Air Temperature (°C)	23.0 – 26.5	24.50 ± 1.22	16.0 – 24.0	20.70 ± 3.52	16.0 – 26.5	24.5±0.36	7.163*	0.023
Water Temperature (°C)	26.0 – 29.0	26.85 ± 1.31	22.0 – 27.0	24.60 ± 1.95	22.0 – 29.0	27.08±0.39	5.814*	0.037
Dissolved Oxygen (DO) mgl^{-1}	1.8 - 7.2	3.74 ± 1.68	2.8 - 4.8	4.00 ± 0.94	1.8 - 7.2	3.83 ± 1.37	0.094	0.766
Biochemical Oxygen Demand (BOD) mgl^{-1}	1.2 - 2.8	2.00 ± 0.77	0.8 - 2.0	1.36 ± 0.46	0.8 - 2.8	1.73 ± 0.71	2.745	0.129
Acidity ($CaCO_3$ mgl^{-1})	40 - 56	46.57 ± 5.00	41 - 66	51.00 ± 9.00	40 - 66	48.42 ± 7.02	1.178	0.303
Alkalinity ($CaCO_3$ mgl^{-1})	78 - 108	93.86 ± 10.75	64 - 86	77.20 ± 9.01	64-108	86.92 ± 12.89	7.952*	0.018
Hydrogen Ion concentration (pH)	6.60 - 7.52	7.07 ± 0.41	7.35 - 7.55	7.46 ± 0.09	6.60 - 7.55	7.24 ± 0.37	4.202	0.068
Conductivity (µScm)	76 - 132	100.86 ± 18.73	102 - 153	128.20 ± 22.32	76 - 153	112.25 ± 23.89	5.322*	0.044
Transparency (cm)	68-87	78.17±3.27	85-96	89.83±1.56	68-96	84±2.47	9.770**	0.011

* = Significant ; ** = highly significant

Table 2: Abundance, diversity, length and weight structure.

Fish species	No examined	Fish %	Std. length (cm) Range	Mean ± SD of mean	Weight (g) Range	Mean ± SD of mean
Hepsetus odoe	54	10	26.5-30.5	28.5±2.83	282-382	332±70.7
Clarias gariepinus	16	3	24.0-46.2	37.9±12.1	144-1100	698±496
Parachanna obscura	21	4	32.0-40.5	34.88±4.8	418-1055	689±308
Hemichromis fasciatus	32	6	8.2-12.1	10.2±1.30	22-62	38±17.1
Oreochromis niloticus	45	8	21.5-28.5	25.1±3.50	388-876	604±249
Chromidotilapia guntheri	50	9	7.8-12.7	9.4±2.16	14-56	32±20,4
Sarotherodon galilaeus	110	20	9.5-19.0	13.82±2.46	37-300	122±63.6
Tilapia zillii	215	40	11.8-205	15.89±3.24	66-388	185±98.7

Table 3: Sex ratio and condition factor.

Fish species	Sex ratio					Condition Factor (K)	
	Male	Female	(Sex ratio)	X^2 value	P(0.05)	Range	Mean ± SD of mean
Hepsetus odoe	36	18	1:0.5	1.12	NS	0.586-1.326	0.773±0.042
Clarias gariepinus	10	6	1:0.6	0.05	NS	0.509-0.878	0.666± 0.057
Parachanna obscura	12	9	1:0.8	0.14	NS	0.789-1.008	0.861±0.049
Hemichromis fasciatus	24	8	1:0.3	8.00	S	1.523-1.974	1.753±0.311
Oreochromis niloticus	25	20	1:0.8	0.12	NS	1.480-1.977	1.708± 0.216
Chromidotilapia guntheri	35	15	1:0.4	0.50	NS	1.424 -2.038	1.677±0.153
Sarotherodon galilaeus	85	25	1:0.2	12.0	S	1.675-2.280	2.004±0.242
Tilapia zillii	165	50	1:0.3	12.3	S	1.275-3.009	1.850±0.278

NS = not significant ; S = significant

Table 4: Correlation coefficient between fish species' standard length and physicochemical water parameters.

Parameters	**Spearman's Rho**	***Clarias gariepinus***	***Tilapia zillii***	***Parachanna obscura***	***Sarotherodon galilaeus***	***Oreochromis niloticus***	***Hepsetus odoe***	***Hemichromis fasciatus***	***Chromidotilapia guntheri***
Dissolved oxygen (mgl^{-1})	Correlation Coefficient	0.08	0.048	-0.155	0.495	-0.392	-0.551	0.082	-0.360
	Sig. (2-tailed)	0.806	0.882	0.632	0.102	0.207	0.063	0.8	0.427
Biological oxygen demand (mgl^{-1})	Correlation Coefficient	0.213	0.09	-0.111	0.467	-0.39	-0.527	0.032	-0.378
	Sig. (2-tailed)	0.506	0.78	0.731	0.126	0.21	0.078	0.922	0.403
Acidity ($CaCO_3$ mgl^{-1})	Correlation Coefficient	-0.01	0.085	0.312	-0.231	**0.610***	0.37	-0.018	-0.107
	Sig. (2-tailed)	0.974	0.792	0.323	0.471	**0.035**	0.236	0.956	0.819
Alkalinity ($CaCO_3$ mgl^{-1})	Correlation Coefficient	-0.02	0.095	0.044	-0.011	-0.039	0.207	-0.141	0.393
	Sig. (2-tailed)	0.948	0.768	0.892	0.974	0.905	0.519	0.662	0.383
pH	Correlation Coefficient	0.2	0.41	0.427	-0.018	0.414	0.304	0.086	0.445
	Sig. (2-tailed)	0.532	0.185	0.166	0.955	0.181	0.337	0.79	0.317
Conductivity (µScm)	Correlation Coefficient	-0.25	-0.09	-0.312	-0.512	**-0.663***	0.533	-0.357	0.000
	Sig. (2-tailed)	0.424	0.781	0.323	0.088	**0.018**	0.074	0.255	1.000
Air Temperature (°C)	Correlation Coefficient	-0.31	-0.08	-0.208	-0.337	-0.298	0.223	0.235	-0.408
	Sig. (2-tailed)	0.328	0.814	0.517	0.284	0.347	0.487	0.462	0.364
Water Temperature(°C)	Correlation Coefficient	-0.17	0.267	-0.105	0.127	0.06	0.258	0.478	-0.360
	Sig. (2-tailed)	0.601	0.401	0.745	0.693	0.853	0.417	0.116	0.427

**Correlation is significant at the 0.01 level *Correlation is significant at the 0.05 level

Table 5: Correlation coefficient between fish species' weight and physicochemical water parameters.

Parameters	**Spearman's Rho**	***Clarias gariepinus***	***Tilapia zillii***	***Parachanna obscura***	***Sarotherodon galilaeus***	***Oreochromis niloticus***	***Hepsetus odoe***	***Hemichromis fasciatus***	***Chromidotilapia guntheri***
Dissolved oxygen (mgl^{-1})	Correlation Coefficient	0.138	0.101	-0.29	**0.750****	-0.35	-0.491	0.216	-0.234
	Sig. (2-tailed)	0.669	0.754	0.355	**0.005**	0.265	0.105	0.501	0.613
Biological oxygen demand (mgl^{-1})	Correlation Coefficient	0.2	0.037	-0.2	**0.729****	-0.334	-0.467	0.172	-0.252
	Sig. (2-tailed)	0.532	0.909	0.534	**0.007**	0.289	0.125	0.592	0.585
Acidity ($CaCO_3$ mgl^{-1})	Correlation Coefficient	-0.18	0.082	**0.567***	-0.34	0.501	0.342	-0.18	-0.250
	Sig. (2-tailed)	0.568	0.801	**0.054**	0.277	0.097	0.276	0.583	0.589
Alkalinity ($CaCO_3$ mgl^{-1})	Correlation Coefficient	0.147	0.056	0.09	0.057	-0.018	0.308	-0.16	0.429
	Sig. (2-tailed)	0.648	0.862	0.781	0.861	0.957	0.33	0.609	0.337
pH	Correlation Coefficient	0.171	0.169	0.485	-0.11	0.368	0.4	0.064	0.259
	Sig. (2-tailed)	0.594	0.599	0.11	0.742	0.239	0.198	0.843	0.574
Conductivity (µScm)	Correlation Coefficient	-0.2	-0.171	-0.05	-0.36	**-0.698***	0.537	-0.32	0.054
	Sig. (2-tailed)	0.533	0.594	0.883	0.251	**0.012**	0.072	0.312	0.908
Air Temperature (°C)	Correlation Coefficient	-0.35	0.04	-0.25	-0.25	-0.374	0.04	0.237	-0.334
	Sig. (2-tailed)	0.267	0.902	0.431	0.437	0.232	0.903	0.458	0.465
Water Temperature (°C)	Correlation Coefficient	-0	**0.578***	-0.28	0.28	-0.042	0.166	0.396	-0.270
	Sig. (2-tailed)	0.991	**0.049**	0.379	0.377	0.896	0.605	0.202	0.558

**Correlation is significant at the 0.01 level ; *Correlation is significant at the 0.05 level

DISCUSSION

Physicochemical water quality

Osinmo reservoir is alkaline in nature with dissolved oxygen concentration (1.8-7.2 mgl^{-1}) and alkalinity (64 $CaCO_3$ mgl^{-1}-108 $CaCO_3$ mgl^{-1}) which were within the optimum range for growth and survival of fish (Bhatnagar and Devi, 2013). However the rate of primary productivity in the reservoir is low as indicated by low water transparency value which is greater than 50 cm.While the low level of BOD_5 (0.8 mgl^{-1} - 2.8 mgl^{-1}) as recorded from the reservoir shows that the water body is much more within the desirable limit and is less polluted (Uzukwu, 2013).

The observed significant seasonal variation in the physicochemical water quality of the reservoir according to Ayoade et al. (2006) is due to rainfall and water use.The water temperature was greatly influenced by the air temperature which decreased with rains hence the water temperature were generally low during the rainy season. This, according to Akinbuwa (1999 cited Adedeji, 2011) is a phenomenon common to the West African aquatic system owing to time lag between the onset of rains and the time run-offs get into the aquatic system. These patterns of results were similar to the observation of Atobatele and Ugwumba (2011) and Komolafe and Arawomo (2011) in Aiba and Erinle reservoirs which were in the same axis with the present reservoir. Low transparency of 68 cm and maximum of 96 cm during rainy season and dry season is as a result of heavy rainfall which brought about abundance of decayed organic matter in suspension, while surface runoff from streams and rivulets also carried particulate maters which influenced water transparency as was reported by Mustapha (2008). The hydrogen ion concentrations (pH) recorded for the reservoir were generally above pH 7 during the period of study, was within the range of 6.5 - 8.5 known for most lakes and streams of the world (Tepe et al., 2005). Moreover, the recorded range of pH values (6.60 – 7.55) in the study is ideal for fish growth and development (Uzukwu, 2013). A low pH value had been observed to lower fish blood pH in the gills and hence the capacity to function during respiration (Carmona et al., 2004). The minimum value of pH as recorded during the rainy season was as a result of influx of acidic flood and re-suspension of bottom sediment during the rains (Russell and Helmke, 2002). According to Gupta and Gupta (2006), accumulation of free carbon dioxide due to little photosynthetic activities of phytoplankton (during rainy season) will lower the pH values of waterbody while intense photosynthesis by phytoplankton (during dry season) will increase pH values. Tropical water-bodies had been observed to show a wide range of fluctuations in total alkalinity as a result of location, bottom deposits and season, while high alkalinity values above 300 ppm had been reported to adversely affect spawning and hatching of freshwater fish (Gupta and Gupta, 2006). The mean alkalinity of 85.75 ± 3.50 $CaCO_3$ mgl^{-1} recorded in this study was within the optimum tolerance limits for freshwater fish which were 50 $CaCO_3$ mgl^{-1} to 700 $CaCO_3$ mgl^{-1} (Uzukwu, 2013). The mean of alkalinity of 85.75 ± 3.50 $CaCO_3$ mgl^{-1}in the present study suggested that Osinmo reservoir could be considered good for fishery development.The mean overall acidity level of 49.92 ± 2.14 $CaCO_3$ mgl^{-1} for the reservoir also reflects the level of pH and alkalinity of the reservoir. Acidity of water has capacity to neutralize a strong base and is mostly due to the presence of strong mineral acids, weak acids and the salts of strong acid and weak base (Uzukwu, 2013). Acidity and Alkalinity of Osinmo reservoir might probably be due to the area being underlain by pre-Cambrian basement complex rocks containing carbonate, bicarbonate and hydroxide compounds.

Minimum and maximum conductivity of 76 µScm and 153 µScm were within the range of African most dilute water body known to be poor in ionic concentration (Kemdirim, 2005). Conductivity level of the reservoir seemed fairly high when compared to Aiba reservoir (Atobatele and Ugwumba, 2008) who reported conductivity range of 49.4 µ/Scm to 78 µScm. The significant seasonal variation in the conductivity values, might be attributed to dilution by influx of rain water and runoff from farmlands containing fertilizers and herbicides during the rainy season and the reduction in water level due to evaporation during the dry season as reported by (Oben, 2000). Hence, the present study is consistent with Egborge (1994 cited Atobatele and Ugwumba, 2008) who reported conductivity levels of inland water bodies of Nigeria to be less than 500 µ/Scm at the peak of dry season and less than 100 µ/Scm in the rainy seasons.

The low concentration of dissolved oxygen (DO) recorded in the reservoir was as a result of suspended materials brought into the aquatic system by rains which increased oxygen demand while oxygen production by photosynthesis was reduced by turbidity (Tepe and Mutlu, 2005). The observed result is in agreement with what were obtained in some African waters as reported in Opa reservoir (Akinbuwa, 1988 cited Adedeji, 2011) and Oyun Reservoir (Mustapha, 2008). However, the range of dissolved oxygen recorded in the reservoir which was between 1.8 mgl^{-1} – 7.2 mgL^{-1} was within the optimum performance range for fish (Uzukwu, 2013). Boyd (1979 cited Pillay, 2008) also reported that dissolved oxygen concentration of 3 mgl^{-1} to 12 mgl^{-1} will promote the growth and survival of fish reservoir.

Fish abundance, diversity, length and weight structure

There were four families of fish comprising eight species in this study. The Cichlidae with 83% of the population was the most abundant while Hepsetidae, Canninidae and Clariidae followed with 10%, 4% and 3% respectively. The diversity of fish was low when compared to Opa and Erinle reservoirs with eleven and nineteen species made up of five and ten families (Komolafe and Arawomo, 2007, 2011). The mean standard length of *C. guntheri* at 9.4±2.16 cm was the least when compared to *C. gariepinus* of 37.9 ± 12.1 cm. This pattern of result was also recorded in the mean weight of the species with 32 ± 20.4 g as the least mean weight of *C. guntheri* while *C. gariepinus* had a mean weight of 698±496 g. Other fish species with appreciable mean standard length and mean weight were *P. obscura, H. odoe, O. niloticus* and *T. zillii*. The mean standard length and mean weight varied according to species as was also reported for the nineteen species of fish in Erinle reservoir (Komolafe and Arawomo, 2011).

Sexratio and condition factor

The sex-ratio of *T. zillii*, *S. galilaeus* and *H. fasciatus* were statistically significant (P<0.05) indicating a growing population while the sex ratio of five fish species viz; *H. odoe, C. gariepinus, P. obscura, O. niloticus* and *C. guntheri* were not statistically significant (P>0.05) also indicating populations with reproductive efficiency towards optimum as reported by Obadia and Waltia (2003) in Tona reservoir. The mean condition factor of 0.666±0.057 observed for *C. gariepinus* was the least while *S. galilaeus* with a mean condition factor of 2.00±0.242 was the highest. High condition factors were recorded for all the fish species contrary to low condition factor observed for *Chryschthys nigrodigitatus* in Aiba reservoir (Atobatele and Ugwumba, 2008). Low condition factor as recorded for *C. gariepinus* might be attributed to poor environmental conditions and weight loss during reproductive activities. While high condition factor observed for fish species in this study indicated the presence of adequate food and other essential materials for the well-being of the species in the habitat.

Effect of water quality on fish biometric characteristic and abundance

The dissolved oxygen, biological oxygen demand, acidity, conductivity and water temperature were observed to have direct impact on the well-being the fish species. These water quality parameters showed either positive or negative correlation with either the standard length or weight of the fish species as reported for *S. galileaus, O. niloticus P. obscura* and *T. zillii* which constituted the main catch during the period of study. Water transparency and conductivity also had direct relationship with the fish species abundance. This could be as a result of great influence that these water quality parameters have on fish composition, distribution and abundance (Muyodi et al., 2011).

Conclusion

Based on the result of water quality parameters of Osinmo reservoir examined, the sex ratio of the fish species recorded which showed a growing population and the well-beings of the fishes which were very adequate with respect to their condition factors. The productivity of the reservoir can be improved through proper management of the water body such as the control of aquatic weed, enhancement of primary productivity and controlling fishing activities.

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