EFFECTS OF FISH CAGE–CULTURE ON ZOOPLANKTON ABUNDANCE IN THE TROPICAL RESERVOIR OF ITAPAJI, SOUTH-WEST, NIGERIA

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ABSTRACT

Zooplankton are important components in the aquatic food web and their abundance are dictated by prevailing environmental conditions. The limited information on the effects of cage culture on zooplankton population in Itapaji geared this study. Four cages located 50m equidistantly and tagged A, B, C, and D with cage D located upstream. Water quality and zooplankton abundance were investigated before stocking (BS), during culture (DC), before harvesting (BH). The mean values of water quality parameters measured were dissolved oxygen (BS= 4.73 ± 0.34mg/L, *DC = 3.72* ± 0.13mg/L, BH = *3.40* ± 0.11mg/L), *temperature (BS= 28.45* ± 0.10^{o}C, *DC = 27.30* ± 0.13^{o}C, BH = 27.*09* ± 0.10^{o}C), *pH (BS= 6.19* ± 0.12, *DC = 6.05* ± 0.10, BH = *5.73* ± 0.10), *phosphate (BS= 0.21* ± 0.01mg/L, *DC = 0.17* ± 0.02mg/L, BH = *0.12* ± 0.01mg/L), *and nitrate (BS= 0.001.19* ± 0.00mg/L, *DC = 0.001* ± 0.00mg/L, BH = 0.001.*00* ± 0.00mg/L). *Zooplankton species identified taxonomically using appropriate keys were a total of 13912 individuals (BS = 49.7% [6914 individuals], DC = 26.9% [3737 individuals] BH = 23.4% [3261]) belonging to 3 taxonomic groups (protozoan = 70.9% [9869 individuals], rotifers =15.2% [2116 individuals] and crustacea = 13.9% [1927 individuals]) with 9 species (Euglena [10.8%], Chilomona [0.9%], Frontonia [21.1%], Coleps [5.3%], Rotaria [15.21%], Cypridopsis [13.9%], Vorticella [3.9%], Paramecium [25.2%], and Chilodonella [3.7%]). Spatial variations in zooplankton abundance between cage sites were observed from the Principal Component Analysis (PCA), BS had PC1 (76.4%) and PC 2 (20.3%), DC had PC 1 (70.0%), PC 2 (19.8%) and PC 3(10.2%) and BH had PC1 (67.3%) and PC 2 (27.8%) accounting for the total proportion of zooplankton species. This revealed that the zooplankton abundance varied due to the prevailing cage activities, and it is therefore essential to maintain a healthy environment for the sustenance of aquatic biota.*

Keywords: ***Cage culture, Ecosystem, Itapaji Reservoir, Zooplankton abundance.***

INTRODUCTION

Water is required in the right quantity and quality for the sustenance of life in organisms. Water quality describes the unique physical, chemical, and biological properties that are important for sustainable development (Adebayo & Ayoade, 2019). Water is a scarce resource, and its management is very crucial as opined by Taiwo et al., (2012). Indiscriminate refuse and sewage disposal is a serious problem in most developing countries today coupled with the increasing population, intensive agriculture, and poor environmental management (Galadima et al., 2011). Their impacts have affected water bodies thereby losing their natural ability and self-purification capacity; and this has called for a dire need to monitor the resources for sustainability (Esenowo & Ugwumba, 2010).

Zooplankton are microscopic animals that are suspended in water. They are important in the food chain thereby forming a link between the transfers of energy from phytoplankton to the fish (Ipinmoroti & Iyiola, 2011). Water parameters such as temperature, dissolved oxygen, nitrates, and phosphates have been identified to affect their abundance (Ayodele & Adeniyi, 2006).

Itapaji Reservoir which was created by impounding River Ele flows through various communities and dissolves various substances along its course. The reservoir is prone to the inflow of organic materials from agricultural lands, household wastes/ domestic uses and fish-rearing activities. Areas that receive run-offs are quite desirable because all the essential nutrients required for zooplankton production are in the right proportion, but issues of eutrophication are eminent if the water quality is not monitored (Kashindye et al., 2015).

With the increasing rate of urbanization, human population and fish exploitation around the reservoir, there is a need to investigate the effect these activities will impose on the environment and water quality. There have been reports on zooplankton distribution in the Asu River in Ebonyi State (Nwinyimagu et al., 2021), Opobo River (Enerosisor et al., 2020), Esa-Odo Reservoir in Osun State (Isichei et al., 2020), River Ossiomo in Niger Delta (Ikhuoriah et al., 2015), Oyun Reservoir (Mustapha 2000) to mention a few, but limited documented information the effects of cage culture on the zooplankton species in Itapaji Reservoir. Hence, there is a dire need for this study which aims at investigating the effects of cage culture on the species, abundance, and distribution of zooplankton in the reservoir.

MATERIALS AND METHODS

Study area

Itapaji reservoir is located between Latitude 07° 56´ and 07° 57´N and Longitude 05° 27´ and 05° 28´ on River Ele. It is in Itapaji in Ikole Local Government Area of Ekiti State and is the second-largest reservoir in the state. The reservoir supplies portable water to 13 towns in 3 local government areas of Ekiti state. The water is also used for irrigation and fishing activities. Three cages tagged A, B and C of dimensions 8ft by 6ft by 5.6ft were stocked with 250 healthy juvenile African Catfish, *Clarias gariepinus* (average weight of 28g) per cage, were located at the downstream area, and were situated at 50m apart while the fourth cage (D) which served as the control was located upstream which is a free area and undisturbed by human activities (Fig. 1). Fish were fed a commercial catfish feed (Skretting) throughout the experimental period. The sampling points (around the cages) were about 5.5km from the shore and water samples were collected from each point at a depth of 25 m. The use of a speed boat was employed in the sampling of the entire stations daily between the hours of 9 am and 2 pm for a period of three months (January – March 2019). Water samples were collected in three major periods outlined:

BS - Samples were collected before fish stocking in January (Before culture)

DC - Samples were collected on the sixth week (during culture)

BH - Samples were collected on the twelfth week (before harvesting)

Zooplankton quantification and data collection

Water samples for zooplankton identification were collected from the points using a Juday net as described by Vinogradov et al., (1989). It had an opening diameter of 36 cm and a mesh size of 100 μm. A vertical haul with the net was done

from the bottom to the surface at every sampling point. The concentrates collected from the haul were decanted into 100-mL plastic bottles and fixed in 4% borax-buffered formaldehyde and further analysis were carried out in the laboratory.

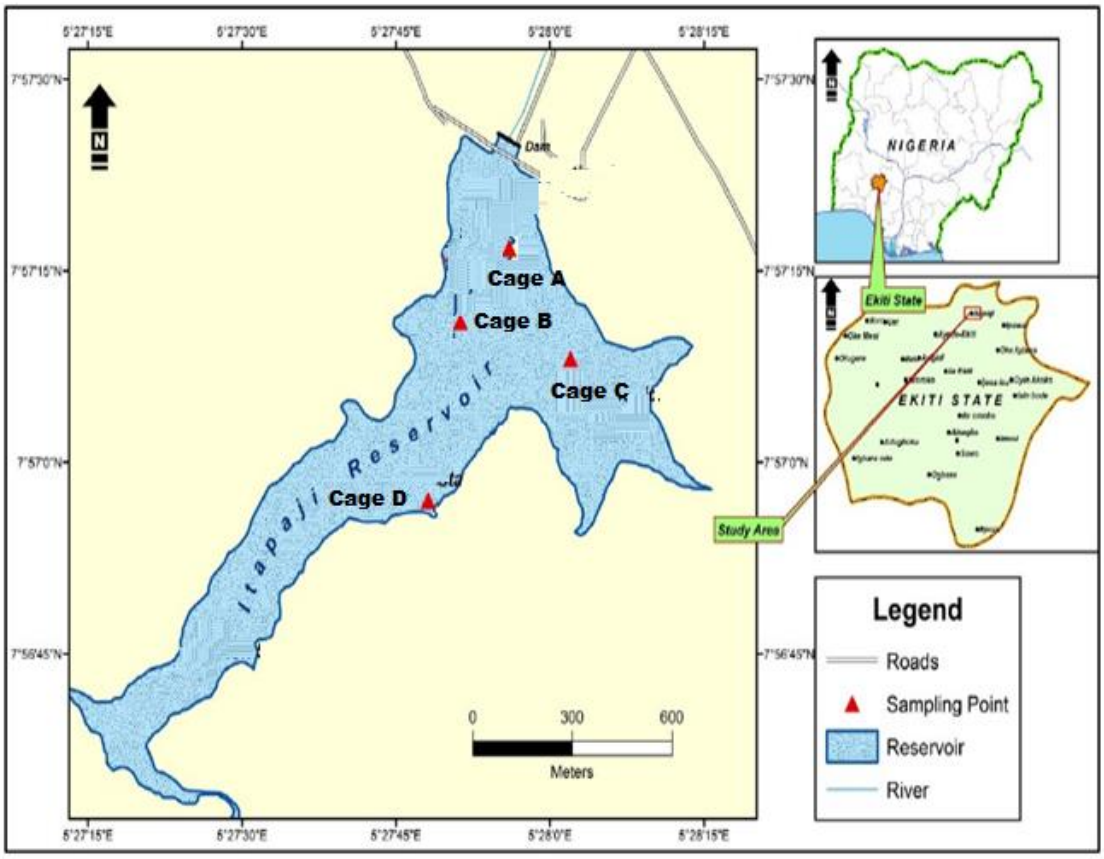

Figure 1: Map of the study area. Source: Adapted from Adebayo & Ayoade (2019).

Zooplankton Identification

Water samples from each point and period were divided into sub-samples using a 1mL Hensen-Sample pipette and transferred to a Bogorov chamber (KR20090070184A) for identification. The abundance of zooplankton before fish stocking in the cage, during culture, and before harvesting of fish species from the cage was noted to observe the variations in the reservoir. The individuals were examined under an inverted microscope at a magnification of x40 and x100 as described by Harris et al., (2000) while counting and taxonomic identification were done using a Sedgewick Rafter Cell under an inverted electron microscope (Conway et al., 2003; Kyewalyanga & Malesa 2024).

Water Quality Parameters

Water samples collected per point and period were measured for Dissolved Oxygen (DO), pH, temperature, phosphate, and nitrate. DO and pH were measured *in situ* using a CTD multi-probe (Sea-Bird Electronics, Model 19-03), and phosphate was measured in the laboratory as described by APHA (1998). Temperature and nitrate were measured using a mercury-in-glass thermometer and nitrate test kit manufactured by MARS Fish Care, USA respectively.

Data Analysis

One-way Analysis of variance was used to compare mean values of zooplankton abundance and follow-up tests were done with the Least Square Design (LSD) analytical procedure. The dominant taxa and correlation matrix of zooplankton taxa between stations were determined by Principal Component Analysis (PCA). All statistical analysis was at $P<0.05$ using Minitab (Version 21).

RESULTS

Zooplankton Distribution

The relative composition of zooplankton identified is outlined in Table 1. A total of 13,912 individuals were identified belonging to 9 species, which comprised of 49.7% (BS), 26.9% (DC) and 23.4% (BH). Cage A recorded the highest value of 39.3% while the least was recorded in Cage C (17.4%). Paramecium had the highest relative abundance (25.2%), while the least species identified was *Chilomona* (0.9%). The protozoan group was the most abundant (70.9%) while the crustacean (13.9%) was the least abundant species identified (Table 2).

Protozoans (5 species), Rotifers (1 species) and Crustaceans (1 species) were detected during fish culture. Across the cages, cage D recorded the most abundant (47.0%) while the least was in cage B (8.8 %). In the PCA, the first PC accounted for 70.4% of the total variance and the coefficients listed under the PC1 showed how to calculate the principal component scores. In the PC1, negative values were observed with Euglena (-0.663), and *Rotaria* (-0.013) while positive values were with *Chilodonella* (0.026), *Coelps* (0.276) and *Cypridosis* (0.094) (Table 4, Figure 3).

In the PCA, the first principal component accounted for 76.4% of the total variance and the coefficients listed under the PC1 showed how to calculate the principal component scores. In the PC1, a negative value was observed with Paramecium (-0.922) and positive with *Frontonia* (0.311) and *Rotaria* (0.230) (Table 3, Figure 2).

Table 1: Zooplankton abundance identified during the study period.

ZOOPLANKTON	Cage A	Cage A (%)	Cage B	Cage B (%)	Cage C	Cage C (%)	Cage D	Cage D (%)	Total	Total (%)	TOTAL (BS + DC + BH)	TOTAL [%] (BS + DC + BH)
BEFORE STOCKING (BS)												
Paramecium (Protozoan)	2150	63.6	ND	ND	ND	ND	1350	100	3500	50.6		
Frontonia (Protozoan	1232	36.43	932	100	750	60	ND	ND	2914	42.1		
Rotaria (Rotifers)	ND	ND	ND	ND	500	40	ND	ND	500	7.2		
Total	3382	100.0	932	100	1250	100	1350	100	6914	100.0	6914	49.7
Relative abundance (%)	48.9		13.5		18.1		19.5		100.0			
DURING CULTURE (DC)												
Chilodonella (protozoan)	521	52.5	ND	ND	ND	ND	ND	ND	521	8.8		
Euglena (Protozoans)	346	34.8	ND	ND	ND	ND	714	48.5	1060	32.3		
Coleps (Protozoans)	ND	ND	ND	ND	423	100	ND	ND	423	17.6		
Vorticella (Protozoans)	ND	ND	ND	ND	ND	ND	546	37.1	546	23.5		
Rotaria (Rotifers)	126	12.7	ND	ND	ND	ND	211	14.3	337	4.4		
Cypridopsis (Crustacean)	ND	ND	850	100	ND	ND	ND	ND	850	8.8		
Total	993	100.0	850	100	423	100	1471	100.0	3737	100	3737	26.9
Relative abundance	26.6		22.7		11.3		39.4		100			
BEFORE HARVESTING (BH)												
Euglena (Protozoan)	252	23.1	ND	ND	193	26.0	ND	ND	445	13.6		
Chilomona (Protozoan)	121	11.1	ND	ND	ND	ND	ND	ND	121	3.7		
Frontonia (Protozoan)	ND	ND	ND	ND	18	2.4	ND	ND	18	0.6		

Coleps (Protozoans)	ND	ND	ND	ND	321	43.2	ND	ND	321	9.8		
Rotaria (Rotifers)	453	41.5	826	64.8	ND	ND	ND	ND	1,279	39.2		
Cypridopsis (Crustacean)	265	24.3	449	35.2	211	28.4	152	100	1077	33.0		
Total	1,091	100.0	1275	100	743	100	152	100	3261	100	3261	23.4
Relative total (%)	33.5		39.1		22.8		4.7		100			
TOTAL (CAGES)	5,466		3,057		2,416		2,973		13,912		13912	100
TOTAL [%] (CAGES)	39.3		21.97		17.4		21.4		100			

*ND stands for Not Detected

Table 2: Taxonomic groups and species of zooplankton identified during the study.

Protozoan			Crustacean			Rotifers			**Total**
Genera	Abundance	Relative abundance (%)	Genera	Abundance	Relative abundance (%)	Genera	Abundance	Relative abundance (%)	
Chilodonella	521	5.3	Cypridopsis	1927	100	Rotaria	2,116	100	
Chilomona	121	1.2							
Coleps	744	7.5							
Euglena	1505	15.2							
Frontonia	2932	29.7							
Paramecium	3500	35.5							
Vorticella	546	5.5							
Total	9869	100		1927	100		2,116	100	13,912
Total (%)	70.9			13.9			15.2		100

Table 3: Principal Component Analysis (Engen) of Covariance Matrix of zooplankton Before stocking

Variable	PC1	PC2	PC3
Paramecium	-0.922	-0.386	0.008
Frontonia	0.311	-0.753	-0.580
Rotaria	0.230	-0.532	0.815
Engen Value	397809	105587	17437
Proportion	0.764	0.203	0.033
Cumulative	0.764	0.967	1.000

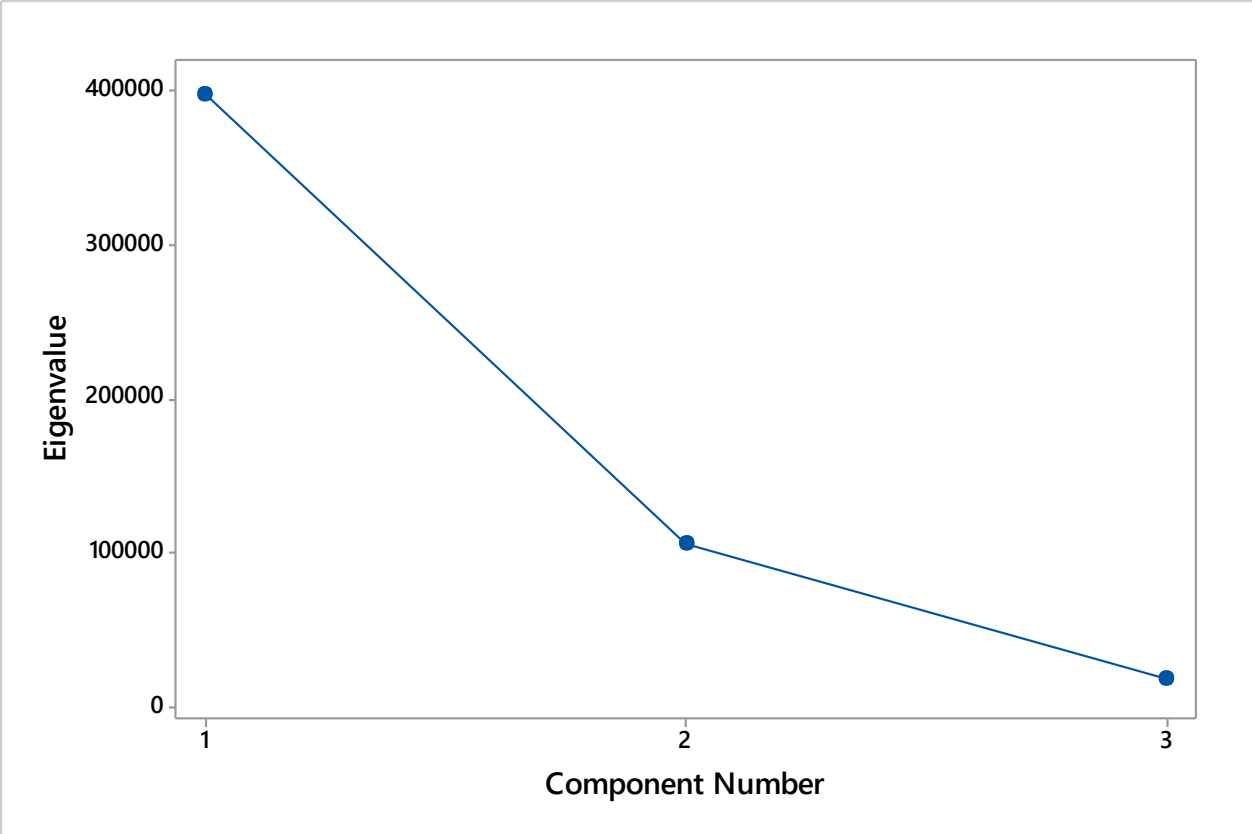

Figure 2: Scree Plot for zooplankton detected before stocking.

Table 4: Principal Component Analysis (Engen) of Covariance Matrix of zooplankton during culture

Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Chilodonella	0.026	-0.310	0.549	0.305	0.555	-0.440	-0.082
Euglena	-0.663	-0.010	0.305	0.280	-0.586	-0.207	0.054
Coelps	0.276	0.845	0.241	0.076	-0.085	-0.289	-0.234
Vorticella	-0.689	0.300	-0.245	-0.223	0.522	-0.010	-0.230
Rotaria	0.013	-0.156	0.277	0.009	-0.108	0.478	-0.812
Cypridosis	0.094	-0.025	-0.578	0.153	-0.169	-0.579	-0.469
Engen Value	218094	61627	31621	0	-0	-0	-0
Proportion	0.700	0.198	0.102	0.000	-0.000	-0.000	-0.000
Cumulative	0.700	0.898	1.000	1.000	1.000	1.000	1.000

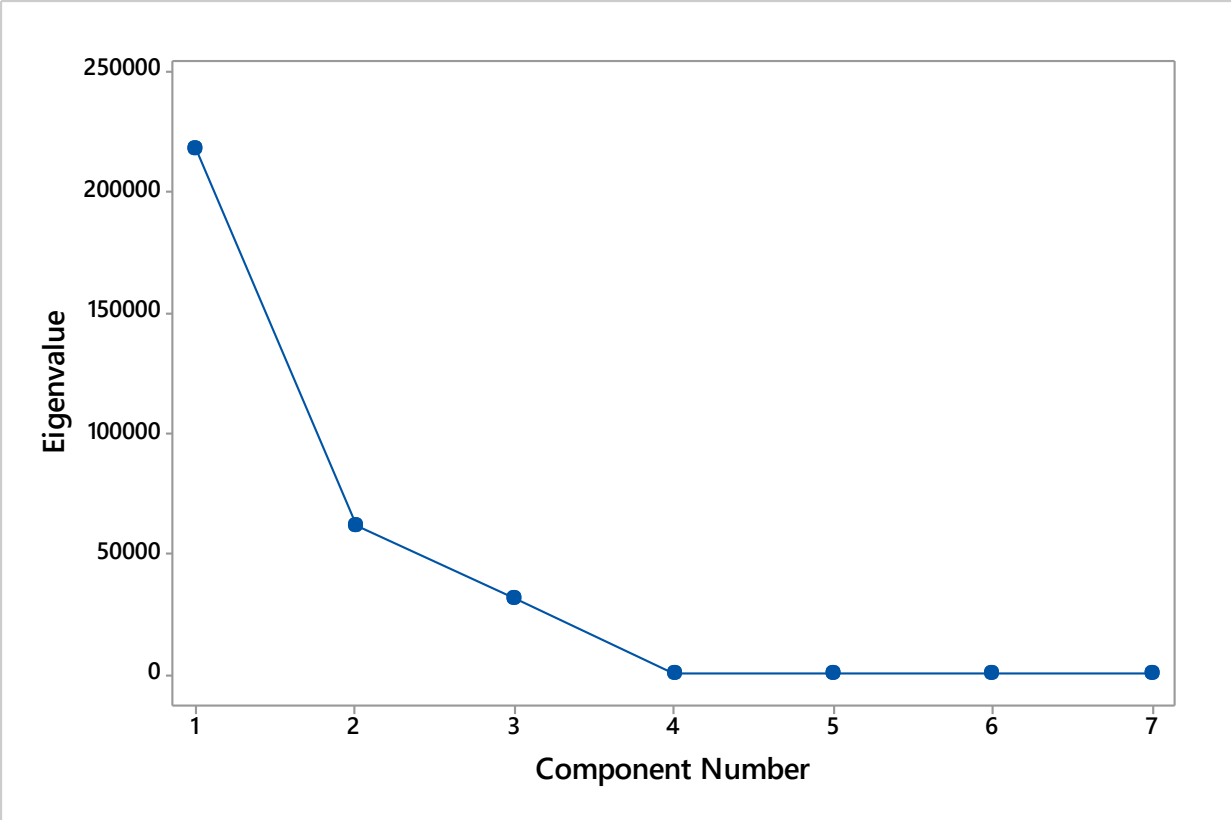

Figure 3: Screen plot for zooplankton identified during stocking.

Eight species comprising Protozoan (6 species), Rotifers (1 species), and Crustacean (1 species) were detected before harvesting of fish. In cage A, five were *Rotaria* species (38.8%), and the least was *Chilomonas*. In cage B, only *Rotaria* species (64.8%) and *Cypridopsis* (32.5%) were identified. In cage C, five out of the eight species were detected with *Coleps* being the most abundant (42.1%) and the least identified species being Euglena (7.7%). In Cage D, only *Cypridosis* (100%) was identified. Across the cages, cage C had recorded the most abundant (42.9%) while the least was in the control (2%).

In the PCA, the first PC accounted for 67.3% of the total variance. In the PC1, negative values were observed with Euglena (-0.098), *Chilidonella* (0.078) and *Rotaria* (-0.519) while positive values were with *Frontonia* (0.275), *Coelps* (0.753) and *Cypridosis* (0.183) (Table 5, Figure 4).

Water Quality Parameters

The water parameters measured from the reservoir are presented in Table 6. Before stocking in Cage A, overall mean of DO (5.30 ± 0.30mg/L); Temperature 28.45 ± 0.1^0C; pH (6.20 ± 0.01); Phosphate (0.21 ± 0.00mg/L). The concentration of Nitrate measured was the same across the cages with mean values of 0.001 ± 0.00mg/L. During fish culture, the DO overall mean (3.72 ± 0.13mg/L); Temperature (27.30 ± 0.12^0C); pH (6.05 ± 0.10); phosphate (0.17 ± 0.02mg/L) and nitrate (0.001 ± 0.00mg/L). Before harvesting, the mean value for parameters was DO (3.40 ± 0.11mg/L); Temperature (27.09 ± 0.10^0C); pH (5.73 ± 0.10); Phosphate (0.12 ± 0.01mg/L) while Nitrate was (0.001 ± 0.00mg/L).

Table 5: Principal Component Analysis (Engen) of Covariance Matrix of zooplankton before harvesting.

Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Euglena	-0.098	-0.535	0.723	-0.055	-0.399	-0.000	0.125	-0.059
Chilomona	-0.078	-0.156	0.248	0.035	0.500	-0.707	-0.204	0.074
Frontonia	0.275	-0.132	-0.044	-0.193	0.316	-0.000	0.871	0.098
Coleps	0.753	-0.362	-0.120	0.369	-0.082	0.000	-0.222	0.309
Rotaria	-0.519	-0.608	-0.513	0.282	-0.007	-0.000	-.101	0.090
Cypridopsis	0.183	-0.373	-0.272	-0.783	0.020	0.000	-0.281	-0.249
Engen Value	751761	310471	55145	0	0	-0	-0	-0
Proportion	0.673	0.278	0.049	0.000	0.000	-0.000	-0.000	-0.000
Cumulative	0.673	0.951	1.000	1.000	1.000	1.000	1.000	1,000

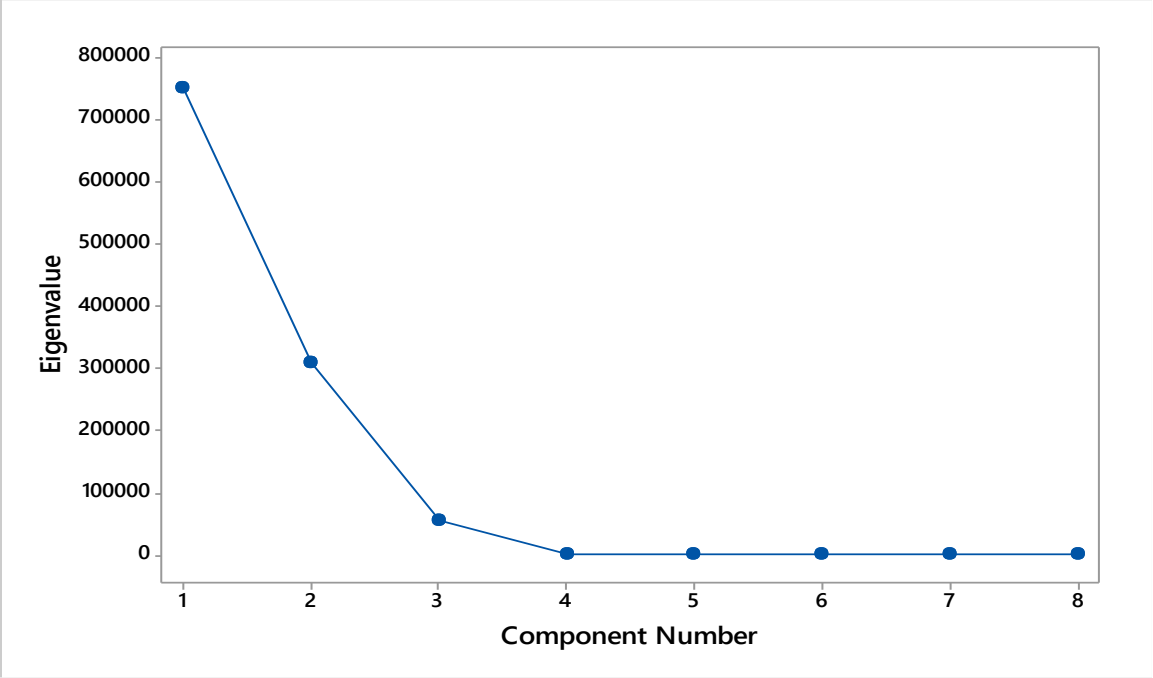

Figure 4: Scree plot for zooplankton identified before harvesting.

Table 6: Mean values and standard error of the mean of water quality parameters measured.

Parameters	Cage A	Cage B	Cage C	Cage D (control)	Mean values	Recommended levels
BS						
DO (mg/L)	5.30 ± *0.30*	4.8 ± *0.30*	4.30 ± *0.2*	4.50 ± *0.10*	4.73 ± *0.34*	5[a]
Temp (^{0}C)	28.14 ± 0.22	27.93 ± 0.12	29.37 ± 0.18	27.14 ± 0.1	28.45 ± 0.1	25 – 32[b]
pH	6.20 ± *0.01*	6.17 ± *0.04*	6.16 ± *0.06*	6.11 ± *0.01*	6.19 ± *0.12*	5-9[c]
Phosphate(mg/L)	0.21 ± *0.01*	0.21 ± *0.00*	0.20 ± *0.01*	0.21 ± *0.00*	0.21 ± *0.01*	1 – 3[d]
Nitrate (mg/L)	0.001 ± *0.00*	0.001 ± *0.00*	0.001 ± *0.00*	0.001 ± *0.00*	0.001 ± *0.00*	<100[e]
DC						
DO (mg/L)	3.30 ± *0.20*	3.30 ± *0.10*	4.20 ± *0.10*	4.10 ± *0.10*	3.72 ± *0.13*	5[a]
Temp (^{0}C)	26.90 ± 0.04	27.27 ± 0.02	27.63 ± 0.21	27.10 ± 0.17	27.30 ± 0.12	25 – 32[b]
pH	5.20 ± *0.10*	6.20 ± *0.10*	6.30 ± *0.10*	6.50 ± *0.10*	6.05 ± *0.10*	5-9[c]
Phosphate(mg/L)	0.17 ± *0.05*	0.14 ± *0.01*	0.16 ± *0.02*	0.19 ± *0.01*	*0.17* ± *0.02*	1 – 3[d]
Nitrate (mg/L)	0.001 ± *0.00*	0.001 ± *0.00*	0.001 ± *0.00*	0.001 ± *0.00*	*0.001* ± *0.00*	<100[e]
BH						
DO (mg/L)	2.90 ± *0.10*	3.65 ± *0.15*	3.20 ± *0.10*	3.90 ± *0.100*	*3.40* ± *0.11*	5[a]
Temp (^{0}C)	26.09 ± 0.34	27.64 ± 0.10	29.01 ± 0.10	27.09 ± 0.10	27.09 ± 0.10	25 – 32[b]
pH	5.90 ± *0.10*	5.40 ± *0.10*	5.30 ± *0.10*	6.30 ± *0.10*	*5.73* ± *0.10*	5-9[c]
Phosphate(mg/L)	0.12 ± *0.01*	0.09 ± *0.01*	0.13 ± *0.01*	0.13 ± *0.01*	*0.12* ± *0.01*	1 – 3[d]
Nitrate (mg/L)	0.001 ± *0.00*	0.001 ± *0.00*	0.001 ± *0.00*	0.001 ± *0.00*	*0.001* ± *0.00*	<100[e]

DO – Dissolved oxygen, TDS – Total Dissolved Solids, Temp – Temperature, [a - e] Bhatnager and Devi (2013)

DISCUSSION

Zooplankton abundance

The abundance of zooplankton in an aquatic system is a function of the prevailing fertility of water and can be a source of food for fin and shellfish. (Ayodele & Adeniyi, 2006; Bagheri et al., 2013). Protozoans were observed to be the most abundant with 9 species across the sampling periods with no significant difference ($P<0.05$) between the species abundance in Cages A, B, C, and D. The result deviated from the findings by Adebayo & Ayoade (2019) who reported a dominance of rotifers in Itapaji reservoir. The presence of rotifers in aquatic systems is a characteristic of eutrophic systems (Dumont, 1983 cited in Adebayo & Ayoade, 2019) and their abundance in the reservoir was quite high but not dominant as reported by Mustapha & Omotosho (2006) and Ayodele & Adeniyi (2006) in Moro Lake and River Osun respectively. The increased abundance before harvest indicated that the water was eutrophic and was the most abundant during this period as corroborated by Kashindye et al., (2015) in Lake Victoria.

The estimates of numerical abundance of zooplankton species indicated higher values before stocking fish when compared with abundance during fish culture and before harvesting. This is possible because zooplankton serves as a direct source of food for fish (Ayodele & Adeniyi, 2006), and their abundance will be highest before the introduction of fish into the cage as observed in the Capsian sea (Bagheri et al., 2014). Similarly, the water quality parameters before stocking most especially the dissolved oxygen and phosphate concentrations were higher than the concentrations DC and BH. In the other two periods i.e., during culture and before harvesting, the fish species were already stocked in the cages, and they will naturally feed on zooplankton to supplement the artificial feed given to them.

In the PCA before stocking, the PC1 showed a positive correlation with *Frontonia* and *Rotariar* species and it implied that increasing the abundance of these species will increase the first principal component. The PC2 showed a negative correlation with zooplankton abundance which implied that increasing the abundance of these species will reduce the principal component. The PC3 showed a positive correlation with *Frontonia* species which implied that increasing the abundance of the species will increase the principal component. The three principal components (PC1 – 3) explain 100% of the variation in zooplankton abundance and can be used to analyze the abundance of zooplankton before stocking. During culture, the PCA showed a covariance of 70.4%, and the first three principal components (PC1 – 3) can be used to analyze the abundance of zooplankton because they add up to 100%. The PC1 was positively related with *Chilodonella*, *Coelps*, *Rotariar*, *and Cyprodosis*; PC 2 was positively correlated with *Coelps*, *Vorticella*; PC3 was positively correlated with *Chilodonella*, Euglena, *Coelps*, and *Rotariar*. This implied that increasing the abundance of the species will increase the principal component during culture. Before harvesting, the PCA showed a covariance of 67.3% and the first three principal components (PC1 – 3) can be used to analyze the abundance of zooplankton because they add up to 100%. PC1 was positively correlated with *Frontonia, Coelps, Cyprodopsis*, and PC3 with *Euglena* and Chilomona. This implied that increasing the abundance of these positively related species will increase the principal component.

Water quality parameters

Water quality is important in zooplankton production and is the best predictor of the total abundance of zooplankton in aquatic systems. The effects of some water quality parameters on production can be direct or indirect (Bowszys et al. 2020). Dissolved oxygen is essential for the sustenance of aquatic organisms and the mean values measured were below the recommended levels of 5mg/L for aquatic life (Omeje, 2016), although the values in cage A were above the recommended limit. These levels of oxygen concentration were expected because the oxygen demand increases with an increase in biological activities; at this point, fish had not been stocked into the cage. These results explain that the oxygen content in an aquatic system is a function of the abundance of biological life present and was corroborated by Iyiola and Jenyo-Oni (2023), and Bowszyz et al. 2020).

The temperature ranged between 26.90 - 29.05 and there was no significant difference in the temperature of all the stations. These findings were like the report of Ogamba et al., (2004) who attributed minimal variation in temperature between stations to the absence of microclimatic variations in temperature. pH describes the concentration of hydrogen ions in water and its concentration is a function of carbon dioxide which is acidic (Dimowo, 2013). The mean values measured BS, DC and BH were within the recommended level of 5 – 9 by Omeje (2016). Phosphates are free in the aquatic environment and can be inorganic or inorganic forms. The mean values measured BS, DC, and BH were within the recommended levels of 1 – 3mg/L.

Nitrate occurs from Nitrogen and its concentration in water is always low except when the water receives runoff from agricultural lands, refuse dumps, and human or animal faeces (Adebayo & Ayoade, 2019). The levels measured from the study sites BC, DC, and BH were 0.001 ± 0.00mg/L respectively and were within the recommended level of <100mg/L. The results of the water quality parameter were

like the findings by Adebayo & Ayoade (2019) in Itapaji Reservoir.

CONCLUSION

Zooplankton serves as food for fish and the abundance of rotifers in the reservoir indicates that it is eutrophic. This was evident by the abundance of zooplankton identified in the reservoir. The zooplankton was highest before stocking and reduced during culture and before harvesting, because of the consumption of the zooplankton species by the stocked fish in the cages. The water quality before stocking was far better than the other periods because the presence of uneaten supplementary feed can degrade the water quality, and the decomposition of biomaterials may also be responsible for the new trend. There should be regular monitoring of the physicochemical parameters in future as there is an increase in anthropogenic activities around the area.

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