



## Evaluation of the Phytoplanktons Species Diversity, Distribution and Physicochemical Characteristics of Pindiga Pond in Gombe State of Nigeria

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**ABSTRACT:** Studies were conducted on the diversity, distribution and physicochemical characteristics of phytoplanktons of Pindiga Pond. Water and phytoplankton samples were collected for three months at ten (10) days interval. The objective of the present research is to determine the phytoplanktons distribution and physicochemical characteristics of the Pond. Standard procedures were adopted for determination of physicochemical parameters viz; Temperature, pH, Transparency, Conductivity, Nitrate, Phosphate, Dissolved oxygen (DO), Biological Oxygen Demand (BOD). These physicochemical characteristics were observed to have varied within the period of the study. Seventeen (17) genus, Thirteen (13) orders, four (4) classes, and four (4) division of phytoplankton were identified, and the class Bacillariophyceae (46 %) was the highest percentage recorded during the study, Chlorophyceae (32 %), Euglenophyceae (19 %) and Cyanophyceae (3%) the least in occurrence and distribution. The study also revealed that pindiga pond had luxuriant phytoplanktons flora, diverse and seasonal with fluctuating pattern of physicochemical characteristics recorded. The physicochemical characteristics were also within productive limit in Pindiga pond.

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Algae are chlorophyll bearing plants with a plant body showing no differentiation into true tissues. It never forms a root, stems and leaves and is thus called a thallus. The thallus is non-vascular and thus has no elements for the transport of fluid. Algae can afford this simplicity because with only a few exceptions they are water dwellers. Included organisms size ranges between 0.2um – 200um from unicellular genera, such as chlorella and the diatoms, to multicellular forms, such as the giant kelp, a large brown alga which may grow up to 60m in length. One definition is that algae have chlorophyll as their primary photosynthetic pigment and lack a sterile covering of cells around their reproductive cells (Lee, 1980). Microalgae, which cover almost 75% algae species, contribute approximately 40% of the oxygen in the atmosphere. Algae can grow in a wide variety of conditions from freshwater to extreme salinity. They are more efficient converters of solar energy than terrestrial plants (Hussain *et al.*, 2010). Phytoplanktons are the autotrophic components of the plankton community and a key part of oceans, seas and fresh water ecosystem. They are the initial biological components from which the energy is transferred to higher organisms through food chain (Tiwari and Chauhan, 2006 and Saifullah *et al.*, 2014). The name comes from Greek word (phyton) meaning plant and

(planktons) meaning wanderer or drifter. Most Phytoplanktons are too small to be seen with unaided eye. However, when present in numbers, some varieties may be noticeable as coloured patches on the water surface due to the presence of chlorophyll within their cell walls and accessory pigments (such as xanthophylls) in some species. Phytoplanktons are photosynthesizing microscopic organisms that inhabit the upper layer of almost all oceans and bodies of fresh water on earth. Phytoplankton obtain energy through the process of photosynthesis and must therefore live in the well-lit surface layer (term the euphotic zone) of an ocean, sea, lake, or other water body. The objective of this paper is to evaluate the phytoplanktons species diversity, distribution and physicochemical characteristics of Pindiga pond in Gombe State of Nigeria

### MATERIALS AND METHOD

**Study site:** The study area is located at Akko local government area (Pindiga town), Gombe state, Northeastern, Nigeria. Pindiga pond lies on latitude 9.9°N and longitude 10.9°E. The area is accessible by roads and a network of footpaths. The major road to the main town is the Gombe - Kashere, and the road junction along Gombe - Yola main road. Pindiga pond is located along Pindiga-Gombe road opposite cottage

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hospital Pindiga and was dug by the then Bauchi state government and was rehabilitated twice. The water channels are from the hills and the drainages in the town.

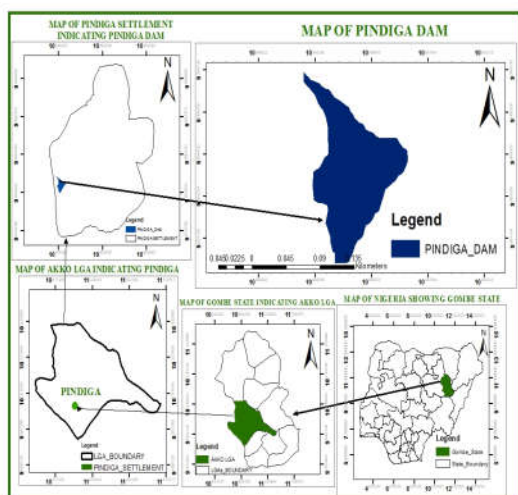


Fig 1: Map of Pindiga Pond Showing Study Site

**Collection of Water Sample for Physicochemical Characteristics and Phytoplanktons:** Water samples for Phytoplanktons were collected using plankton net of 55 $\mu$ m mesh size. Plankton samples were then transferred to a screw capped properly labeled plastic container. Samplings were carried out between 07.00 - 8.00 A.M hours on each sampling day. Samples for phytoplankton were preserved in 4% formalin and 2% lugol iodine and then transported to the laboratory for microscopy (Zaky, 2015).

**Centrifugation and Preservation:** With the help of an electrical centrifuge collected water sample were centrifuged for 20 minutes at 1500 rpm. The supernatant water was removed by decanting. The planktons were preserved by adding a few drops of 4% formalin and/or 2% Lugol's solution.

**Microscopy:** Preserved and centrifuged phytoplankton samples were dropped on a clean and dry glass slide mounted on the microscope using pipette and viewed with the help of objective lens of x4, x10, and x40.

**Identification of Algae:** Identification was carried out with the aid of a binocular microscope, reference of the identification was made to the Manual and atlas of (Kadiri, 1996), (Needham and Needham, 1975), (Palmer 1980).

**Cell Counting:** The glass slide mounted with a drop of phytoplankton sample and covered with cover slip is

placed under the microscope provided with a mechanical stage. The planktons are then counted from the microscopic field of the left top corner of the slide. Then slide is moved horizontally along the right side and plankton in each microscopic field is thus counted.

When first microscopic field row is finished the next consecutive row is adjusted using the mechanical device of the stage. In this way all the plankton present in entire microscopic field are counted (Verlencar and Desai, 2004).

**Determination of Physicochemical Characteristics:** Water temperature was measured using Mercury – in – glass thermometer; Conductivity was measured using DDSJ – 308 A model of conductivity meter, pH was determine using pH meter, while (BOD track test method) was adopted in the determination of biological oxygen demand, Indigo carmine method was used to determine the concentration of dissolved oxygen according to Gilbert *et al.*, 1982). Transparency was determined using a standard secchi disc according to (Agaoru, 2012). Phosphate and nitrate were determined using portable data logging spectrophotometer Hach DR/2010.

**Statistical Analysis:** This was carried out using SPSS version 20, one way ANOVA was used to determine the variation of physicochemical characteristics.

## RESULT AND DISCUSSION

Pindiga pond is a lentic water exhibiting luxuriant growth of macrophytes and phytoplankton which are used in environmental monitoring and water quality assessment. The phytoplankton recorded were grouped in to four (4) divisions, Bacillariophyta (46 %), Chlorophyta (32 %), Euglenophyta (19 %) and Cyanophyta (3 %), four (4) class, thirteen (13) orders, and a total of seventeen (17) genus, as shown in the table 1, 2, 4 and 4 respectively. The phytoplanktons recorded in this study were similar to the species found in other Nigerian lakes, Dams and other freshwater bodies. The physico-chemical characteristics, phytoplankton distribution, in Pindiga pond fell within the productive values for aquatic ecosystem and indicated that the pond is eutrophic. The study also revealed the interaction between phytoplankton and abiotic factors in an example of a natural tropical freshwater habitat. The phytoplankton present in this report belonged to the different orders of the class Bacillariophyceae, Chlorophyceae, Cyanophyceae, and Euglenophyceae. The major factors in water quality affected by pollution are dissolved oxygen and concentration of (pH). Depletion of dissolved oxygen value arises from bacterial degradation of the organic

constituents utilizing oxygen. In Pindiga pond dissolved oxygen values recorded were low in station A and B at the onset of the raining season, this could be due to the turbidity and lots of organic matter introduced into the water. The subsequent increase in dissolved oxygen values in the latter part of the wet season could be due to the role played by aquatic plants like increasing the oxygen levels in the water. These findings are similar to that of (Olawusi-Peter, 2008). The dissolved oxygen content of water results from the photosynthetic and respiratory activities of the biota in

the open waters, the significant decrease in dissolved oxygen content during the dry season in Pindiga pond is probably as a result of high organic load of the water mainly in the form of leaf litter whose decomposition increases the oxygen depletion while the increase in dissolved oxygen content in rainy season would be due to the increased aeration during rainfall and increased wind speed experienced in that period. The seasonal pattern of the dissolved oxygen content is similar to the previous findings of Echi *et al.* (2009).

**Table 1:** Mean variation of physicochemical characteristics of Pindiga Pond March – June 2017

Months	Temp (°C)	pH	Trans (cm)	Cond (µS/cm)	NO <sub>3</sub> <sup>-</sup> (mg/L)	PO <sub>4</sub> <sup>3-</sup> (mg/L)	D.O (mg/L)	B.O.D (mg/L)
April	25.70	7.20	17.30	3076.70	29.40	0.38	5.30	24.70
	26.70	7.36	17.70	3123.30	8.10	0.38	4.90	20.70
	25.30	7.40	18.30	3226.70	7.30	0.34	5.00	20.30
May	24.30	7.40	19.70	3226.70	10.20	1.13	7.40	44.00
	25.30	7.30	18.00	3056.70	8.80	0.92	5.70	35.00
	25.30	7.30	15.30	2213.30	9.20	0.96	5.80	34.00
June	25.30	7.20	13.70	1504.00	16.60	1.18	5.70	9.10
	25.00	7.00	11.70	1494.70	17.10	1.28	6.10	9.80
	24.70	7.00	11.00	1458.00	18.60	1.41	6.20	9.30

Key: Temp = Temperature, Trans = Transparency, Cond = Conductivity, NO<sub>3</sub><sup>-</sup> = Nitrate, PO<sub>4</sub><sup>3-</sup> = Phosphate, D.O = Dissolved oxygen, and B.O.D = Biological oxygen demand.

**Table 2:** Species of Phytoplanktons Identified in Pindiga pond March – June 2017

DIVISION	CLASS	ORDER	GENUS
Bacillariophyta	Bacillariophyceae	Stephanodiscales	<i>Cyclotella spp</i>
		Fragilariales	<i>Synedra spp</i>
		Naviculales	<i>Navicula spp</i>
		Pennales	<i>Flagilaria spp</i>
		Tabellariales	<i>Diatoma spp</i>
Chlorophyta	Chlorophyceae	Incertae	<i>Botryococcus spp</i>
		Volvocales	<i>Chlamydomonas spp</i>
			<i>Volvox spp</i>
		Chlorococcales	<i>Golenkinia spp</i>
		Chlorolalles	<i>Chlorella spp</i>
		Zygnematales	<i>Spirogyra spp</i>
Cyanophyta	Cyanophyceae	Nostocales	<i>Closterium spp</i>
			<i>Anabaena spp</i>
			<i>Nodularia spp</i>
Euglenophyta	Euglenophyceae	Spirinales	<i>Spirulina spp</i>
		Euglenales	<i>Phacus spp</i>
			<i>Euglena spp</i>

There was a negative correlation of dissolved oxygen and temperature which agreed with (Agaoru, 2012), and (Ekwoye, 1995) that increase in water temperature reduces the dissolved oxygen content as a result of increase dissolved oxygen demand of aquatic organisms which is caused by high metabolic activities. In Pindiga pond, there were fluctuations in the surface water temperature and transparency values. During the dry season, there is higher transparency in Pindiga pond as compared to the onset of the rainy season. As water level decrease, surface water temperature and transparency increased, such increase could be due to relative stability of the water and the high rate of evaporation, (Ezra, 2000). Transparency

was higher in the dry than the wet season. This may be linked to the effect of rainfall. (Ezra and Nwankwo, 2001) are of the view that a low transparency in the Gubi reservoir is as a result of silt particles brought in by floodwaters. The pH of most natural waters falls in the range of 6.0 to 8.0. The range of pH (6.9 to 7.4) obtained in this research was adequate for aquatic life. pH range of 5.50 to 9.50 (Avoaja, 2005) is suitable for aquatic production, similar range of pH was recorded by Attama (2003) and Odo (2004). There was marked seasonality in the pH with 7.4 (dry season) and 6.9 (rainy season) which was in common with a general trend noted by (Avoaja, 2004) that there is usually a dry season rise and flood season fall in pH of African

freshwaters. The maximum nitrate concentration of 67.5 mg/L at the month of April in station C was higher than most other freshwaters in Nigeria, although unusual; this could be due to dry season increase due to nitrate enrichment from previous rainy season. Nitrate concentration of 4.41 mg/L in Anambara River (Odo, 2004), was contrary to the present findings. There was increase in nitrate at the onset of rainy season in Pindiga pond, this could be as a result of enrichment of the water by nitrate ions during flood water which was equally noted by Davies *et al.* (2009) but on the other hand it was not in line with the findings of Odo (2004) where there was a dry season increase due to nitrate enrichment from previous rainy season. In Pindiga pond, the Biological Oxygen Demand recorded highest value was 44.00 mg/l. The higher Biological Oxygen Demand recorded could be as a result of organic materials like wood and debris. This could also be due to woody area of the pond, therefore organic matter decay process used up the dissolved oxygen, thus resulting in lower dissolved Oxygen content and high biological oxygen demand. Obioha (1984), (Ojutiku *et al.*, 2016) and (Magami *et al.*, 2015) observed similar effects in Eleyele reservoir in Ibadan, Agaie – Lapai Dam in Niger and Kware lake in Sokoto, Nigeria respectively. The range of Biological Oxygen Demand was found to be from 12.9 mg/l to 40 mg/l.

**Table 3:** Phytoplankton cell counts in pindiga pond water samples of stations A, B, and C, March – June 2017

Class	Order	A	B	C
Bacillariophyceae	Fragilariiales	+	-	+
	Naviculales	-	+	+
	Pennales	+	+	+
	Tabellariales	+	+	+
	Stephanodiscales	+	+	+
Chlorophyceae	Incertae	-	-	+
	Volvocales	+	+	+
	Chlorococcales	+	+	+
	Zygnematales	+	+	+
	Chlorollales	+	+	+
Cyanophyceae	Nostocales	+	+	-
	Spirinales	+	+	+
Euglenophyceae	Euglenales	+	+	+

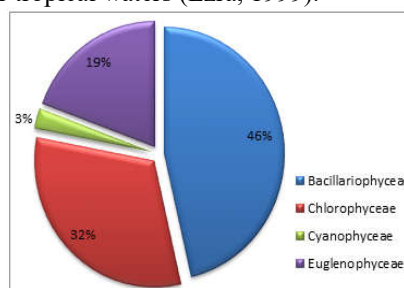
Key: + = Present, and - = Absent

**Table 4:** Relative abundance of cell counts in pindiga pond water samples of station (A, B, and C) March – June 2017

Phytoplankton group	Station A (Cells/)	Station B (Cells/)	Station C (Cells/)	Mean (Cells/)
Bacillariophyceae	272	287	287	282
Chlorophyceae	177	203	195	192
Cyanophyceae	16	19	13	16
Euglenophyceae	117	124	113	118
Total no.of cells	582	633	608	608

The observed seasonal variation and distribution of the phytoplankton may be a reflection of the changing water environmental conditions. Euglenophyta were

observed in the three study stations as indicator of relatively pollution level of the water bodies. Cyanophyta occurrence is a suggestion of eutrophication which result in negative effect on the water quality, Similar observations were made by (Zaky, 2015). A total of 17 phytoplankton species were recorded in this study. This diversity was higher in the dry season than the wet. Bacillariophyceae were the more abundant group among the phytoplankton recorded in pindiga pond within the period of study. The quantitative dominance of bacillariophyceae is worthy of note because they have been known to be indicators of water quality and environmental conditions, similar findings were noted by (Kelly, 1998 and Onyema, 2013), and it was also discovered in other tropical waters (Ezra, 1999).



**Fig 1:** Percentage abundance of algal cell base on Taxa of Pindiga Pond

**Conclusion:** From the results obtained, it can be concluded that the physico-chemical characteristics were within productive limit in Pindiga pond,also revealed a fluctuating pattern of the values recorded ,and abundant phytoplanktons in the pond,and they occurred within four (4) divisions, diverse and seasonal.A baseline information on the species of phytoplanktons and physico – chemical characteristics of pindiga pond has been established.

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