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The Relative Abundance, Distribution and Species Diversity of Phytoplanktons in Kanye Dam in Kano, North western- Nigeria

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Abstract: *The abundance and distribution of phytoplankton algae of Kanye Reservoir was studied from Five (5) sampling sites for the period of five (5) Months and analysed for Physico - chemical attributes such as Temperature, pH, Dissolved Oxygen, Biological Oxygen Demand; Nitrogen-Nitrate, Phosphorus-Phosphate and Electrical Conductivity using standard methods. Results showed that the physico- chemical characteristics recorded was that of a typical tropical region. The highest cell count(8.8×10^4)cells/ml was recorded in Site 'E', followed by site 'A' (6.4×10^4 cells/ml), the least was recorded in site 'C' (8.3×10^3cells/ml) Physico-chemical attribute did not vary significantly among the sites. Four (4) Classes of Algae were identified which was dominated by Chlorophyta 23(46%), followed by Baccilariophyta 20,(40%), Cyanophyceae 5,(10%) with poor representation of the Harmful types by three (3) species namely: Microcystis aeruginosa, Oscillatoria princeps and Anabaena circinalis with a total cell count (9.6×10^3 cells/ml) less than 2×10^4 Cells/ml, there was generally high number of algal cells observed during the wet season than in the dry season. However, Oscillatoria princeps was identified with the highest number of occurrence in both site 'B' and ''E' (4.9×10^3 cells/ml) followed by Microcystis aeruginosa and Anabaena cercinalis identified at site 'E' and 'A' (1.6×10^3cells/ml and the class with the least number of species was Euglenopyta 2, (4%). L. there was a positive significant correlation between algae and physicochemical attributes of the reservoir. The study showed that the reservoir is not polluted and the water is safe for domestic use since the number of harmful algal cells recorded is relatively low which is within the WHO standard for safe water*

Keywords: *Planktonic, Kanye, Tropical, Reservoir, Polluted, Harmful, WHO, Cyanophyceae.*

I. Introduction

Water reservoirs and Dams are major water resources, which are very diverse both in terms of size and fisheries potential. The relationship between the physico-chemical parameters and Phytoplankton production of water bodies are of great importance in management strategies of aquatic ecosystems. Reserviour and ponds are often used for domestic and agricultural purposes therefore the quality of the water may be described according to their physico-chemical and phytoplankton characteristics. Phytoplankton, because of their role as primary producers in an aquatic ecosystem are the subject of great interest and their qualitative and quantitative estimates can provide good indices of quality and productive capacity of water in tropical reservoirs, though some species on the other hand can be harmful to human and animals by releasing toxic substances (hepatotoxins or neurotoxin etc) into the water (Sigee 2004) Phytoplankton are recognised worldwide as bioindicators organisms in the aquatic environment (Underwood, *et al.*,1999)

II. Materials and Methods

Study Area

Kanye Dam is located in the Sudan savanna zone of Northern Nigeria on latitude 11°57'N and longitude 8°.1'E with two distinct seasons (wet and dry). The rainy season lasts from May to October while the dry season lasts from November to April. Kanye Dam is approximately 50 km away from Kano, along Kano-Gwarzo road in Kabo Local Government Area of Kano State, and about 11.25 km from Kabo town. It has an area of 11.31km^2. It was constructed in 1969 and commissioned in 1970. The dam was constructed for agricultural purposes (such as irrigation, fisheries, forestation), domestic uses and to control flooding. The Dam has a total storage capacity of 24.60 million cubic meters, active storage capacity of 21.53 million cubic meters and dead storage capacity of about 3.07 million cubic meters (RSMP, 1982). It has two major sources these are river Guzu-Guzu and river Kanyan maja.

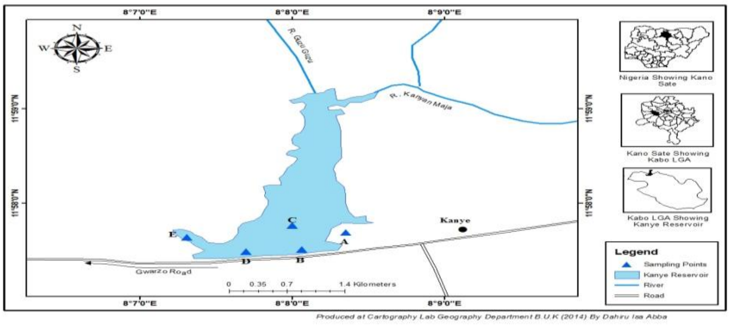


Figure 1: Map of Kano Showing the Study Area and Sampling Sites

Sampling sites

The sampling site was divided in (5) sampling locations namely: sites A, B, C, D and E they were selected based on intensity/type of anthropogenic activities. GPS 12 model (GRAMIN, USA) was used in taking the global position of the sites as follows:

Site A: This is an enclosure that is directly linked with the dam about 30m to the inshore of the dam. At this site human activities like farming, washing ,bathing, were taking place and is located at Lat 11° 57' 32.02" N and Long 8°08' 25.13"E.

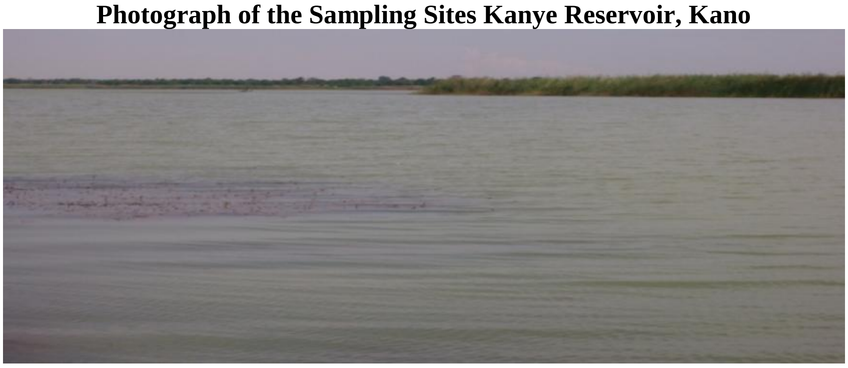
Site B: Point B is the inshore of the Dam. Washing, bathing, Irrigation and fishing were taking place at the site and is located at Lat 11° 57' 31.79"N and Long 8° 08' 21.59"E.

Site C: This is the midshore of the Dam, it is the middle of dam, only fishing was found to be taking place at the site, it is considered to be deepest part of the dam. And is located at Lat 11° 57' 31.09"N and Long 8° 08' 07.93"E.

Site D: Site D is the outlet of the dam, where water is taken to the treatment plant through a pipe, human activities like bathing also take place at the site. It is located at Lat 11° 57' 28.33"N and Long 8° 08' 07.91"E.

Site E: This is the offshore of the Dam where fishing, huge agricultural/farming activities were taking place; this is where possibly the water and other algal communities may be influenced by the chemical substances from surface runoff. Washing and bathing are frequent at this sampling site. It is located at Lat 11° 57' 23.74"N, and Long 08° 07' 22.02"E.

Photograph of the Sampling Sites Kanye Reservoir, Kano



Figbure 2: A general view of the Kanye Dam

Figure 3: Kanye Dam showing the rocky bank where anthropogenic activities take Place

Collection of Water Samples

All surface water samples were collected between 7 – 8am from the months of March-August 2013and analysed either in the field (*in situ*) or within six hours in the laboratory. Surface water Temperature was determined *in situ* with mercury in glass thermometer (Fisher S- 41624 model) graduated in units of ℃ as described by Offem, *et al.,* (2009). pH was determined using dip in mobile battery pH meter as described by (APHA, 1999) Dissolved Oxygen was determined using Hach 7021Model Jenway Dissolved Oxygen Meter as described by (APHA, 1999). Biological Oxygen Demand (BOD_5) was determined after 5 days incubation method as described by (APHA, 1999) The Nitrogen- nitrate was determined using portable data logging spectrophotometer Hach DR/2010 model. Phosphorus-phosphate (PO_4^{3-}): The concentration of phosphate was also determined using portable data logging spectrophotometer Hach DR/2010 model. The Electrical conductivity was determined using conductivity meter (Hach- CO 150/2010) as described by APHA (1999).

Collection of Phytoplankton

Phytoplanktons were collected using plankton net of mesh size 55µm towed at low speed for 10min and immediately collected in screw capped bottles and immediately fixed with 4% formalin. This was transferred to the laboratory in ice packed container prior to identification.

Identification of Algae

The water samples containing the algae were centrifuged in the laboratory at 1500rpm for 30minutes using centrifuge machine model (Merlin 502000). A portion of each of the sample was examined with the aid of microscope. This was carried out using a UNICO binocular microscope in the laboratory. Photomicrographs were made, using a photomicroscope, to further aid identification. References on identification of species of algae were made to that of Patrick and Reimer (1975), Needham and Needham (1962), Prescott (1961), Watanabe *et al.,* (1995) and Kadiri (1996).

III. Result and Discussion

Result

A total of fifty (50) different algal species identified was recorded during the period of study which was of four Taxa: Bacillariophyta, Chlorophyta, Cyanophyta and Euglenophyta. Chlorophyta had 23, (46%), Bacillariophyta 20, (40%), Euglenophyta 2, (4%) and Cyanophyta 5, (10%). Three (3) out of the five (5) species of Cyanophyta identified were classified harmful in nature. There was relatively high algal cell count recorded in site 'E' with a total of (8.8×10^4cell/ml), followed by site 'A' with (6.4×10^4cells/ml) and the least was recorded in site 'C' with (8.3×10^3algal cell/ml). The highest cell count recorded in site E could be attributed to eutrophication as a result of runoff from neighbouring farmland and discharge in to the water body. Site 'C 'and 'D' recorded a relatively low algal cell count, this could be due to relatively fewer activities taking place at both sites. Site 'B' recorded higher algal cell than site 'C' and 'D'. The number of algae identified correlate with the values of physico-chemical parameters recorded and the activities taking place at the various sampling sites.

It was also observed that the algae were recorded in higher densities in the rainy season than in the dry season, this contradict the findings of (Indabawa and Abdullahi 2004) who recorded higher algal cells in the dry season than in the rainy season. The dominance of Chlorophyta recorded in this study is a typical of most African waters (Kadiri 1996). The relatively high Chlorophyta algal cell recorded during the period of study could be due to increase in nutrient content of the dam leading to the development of phytoplankton as observed by (Kilhem and Hecky; 1988).However the abundance of Bacillariophyta (diatoms) is also interesting, since it has also been reported in other fresh water environment (Kadiri 1993), (Ezra *et al.,* 2008). Euglenophyta and Cyanophyta were poorly represented as 4% and 10% of the total algal cells which are two groups of Eutrophic or nutrient rich water bodies (Calgon and Conforti, 1991). Their poor representations could be as a result of the poor nutrient status of Kanye Reservoir. A reasonable number of desmids were also recorded as they are inhabitants of oligotrophic (nutrients poor) water bodies as reported by Kadiri (2003). The surface water temperature influences most of the physical, chemical and biological characteristics of water bodies. The highest mean temperature value was recorded at site 'A' and 'D' (25.83°C) while the least was recorded at site 'B' (25.25°C). The result also indicates that temperature has significant correlation with Nitrate, Phosphate and Electrical conductivity at 0.01% level of significance. It also correlates with the abundance and distribution of algae. In site 'E' as the temperature increased *Oscillatioria* cells decreases from (3.3×10^3 to 1.6×10^3 cells/ml). The high mean values of temperature recorded at site 'A' and 'B' could be associated with high solar radiation, high evaporation and low rainfall, while the relatively low mean values of temperature recorded at site 'B' could be due to low evaporation, low solar radiation and rainfall. It increased from March to April and decreased gradually through May to August. The pattern of temperature changes from dry to rainy season could be attributed to low solar radiation, low evaporation and rainfall. This agrees with the observation made by Ezra and Abdulhameed (1997).

The mean physico-chemical attributes is recorded in Table 1 where the Surface Water Temperature during the period of study influenced the other physico-chemical and biological characteristics of water bodies. In this study the highest mean temperature value was recorded at site ‘A’ and ‘D’ (25.83°C) while the least was recorded at site ‘B’ (25.25°C). This could be as a result of the variation in season result also indicates that temperature has significant correlation with nitrate, phosphate and electrical conductivity at 0.01% level significance. According to work of Ezra and Abdulhameed (1997), the high values of temperature recorded could be associated with high solar radiation, high evaporation and low rainfall, while the relatively low mean values of temperature recorded at site ‘B’ could be due to low evaporation, low solar radiation and rainfall. Generally the temperatures during the period of study reflected that of tropical region. It increased from March to April and decreased gradually through May to August. The pattern of temperature changes from dry to rainy season could be attributed to low solar radiation, low evaporation and rainfall.

pH range of (8.2-8.7).Neutral or lower values in water decreases algal growth. WHO (2003) standard of pH range in fresh water is (7-9). In this study, the highest mean pH value was recorded in site ‘E” (7.9) while the least was recorded in site ‘D’ (7.6). The values of pH recorded in this study fall within the WHO (2003) standard and correlates positively significantly with electrical conductivity. The highest value of pH recorded could be attributed to run off from the neighbouring farm land as well as discharge into the water bodies. Similar observation was made in site A’ which are the two sites that have direct influx from neighbouring farm land. This finding agrees with the findings of Antoine and Al-Sa’adi (1982) who associated the pH values recorded in their studies to run off from agricultural land.

The highest mean value for dissolved oxygen was recorded in site ‘A’ (4.70mg/L) while the least was recorded in site ‘C’ (3.35mg/L). The result indicated a negative correlation with temperature and significant correlation with conductivity. This is not unconnected with the nature of anthropogenic activities taking place around sites ‘A’ and ‘E’ such as farming, washing and bathing. This agrees with the findings of Indabawa and Abdullahi (2004) who reported a DO of (0.51-9.25mg/L). Lind (1968) also reported seasonality of DO in two highland reservoirs that are influenced by runoff in the rainy season.

Nitrate and phosphates are the two most important factors contributing to eutrophication in water. The highest mean nitrate value was recorded at site ‘A’ (2.62mg/L) while the least was recorded at site ‘B’ (1.35mg/L). The

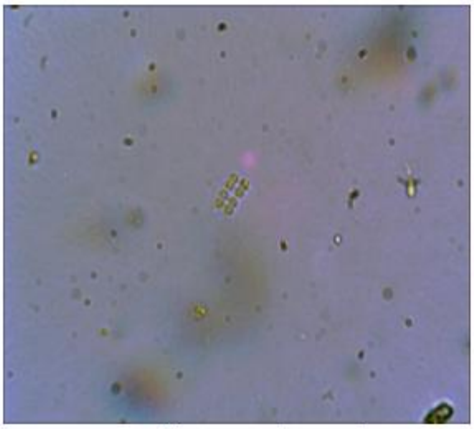
Table 1. Mean ± SE in Physico-chemical Variations at Sampling Sites (A -E) of Kanye Dam Reserviour, Kano State

Sites	Temperature (°C)	pH	DO (mgL^{-1})	BOD (mgL^{-1})	N-NO_3 (mgL^{-1})	P-PO_4 (mgL^{-1})	EC (µS/cm)
A	25.8 ± 0.6	7.7 ± 0.2	4.7 ± 0.9	2.1 ± 0.4	2.6 ± 1.2	1.0 ± 0.5	612 ± 39.1
B	25.5 ± 0.6	7.7 ± 0.3	3.4 ± 0.4	2.2 ± 0.4	1.4 ± 0.7	1.0 ± 0.5	625 ± 42.4
C	25.3 ± 0.6	7.8 ± 0.3	3.4 ± 0.4	1.8 ± 0.4	1.6 ± 0.9	0.9 ± 0.5	606 ± 47.3
D	25.8 ± 0.6	7.6 ± 0.3	3.3 ± 0.4	2.1 ± 0.4	1.8 ± 1.2	1.1 ± 0.6	623 ± 51.5
E	25.7±0.8	7.9±0.3	3.7±0.6	2.2±0.6	2.0±1.1	1.0±0.6	626±45.7

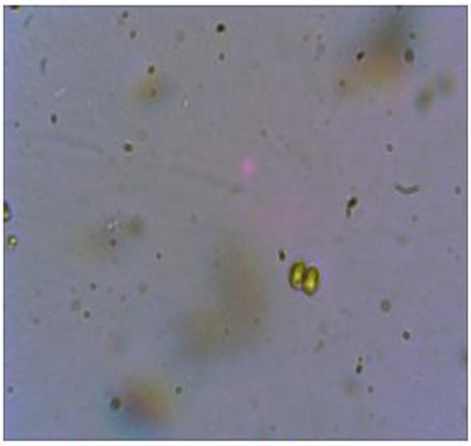
Do = Dissolved Oxygen, BOD = Biochemical Oxygen Demand, P-PO_4 = Phosphorus Phosphate, N-NO_3 = Nitrogen Nitrate, EC = Electrical Conductivity

nitrate values recorded in this study fall within WHO (2003) limit. Nitrate values recorded positively correlate with temperature and phosphate at 0.01% level significance. However, the values of Nitrate fluctuated with variations in seasons. This could be attributed to the runoff from neighbouring farm land fed with inorganic fertilizers by farmers, discharged in to the water bodies. Similar observation was made by Olaniyan (1969) and Watanabe *et al*., (1995), who reported that nutrients are potential determinant of ultimate productivity, as evidenced by many limnological studies correlating high nitrate and phosphate values to abundant phytoplankton flora. The Biochemical Oxygen Demand was within the W HO (2003)standard limits for BOD of unpolluted water is less than 5mg/L. The highest mean BOD value was recorded at site 'E' ($2.23mgL^{-1}$) while the least was recorded in site 'C' ($1.77mgL^{-1}$), the result indicated a significant negative correlation with DO and phosphate. The highest mean electrical conductivity value was recorded in site 'E' (626µS/cm) while the least was (606µS/cm) in site 'C' the values recorded in this study correlate significantly with temperature, and pH. The EC values recorded also fluctuates with season due to different some human activities taking place in the Dam and discharge from surface run off. Similar observation was made by Adeniji (1993) and Sunda *et al.,* (2006) in Shiroro Lake who reported a dry season mean conductivity attributed to higher concentration effect due to reduced water volume; however the higher conductivity of the water may be a pointer of eutrophication of the Dam.

Some Cyanophyta Algal species Identified in Kanye Reservoir

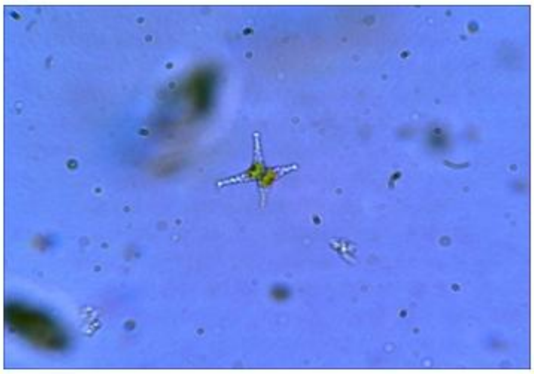


Agmenellum spp (× 600)



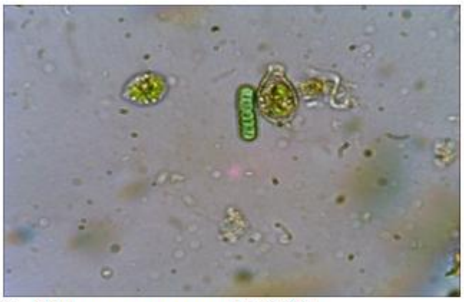
Chlorococcus spp (× 600)

Chlorophyta Algal species Identified in Kanye Reservoir

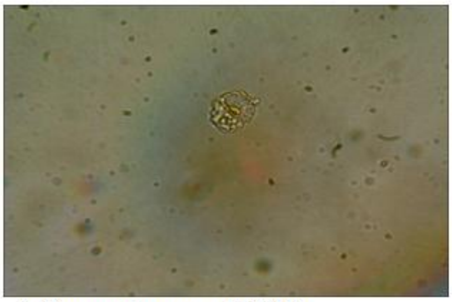


1: *Akistrodesmus* spp (× 600)

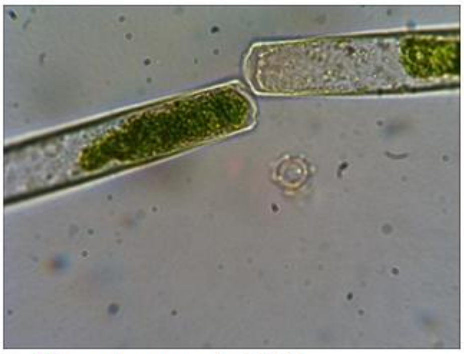
2: *Chaetophora incrassata* (× 600)



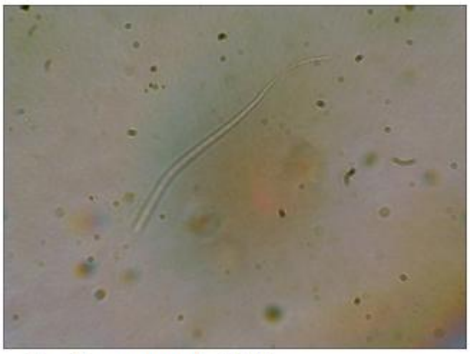
3: *Chlorococcus* spp (× 600)



4: *Cosmarium* spp (× 600)

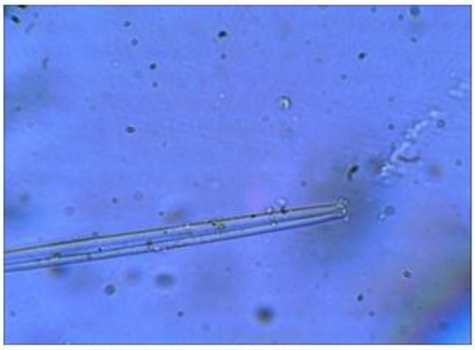


5: *Closterium* spp (× 600)

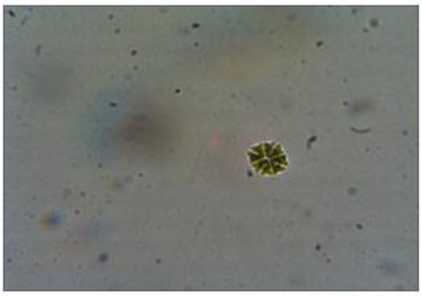


6: *Chara* spp (× 600)

7: *Characiopsis spinifer* (× 600)



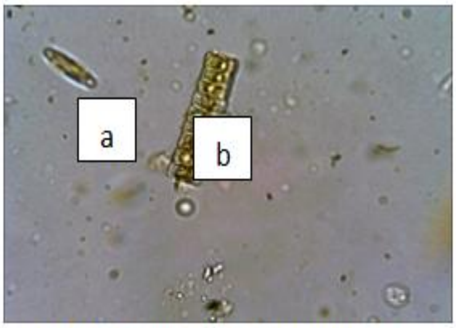
8: *Cylindrocystis* spp (× 600)



9: *Micrasterias* spp (× 600)

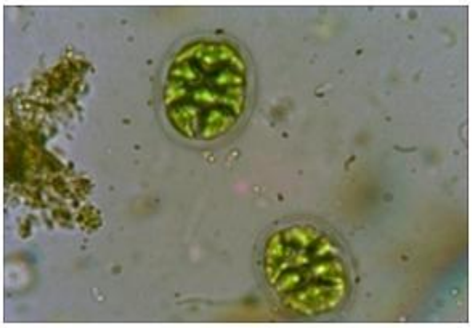
10: *Mougeotia scalaris* (× 600)

11: *Plageotropis Lepidoptera* (× 600)

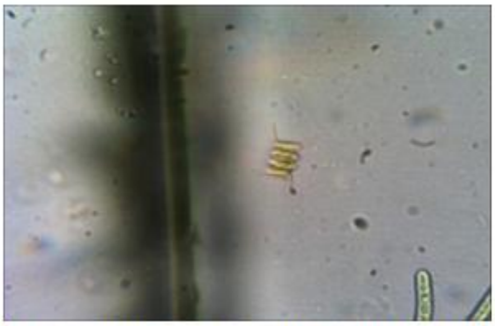


12: *(a): Navicula* ilopangoesis spp
(b). Zygnema (× 600)

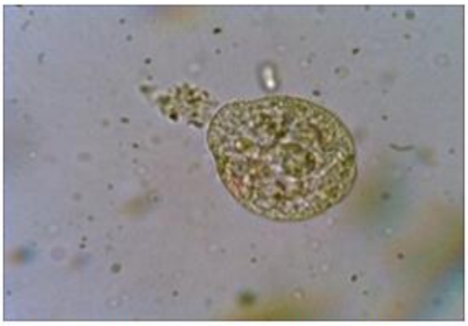
13: *Pedistrum nauticum* (× 600)



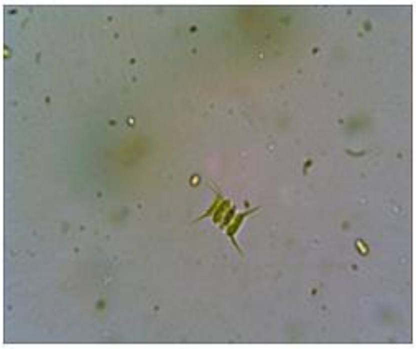
14: *Pediastrum intergrum* (× 600)



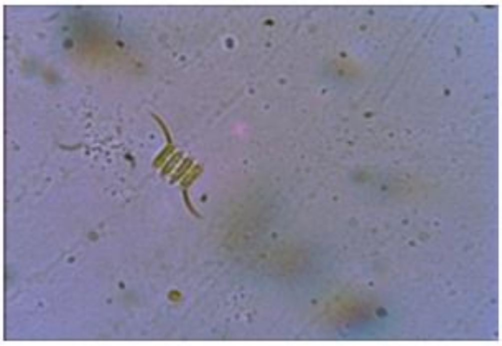
15: *Scenedesmus quadricauda* (× 600)



16: *Tetraspora* spp (× 600)

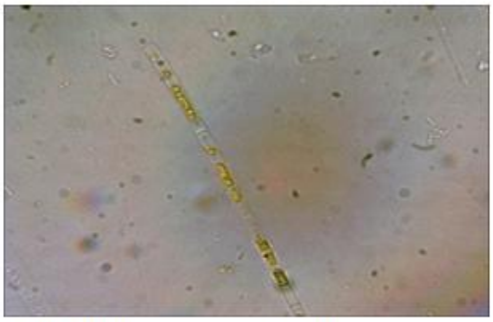


17: *Scenedesmus quadricauda* (× 600)



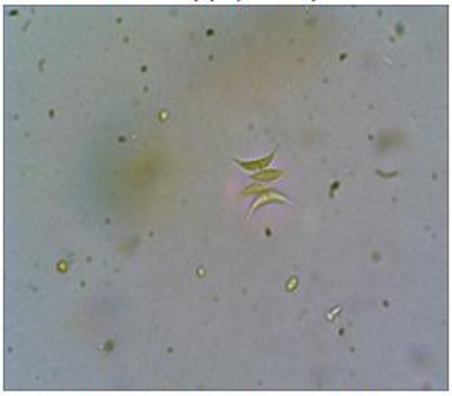
18: *Scenedesmus bijuga* (× 600)

19: *Spirogyra* spp (× 600)



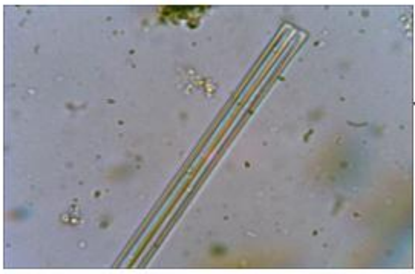
20: *Ulothrix* spp (× 600)

21: *Phytoconeis botryoides* (× 600)

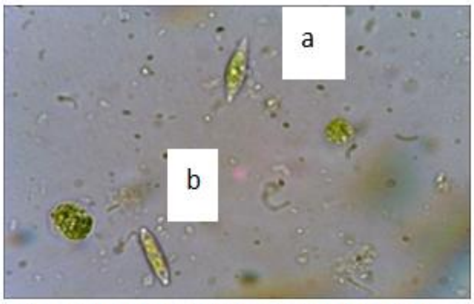


22: *Characium limneticum* (× 600)

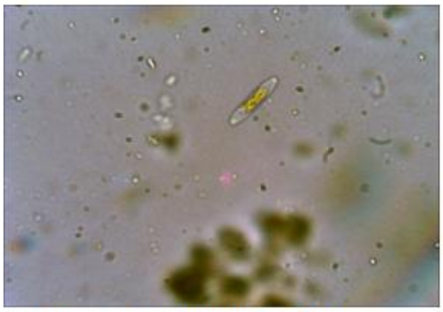
Bacillariophyta



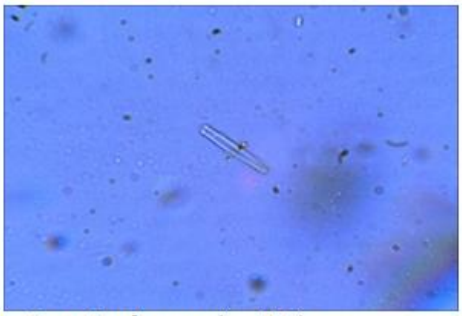
1: *Asterionella formosa* (× 600)



(a) *Anomoenies serians* (x 600)
(b)Stauronies spp (× 600)



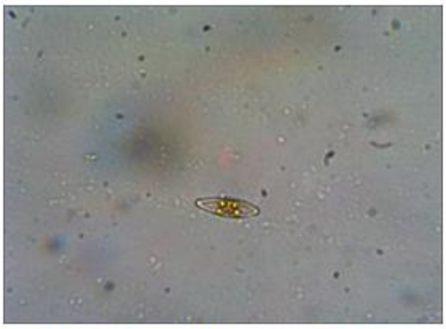
3: *Diatoma vulgare* (× 600)



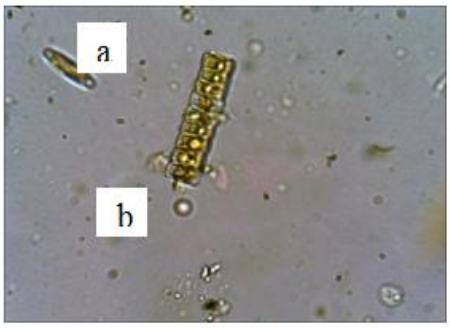
4: *Denticula* spp (× 600)

5: *Denticula elegans* (× 600)

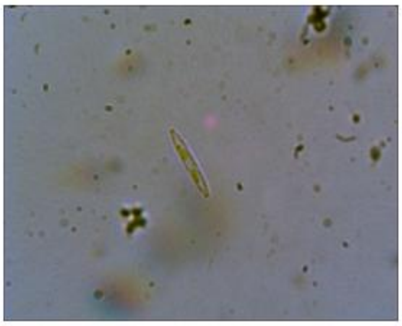
6: *Melosira* spp (× 600)



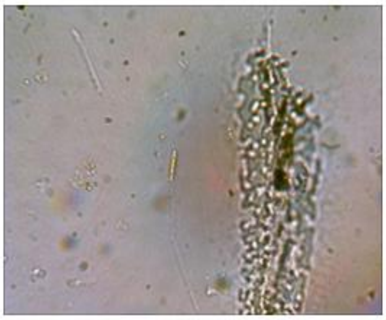
7: *Navicula gastrum* (×600)



8: (a) Navicula ilopangoesis
(b) *Zygnema* spp ×600

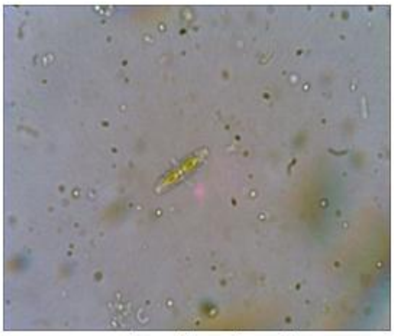


9: *Navicula cuspidata* cell (× 600)



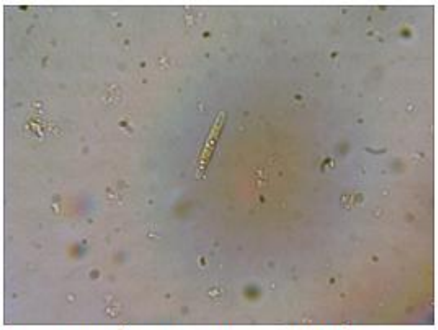
10: *Navicula notha* (× 600)

11: *Navicula graciloides* (× *600)*

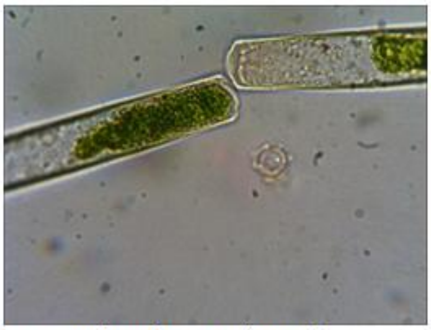


Single cell

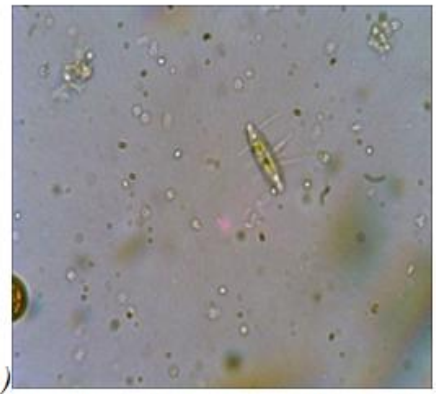
12: *Frustulia rhomboides* (× 600)



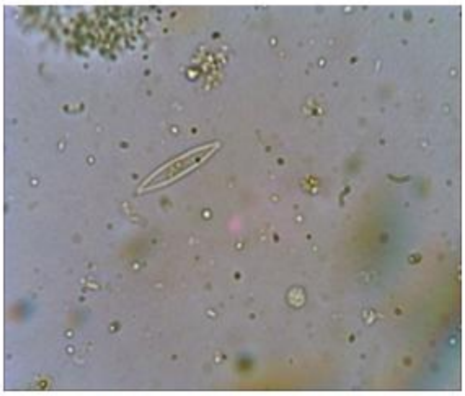
13: *Pinnularia* spp *(×600)*



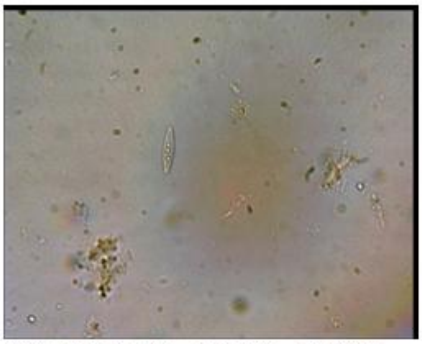
14: *Cyclotella* spp (x600)



15: *Cymbella angustata* (× 600)



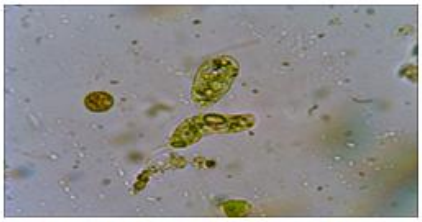
16: *Cymbella diluviana* (× 600)



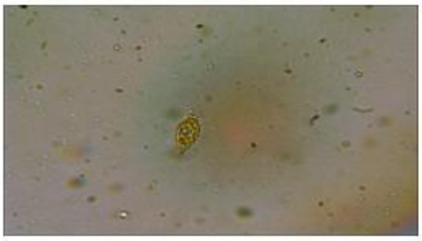
17: Cymbella minuta (×600)

18: (a) Synedra spp (×600)
(b) P. integrum

Euglenophyta Algal species Identified in Kanye Reservoir



Trachelomonas spp (× 600)



Euglena viridis (× 600)

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