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Research Paper

Identification of Planktons (Zooplankton and Phytoplankton) behind Girls' Hostel University of Abuja, Nigeria

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The major aim of this study was to determine the quality of the water reservoir behind the girls' hostel, University of Abuja. Planktons including zooplanktons are the animal plankton (e.g. include the larval stages of most fish species and arthropods as well as animals that remain plankton for their entire existence) while phytoplanktons are the plant plankton (e.g Sea weeds, algae, diatoms and dino flagellates). This study was carried out over a period of three months between May and July 2016. A total of 444 Species belongs to phytoplankton in which 53 Bacillariophyta, 173 chlorohyta, 213 cyanophyta and 5 euglenophyta while 59 Species belonging to zooplankton of which 35 are copepods, 14 rotifers and 10 ciliophora. Simple percentage tables bar chart and pie chart was used to analyze the data. The findings reveal that the reservoir water contains lots of planktons in the reservoir.

Key words: Zooplankton, Phytoplankton, and Dino flagellates.

INTRODUCTION

Water, after air, is the most essential commodity to survival of life. Human life depends to a large extent on water, it is used for an array of activities; chief among these being for drinking, food preparation as well as for sanitation purpose. The growing demands for adequate quality water resources create an urgent need to link research with improved water management, better monitoring, assessment, and forecasting of water resources and the sanitation issue with much emphasis on the roles of stakeholders (Yamaguchi and Wesselink, 2000). Reservoirs provide much of drinking water supplied to a community, and plankton can greatly influence the water quality of these reservoirs. Uncontrolled growth of certain species of phytoplankton can increase toxicity levels in the water (Watson, 2004; Waya and Mwambungu, 2004). This can lead to unpleasant taste, especially if these toxins are produced in drinking water and if poor filtration system exist (Watson, 2004; Waya and Mwambungu, 2004). Similarly, disease can be spread through zooplankton that supports the growth of vibro cholera, the infectious agent of cholera, and can aid in its spread through unfiltered or poorly filtered drinking water (Hug *et al.,* 1996). It has been observed that cholera outbreaks are rampant after plankton blooms (Hug *et al.,* 1996).

The term 'Plankton' means to drifter (Derived from the Greek words phyto (plant) and plankton (made to wander or drift), phytoplankton are microscopic organisms that live in watery environments, both salty and fresh), thus the plankton are at the mercy of currents more so than fish and other larger organisms. It is composed of organisms with chlorophyll (phytoplankton) and animals (zooplanktons). Phytoplankton is the primary producer community and consists of mainly algal such as diatoms, dinoflagellate, and a variety of forms from other division of the plant kingdom. Zooplankton contains consumer's species from all major groups of animals except sponges, bryozoans, branchipods, ascidians and mammals (Johnson, 1957).

Planktons are very sensitive to the environment they live in, any alteration in the change in the abundance, diversity and dominance in habitat. Therefore, plankton population observation may be used as a reliable tool for biomonitoring studies to assess the population status of aquatic bodies (Mathivanan and Jayakumar, 1995). The study of plankton as an index of water quality with respect to industrial, municipal and domestic pollution has been reported earlier (Acharjee *et al.,* 1995) This study was therefore carried out to identify the planktons (Zooplankton and Phytoplankton) in the reservoir behind girls' hostel University of Abuja.

BIOLOGY AND ECOLOGY OF PLANKTON (ZOOPLANKTON AND PHYTOPLANKTON)

Zooplankton and phytoplankton are essentially non-motile organism relative to water mass, but drift with it (Dicks,1976). The use of living organisms to determine the presence, amounts, changes in and effects of physical, chemical and biotic factors in the environment is termed biological monitoring (Baker, 1976). Different types of invertebrates have different tolerances to pollution and are also affected by quality of their habitat. This means we can tell how good the water and habitat quality is by the types and numbers of invertebrates living in the water body (Environment Waikato, 2006).

Zooplankton consists of macro and microscopic animals, comprising representatives of almost all major taxa particularly the invertebrates (Goswami, 2004). Zooplankton are microscopic animal found in both marine and freshwater ecosystems and their Waya and Mwambungu, 2004). Zooplankton can also be categorized as herbivorous and carnivores' zooplanktons based on their nature of feeding and in turn make up an important food item to other aquatic animals in the higher tropic levels (Havens, 2002; Waya and Mwambungu, 2004). They are important water quality indicator due to their shorter life spans combined with their different tolerance levels towards physiochemical parameters (Gajbhiye, 2002), and are myriads of diverse floating and drifting animals with limited power locomotion majority are microscopic, unicellular, or multi-cellular forms with size.

Zooplankton plays an important role to study the fauna bio diversity of aquatic ecosystem. They include representatives of almost every taxon of the animal kingdom and occur in pelagic environment either as adults (holoplankton) or eggs and larva (meroplankton). By sheer abundance of both types and their presence at varying depths, the zooplanktons are utilized to assess energy transfer at secondary trophic level. They feed on phytoplankton and facilitate the conversion of plant material into animal tissue and in turn constitute the basic food for higher animals including fishes particularly their larva (UNESCO, 1968).

The major zooplankton groups found in most tropical freshwater lakes are the rotifers, cladoceran, copepods and ostracods (Witty, 2004; Waya and Mwambungu, 2004). The zooplanktons play a very important role in the aquatic system due to their link between phytoplankton and higher tropic levels (Gajbhiye, 2002). Their composition of proteins, minerals, fatty acid, lipids provides an important source of feed for fish (Kribia *et al.,* 1997 in Khalid, 2012). The zooplankton responds to different types of stresses in different ways, therefore, they are increasingly used as biological indicators in aquatic ecosystem (Wanessa *et al.,* 2008) and (Okorafor *et al.,* 2013).

Rotifers

Rotifers are distinguished by their elongated body, head and have ciliated parts on the corona that direct food into the mouth, while the food consist of particular organic detritus, protozoan and algal. Their mode of reproduction is a sexual through cyclical parthogenetics, though exhibit sexual reproduction. Rotifers have widely been used as biological indicators in studies due to their sensitivity to different levels of water quality parameter (Radix *et al.,* 2002).

Unlike rotifers, copepods and cladoceran have segmented bodies with an exoskeleton which has joined appendage (Shiel, 1995). Apart from smaller zooplankton, both copepods and cladoceran feeds on wide range of organisms including algae and reproduce sexually through cladoceran predominantly reproduce asexually (Forro *et al.,* 2008).

Copepods

Copepods are group of crustacean that passes through a series of naupluis and copepod stages before becoming adult. Copepods unlike other zooplankton have a much under adaptation to unfavourable climate (Reid and Williamson, 2010) and are also reported to be the abundant members of the zooplankton population.

Cladoceran

Cladocerans are reported to be the most abundant in freshwater (Forro *et al.,* 2008). Many small larger ones may be predators and feeds on detritus or bacteria. Both copepods and cladoceran's abundance is much dependent on availability of enough variable foods and favourable temperature (Sharma *et al.,* 2013).

Ostracods

Ostracods are formed in almost all aquatic environments such as marine brackish water and freshwater. They are mainly benthic and also occur in semi-terrestrial environment (Pieri *et al.,* 2009). Their bodies are feat on either side with a hinged bivalve chitinous shell and have a smooth, thin calcified bean shaped carapaces with a body not clearly distinguish into segments like the other crustaceans. Ostracode reproduced sexually and also asexually depending on the environmental conditions and passes through several growth stages to the final adult stage. They feed on a variety of feed such as detritus, bacteria and diatoms (Pieri *et al.,* 2009). Unlike other crustaceans, the outer shell of ostracods is hard and easily fossilified and hence is known to have the most complete fossil record and because of time, is increasingly being used as palco-environmental indicator (Rodriguez-Lazaro and Ruiz-Muñoz 2012).

Some phytoplanktons are bacteria, some are protist and some are single-celled plant. Among the common kinds are cyano bacterial, silica-coated coccolithophores.

Phytoplanktons

Phytoplanktons are single-celled marine algae, some of which are capable of movement through the use of flagella while others shift with current. These microscopic plant range in size from 1/1000 of a millimetre to 2 millimetres and float or swim in the upper 100 m of the ocean, where they depend on sun light for photosynthesis. In addition to light and oxygen (O_2), they require basic simple organic chemical nutrients such as phosphate (PO_4) and nitrate (NO3), then also require carbon in form of carbon dioxide (CO_2). Some phytoplankton, the diatom also requires a form of silicon (Silicase, SiO_4) because they have a glasslike shell, (Sournia, 1978). The phytoplankton are of great importance as these are the primary producers of the oceans and thus provide the principal source of primary nutrition for organisms such as the zooplankton (Figure 1), the phytoplankton itself can be further divided with three orders of algae predominating.

(a) The diatoms
(b) The dinoflagellates
(c) The smaller flagellates such as the coccolithophorids.

The Diatoms (class Baccillariophyceae)

Diatoms are autotrophic (produce energy from photosynthesis) and generally range in size from 15 to 400 um. Diatoms are characterised by their siliceous cells or frustules. The diatom frustules is composed of two overlapping valves that fit together much like a pill-box or Petri-dish.

The dinoflagellates (class dinophyceae)

The dinoflagellates are generally heterotrophic, so rely on performed organic matter, though some are also capable of photosynthesis. They are of a smaller to the diatoms but have a large portion of smaller forms. The dinoflagellate can be further divided into naked and armored forms. Both forms are capable of locomotion by means of the whip-like appendage called flagella.

The smaller flagellates

Small flagellates make up part of the nanoplankton (organisms 2-20um in diameter) and picoplankton (organism 0.2 -2 um in diameter), along with bacteria, fungi and a number of smallest diatoms and dinoflagelltes. Although, they are small in size, they are though hoe to make a considerable contribution to primary production, and act as an important food source of many larvae (Tait, 1992; Mandali de Frigueiredo, 2003).

Factors that influenced Zooplanktons and Phytoplanktons

In winter, a lack of light is responsible for a minimum of phytoplankton and a lack of food for a minimum of Zooplankton (Sommer *et al.,* 1986). With an increase in light and nutrients, there is a spring bloom of phytoplankton as well as zooplanktons bloom due to edible phytoplankton species (Sommer *et al.,* 1986). The abundance and species composition of phytoplankton result from the opposing interaction of cellular growth and division versus population loss rates. The former are determined by the complex interplay between organism physiology and environmental conditions such as temperature, light, salinity, nutrients, and turbulence, and later by loss processes such as Advective transport, grazing and pathogen- induced mortality. However, light penetration, temperature, nutrient enrichment, toxic substance, mixing of water, parasites, herbivores and heterotrophic micro-organism activities influenced the phytoplankton growth (Reynolds, 1987).

Major factors affecting Phytoplankton

Light

Phytoplankton must grow within the illuminated surface water, so light can be considered the ultimate limiting factor of cellular growth. Although many phytoplankton species can photosynthesize at relatively low light intensities, primary production is ultimately limited by depth, given the attenuation of light in sea (Smayda, 1980). At high light intensities, cell growth is limited by the rate at which carbon is fixed, which in turn depends on cell metabolism. Thus, cells in bright light devote less energy and nutrients to chlorophyll synthesis and more to the synthesis of enzymes that can increase carbon fixation. Here again, species differs dramatically in their tolerances and adaptation to high light intensities. Thus, light is a fundamental controlling factor in phytoplankton

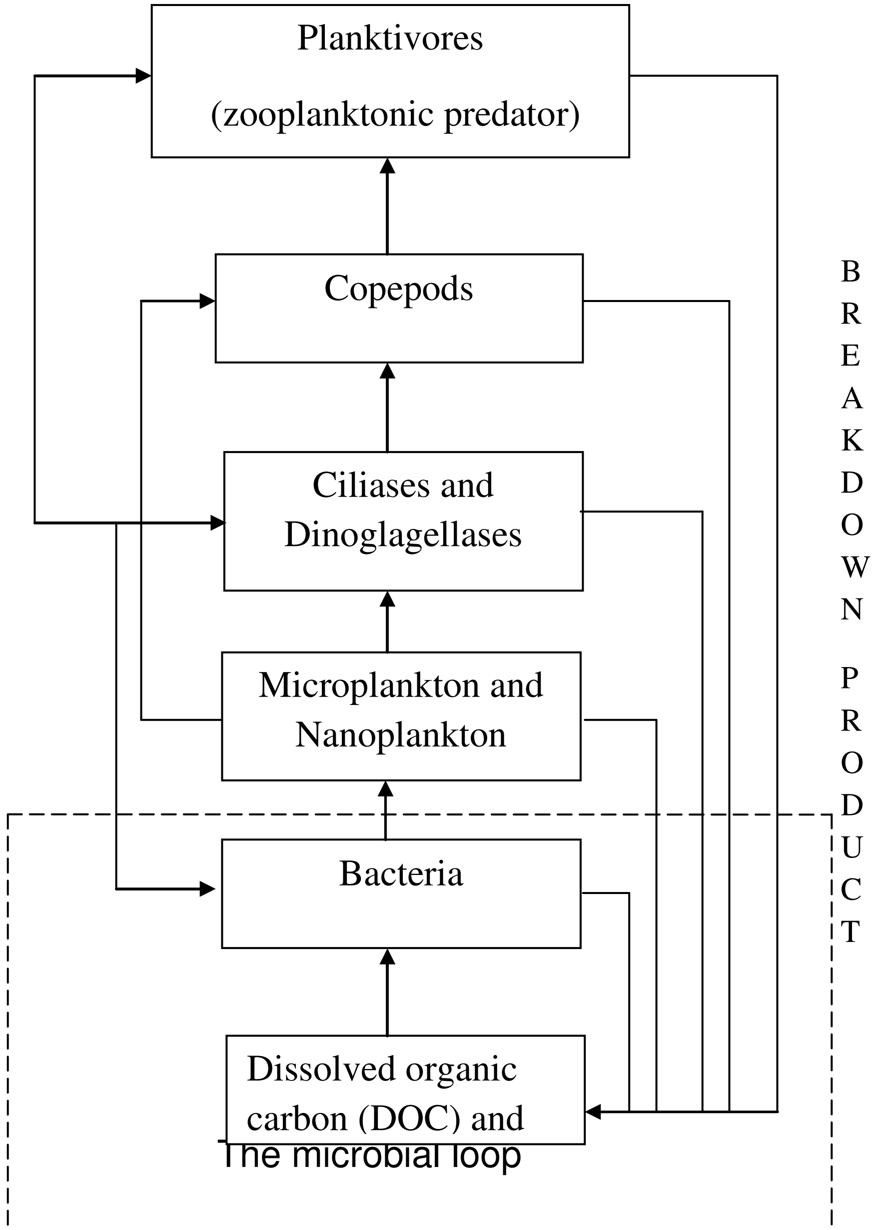

Figure 1. Simplified plankton food web showing direction of consumption (black lines) and recycling of waste material (red lines), where breakdown products from phytoplanktonic groups also includes the phytodetritus.

ecology, affecting the rate of carbon fixation and cell growth, the species composition and spatial structure of that community.

Temperature

The second major environmental factor that affects cell and population growth is temperature. Since the temperature of relatively large bodies of water is relatively constant on a dial basis, phytoplankton ecologist are more concerned with seasonal and latitudinal impact of temperature rather than daily temperature fluctuation. Temperature is an extremely important variable in mixing because of its wide known affect on density of water column(Cibik *et al.,* 1998). Phytoplankton are directly affected by temperature in the growth rates typically increase with increasingly temperature up to some optimum after which growth rate declines often abruptly (Eppley, 1972). The diatom *skeleton Macostanum*, for example is Enrythermal and capable of growth between 0 and 30°C, whereas *Detomulaconferiacea* cease growth above 15°C. Such differences are clearly a major factor in phytoplankton succession.

Nutrient

Phytoplankton must obtain a range of substance from their environment in order to sustain growth and division some of the required element (carbon and ions such as sodium, potassium and magnesium) are available in abundance relative to what is needed. In addition to these abundance constituents, phytoplankton requires a variety of elements which are present in much lower concentration in sea water. The most important of these are the macronutrient, nitogen, phosphorus and silicate. The nitrogen and phosphorus are important for all algae (Berland *et al.,* 1976).

Zooplankton

Zooplankton are abundance varies from one area to another within the same geographical areas.

Major factors affecting Zooplankton

Food availability

This can limit the overall distribution of certain species of zooplankton such as *Centropages typicus* (Davis and Alatalo, 1992).The role of food limitation versus predation in controlling zooplankton population is an active area of research in marine zooplankton ecology (Kleppel *et al.,* 1996). Food availability is actually determine by the encountered rate of an organism with its prey. It is also established that copepods feed on protozoans well as on phytoplankton, and that protozoan provide an important nutritional source for copepods. Zooplankton production would be reduced if the nutritional quality of food species becomes poor (Cibik *et al.,* 1998).

Temperature

Changes in temperature can have both direct and indirect effect on zooplanktons population abundance. Direct effect includes limitation in the rate of egg production and survival. Indirect effect includes limitations to growth and development rates which in turn affect final adult size and generation time.

MATERIALS AND METHODS

Study area

The study was carried out at University of Abuja main campus, located along Nnamdi Azikiwe Airport Road, F.C.T, Abuja. It is situated at Lat 9° 32N and long 50° 10E with a land mass of 11,824 hectares, Abuja has rich sol for cultivation and enjoys equable climate that is neither too hot (35° C) none too cold (22°C) all year round.

The reservoir is located behind the girls' hostel, made up of blocks and cement and it's rectangular in shape with lengths of 22.25 cm, width of 190 cm and also depth of 35 cm respectively. The reservoir is an alternative source of water to the Girls' hostel (Figure 2).

MATERIALS /INSTRUMENT USED

Plankton net
Sample bottles
Microscope slide
Microscope cover
70% ethanol
Light binocular microscope
Pipette

Sampling collection and data analysis

The experiment was between May-July 2016.The samples of planktons (zooplankton and phytoplankton) were collected between 7 – 9 am twice in week. Samples were collected by Deeping the plankton net about 5cm below the water surface which are then transferred into samples bottles. Samples of 20 ml each were collected in each sample bottle with a duplicate and 10 ml of 70% ethanol was added into it. The samples were then stored for three days before laboratory analysis for planktons. In the laboratory, samples were decanted; the sediment was dropped on a microscope slide using a pipette and was cover with a microscope cover. The samples were then viewed under a light binocular microscope with magnification of x25. The duplicate sediment was decanted and analyzed for comparison. Identification of planktons was carried out using a relevant reference. Planktons were identified up to species level. The frequency level and occurrence, number of abundance of each species in monthly samples were estimated.

RESULTS AND DISCUSSION

Tables 1-3 show Cyanophyta species has the highest percentage of 213%, followed by the chlorophyta species with 173%, Bacillariophyta species of 53% and Euglenophyta which is very low with 1.13%. Tables 4and 5 show that the copepod species has the highest percentage of 42.4 % followed by Cladoceran with 38.03%, rotifer with 15.22% and Ciliophora with 4.35% which is the lowest (Figures 3-4). The dominance of copepod species among zooplankton has been reported

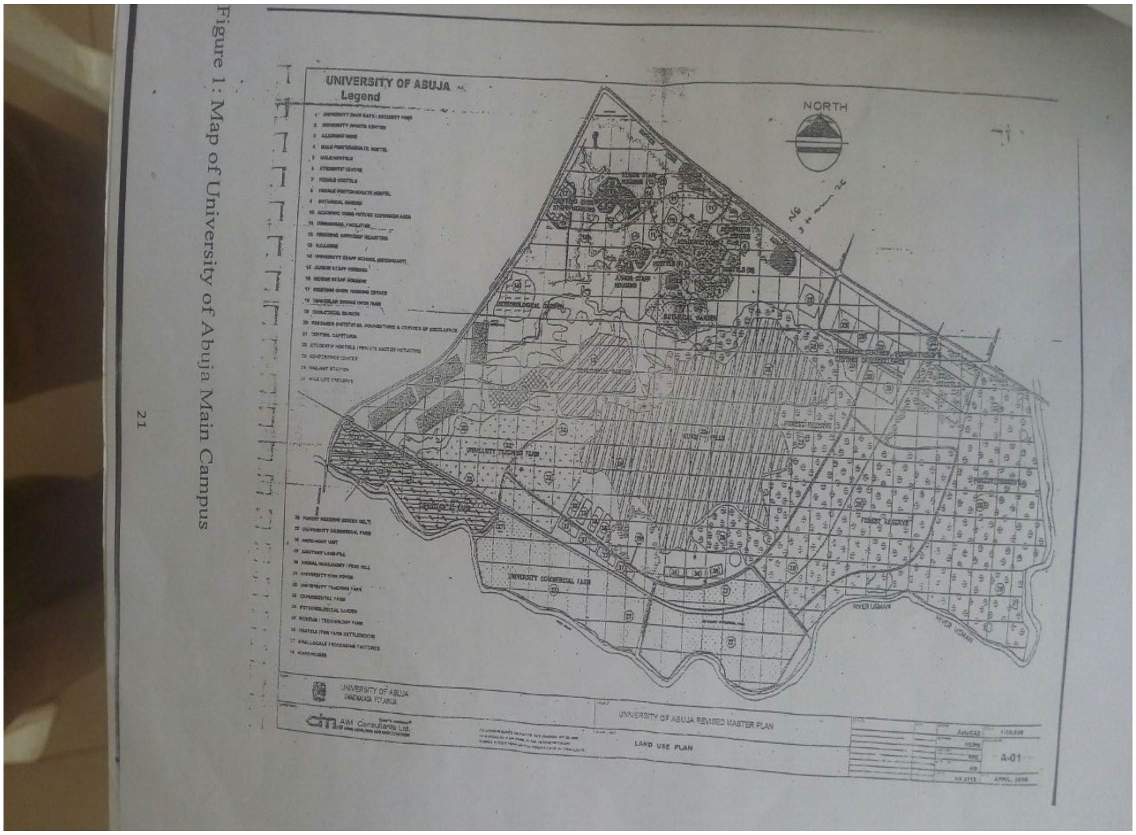

Figure 2. Map of university of Abuja main campus.

Table 1. Phytoplankton distribution monthly.

Phytoplankton taxon	Species	May	June	July	Total	% Abundance
Bacilllariophyta	Nitzchia sp.	7	10	12	29	6.532
	Fragillariopsi	0	7	6	13	2.928
	Navicula sp.	8	0	0	8	1.802
	Pleurosigma	3	0	0	3	0.676
Chlorophyta	Pediastrum	33	10	15	58	13.063
	Scenedesmu	26	31	10	67	15.090
	Chlorella sp.	3	0	0	3	0.676
	Cladophora .		16	0	28	6.306
	Sorastrum	2	2	0	4	0.900
	Ankistrodes	3	3	7	13	2.928

also in Lake Victoria (Ajuonu et al., 2011). In the present study, copepods had the highest abundance compared to other zooplankton. Similarly findings have been reported by Silvia, (1998) and Waya and Mwambungu (2004), in Chilean inland waters and Lake Victoria respectively. This can be explained by their feeding behaviour; by grasping feeders that generally eat variety of food than other zooplankton (Irvine and Waya, 1992). Rotifers constitute one of the lowest among all zooplankton in this present study.

Contrary to this study, rotifers were among dominant taxa in lake Victoria Basin with 18 species (Waya and Chande, 2004). The species richness in the present study was generally poor compare to other study conducted elsewhere, Ezekiel *et al.* (2011) in tropical lake in Nigeria. The higher presence of copepod shows that copepod was more for all groups of zooplankton. The blue – green algae (cyanophyta) dominated with 47.97% in which NOSTOC SP were the most abundance due to high nitrate of the water body. Chlorophyta been the second highest may be due to the water been slightly clean at the time of sample collection and *scenedesmus* species which also support Venkatswaelu and Reddy, (2000) which reported that

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	Cladophora .		16	0	28	6.306
	Sorastrum .	2	2	0	4	0.900
	Ankistrodes	3	3	7	13	2.928
Cyanophyta	Spirulina .	15	12	5	32	7.207
	Nostoc sp.	35	20	20	70	15.766
	Lyngbya sp.	13	24	20	57	12.838
	Chroococcus .	15	12	15	42	9.460
	Anabaena .	3	7	2	12	2.703
Euglenophyta	Pleuromona	2	2	0	4	0.901
	Bodo	1	0	0	1	0.225
Total	17				444	100.00

Table 3. Phytoplankton total distribution.

Phytoplankton taxon	Total density	% Abundance
Bacillariophyta	53	11.94
Chlorophyta	173	38.96
Cyanophyta	213	47.97
Euglenophyta	5	1.13
Total	444	100

Table 4. Zooplankton Distribution Monthly.

Zooplankton Taxon	Species	May	June	July	Total	% Abundance
Copepod	Harpacticoida	3	0	0	3	3.26
	Corycaeus .	3	0	6	9	9.78
	Calaus	0	7	0	7	7.61
	Zoea	0	3	0	3	3.26
	Nauplius .	2	3	0	5	5.43
	Amphipod .	3	0	5	8	8.70
	Calanoida .	0	0	0	0	0.00
	Cyclopse	2	0	0	4	4.35
Cladocera	Moina	5	7	8	20	21.74
	Daphnia	6	4	5	15	16.30
Rotifer	Euchlanis	3	8	3	14	15.22
Ciliophora	Vorticella	0	3	1	4	4.35
	Total				92	100%

Table 5. Zooplankton total distribution.

Zooplankton taxon	Total Density	% Abundance
Copepod	39	42.4
Clacedora	35	38.03
Rotifer	14	15.22
Ciliophora	4	4.35
Total	92	100%

clean water bodies support more chlorophyta. In this order, euglenophyta seems low in this period, which means its dominance is relative absent (Figure 5).

Conclusion

The presence of planktons (zooplankton and phytoplankton) in the reservoir are different and are less in which zooplankton have the total of 12 species and 4 taxa in a decreasing order as copepod Clacedoran > Rotifer > Ciliophora, resulting in copepod having highest number of species (8) and abundance with 42.4%. Phytoplankton, however have a total number of 17 species and 4 taxa, Resulting in Cyanophyta dominant the water body more with 47.79%. In conclusion, there were plankton in the reservoir water, while , phytoplankton dominated the water body more than zooplankton.

Recommendation

Although the reservoir water is good for domestic activities like washing, cleaning etc. but was not healthy for consumption. Student should take precaution on how to use the water and not to neglect the importance of plankton.

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