# Diversity of Microinvertebrate from Lake Ecosystem

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**Abstract:** ***Quantitative assessment of plankton was carried out from various sites of the Mhaishallake, in the period of January, 2011 to December, 2013. Phytoplankton diversity was observed in distinct groups as Cyanophyceae, Bacillariophyceae, Chlorophyceae, Desmidiaceae, Acanthocystidae and Miscellaneous. Among these, Bacillariophyceaewas found dominating with other eleven species. Diversity of Zooplanktons included Protozoa, Rotifera, Chrysophyceae and Cercomonadida. Protozoans were found to be dominating with nine diversified species among themselves. The obtained planktonic data was discussed with water quality of Mhaishallake by applying stastical methods for the diversity indices.***

**Keywords:** Planktonic diversity, Seasonal impact, Mhaishallake, Mhaishal.

## 1. Introduction

Aquatic invertebrates can be found in any habitat. Generally in stagnant water including small ponds to large lakes and from small streams to large rivers in case of flowing or running waters. They can be classified into four major groups, *viz*. plant kingdom, protozoa, bacteria, and fungi each varying in their biological characteristics, habitat and adaptations, but attached within a complex network of ecological roles and relationships. These organisms differ in shape and structure and share only their small size. Most of species were not visible without a microscope; on the other hand some can be seen with the naked eye (Bouchard, 2004).The term aquatic invertebrates includes the floating plankton, swimming nekton, organisms associated with plants (periphyton) and sediments (benthos) and the surface-dwelling neuston (Grant, 2002).

Plankton is part of aquatic life, which is composed of microorganisms which are living and flowing in the direction of water current. It acts as the main source of food for most aquatic fauna, in lotic and lentic water ecosystems. Plankton has prime importance in the freshwater ecosystem as these are the basic source of energy with very high nutritive value. Planktons serve as food for many invertebrate larvae, which in turn become food for other animals and thus forms a food chain in ecosystem and so is the need of time to understand the diversity of phytoplankton of lake ecosystem.(Dabgar, 2012).

Phytoplankton has great importance and serves as major source of organic carbon located at the base level (Gaikwad *et al*., 2004).The plant originated phytoplankton play the vital role in synthesizing the light energy with utilization of the $CO_2$ and water in to the food. Higher value of oxygen found dependent on the phytoplankton population and the growth of phytoplankton is related with the physicochemical parameters of the water (Rashmi*et.al*, 2013).

Zooplanktons are microscopic animals that eat other plankton. Zooplanktons occupy a central position between the autotrophs and other heterotrophs and form an important link in food web of the freshwater ecosystem. We found greater diversity among zooplankton as compared to phytoplankton and their composition which varies with seasonal production of meroplankton such as eggs, larvae and juveniles of the benthos, nekton, etc. (Walsh, 1978).Zooplankton was cosmopolitan in nature and they inhabit in all freshwater habitats of the world, including in industrial and municipal waste waters. Zooplanktons are useful as bioindicators of pollution study. Comparative account of size, structure, fecundity and reproductive stages of zooplankters found indication of nature and extent of pollutant load. (Sharma, 1996; Mukhopadhyay *et. al*. 2000).The measurement of planktonic productivity both at primary and secondary level seems to be important for ecosystem which oriented reservoir management (Boyd and Tucker, 1998).

The water quality assessment and planktonic study serve as important tool for assessment of productive nature of lake (Pawar and Pulle, 2005).Therefore, the present investigation attempted to focus on some of the limnological parameter and their relationship among phytoplankton and zooplankton from Mhaishallake, Dist Sangli, Maharashtra, India.

## 2. Materials and Methods

### 1) Study area with Geographical location

Study area includes, district Sangli, situated at site of western Maharashtra. Geographically located at 16º86´70″N latitude and 74º56´70″ E longitude. Sanglicity is the district headquarters having total area is 8, 578Km².The sampling site was Mhaishallake located in Miraj tahsil an important tahsil from Sangli district.

### 2) Collection Site:

Mhaishallake is a perennial lake, and important source of water and has connectivity of Krishna river itself and hence the water in the lake is always flowing. Lake is situated at latitude 16º44´3094″ N and longitude 74º43´1074″ E. The lake is used for surrounded by agricultural fields and hydrophytes. Water gets utilized for domestic purpose. As a result lake receives all sorts of organic as well as domestic pollution coming from both agricultural land and as domestic sewage, so selected site get contaminated by physicochemical moiety.


**Figure 1:** (a) Map showing Mhaishal Lake situated at Sangli, (Maharashtra).

**3) Field Sampling and Analysis**

Samples were assessed monthly in each season from all selected sampling stations. Collection of plankton was made by filtering 50lit.of water sample through bolting silk net No.25 (64µ) (Munshi*et.al.*, 2010). Water samples were collected in Amber – coloured bottle to prevent discoloration of algae. Samples were preserved in Lugol's iodine solution (1v/100v) and 70% alcohol, which maintain the fragile structure of microorganisms and also helpful for settling the sample. Sedge Wick – Rafter counting cell at (100 magnifications) used for quantitative analysis of phytoplankton and zooplankton (Sedge wick, 1988). Routine analyses of water from different sites were analyzed by taking account of some of the standard physicochemical parameters. Identification of micro invertebrate (flora and fauna) was carried out by using standard literature i.e. Munshi*et al.*, (2010); Edmondson, (1945);Sarode and Kamat (1984) and Needham and Needham (1964).

## 3. Results and Discussion:

### A) Phytoplankton

Phytoplankton as primary producers used as direct source of food by other aquatic plants and animals to maintain the energy flow (Senthilkumar and Sivakumar, 2008).Composition and development of phytoplankton get influenced by short and long term environmental changes in the aquatic ecosystems (Yerli*et. al.*, 2012). Pollution indicators as a phytoplankton get specified by its typical species composition along with quantitative parameters during developments (Yarushina *et. al.*, 2003).

In the assessment, we found phytoplanktonic population among five families *viz*; *Cyanophyceae, Bacillariophyceae, Chlorophyceae, Desmidiaceae, Acanthocystidae and Miscellaneous* population with biota. Comparatively *Bacillariophyceae* was dominated with 11species in it. Next to *Bacillariophyceae,* from family *Chlorophyceae* nine species were recorded, whereas *Cyanophycea*, showed eight diversified species in the area. *Desmidiaceae*showed two species and remaining family *i.e. Acanthocystidae and Cruciferae* showed only one species. Family wise diversity in the selected freshwater body was as follows, (Table. No.1 and 2).

**i) *Bacillariophyceae*:**

Most *Bacillariophyceae* were unicellular, although they can exist as colonies having filaments or ribbons, fans, zigzags, or stars shaped. Family *Bacillariophyceae* showed 11 species which included, *Synedra, Nitzschia, Tabellaria, Navicula, Gomphonema, Asterionella, Diatoma*, *Staronesis, Suriella, Pinularia,* and *Cymbella.* Stastical analysis showed that, family *Bacillariophyceae* was dominating with 11 species as compared to others. Members of *Bacillariophyceae* was found maximum in post mansoon season. Highest population was observed in winter, which may be due to weak light and low temperature which was suitable for growth of the Bacillariophyceae members (Zafar, 1967; Goldman *et, al.*, 1968). Similar type of data was presented by Kant and Kachroo, (1977) in postmansoon season at Dal lake, Kashmir.

**ii) *Chlorophyceae*:**

*Chlorophyceae*showed09 species and found to be maximum in mansoon season as compared to pre and post mansoon. Members included, *Ankistrodesmus, Chlorella, Spirogyra, Palmella, Scenedesmus, Trubarium, Pediastrum, Gonatozygon and Arthrodesmus.* The green algae i.e. *Chlorophyceae* found with greater diversity of cellular organization as morphological structure and reproductive processes, than those found in any other algal division (Bold *et. al.*, 1978). Among phytoplankton, *Chlorophyceae* was second dominating family with nine species maximum quantity was found in premansoon period and minimum in postmansoon season indicating increased population of family *Chlorophyceae.* Algae populations were drastically reduced at the beginning of monsoon as the water of the lake were flooded. (Kumar and Sahu, 2012).Seasonal variations of phytoplankton showed maximum density in summer, which indicated that the water temperature was major factor for increasing the population of phytoplankton. Similar observations were made by Nandan and Kumavat, (2003) they also noted that, dominance of various phytoplankton species was less in monsoon months. The above quantified data was due to dilution of water by water flow as rain and water movement and flooding.

**iii) *Cyanophyceae*:**

The name Cyanobacteria and "blue-green algae" (*Cyanophyceae*) found valid and compatible terms. These micro-organisms comprises unicellular to multicellular prokaryotes that possess chlorophyll - a and perform oxygenic photosynthesis (Castenholz and Waterbury, 1989).Members of *Cyanophyceae* grow at any place and in any environment where ample moisture and sunlight is available. However, specific algae grow in specific environment and therefore their pattern ofdistribution ecology, periodicity, qualitative and quantitative occurrence differs widely (Subramaniyan *et. al.*, 2012). *Cyanophyceae,* comes with 08 species as *Anacystis, Gomphosphaeria, Oscillatoria, Merismopedia, Coelosphaerium, Synechocystis, Protococcus* and *Glaecapsa.* Highest population of *Cyanophyceae* was observed in premansoon, which may be due to sufficient light and high temperature suitable for growth of the family (Mondal and Pal, 2012). It was observed that, higher concentration of oxidisable organic matter and higher penetration of light appeared to be more responsible for the growth of blue green algae i.e. *Cyanophyceae* during summer(Rao, 1955).

**iv) *Desmidiaceae*:**

Desmids are an attractive and unusual group of freshwater algae. They are microscopic flowerless plants without roots, stems or true leaves. They are single cells, some are the largest single cells in the Plant Kingdom. According to Gerrath, (1993) approximately 3, 000 desmid species recorded worldwide. Family *Desmidiaceae* showed only two species with acute dominancy. We found that *Desmidiaceae* showed two species i.e. *Chlosterdium* and *Closteriumdepressum.* Similar result was observed by Ngodhe *et. al.*, (2013) obtained three species from lake Victoria basin, Kenya. Desmid flora of various countries have been investigated by the following workers, *viz.* Lenzenweger and Wert – I, (2001) at Austria; Coesal, (2002) on Netherland; Dingley, (2002) and Lengen- wager, (2003) at Australia; Felisberto and Rodrigues, (2002) and Taniguchi *et.al.*, (2003).

**v)*Acanthocystidae***

*Acanthocystidae* included only one species as *Acanthocystis.* Quantified phytoplanktonic population recorded in the selected aquatic bodies showed order of dominancy among the species was as follows,

***Bacillariophyceae>Chlorophyceae>Cyanophyceae>Desmidiaceae>Acanthocystidae***

**2] Zooplankton analysis**

Among all the freshwater aquatic biota, zooplankton population able to reflect the nature and potential of any aquatic systems (Kumar*et. al.*, 2010).The Zooplankton community fluctuates according to physicochemical parameter as per environmental conditions (Karuthapandi*et.al.*, 2012).The zooplanktons were important for fishes as they play role in maintaining food chain (Dede and Deshmukh, 2015).Generally Zooplanktons found extremely abundant in freshwater and comprise a major component of most planktonic, benthic and groundwater communities, including semi-terrestrial situations such as damp moss and leaf litter and also in humid forests. (Boxshall and Defaye, 2008).

The major groups of zooplankton observed during study period were *Protozoa, Rotifera, Chrysophyceae, Cercomonadida, and Euglyphidae*. Quantitatively data showed *protozoa* as dominant with eight species, other all groups showed onlyone species each.

**i) *Protozoa*:**

For the aquatic systems, *Protozoa* found to be dominating groups including nine major species as, *Vorticella, Metapus, Prorodon, Paramaecium, Chilodonella, Didinium, Euglena, Colpidium, and Spirostomium.* Number of Scientists have studied and recorded freshwater *Protozoa* scientists have studied the freshwater protozoa and inter relation among them (Pathak and Mudgal, 2004, Sharma, 2009 and Rathore, 2009).

**ii) *Rotifera:***

Duggan *et. al., (*2001) suggested that rotifers may provide useful bioindicators of water quality of lake. Water quality. *Rotifer* has important role in energy flow and nutrient cycling, accounting for more than 50% of the zooplankton production in some freshwater systems (Saler and Sen, 2002).Padmarabha *et. al.*, (2007) reported diversity indices of Rotifers for the assessment of pollution in Kukkarahalli and Karanji lakes in Mysore Karnataka State. The group with one species in study area as *Branchionus.* Rotifers in freshwater aquatic bodies were studied by(Steinberg *et. a*l., 2009;Karabin, 1995; Saksena, 1987 andVaishali*et.al*., 2012) and reported its aquatic population for the diversity point of view.

**iv) *Chrysophyceae*:**

The *Chrysophyceae,* usually called brown algae or golden algae found mostly in freshwater. The quantitative analysis of the selected aquatic body showed only one type of species i.e. Uroglenopsis.

**vi) *Cercomonadida:***

Cercomonads are small flagellates, widely spread in aqueous habitats. Present study showed only single species of group, as *Cercomonas.* Cercomonads found among the most abundant and widespread zooflagellates in soil and freshwater. The classical genus Cercomona (Dujardin, 1841) recorded second most commonly and widely encountered zoo flagellate among freshwater (Arndt et. al., 2000). Quantified data and statistical analysis of zooplanktonic population recorded in the aquatic bodies showed order of dominancy among the species as, ***Protozoa>(Rotifera, Chrysophyceae*** and ***Cercomonadida)*** Composition of phytoplankton throughout the study period showed *Chlorophyceae* 26%, *Cyanophyceae* 23%, *Bacillariophyceae* 31%, *Desmidiaceae* 6%, *Acanthocystidae* 3% and *Miscellaneous* 11% (Fig. 2). Relatively zooplankton showed *Protozoa* 75%, *Rotifera*09%, *Chrysophyceae* 8%, *and Cercomonadedae*8% out of total population (Fig. 3).

## 4. Conclusion

Based on the present study, it was concluded that, Mhaishallake showed fluctuating physicochemical parameters indicating moderately altered water quality and has effect on growth and development of varied aquatic flora and fauna. The stastical data showed that, Percentage of plankton species were higher in premansoon as compared to mansoon and postmansoon, indicating order of dominancy as summer > winter > rainy season. The quantified data of the respective lake showed phytoplanktonic diversity and has comparatively more planktonic population showing moderately polluted aquatic body. As the water bodies are major site for the planktonic and micro invertebrate reproduction so is the need of time to control the further entry of industrial domestic and sewage contamination.

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**Table 1:** Seasonal changes in the physicochemical parameters ofMhaishal lake, MirajTahsil, Maharashtra (Feb 2011 – Jan 2014).

| Sr.No | Physicochemical Parameters (mg/l) | Summer (Feb - May) | Rainy (June - Sep) | Winter (Oct - Jan) |
|---|---|---|---|---|
| **1** | **Temperature (˚C)** | 28.166 ± 1.154 | 27.66 ± 0.629 | 24.75 ± 0.901 |
| **2** | **Turbidity** | 136.49 ± 5.958 | 101.5 ± 5.448 | 147.66±116.13 |
| **3** | **pH** | 7.53 ± 0.057 | 8.35 ± 1.730 | 9.36 ±0.472 |
| **4** | **Total Alkalinity** | 237 ±30.315 | 280.6 ± 0.577 | 286.83 ± 63.49 |
| **5** | **$CO_2$** | 22 ± 11.614 | 20.533±4.164 | 34.13 ±8.623 |
| **6** | **DO** | 14.6±3.983 | 9.233 ± 1.650 | 9.916 ±0.900 |
| **7** | **BOD** | 19.75 ± 6.628 | 16.416 ±3.923 | 13.66 ±3.105 |
| **8** | **COD** | 49 ±25.607 | 60.833 ±16.825 | 38.75 ± 4.769 |
| **9** | **Phosphate** | 0.408±0.028 | 0.731 ± 0.412 | 0.17 ±0.04 |
| **10** | **Chloride** | 124.44 ± 5.063 | 140.32 ±0.524 | 216.19 ± 113.16 |
| **11** | **Hardness** | 342.66±21.38 | 502 ± 91 | 337.66 ± 9.073 |
| **12** | **TS** | 513±29.043 | 515.5±52.575 | 446.41±22.282 |
| **13** | **TDS** | 469.5±32.271 | 506±47.137 | 437.75±14.506 |

**Table 2:** Seasonal variations andenumeration of phytoplankton occurring at the study site throughout the period period.

| Phytoplankton | Seasons | | |
|---|---|---|---|
| | Premonsoon | Monsoon | Postmonsoon |
| **1. *Cyanophyceae*** | | | |
| *Anacystis* | + | + | + |
| *Gomphosphaeria* | _ | + | _ |
| *Oscillatoria* | + | _ | + |
| *Merismopedia* | + | + | _ |
| *Coelosphaerium* | + | + | _ |
| *Synechocystis* | + | + | + |
| *Protococcus* | + | _ | _ |
| *Glaecapsa* | + | _ | _ |
| *Pinnularia sp.* | + | _ | _ |
| **2. *Bacillariophyceae*** | | | |
| *Synedra* | + | + | + |
| *Nitzschia* | + | + | _ |
| *Tabellaria* | _ | + | _ |
| *Navicula* | _ | + | + |
| *Gomphonema* | _ | _ | + |
| *Asterionella* | + | _ | + |
| *Diatoma* | + | _ | + |
| *Staronesis* | _ | + | _ |
| *Suriella* | _ | + | + |
| *Cymbella* | _ | _ | + |
| **3. *Chlorophyceae*** | | | |
| *Ankistrodesmus* | _ | + | _ |
| *Chlorella* | + | _ | + |
| *Spirogyra* | _ | _ | + |
| *Palmella* | + | _ | _ |
| *Scenedesmus* | + | _ | + |
| *Trubarium* | _ | + | _ |
| *Pediastrum* | + | + | + |
| *Gonatozygon* | _ | + | + |
| *Arthrodesmus* | + | _ | _ |
| **4. *Desmidiaceae*** | | | |
| *Cosmarium sp.* | + | _ | + |
| *Closteriumdepressum* | _ | + | + |
| **5. *Acanthocystid*** | | | |
| *Acanthocystis* | _ | + | _ |
| **6. *Miscellaneous*** | _ | + | _ |

**Table 3:** Enumeration of zooplankton occurring at the study site throughout the study eriod under premonsoon, monsoon and postmonsoon seasons.

| **Zooplankton** | **Seasons** | | |
|---|---|---|---|
| | **Premonsoon** | **Monsoon** | **Postmonsoon** |
| **1. *Protozoa*** | | | |
| *Vorticella* | + | + | _ |
| *Metapus* | + | _ | _ |
| *Prorodon* | + | _ | _ |
| *Paramaecium* | _ | + | _ |
| *Spirostomium* | _ | + | _ |
| *Chilodonella* | _ | + | _ |
| *Colpidium* | + | _ | _ |
| *Didinoium* | _ | + | _ |
| *Euglena* | + | _ | _ |
| **2. *Chrysophyceae*** | | | |
| *Uroglenopsis* | _ | + | _ |
| **3. *Cercomonadida*** | | | |
| *Cercomonas* | _ | + | _ |
| **4. *Rotifera*** | | | |
| *Brachionus* | _ | + | _ |

PLATE - I

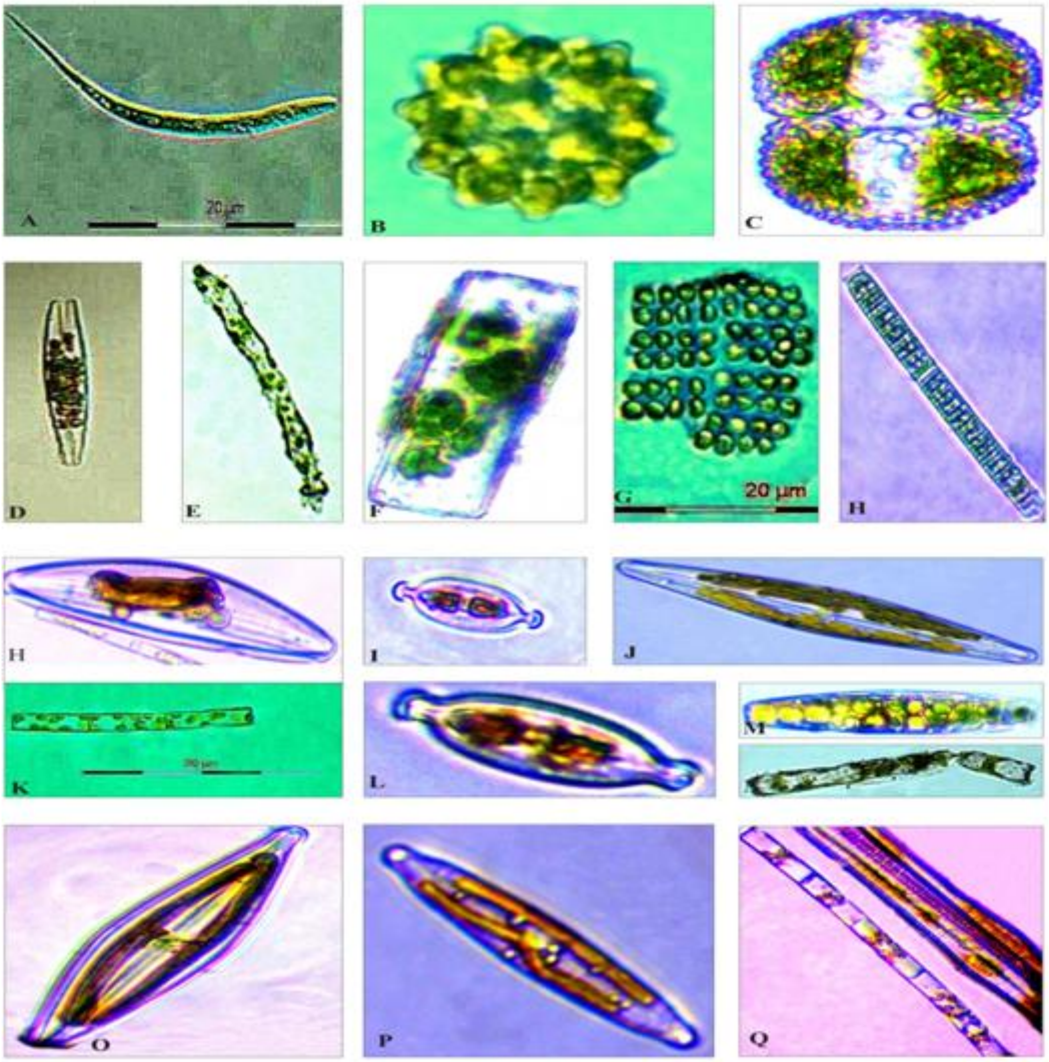

**Plate I**

**Plankton Diversity from Mhaishallake, Sangli.**

**Fig. A -** *Ankistrodesmus* - Chlorophyceae.
**Fig. B** -*Coelastrummicrosporum.* - Chlorophyceae.
**Fig. C**-*Cosmarium botrytis* - Decmidiaceae.
**Fig. D** -*Cymbellacesatii* - Bacillariophyceae
**Fig. E** - *Diatoma species* - Bacillariophyceae
**Fig. F**- *Diatoma vulgaris* - Bacillariophyceae.
**Fig. G** -*Merismopediatennusima* - Cyanophyceae.
**Fig. H**-*Oscillatori*(blue green algae) -Cyanophyceae.
**Fig. I**- *Cymbellaafinnis* - Bacillariophyceae.
**Fig. J -** *Naviculacuspidata.* - Bacillariophyceae.
**Fig. K -** *Navicularadiosa.* - Bacillariophyceae.
**Fig. L** - *Diatoms ehrenbergii* - Bacillariophyceae.
**Fig. M -** *Naviculagastrum* - Bacillariophyceae.
**Fig. N -** *Stauroneis*speciesb - Bacillariophyceae.
**Fig. O -** *Diatoma* species - Bacillariophyceae.
**Fig. P -** *Navicularhynchocephala* - Bacillariophyceae.
**Fig. Q -** *Naviculalanceolata* - Bacillariophyceae.
**Fig. R** - *Pinnularia*species - Cyanophyceae andskeletonema species.

Plate II

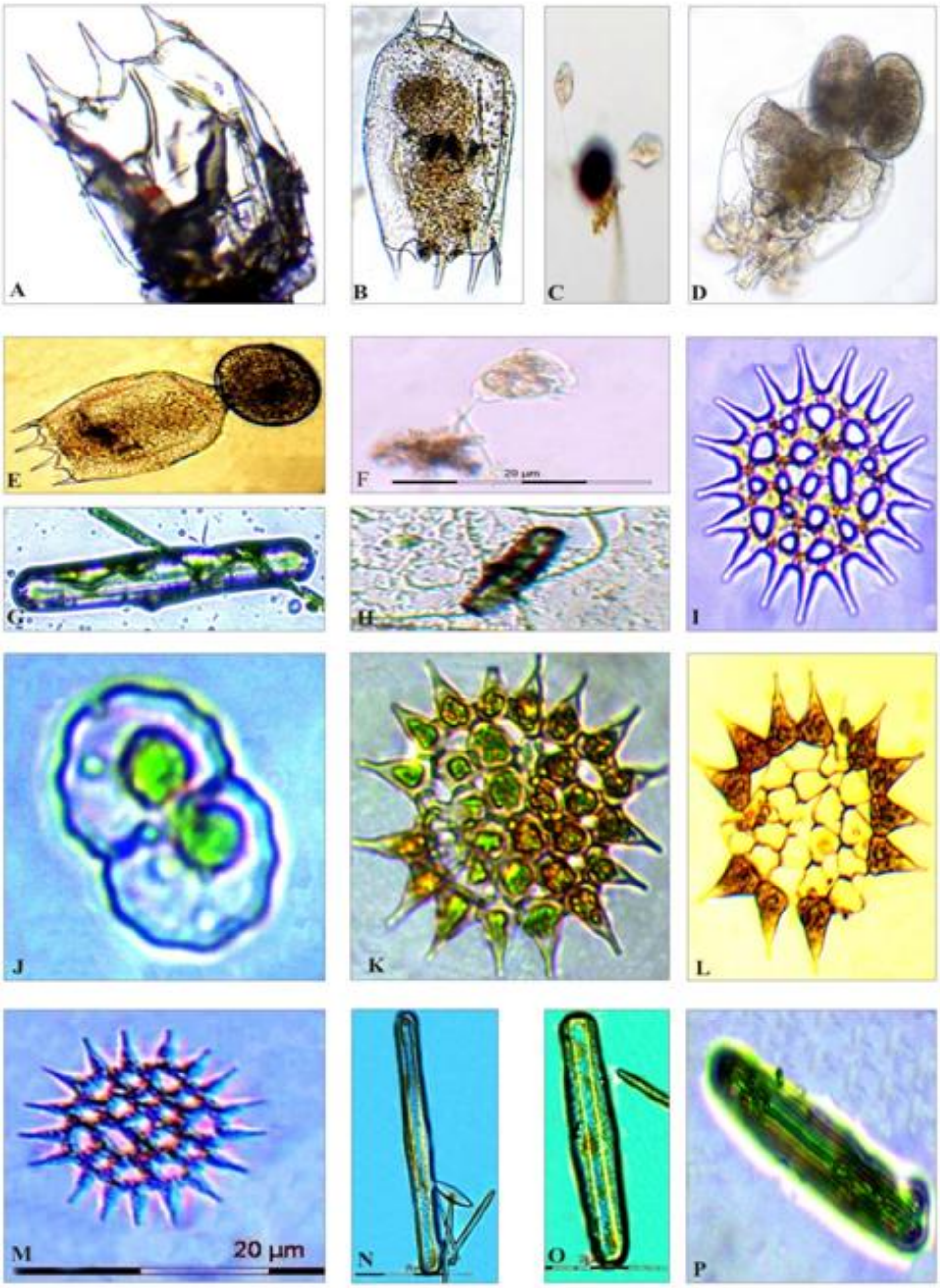

**Plate II**

**Plankton Diversity from Mhaishallake, Sangli.**

**Fig. A -** *Brachionuscalyciflorus* - Rotifera
**Fig. B** -*Brachionuscalyciflorus* - Rotifera
**Fig. C**- *Vorticella species* - Protozoa
**Fig. D** -*Brachionusrotundiformis* - Rotifera
**Fig. E** - *Brachionusplicatilis* - Rotifera.
**Fig. F**- *Ciliate vorticcella* - Protozoa
**Fig. G** - *Single spirotaenium cell* - Chlorophyceae.
**Fig. H**- *Spirogyra species* - Chlorophyceae.
**Fig. I**- *Pediastrum simplex* - Chlorophyceae
**Fig. J** *Cosmariumsubprotumidum* - Desmidiaceae
**Fig. K -** *Pediastrumboryanum* - Chlorophyceae
**Fig. L** - *Pediastrummusterii* - Chlorophyceae
**Fig. M -** *Pediastrum simplex* - Chlorophyceae
**Fig. N**- *Pinnularia species* - Cyanophyceae
**Fig. O -** *Pinnularia species* - Cyanophyceae
**Fig. P** - *Pinnulariaviridis*-Cyanophyceae

**Fig. 3 Percentage composition of Phytoplankton (2011 - 2013)**

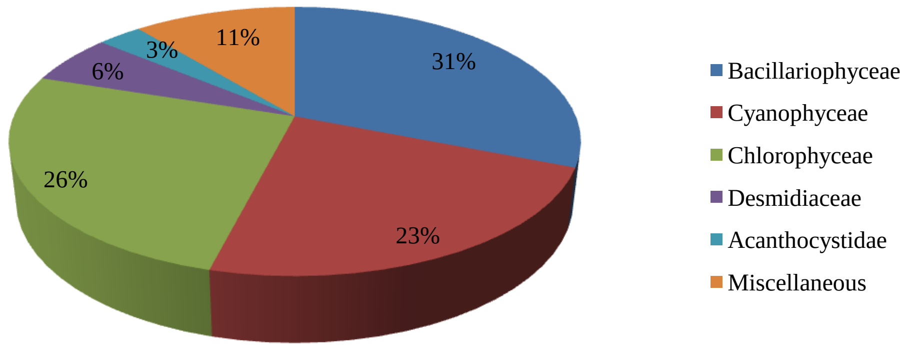


**Fig. 3 Percentage composition of Zooplankton (2011 - 2013)**