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QUALITATIVE ANALYSIS OF PHYTOPLANKTON AND MACROPHYTES IN LENTIC ECOSYSTEM OF DHUKESHWARI TEMPLE POND DEORI DISTRICT GONDIA

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Abstract:

The phytoplankton, an important primary producer which forms food pyramid and it has to be considered in all schemes regarding the complexity of the entire ecosystem. It acts directly on nutrient input and therefore it is an important parameter for monitoring programme. Phytoplankton in an aquatic ecosystem belongs to algae. In the present study 38 genera from the 27 families of algae were observed. The diversity of aquatic weeds reflects limnological status of an ecosystem. Some weed species are bio-indicators of aquatic pollution. The diversity of macrophytes was represented by 13 species from the Pond. Oscillatoria, Spirulina, Mycrocystis, Navicula, Ulothrix, Scenedesmus, Coelastrum, Ankistrodesmus indicates organic enrichment.

Key Words: *Phytoplankton, Macrophytes, Lentic Ecosystem, Biological indicator, trophic status*

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INTRODUCTION:

The Importance of plankton communities, in the trophic dynamics of freshwater ecosystems has long been recognized, as these organisms, not only regulate the aquatic productivity by occupying almost middle position in food chain, but also indicate environmental status in a given time. These organisms are regarded as valuable bio-indicator to depict the trophic status of water quality of their environments within limnosaprobity [1]. The phytoplankton, an important primary producer which forms food pyramid and it has to be considered in all schemes regarding the complexity of the entire ecosystem. It acts directly on nutrient input and therefore it is an important parameter for monitoring programme. Phytoplankton in an aquatic ecosystem belongs to algae. It exists in several forms like Neuston, Aufwuchs (periphyton) and benthic algae. The study on algae is routinely carried out in ecological studies pertaining to biotic components of the aquatic ecosystems as a part of water pollution investigation and biological waste water treatment plants. Algae serve as a very good indicator of pollution and have been used extensively for this purpose [2,3]. Dense blooms of phytoplankton may occur in lakes where nutrients are abundant, turning water turbid and green. Little light can penetrate to the bottom under such conditions, thus preventing the growth of benthic macrophytes and photosynthetic algae in biofilms. As a result, phytoplankton may form the basis of the food web in Eutrophic waters. A wide variety of other heterotrophic microbial organisms, including unicellular bacteria, ciliate and flagellate protozoa and multi-cellular organisms may also be abundant in the pelagic environment. The studies on aquatic macrophytes are important to limnologists in order to understand the functioning of the aquatic ecosystems. Most of the macrophytes may become a nuisance when growing profusely. They are termed as aquatic weeds and become a concern of water management. The diversity of aquatic weeds reflects limnological status of an ecosystem. Some weed species are bio-indicators of aquatic pollution. The algal blooms can be harmful to the health of an ecosystem [4].

Material and Method: Phytoplankton were collected once in a month during the period and identified by following pertinent literature, [5-8] and photographed were made with Metzer-M-Co-axial Trinocular Digital Research Microscope Vision plus-5000 DTM.

A Lentic Ecosystem of Dhukeshwari Temple Pond, Near National Highway Six, Deori

Observation and Result:

Phytoplanktons: (Table 1). In the present study 38 genera from the 27 families of algae were observed. The identification of the algae is carried out up to family level, out of 27 families; the Desmideaceae has showed dominant with 4 genera *(Cosmarium spp, Closterium spp, Cosmocladium spp & Desmidium spp)*, while Selenastraceae family has showed co-dominant with 3 genera *(Anikstrodesmus spp, Selenastrum spp, Monoraphidium spp)*, and some of the 6 family showed 2 genera for each (The genera name is given in parentheses). Family Coelastraceae *(Scenedesmus spp & Coelastrum spp)*, Achananthaceae *(Ditomes & Pleurosigma spp)*, Euglenaeae *(Euglena spp & Phacus spp)*, Chroococceae *(Aphanothece spp & Mycrocystis spp)*, Oscillatoriaceae *(Oscillatoria spp & Spirulina spp)* and Zygnemataceae *(Mougeotia spp & Zygnema spp)*. Rest of the 19 families showed single genus each as given as follows. Family Oocystaceae *(Oocystis spp)*, Hydrodictyaceae *(Pediastrum spp)*, Ulotrichaceae *(Ulothrix spp)*, Oedogoneaceae *(Oedogonium spp)*, Zygnemaceae *(Spirogyra spp)*, Fragilariaceae *(Fragilaria spp)*, Gomphonemataceae *(Gomphonema spp)*, Naviculaceae *(Navicula spp)*, Cocconeidacese *(Cocconema spp)*, Ulnariaceae *(Ulnaria spp)*, Chrysophyceae *(Dinobryon spp)*, Amphipleuraceae *(Frustulia spp)*, Klebsormidiaceae *(Klebsormidium spp)*, Chlorococcaceae *(Characium spp)*, Volvocaceae *(Pandorina spp)*, Palmellaceae *(Sphaerocystis spp)*, Stauroneidaceae *(Stauroneis spp)*, Characiopsidacae *(Characiopses spp)* and Hyalodiscaceae *(Hyalodiscus spp)*.

Macrophytes: (Table 2). The diversity of macrophytes was represented by 13 species from the Dhukeshwari Temple Pond. Free floating species and marginal species were abundant in comparison to submerged and emergent species. Among the marginal weeds *Marsilea quadrifolia*, *Marseilea minuta*, *Saggitaria spp*, *Ipomoea aquatica*, *Ipomoea carnea;* emergent weeds like *Nymphoides spp*, *Nelumbo and Nymphaea stellata*; submerbed like *Hydrilla*, *Utricularia*, *Ceratophylum* while floating weeds like *Trapha*, *Salvinia* also were observed.

Table 1: List of Algae in Dhukeshwari Temple Pond.

SN	Family	Algae name
1	Oocystaceae	*Oocystis spp*
2	Selenastraceae	*Anikstrodesmus spp*
3		*Selenastrum spp*
4		*Monoraphidium spp*
5	Hydrodictyaceae	*Pediastrum spp*
6	Coelastraceae	*Scenedesmus spp*
7		*Coelastrum spp*
8	Ulotrichaceae	*Ulothrix spp*
9	Oedogoneaceae	*Oedogonium spp*
10	Zygnemaceae	*Spirogyra spp*
11	Desmideaceae	*Cosmarium spp*
12		*Closterium spp*
13		*Cosmocladium spp*
14		*Desmidium spp*
15	Fragilariaceae	*Fragilaria spp*
16	Gomphonemataceae	*Gomphonema spp*
17	Naviculaceae	*Navicula spp*
18	Achananthaceae	*Ditomes spp*
19		*Pleurosigma spp*
20	Euglenaeae	*Euglena spp*
21		*Phacus spp*
22	Chroococceae	*Aphanothece spp*
23		*Mycrocystis spp*
24	Oscillatoriaceae	*Oscillatoria spp*
25		*Spirulina spp*
26	Cocconeidacese	*Cocconema spp*
27	Ulnariaceae	*Ulnaria spp*
28	Chrysophyceae	*Dinobryon spp*
29	Amphipleuraceae	*Frustulia spp*
30	Klebsormidiaceae	*Klebsormidium spp*

Continue……….

31	Zygnemataceae	*Mougeotia spp*
32		*Zygnema spp*
33	Chlorococcaceae	*Characium spp*
34	Volvocaceae	*Pandorina spp*
35	Palmellaceae	*Sphaerocystis spp*
36	Stauroneidaceae	*Stauroneis spp*
37	Characiopsidacae	*Characiopses spp*
38	Hyalodiscaceae	*Hyalodiscus spp*

Table 2: List of Macrophytes in Dhukeshwari Temple Pond, Deori.

SN	Weed types	Family	Species Name
1	Marginal plant	Marsilaceae	*Marsilea quadrifolia*
2			*Marsilea minuta*
3		Alimaceae	*Saggitaria spp*
4		Convolvulaceae	*Ipomoea aquatic*
5			*Ipomoea carnea*
6	Emergent plant	Nymphaeaceae	*Nymphoids*
7			*Nelumbo*
8			*Nymphoea*
9	Submerged plant	Hydrocharitaceae	*Hydrilla*
10			*Ceratophyllum*
11		Lentibulariaceae	*Utricularia*
12	Free floating plant	Water nut	*Trapa natans*
13		Salviniaceae	*Salvinia*

DISCUSSION:

Phytoplankton: (Table 1). The phytoplanktons are mainly composed of microscopic, floating algae which live suspended in water bodies. Algae are simple photoautotrophic organisms. They are found with various kinds of algae, plankton and zooplankton. These communities provide the idea about the ecosystem health. Algae are the indicators of trophic status of ecosystem. They form the sole base of food chain in lentic ecosystem. The phytoplankton consist of diverse assemblage of major taxonomic groups, many of these have different physiological and environmental requirements. The use of density and diversity of phytoplanktons and their association as biological indicators in the assessment of water quality or trophic status has been made by several workers [9]. The phytoplankton have been used as indicators of water quality as some species flourished in highly Eutrophic water while others are very sensitive to organic or chemical pollution.

In the present study 38 genera from the 27 families of algae were observed. The identification of the algae is carried out up to family level, out of 27 families; the Desmideaceae has showed dominant with 4 genera *(Cosmarium spp, Closterium spp, Cosmocladium spp & Desmidium spp),* while Selenastraceae family has showed co-dominant with 3 genera *(Anikstrodesmus spp, Selenastrum spp, Monoraphidium spp),* and some of the 6 family showed 2 genera for each (The genera name is given in parentheses). Family Coelastraceae *(Scenedesmus spp & Coelastrum spp)*, Achananthaceae *(Ditomes & Pleurosigma spp)*, Euglenaeae *(Euglena spp & Phacus spp)*, Chroococceae *(Aphanothece spp & Mycrocystis spp)*, Oscillatoriaceae *(Oscillatoria spp & Spirulina spp)* and Zygnemataceae *(Mougeotia spp & Zygnema spp)*.

Rest of the 19 families showed single genus each as given as follows. Family Oocystaceae *(Oocystis spp)*, Hydrodictyaceae *(Pediastrum spp)*, Ulotrichaceae *(Ulothrix spp)*, Oedogoneaceae *(Oedogonium spp)*, Zygnemaceae *(Spirogyra spp)*, Fragilariaceae *(Fragilaria spp)*, Gomphonemataceae *(Gomphonema spp)*, Naviculaceae *(Navicula spp)*, Cocconeidacese *(Cocconema spp)*, Ulnariaceae *(Ulnaria spp)*, Chrysophyceae *(Dinobryon spp)*, Amphipleuraceae *(Frustulia spp)*, Klebsormidiaceae *(Klebsormidium spp)*, Chlorococcaceae *(Characium spp)*, Volvocaceae *(Pandorina spp)*, Palmellaceae *(Sphaerocystis spp)*, Stauroneidaceae *(Stauroneis spp)*, Characiopsidacae *(Characiopses spp)*, Hyalodiscaceae *(Hyalodiscus spp)*.

Bellinger and Sigee (2010) [10] stated that the algae can be bioindicator of inorganic trophic status in which planktonic algae preferably epilimnion samples can be used to define lake trophic status in terms of their overall productivity and species composition. The species composition can be related to trophic status in four main ways: seasonal succession, Biodiversity, bio-indicator species and determination of bio-indices. In seasonal succession, the development of algal biomass and sequence of phytoplankton populations directly relate to nutrient availability. In Oligotrophic waters, the diatom and desmids may be present for whole growth period. In some water *Ceratium* and *Gomphosphaeria* may be able to grow in nutrient depleted waters. In Mesotrophic waters, *Asterionella*, *diatome* and blue green algae may be dominated in midsummer. In Eutrophic waters, the spring diatome bloom is further limited, leading to a clear water phase dominated by unicellular algae, followed by a midsummer bloom in which large unicellular *Ceratium*, colonial filamentous Anabaena and globular *Microcystis* blue greens predominate. In hypertrophic water or artificially fertilized fish ponds and waters with sewage discharges, the small unicellular algae dominated throughout the season with short life cycles. The algae form a succession of dense populations, out-competing larger colonial organisms which are unable to establish themselves.

The different phytoplankton as a parameter is useful to know the eutrophication level of water bodies [11]. Algal dynamics in relation to some factors causing eutrophication was investigated by Tiwari and Kumar (1985)[12]. The blooms of Cyanophyceae characterize eutrophic waters, especially in late summer represented by the species of *Microcystis*, *Oscillatoria*, *Lyngbya* etc. [13]. Eutrophic lakes also often have large summer growths of Chlorococcales such as *Pediastrum*, *Scenedesmus*, *Dictyosphaerium*, *Crucigenia*, *Tetrahedron*, *Chlorella* etc. in small lakes and ponds [14]. Generally low productivity indicates oligotrophic nature of the lakes and high productivity indicates eutrophic nature [15]. *Cyclotella* occurs both in oligotrophic and eutrophic waters. Wetzel (1975) [34] recorded it in oligotrophic waters. In contrast Sudhakar et al; (1994) and Sudha Rani (2004) [16,17] recorded it in eutrophic waters.

The occurrence of planktonic organisms under natural conditions is related to tolerance range (ecological optimum) dependent on abiotic environmental factors (temperature, oxygen concentration, pH), as well as on the biotic interactions among organisms [18]. In the multidimensional space (ecological niche) the occurrence of organisms is affected by numerous environmental factors, both anthropogenic and anon-anthropogenic. Bio-indicator species effectively indicate the condition of the environment because of their moderate tolerance to environmental variability [19]. Phosphorus enrichment into water will increase the growth and reproduction of some species [20]. There are number of reports that one more or algal assemblage could be used as organism indicative or water quality [21]. However the condition is contradictory under both polluted and unpolluted water bodies while unpolluted water bodies supports great deal of algal diversity, polluted water support just a few tolerant organisms with one or two being the dominant form [22].

Phytoplankton ecology plays an important role for indicating the eutrophication. Indian freshwater lakes provide an assessment of cultural eutrophication which controls light and temperature on phytoplankton. This may change the response of lake ecosystems to global warming [23]. Aside from its basic importance of the understanding of phytoplanktonic community structure it is always relevant to indicate blooms developed from directional changes in nutrients [24]. It is therefore possible that the presence or absence of particular species of phytoplankton in a habitat could be predicted from the fluctuation of abundance frequency than from the relative abundance [25]. Nitrates and phosphates are favorable for the growth of phytoplankton [26].

Nationwide, diatoms such as *Navicula spp*, *Nitzschia spp*, *Synedra spp*, *Melosera spp* contributed to the phytoplankton composition in early winters. Diatoms occurred in unpolluted part of the lakes which were good indicators of pollution [23]. Nandan and Jain (2005)[27] reported 31 genera of pollution tolerant algae from 3 stations, the pollution tolerant genera of algae like *Navicula*, *Nitzschia*, *Synedra*, *Gomphonema*, *Cyclotell*, *Oscillatoria*, *Phormidium*, *Microcystis*, *lyngbya*, *Chlorella*, *Scenedesmus*, *Ankistrodesmus*, *Closterium*, *Pandorina*, *Melosira*, *Spirogyra*, *Pediastrum*, *Euglena*, *Phacus and trachelomonas* were considered for assessing water quality.

Some outstanding contribution for literature on pollution tolerant phytoplankton for knowing the water status, Ganapati (1960) [28] recorded *Microcystis spp* from Eutrophic pond, Hutchinson (1967) [29] recorded the *Asteronella*, *Fragilaria*, *Oscillatoria*, *Cosmarium*, *Ankistrodesmus*, *Pediastrum*, *scenedesmus* species from various Eutrophic habitats. Rai et al., (2008) [22] recorded *Phacus*, *Euglena*, *Scendesmus*, *Ulothrix*, *Oedogonium*, *Spirogyra species* from polluted water bodies. Singh et al., (2013) [19] suggested indicator planktons of trophic status for Eutrophic water are *Ankistrodesmus falcatus*, *Chlorella vulgaris*, *Closterium acerosum*, *Cryptomonas erosa*, *Cyclotella* *spp, Euglena oxyuris, Gomphonema gracile, Melosira granulate, Microcystis spp, Microcystis aeruginosa, Navicula cryptocephala, oscillatoria limosa, Scenedesmus quadricauda, Synedra ulna.* While plankton for Oligotrophic waters are *Ceratium hirudinella, Closterium pseudodianae, Dimorphococcus lunatus, Dinobryon spp, Euastrum spp, Gloeocapsa spp, Gomphonema gracile, Merismopedia elegans, peridinium, Sorastum, Strombomanas, Synura etc.* based on their findings. Gunale and Balkrishnan (1981)[30] also used algae as biomonitors of Eutrophication in waters of Poona city. Palmer (1969)[31] has shown that genera like *Scenedesmus, Oscillatoria, Microsystis, Navicula and Euglena* are found in organically polluted waters as supported by Goel et al., (1986) [32] similar genera were recorded in present investigation.

In the present investigation, the pollution indicator micro-algal species like *Cosmarium spp, Closterium spp, Desmidium spp, Anikstrodesmus spp, Selenastrum spp, Scenedesmus spp, Ditomes, Euglena spp, Mycrocystis spp, Oscillatoria spp, Spirulina spp, Oocystis spp, Pediastrum spp, Ulothrix spp, Oedogonium spp, Spirogyra spp, Fragilaria spp, Gomphonema spp, Navicula spp, Pandorina spp, Hyalodiscus spp.*etc are recorded in more numbers throughout the year during study period in Dhukeshwari temple pond which indicate its Eutrophic nature. The occurrence of Microcystis, the toxin producing blue green algae [33] in blooms is a significant feature of tropical waters [34].

Macrophytes: (Table 2). The variation in water properties can be assessed by surveying the abundance of macrophytic communities. The trophic nature is mainly influenced by the variety of communities and indicator species occurring at the source. The macrophytes also provide suitable breeding and sheltering place for macro-invertebrates and fishes [35]. Macrophytes in fresh water play major ecological role and help in regulation and stabilization of trophic state and mineral cycling in aquatic ecosystem [36]. They serve as the bioindicator for the possible degree of damage in aquatic ecosystem [37].

In the present investigation 13 species were recorded from the Dhukeshwari Temple Pond. Free floating species and marginal species were abundant in comparison to submerged and emergent species. Among the marginal weeds Marsilea quadrifolia, Marseilea minuta, Saggitaria spp, Ipomoea aquatica, Ipomoea carnea; emergent weeds like Nymphoides spp, Nelumbo and Nymphaea stellata; submerged like Hydrilla, Utricularia, Ceratophylum while floating weeds like Trapa, Salvinia also were reported. It is clear that the Dhukeshwari Temple Pond harbor rich pollution indicator species along with higher density of phytoplankton. This was also observed by Narayana and Somashekhar (2002) [38]. The growth and frequency of distribution of different aquatic macrophytes was correlated with an increase in phosphate and nitrogen content of water bodies by Kiran et al., (2006)[39].

CONCLUSION:

Occurrence of certain pollution indicator algae viz. Oscillatoria, Spirulina, Mycrocystis, Navicula, Ulothrix, Scenedesmus, Coelastrum, Ankistrodesmus indicates organic enrichment. The weeds like Nymphoides and Nymphaea indicates unpolluted nature of pond also was found abundantly over the water surface. The nutrient enrichment and resultant eutrophication is due to the dominancy of phytoplankton in the pond.

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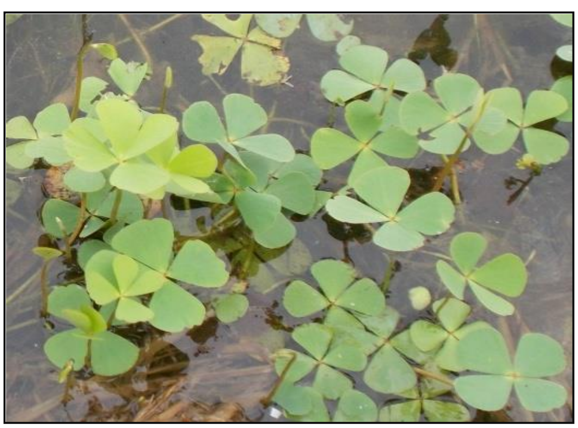

Plate 1: (1-16): Phytoplankton in Dhukeshwari Temple Pond, Deori

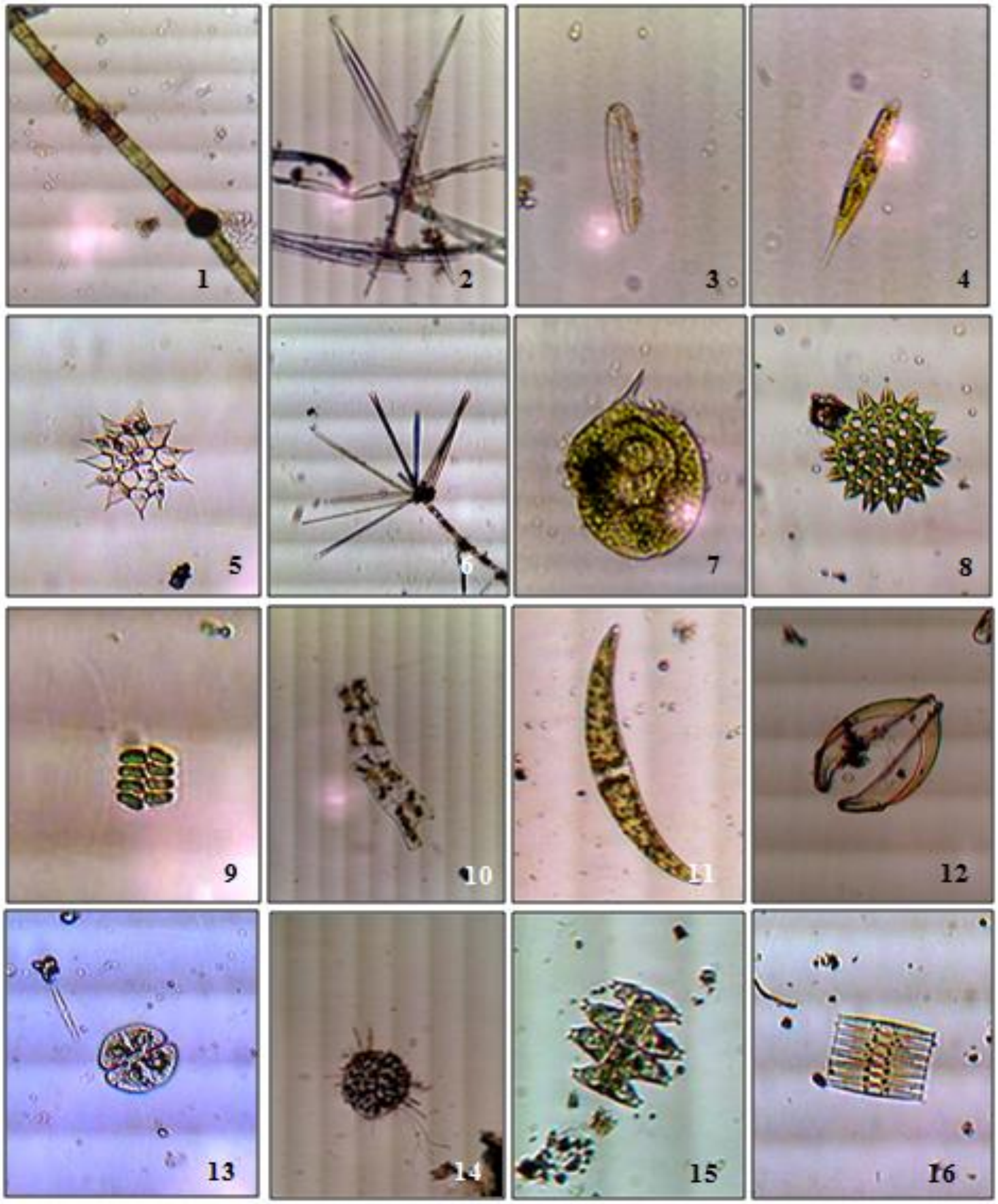

Plate II: (17-32): Phytoplankton in Dhukeshwari Temple Pond, Deori.

Plate III: (33-48): Phytoplankton in Dhukeshwari Temple Pond, Deori.
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Chart of Plate I, II and III: Phytoplankton in Dhukeshwari Temple Pond, Deori.

1.	*Oedogonium spp.,*	**25.**	*Monoraphidium spp.,*
2.	*Anikstrodesmus spp.,*	**26.**	*Spirogyra spp.,*
3.	*Gomphonema spp.,*	**27.**	*Spirulina spp.,*
4.	*Euglena spp.,*	**28.**	*Stauroneis spp.,*
5.	*Pediastrum spp.,*	**29.**	*Ulothrix spp.,*
6.	*Ulnaria spp.,*	**30.**	*Aphanothece spp.,*
7.	*Phacus spp,*	**31.**	*Euglena spp.,*
8.	*Pediastrum spp.,*	**32.**	*Microcystis spp.*
9.	*Scenedesmus spp.,*	**33.**	*Ophiocytium spp.,*
10.	*Spirogyra spp.,*	**34.**	*Oocystis spp.,*
11.	*Closterium spp.,*	**35.**	*Frustulia spp.,*
12.	*Cocconema spp.,*	**36.**	*Cosmarium spp.,*
13.	*Cosmarium spp.,*	**37.**	*Hyalodiscus spp.,*
14.	*Cosmocladium spp.,*	**38.**	*Nevicula spp.,*
15.	*Desmidium spp.,*	**39.**	*Nevicula spp.,*
16.	*Fragilaria spp.*	**40.**	*Pediastrum spp.,*
17.	*Pediastrum spp.,*	**41.**	*Ditome spp.,*
18.	*Pleurosigma spp.,*	**42.**	*Pediastrum spp,*
19.	*Scenedesmus spp.,*	**43.**	*Ankistrodesmus spp.,*
20.	*Coelastrum spp.,*	**44.**	*Fragilaria spp,*
21.	*Oedogoneum spp.,*	**45.**	*Spirogyra spp*
22.	*Oscillatoria spp.,*	**46.**	*Oscillatoria spp.,*
23.	*Selenastrum spp.,*	**47.**	*Phacus spp.,*
24.	*Sphaerocystis spp.,*	**48.**	*Zygnema spp.*

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