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# PRELIMINARY OBSERVATIONS ON PHYTOPLANKTON AT SACRED PALUSTRINE HABITAT, CENTRAL GUJARAT, INDIA

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**Abstract**

The aim of the present study was to depict the phytoplankton composition of Sacred Palustrine Habitat (SPH), Anand District, Central Gujarat, India. Collections of phytoplankton were carried out at three permanent sampling stations on monthly basis for one year (June 2012 to May 2013). The phytoplankton population was represented by 39 genera and 48 species belongs to family Bacillariophyceae (21 species), followed by Cyanophyceae (7 species), Cholorophyceae (18 species), and Euglenophyceae (2 species). Species such as *Ankistrodesmus convolutus* Corda, *Closteriopsis longissima* Lemmermann, *Oscillatoria perornata* Skuja, *Oscillatoria subbrevis* Schmidle, *Syndrea ulna* (Nitzsch) Ehrenberg, were found abundant at all the study sites, while some species were rare 56.25% (n=27).

Key words: *Phytoplankton, Sacred Palustrine Habitat, Central Gujarat, India*

**Abbreviations**: SPH: Sacred Palustrine Habitat; D1: Sampling Station-1; D2: Sampling Station-2; D3: Sampling Station-3

## Introduction

Wetland ecosystems are among the most productive ecosystems in the biosphere. Wetlands receive surface water inputs from streams, precipitation, and overland flow and subsurface water inputs from surface infiltration, stream hypothetic zones, and ground water. These different inputs are important to wetland productivity because they contain markedly different quantities of transported nutrients **(Stanley and Ward, 1997)**, and organic matter **(Mann and Wetzel, 1995)**. Wetlands are recognized as ecosystems that harbour high biological diversity, provide sustenance for millions of people and face various threats

because of human activities throughout the world **(Gopal and Chauhan, 2001)**. As ecosystems, wetlands are highly vulnerable to environmental fluctuations. Although wetland biodiversity constitutes significant portion (15-20%) of the total biodiversity of the Indian Subcontinent **(Gopal and Chauhan, 2001)**, studies of wetland ecosystems are limited **(Tsai and Ali, 1997; Gopal and Zutshi, 1998; Gopal and Chauhan, 2001; De Graaf and Marttin, 2003)**. A pond is a body of standing water, either natural or man-made, that is usually smaller than a lake. They may arise naturally in floodplains as part of a river system, or they may be somewhat isolated depressions; examples include vernal pools and prairie potholes **(Clegg, 1986)**.Usually they contain shallow water with marsh and aquatic plants and animals. The type of life in a pond is generally determined by a combination of factors including water level regime particularly depth and duration of flooding and nutrient levels, but other factors may also be important, including presence or absence of shading by trees, presence or absence of streams, effects of grazing animals, and salinity **(Keddy, 2010)**.

Phytoplankton is an integral component of freshwater wetlands, which significantly contribute towards succession and dynamics of zooplankton and fish **(Payne and Knight, 1997)**. Community structure, dominance and seasonality of phytoplankton in tropical wetlands are highly variable and are functions of nutrient status, water level, morphometry of the underlying substrate and other regional factors **(Gopal and Zutshi, 1998; Zohary *et al*., 1998; Agostinho *et al*., 2001)**. Phytoplankton forms the main producers of an aquatic ecosystem, which control the biological productivity. They not only provide an estimation of standing crop but also represent more comprehensive biological index of the environmental conditions **(Misra *et al*., 2001)**. Phytoplankton is the most important among aquatic micro-flora, which includes blue green algae, green algae, diatoms, desmids, euglenoids etc. They form the primary link in the food chain of all aquatic animals **(Misra *et al*., 2001)**. Many herbivores, mostly zooplankton, graze upon the phytoplankton, thus passing the stored energy to its subsequent higher trophic levels. The study of phytoplankton composition provides information for the characterization of aquatic ecosystems **(Pompeo *et al*,. 1998)**. These organisms constitutes the first and quantitatively most imperative link in the food chain representing the main source of oxygen and energy to the higher trophic level organisms of the aquatic environment **(Juliana *et al*., 2012)**.

## Materials and Methods

***Description of Study Area***

Sacred Palustrine Habitat (SPH), District Anand, Central Gujarat, India, is located at $22.75^0$ N and $73.15^0$ E and has an average elevation of 49 meters (~160 feet) above MSL; temperature ranges from lowest 12 $^0$C (Winter) to highest 34 $^0$C (Summer) **(World Weather Online, 2008)**. According to 2001 census, the human population of Dakor is around 23,784 with an average literacy rate of 76%. More than 70-80 lakhs devotees visit Dakor every year, and on the day of "*Falguni Purinma*" 10-15 lakhs devotees visit Dakor **(Census Commission of India, 2004)**. It is the most worshiped temple of Deity Lord Krishna and has become the source of attraction for the people not only from India but from every corners of the world **(Fig. 1)**.


**Fig. 1.** Holistic View of Sacred Palustrine Habitat (SPH), Central Gujarat, India

***Sampling***

Collection of phytoplankton was carried out at three permanent sampling stations of Sacred Palustrine Habitat (SPH) on monthly basis for one year (June 2012 to May 2013). Collective samples were procured with plankton nets of mesh size 25 µm from the possible euphotic zone of entire study area covering each geographical section of terrains and landscapes. The samples were preserved in 4% formalin on-site, and subsequently brought to the laboratory for further identification. Phytoplankton samples were identified with an aid of a light compound binocular microscope (45X) (Almicro), using standard monographs and manuals **(Desikachary, 1959; Edmondson, 1963;**, **Philipose, 1976; Prescott, 1984; Anand,**

**1998)**. All the samples were preserved in plankton laboratory for comparative studies of other samples as a future reference. The occurrence status of all the taxa were determined on the basis of method depicted by **Matteucci and Colma (1982), as** Abundant (A) - > 80%; Common (C) - ≤ 70%, and Rare (R) - <10%.

**Results and Discussion**

The phytoplankton of SPH was represented by 48 species belongs to 39 genera and 4 families. Of which, 16 genera (41.02%) were represented by Bacillariophyceae, followed by Cholorophyceae 15 (38.46%), Cyanophyceae 6 (15.3%), and Euglenophyceae 2 (5.12%) **(Table 1, Fig. 3)**. The peak gradient of diversity of phytoplankton could be due to high altitude of variety in habitat heterogeneity **(Juliana *et al*., 2012)**, owing to the occurrence of high magnitude of aquatic macrophytes in and around the vicinity of SPH **(Soni and Thomas, 2013)**. Such macrophytes aid as substrates in enhancing the locomotion for the epiphytic algae on hydrological regime of the tank influenced by favoring surface water quality for sustenance of planktons (**Soni and Thomas, 2013a; Soni and Thomas, 2013b)**.

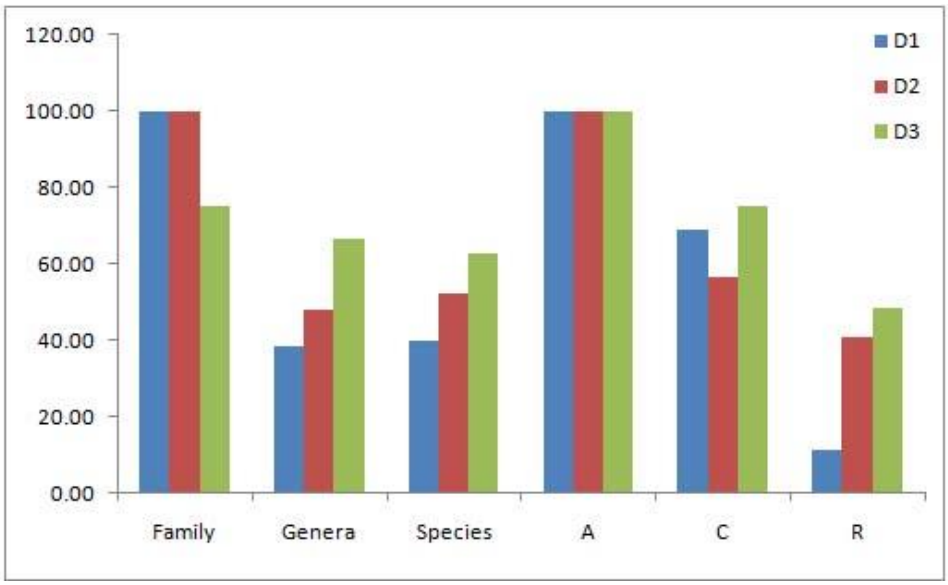


**Fig. 3.** Percent Distribution of Phytoplankton at SPH

**Table 1.**Occurrence of Phytoplankton at SPH

| Family | Genera | Species | G:S |
|---|---|---|---|
| Cholorophyceae | 15 | 18 | 1.20 |
| Cyanophyceae | 6 | 7 | 1.17 |
| Bacillariophyceae | 16 | 21 | 1.31 |
| Euglenophyceae | 2 | 2 | 1.00 |
| **Total (4 Families)** | **39** | **48** | **1:9.8:12 (F:G:S)** |

The dominance of phytoplankton was reflected by the occurrence of members of family Bacillariophyceae 21 species (43.75%), followed by 18 species (37.5%) of Cholorophyceae, Cyanophyceae 7 species (14.58%) and only 2 species (4.16%) of Euglenophyceae. These results clearly depict the importance and dominance of Bacillariophyceae and Cholorophyceae in the aquatic ecosystem of SPH because of cooler climatic conditions during winter **(Agostinho *et al*., 2004) (Fig. 2)**. Plankton can vary widely in space and time because of the plethora of niches exhibited by such ecosystems **(Baruah and Kakati, 2009)**.

Among the total recorded species (21), the most abundant belongs to family Bacillariophyceae, represented by *Syndrea ulna* (Nitzsch) Ehrenberg, which exhibited its occurrence throughout the study period at all the study stations, whereas the common species among them were *Caloneis amphisbaena* (Bory), *Didymosphenia geminata* (Lyngbye) M. Schmidt, *Naviculasp*., *Rhopalodia gibba* (Ehrenberg) Otto Müller, *Tabellaria fenestrata* (Lyngbye) Kutzing, *Tabellaria flocculosa* (Roth) Kutzing; while rest of the species

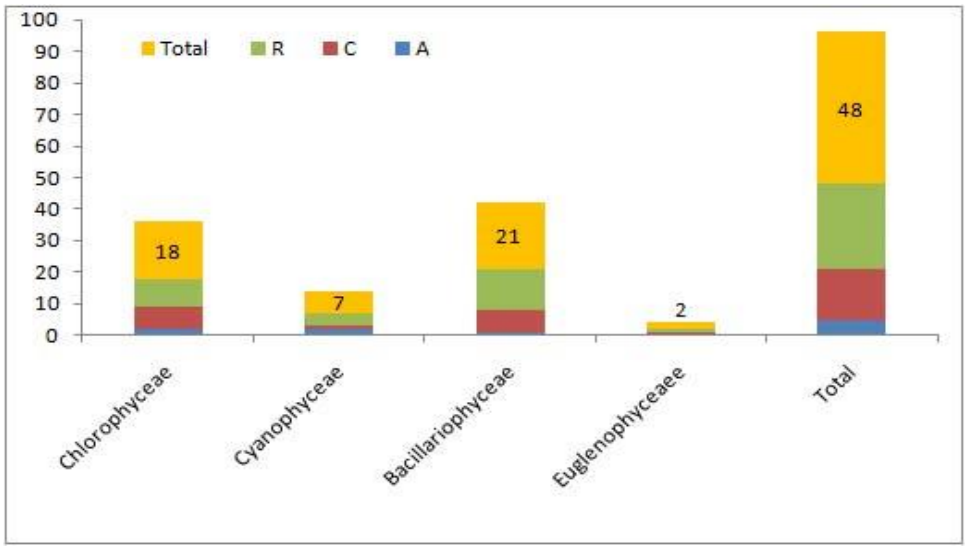


**Fig. 2.** Occurrence and Status of Phytoplankton Families at SPH

of the family were noted rarely. The dominance of Bacillariophyceaen members amongst phytoplankton substantiates the previous work of **Zutshi (1991)**.

Of the reported families, Cholorophyceae formed the second most dominant group of phytoplankton represented by 18 species. Amongst the recorded species, the dominant taxa are *Ankistrodesmus convolutus* Corda and *Closteriopsis longissima* Lemmermann. On the contrary, species such as *Ankistrodesmus falcatus var. radiatus* (Chodat) Lemmermann, *Chlorella vulgaris* Beyerinck, *Raphidonema sempervirens* Chodat, *Scenedesmus bijugatus var. disciformis* Chodat, *Scenedesmus quadricauda* (Turpin) Brebisson, *Selenastrum westii* G.M. Smith, and *Volvox aureus* Ehrenberg were observed as common, and the rest of the species were sporadic. The similar trend was observed by **Juliana *et al*. (2012)** in waters of Contas River, northeastern Brazil.

Of the documented species (7) of Cyanophyceae, *Oscillatoria perornata* Skuja and *Oscillatoria subbrevis* Schmidle dominated the other members of the family, and *Anabaena variabilis* Kutzing was the only species found as common. During the present investigation, it was surprising that the majority of the species were classified as infrequent as these organisms were observed only during one or two months throughout the study period. Contrastingly, family Euglenophyceae was represented by only two species *viz. Phacus longicauda* Ehrenberg Dujardin and *Euglena viridis* Ehrenberg, which could be a resultant impact of minimal degree of pollution at SPH. The findings are well-corroborated with **Misra *et al*. (2001)** at Bhoj wetland of Madhya Pradesh, India.

The reported taxon (39 genera, 48 species) of phytoplankton at SPH is depicted by a ratio 1:9.8:12 (Family: Genera: Species). **Table 1** noticeably indicates remarkable peak of species richness (16 Genera, 21 Species) of phytoplankton taxa belongs to family Bacillariophyceae, with a ratio 1:31 (Genera: Species), followed by Cholorophyceaen members (15 Genera, 18 Species) with Genera: Species ratio (1:20). Besides, family Cyanophyceae was ruled with six genera and seven species (Genera: Species ratio - 1:31), while least recorded taxa were represented by members of family Euglenophyceae with only two genera and two species each (Genera: Species ratio - 1:1).

**Table 2** denotes the site-wise description of reported families, genera and species of phytoplankton along with their status at SPH. Sites D1 and D2 showed the existence of all the documented families (4). Highest numbers of genera (26) of phytoplankton were recorded in water of Site 3 and the least number of genera (15) was observed at Site 1, whereas the water of Site 2 exhibited the intermediate number of phytoplankton genera (23). Similarly, in

**Table 2.**Distribution of Families, Genera and Species at Sampling Stations of SPH

| Description | D1 | D2 | D3 | SPH |
|---|---|---|---|---|
| **Family** | 4 | 4 | 3 | 4 |
| **Genera** | 15 | 23 | 26 | 39 |
| **Species** | 19 | 25 | 30 | 48 |
| **A** | 5 | 5 | 5 | 5 |
| **C** | 11 | 9 | 12 | 16 |
| **R** | 3 | 11 | 13 | 27 |

congruence with the observed genera, the maximum was number of species was noticed at Site 3, following Site 2, and the least species richness was reported at Site 1. With respect to the status, five species of phytoplankton were found abundant in the water of all the sampling stations, whereas 12 species were classified as common at Site 3, following 11 at Site 2, and the least (9) at Site 3. During the study period, some phytoplankton species appeared only during one or two months and thus were categorized as rare species. Highest number (13) of such species was seen at Site 3, preceded by Site 2 (11) and the least at Site 1 (3).

Thus, in total 39 genera and 48 species were recorded at Sacred Palustrine Habitat (SPH) throughout the tenure of the research work. The ratio of Family: Genera: Species revealed that for each family, 9 genera and 12 species of phytoplankton were present. Among the recorded families, family Bacillariophyceae was occurred as the most dominant family accounted for 41%, following Cholorophyceae (38%), Cyanophyceae (15.3%), and the least was Euglenophyceae with 5.1% **(Table 1)**. The site-wise approach at SPH showed the prolific occurrence of all four families of phytoplankton at Sites 1 and 2, whereas Site 3 was recorded with only three families. The peak gradient of phytoplankton species was observed at Site 3 reflected by the existence of members of family Bacillariophyceae and Cholorophyceae. On the contrary, members of family Euglenophyceae (Pollution Indicator) were noted in the water of Sites 1 and 2, whereas Site 3 was devoid of any species of Euglenophyceae. Moreover, the water of Site 2 was found to be dominated by Cyanophyceaen taxa throughout the study period **(Table 2, Annexure-1)**. The dominance of particular taxa of phytoplankton was also observed by **Mittal and Sengar (1991)** and **Zohary *et al*. (1998)**.

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**Annexure 1.** Checklist of Phytoplankton at SPH

| Family | Species | D1 | D2 | D3 | Status |
|---|---|---|---|---|---|
| Cholorophyceae | *Ankistrodesmus convolutus* Corda | + | + | + | A |
| | *Ankistrodesmus falcatus var. radiates* (Chodat) Lemmermann | + | | + | C |
| | *Botryococcus protuberans* West & G.S. West | | | + | R |
| | *Chlorella vulgaris* Beyerinck | + | + | | C |
| | *Cladophora glomerata (Linnaeus)* Kutzing | | | + | R |
| | *Closteriopsis longissima* Lemmermann | + | + | + | A |
| | *Closterium tunidium* | | + | | R |
| | *Raphidonema sempervirens* Chodat | + | | + | C |
| | *Rhizoclonium hieroglyphicum* (C.Agardh) Kutzing | | + | | R |
| | *Scenedesmus bernardii* G.M.Smith | + | | | R |
| | *Scenedesmus bijugatus var. disciformis* Chodat | | + | + | C |
| | *Scenedesmus quadricauda (Turpin)* Brebisson | + | | + | C |
| | *Schizogonium murale* Kutzing | | | + | R |
| | *Selenastrum westii* G.M.Smith | | + | + | C |
| | *Spirotaenia condensata* Brebisson | | | + | R |
| | *Tetraedron victorieae var. major* Smith | | + | | R |
| | *Uronema elongatum* Hodgetts | | | + | R |
| | *Volvox aureus* Ehrenberg | | + | + | C |
| | **Species** | **7** | **9** | **13** | |
| Cyanophyceae | *Anabaena variabilis* Kutzing | + | | + | C |
| | *Merismopedia* Sp. Meyen | | + | | R |
| | *Microcystis aeruginosa* Kutzing | | + | | R |
| | *Oscillatoria perornata* Skuja | + | + | + | A |
| | *Oscillatoriasubbrevis*Schmidle | + | + | + | A |
| | *Synechococcus elongatus* Nagel | | + | | R |
| | *Synechocystis crassa* Voronichin | | | + | R |
| | **Species** | **3** | **5** | **4** | |
| Bacillariophyceae | *Caloneis amphisbaena* (Bory) | + | + | | C |
| | Chaetoceros Ehrenberg, | | + | | R |

| | | | | | |
|---|---|---|---|---|---|
| | Cyclotella meneghiniana Kutzing | | | + | R |
| | Didymosphenia geminata (Lyngbye) M. Schmidt | + | | + | C |
| | *Eunotia pectinalis* (Kutzing) Rabenhorst | | + | | R |
| | *Fragilaria capucina* Desmazieres | | | + | R |
| | *Gomphonema parvulum* (Kutzing) Kutzing | | + | | R |
| | *Gomphonema sphaerophorum* Ehrenberg | | | + | R |
| | *Gyrosigma attenuatum* (Kutzing) Cleve | | | + | R |
| | Meridion circulare var. constrictum (Ralfs) Van Heurck | | | + | R |
| | *Navicula radiosa* Kutzing | + | | | R |
| | *Navicula* sp. | + | | + | C |
| | *Nitzschia amphibia* Grunow | + | + | | C |
| | *Nitzschia palea* (Kutzing) W.Smith | | + | | R |
| | *Nitzschia sigmoidea* (Nitzsch) W.Smith | | | + | R |
| | *Pinnularia* Ehrenberg | | + | | R |
| | *Rhoicosphenia curvata* (Kutzing) Grunow | | | + | R |
| | *Rhopalodia gibba* (Ehrenberg) Otto Muller | | + | + | C |
| | *Syndrea ulna* (Nitzsch) Ehrenberg | + | + | + | A |
| | *Tabellaria fenestrata* (Lyngbye) Kutzing | + | | + | C |
| | *Tabellaria flocculosa* (Roth) Kutzing | | + | + | C |
| | **Species** | **7** | **10** | **13** | |
| Euglenophyceae | *Phacus longicauda* Ehrenberg Dujardin | + | | | R |
| | *Euglena. Viridis* Ehrenberg | + | + | | C |
| | **Species** | **2** | **1** | **0** | |
| | **Total Species** | **19** | **25** | **30** | |

* D1, D2, D3: Sampling Stations