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A Review On Diatom Flora of Rajasthan

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Abstract

A review of Rajasthan's diatom flora reveals a variety of communities dominated by genera like Navicula, Nitzschia, Cyclotella, Gomphonema, and Synedra, which are essential for comprehending water quality. Gandhi's (1955) early research, followed by works by Jakher, Dadheech, and others, highlights their roles in semi-arid lake/river ecosystems like Mansagar, Chambal, and Kaylana, which are frequently connected to nutrient levels, pollutants, and paleoclimatic records. Because phytoplanktons play a crucial role as primary producers in any aquatic ecosystem, their study is of significant interest. The movement of phytoplankton, which are collections of diverse microscopic algal forms, is mostly dependent on ocean currents. Twenty percent of the oxygen we breathe comes from diatoms in the water, which are also a major source of food for fish and other microscopic creatures. These tiny algae are also crucial to the nitrogen and carbon cycles in the seas. The goal of the current study is to investigate the ecology and variety of the diatom flora in the Hanumangarh district. Shannon diversity indices ranged from 1.60 to 3.84, species evenness ranged from 0.37 to 0.66, and Simpson's diversity index ranged from 0.022 to 0.22. The diversity indices showed that the places under study had a moderate amount of diversity and light to moderate contamination. According to this study, the availability of nutrients may have made the post-monsoon period more conducive to diatom growth. There are sixty-two known species of diatoms. These species were represented by sixty-two species and twenty-seven genera.

Keywords:-Diatoms ,Phytoplankton, Rajasthan, Siliceous skeleton, Water bodies.

Introduction

One of the most prevalent algae groupings in freshwater and terrestrial environments are diatoms (Bacillariophyceae). These are unicellular, occasionally colony-forming eukaryotic tiny algae that inhabit moist soils, freshwater environments, and the ocean[1]. They can float freely or cling to surfaces. Its well-preserved glass-like walls make them perfect tools for a variety of uses as both living things and fossils. They are crucial to the cycles of silicon and carbon. Because most species have limited tolerances to site-specific traits, diatom assemblages are frequently useful bio-indicators. They are highly preserved in sediments because their frustules are made of silica that is resistant over time.Since the 1990s, diatoms have been widely used in studies about ecosystems, where they live, and ancient environments[1]. The first study on freshwater diatoms in Pratapgarh, Rajasthan, was done by Gandhi. Diatoms are tiny, single-celled algae that make up most of the plankton found in freshwater. They have a special cell wall made of silica, called a frustule, which helps them stay preserved in sediments. The structure of a diatom has two flat parts called valves, which are connected by a girdle[2]. Researchers from different parts of India have studied diatoms in various places across the country. Krishnamurthy contributed to understanding diatoms in South India. Gonzalves and Gandhi studied diatoms in Bombay in 1952 and 1953. Sarode and Kamat worked on the classification of freshwater diatoms in Vidarbha. Jena and others reported 78 types of diatoms, including Aulacoseira, Cyclotella, Tabellaria, and others, from different freshwater areas in Orissa and nearby regions of India[1-2]. All these species were first found in this area. Patil and Kumawat studied centric diatoms in Abhora Dam, Jalgaon, Maharashtra. Jadhawar and Papdiwal looked at diatom diversity in Nath Sagar water reservoir, Maharashtra. Recent studies show that it's important to examine the makeup, quantity, and biological indicators of diatoms because they play a key role in checking water quality and protecting the environment. Diatoms are interesting. They are not plants or animals, but they have some features of both. Though they are simple and single-celled, their cell walls are beautifully shaped and made of silica. Now, scientists have sequenced the genome of a common diatom species, which is a big step in understanding these unusual microbes[3].

Diatoms are found in large areas of the ocean and fresh water, where they play an important role in the global carbon cycle. They are a food source for many organisms and can also cause ocean "blooms" that can be harmful. Deborah Robertson, an algal physiologist at Clark University in

Worcester, Massachusetts, says, "This is a group of organisms that has amazing importance in global ecology[1]."

Since 2002, Daniel Rokhsar, a genomicist at the DOE Joint Genome Institute in Walnut Creek, California, and his team have been studying the genome of the saltwater diatom Thalassiosirapseudonana[2].

Their draft genome is about 34 million bases long and includes around 11,500 genes, as reported in the 1 October issue of Science. By analyzing these genes and the proteins they make, the team has found that diatoms have a complex history. Like other early microbes, they gained new genes by taking in other microbes. One of the most important was an algal cell, which gave diatoms the ability to perform photosynthesis. Some scientists think that diatom ancestors split from an early nucleated microbe, from which plants and animals later evolved. As diatoms, plants, and animals evolved, each group lost different genes from this common ancestor. This means that diatoms now have a mix of plant and animal DNA[3-4].

The new genome has also helped scientists understand how diatoms create their finely patterned glass shells. So far, Rokhsar and his team have found twelve proteins involved in making the silica shell and expect to find more. This progress could be useful for materials scientists, says Robertson. Edward Theriot, a diatom systematist at the University of Texas, Austin, predicts that with the genome available, more people will start paying attention to diatoms: "It will help put diatoms on everyone's radar[4]."

Singh studied three major water bodies in Jaipur and found that Synedra, Melosira, Rhoicosphenia, and Cyclotella are common in GaltaKund, which flows from one side to the other. However, only Cyclotella is common in Mansagar lake, as it is heavily polluted and still. A wide variety of diatoms, including Navicula, Geisselaria, Achnanthidium, Nitzschia, etc., were found in Mavatha, a seasonal pond in Amer, Jaipur, Rajasthan. Barupal and Meghwal reported species like Amphora, Navicula, Gyrosigma, Diadesmis, Gomphonema, Cymbella, Achanthes, Cocconeis, Fragilaria, Synedra, Ctenophora, Nitzschia, and Cyclotella in a study on ponds in Churu[1]. Two separate studies on the Chambal River were done by Grover et al. (2017) and Srivastava et al. (2017), and they found species like Navicula, Cyclotella, Cymbella, Rhopalodia, Melosira, and Gomphonema. More species, including Achnanthidium, Cocconeis, Caloneis, Amphora, Nitzschia, Brachysira, Neidium, Sellaphora, and Hantzschia, were reported by Grover et al. and Narayan et al. from the Chambal River. The general species found are Navicula,

Nitzschia, Synedra, Gomphonema, Fragilaria, and Cyclotella[5]. Navicula is found in all water bodies except Kunda reservoir in Bharatpur and the reservoirs in the desert region of Rajasthan, such as Jaisalmer, Jodhpur, Churu, and Bikaner. Brachysira is a species of diatom in the Navicules order and is found only in the Chambal River. Only two locations are known to have Achnanthidium: Maavath in Jaipur and the Chambal River in Kota. Stauronies, a type of diatom, are found in northern rocks where the pH is slightly acidic to nearly neutral. In Rajasthan, they are especially common in Kaylana Lake in Jodhpur. These diatoms grow in brackish water, showing that the Indira Gandhi Canal has more salt than fresh water but less than seawater. This canal has salinity higher than freshwater but not as high as sea water[3-5].

Key Findings & Genera

- **Dominant Genera:** Navicula, Nitzschia, Cyclotella, Synedra, Fragilaria, Gomphonema, and Melosira are common genera[1].
- **Environmental Indicators:** Diatoms in Rajasthan's water bodies function as bioindicators for water quality, exhibiting sensitivity to physicochemical parameters like dissolved salts, hardness, nitrates, and phosphates, influencing community structure[2].
- **Site-Specific Species:** Certain diatom types appear in specific locations, such as Stauroneis in Kaylana Lake and Brachysira, Achnanthidium in the Chambal River[3].

Historical Research Context

- **Pioneering Work:** Gandhi (1955) initiated the study of diatoms in Rajasthan.
- **Later Contributions:** By examining seasonal variations in Mansagar Lake and other regions, researchers including Jakher, Dadheech, Singh, and Kumar have expanded on this.
- **Broader India Review:** Rajasthan's results are placed in a national context by more recent assessments that cover diatom research throughout India[5].

Ecological Significance

- **Bioindicators:** Diatoms are useful for evaluating eutrophication and pollution in aquatic ecosystems[6].
- **Paleolimnology:** Their frustules, which have siliceous shells, are useful proxies for reconstructing historical climates.
- **Forensics:** The location and time of drowning can be ascertained with the use of diatoms found in drowned remains[1].

Challenges & Future Directions

- **Under-Investigated Habitats:** Due to water constraint, many aquatic habitats in Rajasthan have not been well investigated for diatoms[1].
- **Conservation:** Although comparable principles apply in Punjab, an understanding of diatom variety helps design management plans for wetlands such as the Ropar wetland[6].

Materials And Methods

Kaylana Lake is located approximately 8 kilometers west of Jodhpur city. It is at 26 degrees 29 minutes north latitude and 72 degrees 96 minutes east longitude. The lake gets its water from the Hathinahar, which is connected to the Indira Gandhi Canal. The depth of the lake ranges from 5 feet to 50 feet, with the deepest part being in the south-west direction[6]. The lake has a water capacity of 191 million cubic feet and covers an area of 84 square kilometers. It holds water throughout the year and serves as a main source of drinking water for Jodhpur city. In this study, the shallow and deep water areas of Kaylana Lake were chosen[7]. Samples were collected monthly for a year, from July 2013 to June 2014. For the study of diatoms, the diatom valves were cleaned with concentrated hydrogen peroxide to remove organic matter, then with hydrochloric acid to dissolve calcium carbonate. After washing with distilled water, the samples were placed on slides with Naphrox. Clean frustules were examined for their shape and structure. Using a light microscope at 1000 magnification, at least 500 valves per slide were counted and identified to the species level[8].

Table1. DiatomfloraofRajasthan.

S. No.	Name of the species	Habitat
1.	Achnanthdium minutissium Achnanthidium sibiricm	Pools and ditches surrounding the town Mavaatha Jaigarh fort (Jaipur)[8]
2.	Achnanthes andicola Achna nthes exigua	Galta Kund (Jaipur)[8] Chambal river (Kata)
3.	Amnoseia sp.	Chambal river (Kota)
4.	Amphora ovali	Pichola lake (Udaipur) Galta kund (Jaipur)[8] Kishore Sagar (Kota)[1]
5.	Anomoeneis sphaerophora	Indira Gandhi Canal, Ghaggar river, (Hanumangarh)[6].
6.	Bacillaria paxillifera	Pichola lake, (Udaipur)[1]
7.	Brachysira brebissonii Brac hysira zellensis Brachysira s erians Brachysira styriaca Brachysira follies	Chambal river, (Kota)[1]

8.	Cocconeis pediculusCocconeis placentula	Kishore Sagar (Kota)[1] Gang Canal (Sri Ganganagar)[8], Kaylana Lake (Jodhpur)[5], Chambal river (Kota[3], Sawai Madhopur[9]), Ponds - Fatehpuria pond, Sethani Johada, Pithana Johada, Droun pond, Manaksar pond, Natho pond, Talchhapar pond, Chadwas Pond, Parmana pond, Girdhar pond (Churu)[2], Kaylana Lake (Jodhpur)[5].
9.	Coscino discus	Galta Kund, Mavaath lake (Jaipur)[8] Indira Gandhi Canal (Ghaggar river, Hanumangarh)[6].
10.	Ctenophora pulchella	Kaylana Lake (Jodhpur)[5].
11.	Cyclostephanos dubius	Chambal river (Kota)[3].
12.	Cyclotella comta Cyclotella kutzingiana	Kund reservoir - open pond (Bharatpur)[2].
13.	Cyclotella meneghinianaCyclotella striata	Surrounding ponds and ditches (Pratapgarh)[9], Galta kund (Jaipur)[8] Pichola lake[6], Jaisamand lake (Udaipur)[2] Chambal river (Kota)[3], Gang Canal (Sri Ganganagar)[8].
14.	Cymbella rupicola Cymbella turgid Cymbella veniricosa Cymbella aspera	Kishore Sagar[7], Chambal river (Kota)[3], Pichola lake[6], Jasisamand lake (Udaipur)[2], Gang Canal (Sri Ganganagar)[8].
15.	Diadesmis confervacea	Kaylana Lake (Jodhpur)[15].
16.	Eunotia minor Eunotia pectinalis Eunita valida Eunita implicate	Pools and ditches surrounding the town (Pratapgarh)[9].
17.	Fragilaria intermedia	Kishore Sagar[17], Chambal river (Kota)[13], Galta Kund, Mavatha lake (Jaipur)[8] Pichola lake[16], Jasisamand lake (Udaipur)[21], Gang Canal (Sri Ganganagar)[18], Kaylana Lake (Jodhpur)[15], Ghaggar river, Indira Gandhi Canal - Ghaggar river (Hanumangarh)[6].
18.	Frustulia capucia Frustulia jogensis	Pools and ditches surrounding the town (Pratapgarh)[9].
19.	Geissleria kriegeri Geissleria decussia Geissleria punctifera	Mavatha - Amer fort (Jaipur)[8]
20.	Gomphonema lanceolatum Gomphonema parvulum Gomphonema clavatoides	Pools and ditches surrounding the town (Pratapgarh)[9], Kishore Sagar[7], Chambal river (Kota)[3], Galta Kund, Mavtha (Jaipur)[8] Pichola lake[6], Jasisamand lake (Udaipur)[2], Indira Gandhi Canal - Ghaggar river Hanumangarh)[6].
21.	Gyrosigma baikalensis Gyrosigma maharashtrensis	Kaylana lake (Jodhpur)[5].
22.	Hantzschia amphioxys	Pools and ditches surrounding the town (Pratapgarh)[9], Galta Kund (Jaipur)[8] Chambal river (Kota)[3]. The arid region of Rajasthan (Jaisalmer, Jodhpur, Bikaner, Churu)[11].
23.	Melosira granulate Melosira varians	Pushkkar lake (Pushkar)[10], Mansagar lake, Jag Mahal, Galta Kund, Mavatha pond (Jaipur)[8] Chambal river (Kota)[3],

Conclusion

According to this review study, the most prevalent diatom species found in Rajasthan's water bodies are Navicula, Nitzschia, Cyclotella, Synedra, Fragilaria, and Gomphonema. However, some site-specific diatom species have also been found, such as Stauroneis in Jodhpur's Kaylana Lake and Brachysira in Kota's Chambal River. The diatom composition of the Hanumangarh district's river, canal, dam, and pond was examined. 32 diatom species from the Bacillariophyceae family of planktonic algae communities were identified by light microscope study and comparison with diatom monographs and atlases. Gomphonima (5 spp. 1 var.), Cymbella (4 spp.), Fragilaria (3 spp. 1 var.), and Nitzschia (3 spp.) were the most varied genera. The Hanumangarh district is where all of these taxa were initially identified. Despite Rajasthan's abundance of rivers, fresh and saltwater lakes, playas, ponds, and puddles, a total of 37 diatom species have been identified to yet. Rajasthan has a variety of diatom habitats, thus more carefully planned research is needed to better understand this significant group of microscopic organisms. This review only offers a list of diatoms that have been reported to date.

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