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CYANOBACTERIAL DIVERSITY IN A FRESHWATER ECOSYSTEM

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ABSTRACT

Cyanobacteria are prokaryotic blue-green algae that are major constituent of planktonic communities in fresh water ecosystems. Various forms of cyanobacteria occur in diverse habitats of Rajasthan. Many workers have explored the freshwater cyanobacteria of Rajasthan. During summer days cyanobacterial species flourish very well. Diversity of cyanobacteria in fresh water ecosystem under high temperature has been reported in this paper. For the identification of cyanobacterial species trinocular microscope was used.

Keywords: *Freshwater, Diversity, Cyanobacteria.*

Introduction

Cyanobacteria are the most primitive, thallophytic, autotrophic and prokaryotic algae, also known as blue-green algae. They are dominant during Precambrian period as per the study of microfossils and carbon isotopic data (Lee, 2008; Whitton, 2012) [12, 21]. They exhibit morphological diversity and may occur in variety of morphological forms. They show variation in size from 1 µm in diameter to several 100 µm (Dodds and Whiles, 2011) [4]. These are the only prokaryotes which can evolve oxygen by photosynthesis (Whitton, 2012) [21]. They also forms blooms. Cyanobacteria can exploit every possible extreme of habitats since their existence (Dodds and Whiles, 2011) [4]. Light, temperature and nutrients affect their growth. Some of these also have the capacity of nitrogen fixation. (Lee, 2008; Moss, 2010) [12, 13].

Rajasthan, also known as Marusthal having Thar Desert, is the largest state of the India. It has some rivers like Luni, Banas, Chambal, Mahi, Parwati, Mez, Parwan etc. Chambal river is the only perennial freshwater river of desert land of Rajasthan in India. In the present study Chambal River in Kota region of Rajasthan was taken as fresh water ecosystem to study cyanobacterial diversity. A coal-based thermal power plant is located on the bank of Chambal River and its water is used as coolant during generation of electricity (http://energy.rajasthan.gov.in/rvunl). The water quality and algal diversity of Chambal river was studied by many workers (Saksena *et al*., 2008; Tiwari and Singh, 2008; Gupta *et al*., 2011; Bhatnagar and Bhardwaj, 2013; Gaur *et al*., 2014; Jain *et al*., 2015; Yadav *et al*., 2014; Grover *et al*., 2017) [18, 19, 7, 2, 5, 8, 22, 17]. Aim of the present research was to study the diversity of cyanobacteria in a freshwater river which is under the influence of a thermal power plant.

Materials and Methods

- **Study Area**

The site of the present study is Kota city of Rajasthan, located in south eastern part of Rajasthan. The freshwater Chambal river originates from Janapao Hills of Vindhya range in south of Mhow town of Madhya Pradesh state and it covers 225 km across Rajasthan state during its course (https://www.waterdatabase.com/rivers/chambal-river/).

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Kota Thermal Power Station, also known as KTPS, is located on the bank of Chambal River. It is the coal based super thermal power plant of Rajasthan operational since 1983, for generation of electricity with total installed capacity of 1240 MW(http://energy.rajasthan.gov.in/rvunl).

- **Sampling**
  - For the present study three sampling sites were selected along the Chambal River and simple random probability sampling method was used for sampling.
  - First station (Stn.1) was near Akelgarh i.e entry pint of river in the city.
  - Second station (Stn.2) was near the thermal power plant
  - Third station was at the Shiv temple (Stn.3) in the downstream (Figure 1, 2 & 3).

Fig 1: Stn.1 near Akelgarh

Fig 2: Stn.2 near the thermal power plant

Fig 3: Stn.3 at the Shiv temple

Results and Discussion

The cyanobacterial diversity of freshwater ecosystem was studied. Total 13 genera with 23 species were observed in freshwater ecosystem Chambal River at selected stations (Table 1).

Mainly in southern part of India some workers has been documented has been the effect of thermal effluents on aquatic flora and fauna (Krishnakumar, 1991; Poornima *et al*., 2005; Vinitha *et al*., 2010) [11, 14, 20]. But they studied cyanobacterial diversity in marine waters. Few workers has studied the algal diversity of freshwater Chambal River in Rajasthan in reference of pollution status and its water quality only. Gaur *et al*. (2014) [5] have reported few taxa of cyanobacteria like *Oscillatoria*, *Microcystis*, *Phormidium, Nostoc* and *Anabaena* in a study on Chambal river water. Bhatnagar and Bhardwaj (2013) [2] have reported total 13 genera and 21 species of cyanobacteria during their study. Cyanobacteria like *Merismopedia, Oscillatoria* and *Microcystis* have been observed of more common occurrence in the studies done on algal diversity of Chambal River by most of the workers.

At upstream station Stn.1, 9 species of cyanobacteria were observed, 20 species at second station Stn.2 while 12 species of cyanobacteria were observed at downstream station Stn.3. in present study station Stn.2 was found rich in cyanobacterial species among the three sites selected. As this one is under the influence of thermal effect due to the discharge from thermal power station, so that may be the possible reason for species richness at this station. Thermal tolerant genera like *Merismopedia, Planktothrix* and *Synechococcus* were more common at Stn.2. *Anabaena, Aphanocapsa, Chroococcus, Merismopedia, Oscillatoria, Planktothrix* and *Spirulina* were observed at upstream stations during the study period. On the other hand cyanobacterial taxa like *Cylindrospermopsis, Gloeocapsa, Lyngbya, Synechococcus* and *Synechocystis* were found to be localized at Stn. 2 only. The thermal power plant uses the river water as coolant and then the heated water is discharged into the freshwater river. Hence there is effect of thermal discharge from the thermal power plant which is making the river water rich in cyanobacterial diversity particulary at station Stn.2.

The thermal effect was not observed at stations Stn.1 and Stn.3, as Stn. 1 is situated at the upstream of the freshwater river, that don't get heated water from thermal. It is not affected by anthropogenic activities and any kind of pollution. So the lowest number of cyanobacterial species was observed at this site. Stn.3 is situated in downstream i.e. far from thermal site, so heated water become normal when reaches here. This site is more affected with human interference which is main cause of organic pollution at this station and so the reason for common occurrence of bloom forming cyanobacteria at station Stn.3. *Microcystis* was found to be dominant at station Stn.3.

Table 1: Occurrence of Cyanobacteria in Freshwater Ecosystem

Cyanobacteria	Stn.1	Stn.2	Stn.3
Anabaena sp**.**	+	+	-
Aphanocapsa grevillei (Hass.) Rabenh.	+	+	-
Aphanocapsa littoralis Hansgirg	-	+	-
Chroococcus sp.	+	+	+
Chroococcus dispersus (v. Keissler) Lemm.	+	+	-
Chroococcus minor (Kütz.) Näg.	-	+	+
Cylindrospermopsis sp. Seenaya & Subba Raju	-	+	-
Gloeocapsa sp.	-	+	-
Gloeocapsa punctata Näg.	-	+	-
Lyngbya sp.	-	+	-
Merismopedia elegans A. Br.	+	+	+
Merismopedia minima Beck	-	+	+
Microcystis aeruginosa Kutz.	-	+	+
Microcystis flos-aquae (Wittr.) Kirchner	-	-	+
Microcystis smithii Komarek et Anagnostidis	-	-	+
Microcystis wesenbergii (Komarek) Komarek in Kondrateva	-	+	+
Oscillatoria subbrevis Schmidle	+	+	+
Oscillatoria tenuis Ag. ex Gomont	-	+	+
Oscillatoria chlorina Kütz. ex Gomont	+	-	+
Planktothrix sp. Anagnostidis & Komárek	+	+	+
Spirulina laxissima forma major f. nov. West, G.S.	+	+	-
Synechococcus sp.	-	+	-
Synechocystis sp.	-	+	-
(+ present - absent)			

Conclusion

As the Stn.1 is located at the upstream of freshwater ecosystem Chambal River and is minimally polluted site, so it was observed with the lowest species of cyanobacteria while Stn.3 is a downstream site with moderate presence of cyanobacterial species. On the other hand, Stn.2 receives the thermal effect in the form of discharge from a nearby thermal power plant so it might be the reason for highest species diversity of cyanobacteria.

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