Freshwater algae of Manali river, Kerala, India

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Abstract
Algae play a pivotal role in maintaining life on earth, beneficial to the aquatic ecosystems and are excellent indicators of water pollution. The present study is an attempt to explore the algal diversity and to make a taxonomic account on it, from Manali River, a tributary of Karuvannur River, Thrissur District, Kerala, which lies at longitude $76^0 15'E$ and latitude $10^0 26'N$. Karuvannur River is one of the major freshwater sources of Thrissur district, which is flowing through the famous Kole lands of Thrissur. The study was carried out for a period of one year, from June 2017 to May 2018. During the period of study, 50 species of phytoplankton were identified which comes under 35 genera belonging to six taxonomic classes. Of these 18 species belongs to Bacillariophyceae (36%), 16 species under Chlorophyceae (32%), 12 species under Euglenophyceae (24%), 2 species under Cyanophyceae (4%), 1 species each under Xanthophyceae (2%) and Dinophyceae (2%). In this river, Bacillariophyceae showed more diversity, followed by Chlorophyceae during the period of study.

Keywords: algal diversity, bacillariophyceae, chlorophyceae, cyanophyceae, dinophyceae, euglenophyceae, Karuvannur river, Manali river, xanthophyceae

Introduction
Karuvannur River is one of the major rivers in Thrissur District with a length of about 48km. It has two main tributaries, Kurumali River and Manali River. Manali River which lies in $76^0 15'E$ and latitude $10^0 26'N$ is originating from the Peechi - Vazhani Wildlife Sanctuary. Rivers are one of the major source of freshwater and an ideal habitat for aquatic organisms including algae. Algae are a large and diverse group of simple, typically autotrophic organisms, ranging from unicellular to multicellular forms. In the freshwater environments, algae are typically present as inconspicuous organisms (Bellinger and Sigee, 2010) [3], however, they have a noticeable role in the ecological aspects, markedly as pollution indicators (Palmer, 1969) [10]. The prime function served by algae is the production of oxygen and maintenance of food chain, since they are the primary producers. It is thought that, algae are generating about half of all the oxygen produced on the planet (Chapman, 2013) [4]. As fundamental components of the water food web, they are among the first to react with the water quality changes (Omar, 2010) [9] and thus algae are useful in the assessment of water quality also.

Materials and methods
The surface water samples were collected from Manali River at monthly intervals from June 2017 to May 2018.

Collected samples were preserved by adding 4% formalin (APHA, 1998) [1] in it and kept undisturbed to allow the sedimentation of plankton suspended in the water. Further these sediments were observed thoroughly under research microscope for the taxonomic analysis. Photomicrographs of algal taxa taken with digital camera attached to the research microscope. Identification of the observed taxa was done with the help of standard floras (Scott and Prescott, 1961; Philipose, 1967; Prescott, 1982; Turner, 1982; Sarode and Kamat, 1984; Islam and Irfanullah, 2005; John and Francis, 2012) [15, 11, 12, 16, 14, 14, 6, 7] and literatures on algae.

Result and Discussion
During the period of study, 50 species of phytoplankton were identified which comes under 35 genera belonging to six taxonomic classes (Table 1). Of these 18 species belongs to Bacillariophyceae (36%), 16 species under Chlorophyceae (32%), 12 species under Euglenophyceae (24%), 2 species under Cyanophyceae (4%), 1 species each under Xanthophyceae (2%) and Dinophyceae (2%). This study shows that, Bacillariophyceae has more diversity in the site, followed by Chlorophyceae during the period of study. Many studies (Babu *et al.*, 2014; Hafiz *et al.*, 2014; Rajeswari and Krishnamurthy, 2015; Malik *et al.*, 2018) [2, 5, 13, 8] has shown Bacillariophyceae as the diverse group of phytoplankton in river system.

Table 1: Algae of Manali River

| Classes	Organism name
Chlorophyceae	1. *Eudorina elegans* Ehr.
	2. *Pandorina cylindricum* Iyengar
	3. *Chlorococcum infusionum* (Schrank) Menegh.
	4. *Schroederia planctonica* (Skuja) Philipose
	5. *Pediastrum tetras* (Ehr.) Ralfs
	6. *Tetraedron gracile* (Reinsch) Hansgirg
	7. *Ankistrodesmus falcatus* (Corda) Ralfs v. *radiatus* (Chodat) Lemm.
	8. *Coelastrum microporum* Naegeli

	9. *Crucigenia quadrata* Morren
	10. *Scenedesmus dimorphus* (Turp.) Kuetz.
	11. *Scenedesmus quadricauda* (Turpin) Breb. v. *bicaudatus* Hansgirg
	12. *Closterium gracile* Breb.
	13. *Closterium kuetzingii* Breb.
	14. *Cosmarium psuedobroomei* Wolle
	15. *Arthrodesmus convergens* Ehr.
	16. *Xanthidium cosmariforme* Turn.
Xanthophyceae	17. *Centritractus belanophorus* Lemm.
Bacillariophyceae	18. *Aulacoseira granulata* (Ehr.) Ralfs
	19. *Aulacoseira granulata* v. *angustissima* O. Muell.
	20. *Cyclotella meneghiniana* Kuetz.
	21. *Tabellaria fenestrata* (Lyngbye) Kuetz.
	22. *Synedra ulna* (Nitz.) Ehr.
	23. *Achnanthes hungarica* Grun.
	24. *Gyrosigma acuminatum* (Kuetz.) Rabh.
	25. *Navicula cari* Ehr. v. *angusta* Grun.
	26. *Navicula cryptocephala* Kuetz.
	27. *Neidium indicum* Gonzalves et Gandhi
	28. *Neidium affine* (Ehr.) Cleve v. *longiceps* (Greg.) Cleve
	29. *Pinnularia acrosphaeria* (Breb.) W. Smith
	30. *Pinnularia brebissonii* (Kuetz.) Cleve
	31. *Pinnularia interrupta* W. Smith f. *minor* Boye Pet.
	32. *Cymbella turgidula* Grun.
	33. *Nitzschia gracilis* Hantzsch
	34. *Nitzschia obtusa* W. Smith
	35. *Surirella tenera* Gregory
Euglenophyceae	36. *Euglena acus* Ehr.
	37. *Euglena oblonga* Schmitz.
	38. *Euglena proxima* Dangeard
	39. *Euglena spirogyra* Ehr.
	40. *Phacus helikoides* Pochmann
	41. *Phacus longicauda* (Ehr.) Dujardin
	42. *Lepocinclis acuta* Prescott
	43. *Lepocinclis ovum* (Ehr.) Lemm.
	44. *Trachelomonas armata* (Ehr.) Stein. v. *longispina* (Playf.) Defl.
	45. *Trachelomonas superba* (Swir.) Defl. v. *swirenkiana* Defl.
	46. *Trachelomonas volvocina* Ehr.
	47. *Strombomonas fluviatilis* (Lemm.) Defl.
Dinophyceae	48. *Peridinium inconspicuum* Lemm.
Cyanophyceae	49. *Merismopedia tenuissima* Lemm.
	50. *Oscillatoria subbrevis* Schmidle

Plate 1: 1. *Eudorina elegans* Ehr. 2. *Pandorina cylindricum* lyengar. 3. *Chlorococcum infusionum* (Schrank) Menegh. 4. *Schroederia planctonica* (Skuja) Philipose. 5. *Pediastrum tetras* (Ehr.) Ralfs. 6. *Tetraedron gracile* (Reinsch) Hansgirg. 7. *Ankistrodesmus falcatus* (Corda) Ralfs v. *radiatus* (Chodat) Lemm. 8. *Coelastrum microporum* Naegeli. 9. *Crucigenia quadrata* Morren. 10. *Scenedesmus dimorphus* (Turp.) Kuetz. 11. *Scenedesmus quadricauda* (Turpin) Breb. v. *bicaudatus* Hansgirg. 12. *Closterium gracile* Breb. 13. *Closterium kuetzingii* Breb. 14. *Cosmarium psuedobroomei* Wolle. 15. *Arthrodesmus convergens* Ehr. 16. *Xanthidium cosmariforme* Turn. 17. *Centritractus belanophorus* Lemm. 18. *Aulacoseira granulata* (Ehr.) Ralfs. 19. *Aulacoseira granulata* v. *angustissima* O. Muell. 20. *Cyclotella meneghiniana* Kuetz.
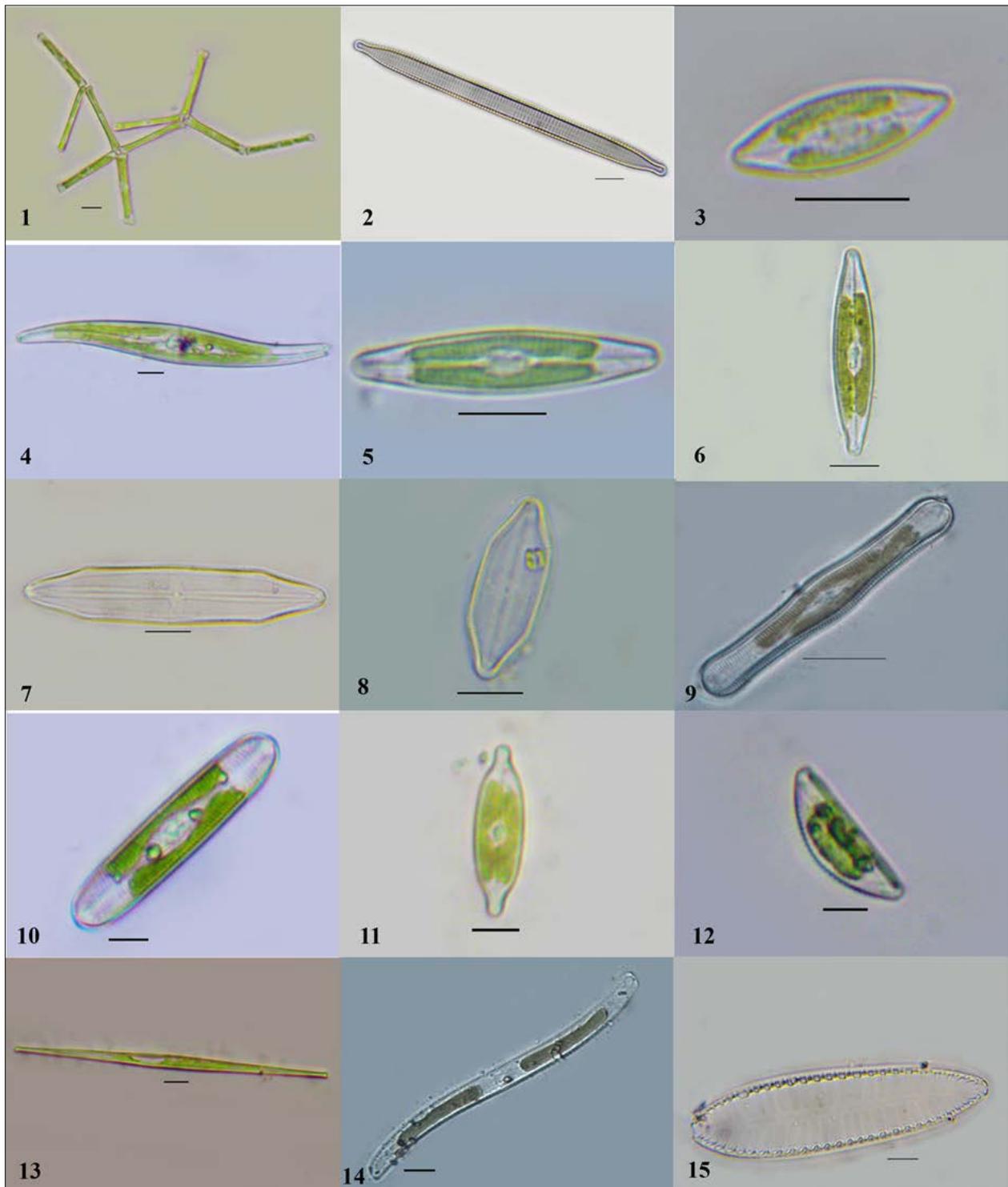
Plate 2: 1. *Tabellaria fenestrata* (Lyngbye) Kuetz. 2. *Synedra ulna* (Nitz.) Ehr. 3. *Achnanthes hungarica* Grun. 4. *Gyrosigma acuminatum* (Kuetz.) Rabh. 5. *Navicula cari* Ehr. v. *angusta* Grun. 6. *Navicula cryptocephala* Kuetz. 7. *Neidium indicum* Gonzalves et Gandhi. 8. *Neidium affine* (Ehr.) Cleve v. *Iongiceps* (Greg.) Cleve. 9. *Pinnularia acrosphaeria* (Breb.) W. Smith. 10. *Pinnularia brebissonii* (Kuetz.) Cleve. 11. *Pinnularia interrupta* W. Smith f. *minor* Boye Pet. 12. *Cymbella turgidula* Grun. 13. *Nitzschia gracilis* Hantzsch. 14. *Nitzschia obtusa* W. Smith. 15. *Surirella tenera* Gregory.
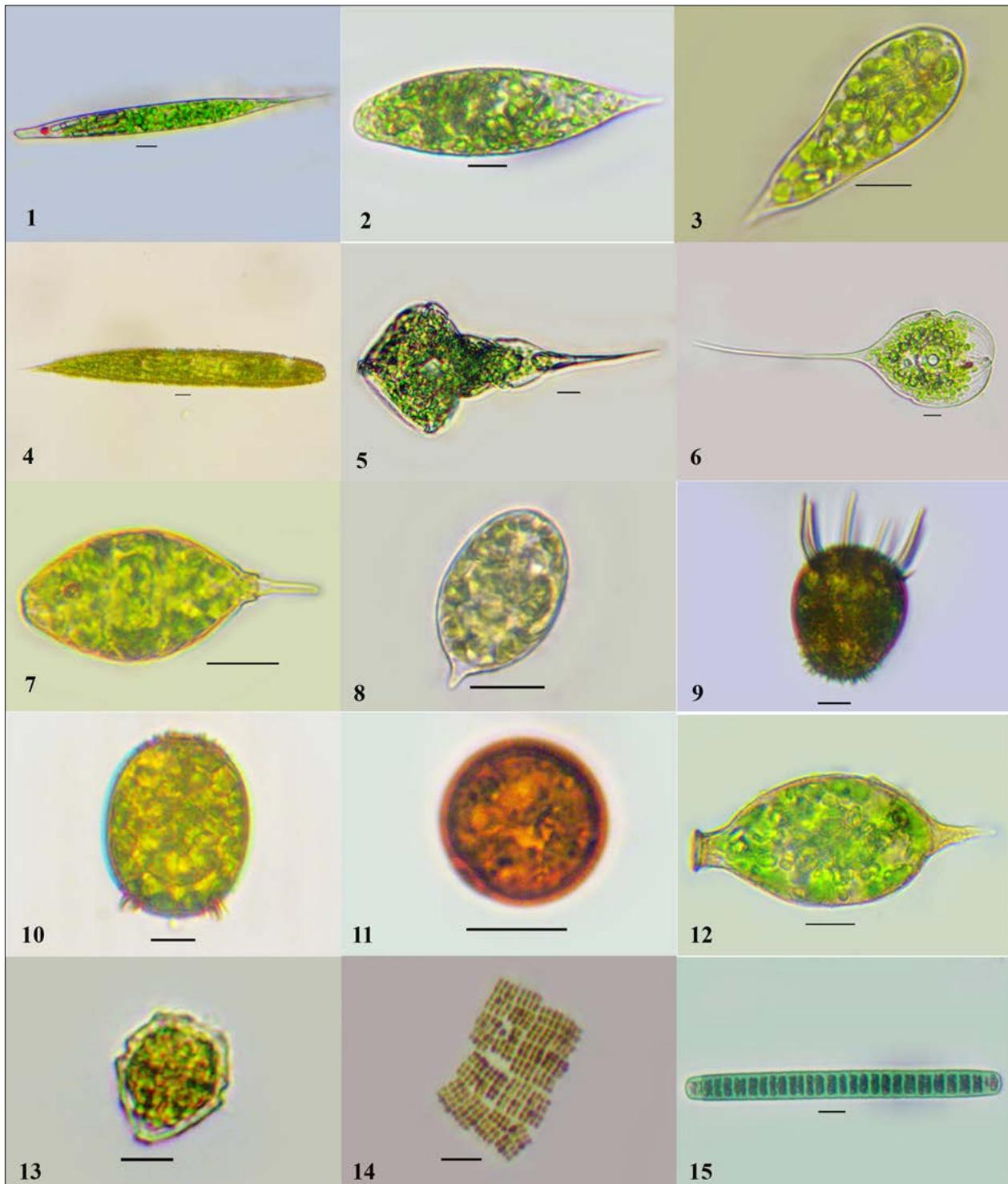
Plate 3: 1. *Euglena acus* Ehr. 2. *Euglena oblonga* Schmitz. 3. *Euglena proxima* Dangeard. 4. *Euglena spirogyra* Ehr. 5. *Phacus helikoides* Pochmann. 6. *Phacus longicauda* (Ehr.) Dujardin. 7. *Lepocinclis acuta* Prescott. 8. *Lepocinclis ovum* (Ehr.) Lemm. 9. *Trachelomonas armata* (Ehr.) Stein. v. *longispina* (Playf.) Defl. 10. *Trachelomonas superba* (Swir.) Defl. v. *swirenkiana* Defl. 11. *Trachelomonas volvocina* Ehr. 12. *Strombomonas fluviatilis* (Lemm.) Defl. 13. *Peridinium inconspicuum* Lemm. 14. *Merismopedia tenuissima* Lemm. 15. *Oscillatoria subbrevis* Schmidle.

Conclusion

This study explored the phytoplankton diversity of Manali River, a tributary of Karuvannur River, Thrissur District, Kerala. 50 species of algae were observed during the period of study which belongs to 6 classes and 35 genera, in which diatoms shows more diversity than other groups.

Acknowledgements

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