



ALGAL DIVERSITY IN DIFFERENT HABITATS FROM NORTHERN REGION OF IDUKKI DISTRICT, KERALA, INDIA

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The present study enumerates in detail with photographs 52 algal taxa belonging to 37 genera and 5 classes from 10 different habitats in northern region of Idukki district of Kerala, India. Out of these Chlorophyceae with 18 genera, Cyanophyceae with 9 genera, Bacillariophyceae with 7, Euglenophyceae with 2 genera and Dinophyceae with 1 genus were reported. This is the first study from Idukki district focusing on the different habitats influencing algal diversity.

Keywords : Algal diversity, Idukki, Kerala and Habitats.

India is one of the World's top mega biodiversity countries. The rich biodiversity and ecosystem at species level is due to its varied climatic conditions and geographical physical features. India has some of the World's most bio diverse regions (Singh *et al.* 2011). Idukki district of Kerala, India is one such heaven on earth due to its wide biodiversity and natural beauty.

Idukki, the largest district of Kerala with an area of 5105.22 km², shows tremendous diversity and uniqueness with respect to geographical, topographical and climatic conditions. It lies between 9° 15' and 10° 21' of north latitude and 76° 37' and 77° 25' of east longitudes (John and Francis 2013). The district is geographically known for its unmatched scenic beauty embracing lush-green tropical forests, enthralling mountainous hills and radiant valleys, co-existing with natural and man-made water bodies, rivers, streams, various panoramic plantations and agricultural fields.

The highlands slope down from Western Ghats, rises to an average height of 900 m, with a number of peaks well over 1900 m in height with, temperature varying between - 1°C to 15°C in November to January and 5°C to 15°C during March to April. This area receives plenty of rains from both the South-West monsoon during June-August and the

North-East monsoon during October-November (John and Francis 2012).

This moderate climate makes it an ever attractive destination for all. The high ranges and characteristic flora and fauna there make the district the “Kashmir of the South”. Freshwater algal flora is abundant in the rivers of the district. There are seven major rivers and several tributaries which are blessed with plenty of water almost throughout the year.

The Western Ghats region of Idukki with tropical ever green forest and rich freshwater resources are rich in microalgal diversity. Being the primary producers in the grazing food chain, microalgae hold the key for the productivity of all water bodies. All animals living in water are directly or indirectly linked with microalgae in their life cycle. Mapping and enlisting all these algal taxa is the preliminary step to understand their links with other life forms (John and Francis 2013), various possibilities of utilizing them as well as to take measures to withstand various anthropogenic pressures on their habitat (John and Francis 2010).

A systematic study was done on the freshwater algal flora of Western Ghats (Idukki District, Kerala, India) (John and Francis 2012), one of the biodiversity hotspots in the world which is an enriched

with great species of algae. The stream under investigation was a seasonal originating from the hills of Iliyari Mala of Idukki district, and flows six kilometers downstream to join Thodupuzha river at Manakad. The lower reach of this stream gets cut off as a pond in summer when the upstream flow ceases, and the pond develops a floating scum of filamentous algae.

Micro algal diversity of the fresh water Vellayani Lake in Thiruvananthapuram district, Kerala was also studied (Gopinath and Kumar 2015). In an another study, diversity of fresh water algae from 37 temple-tanks in Palakkad and Thrissur district in Kerala was observed (Pathmanapan *et al.* 2010) but there was no reports showing the comparison of algal diversity in different habitats in any of these studies. So, the present study was under taken to enumerate the algal flora in their natural habitats from Idukki district, Kerala. As there was no previous report focussing on the influence of the different habitats on the algal diversity from the above mentioned area.

MATERIALS AND METHODS

Algal samples were collected from 10 different habitats namely waterfalls, canals, dam, tea leaves, stems of tea plants, rocks and pebbles, coconut shell, tree barks, soil, small ditches and submerged plants in northern region of Idduki district of Kerala, India. Collections of samples were made in the month of March 2012 from different sampling sites namely- Adimali, Kallar Waterfall, Mattupetty Dam, Echo Point, Kundala Dam, Top Station (Periyar), Periakanal Waterfall, Anayirangal Dam, Chinnakanal Dam, Devikulam and Munnar (Fig. 1).

A total of 50 fresh wet algal samples were collected and preserved in 4% formalin. All the samples were deposited in the LWG herbarium of the CSIR-National Botanical Research Institute, Lucknow. Microscopic observations were made in Leica DM 500 light microscope and photomicrography was done with attached Leica EC3 Camera with computerized image analysis system. Taxa

were identified by referring the standard publications (Prescott 1951), (Tiffany and Britton 1952), (Desikachary 1959), (Scott and Prescott 1961), (Philipose 1967).

RESULTS

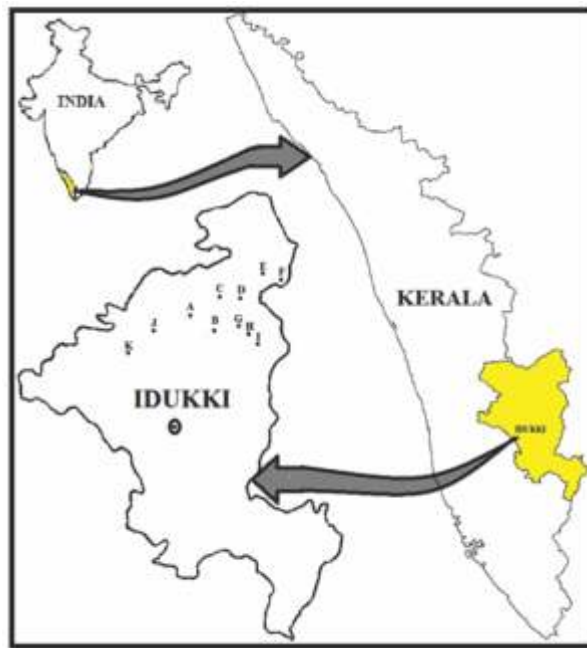


Figure 1 : Map showing sampling sites in Idukki district, Idukki in Kerala (India). Algal sampling sites: A=Munnar, B=Devikulam, C=Mattupetty Dam, D=Echo Point, E=Kundala Dam, F=Top Station (Periyar), G= Periakanal Waterfall, H= Anayirankal Dam, I= Chinnakanal Dam, J= Kallar Waterfall and K=Adimali.

Out of the eleven classes of algae, five are represented in the present study. Out of the 52 taxa of algae recorded, 18 genera belonging to Chlorophyceae, 7 to Bacillariophyceae, 1 to Dinophyceae, 2 to Euglenophyceae and 9 to Cyanophyceae (Fig. 2).

Various habitats harbouring the algal diversity are as follows: in Chinnakanal (*Staurodesmus omearae*, *Tetraedron regulare*, *Scenedesmus abundans*, *Peridinium inconspicuum*, *Phacus longicauda*, *Euglena viridis*, *Melosira varians*, *Pleurotaenium coronatum*, *Oedogonium* sp., *Gyrosigma eximium*), Perikanal (*Aphanothece nidulans*, *Spirogyra plena*, *Nostoc punctiforme*, *Phormidium ambiguun*, *Calothrix thermalis*, *Cocconeis placentula*, *Scenedesmus obliquus*,

Fragilaria pinnata, *Botryococcus braunii*, *Microcystis aeruginosa*, *Pinnularia amabilis*, *Spirogyra* sp.), Kundala Dam (*Nostoc calcicola*, *Chroococcus minor*, *Cosmarium tenue*, *Crucigenia crucifera*, *Coelastrum cambricum*, *Botryococcus braunii*, *Cymbella perparva*, *Gomphonema diminutum*, *Oscillatoria quadripunctulata*, *Staurastrum longibrachiatum*, Kallar Waterfall (*Cylindrocystis brebissonii*, *Chlorella vulgaris*, *Anabaena circinalis*), rocks and pebbles (*Anabaena circinalis*, *Aphanothece saxicola*, *Asterococcus limneticus*, *Phormidium ambiguun*, *Microcystis aeruginosa*, *Scytonema coactile*, *Pediastrum boryanum*, *Cosmarium reniforme*, *Oscillatoria limosa*, *Anabaena constricta*), small ditches (*Chlorella vulgaris*, *Microcystis pseudofilamentosa*, *Cylindrocystis brebissonii*), tree bark (*Trentepohlia aurea*), tea stem (*Nostoc Punctiforme*, *Scytonema alatum*, *Stigeoclonium polymorphum*, *Oscillatoria formosa*), tea leaf (*Trentepohlia aurea*) and on coconut shell (*Draperaldia plumose*), on soil (*Oscillatoria curviceps*, *Chroococcus cohaerens*, *Nostoc Punctiforme*,

Phormidium ambiguun, *Scytonema coactile*), submerge plants (*Cosmarium contractum*, *Staurastrum gracile*, *Scenedesmus dimorphus*).

In present study the algal diversity in various habitats was reported as follows: in Pericanal (15 Genera), Chinnacanal (14 Genera), Kundala Dam (10 Genera), rocks and pebbles (9 Genera), on soil (6 Genera), tea stem (4 Genera), small ditches (3 Genera) followed by submerge plants, Callar Waterfall (1 Genera) followed by tree bark, tea leaves and on coconut shell.

DISCUSSION

Earlier studies on the algal diversity from Idukki district have reported the profuse algal growth. Various different habitats have conserved different algal flora. In Idukki, there are small pools and ditches (Kulangal) used by people for drinking, irrigation purpose, etc. Water tanks also have good number of algal flora. During cultivation and post cultivation periods, they are rich in algal population. Also paddy fields converted for the cultivation of pine apple, areca nut,

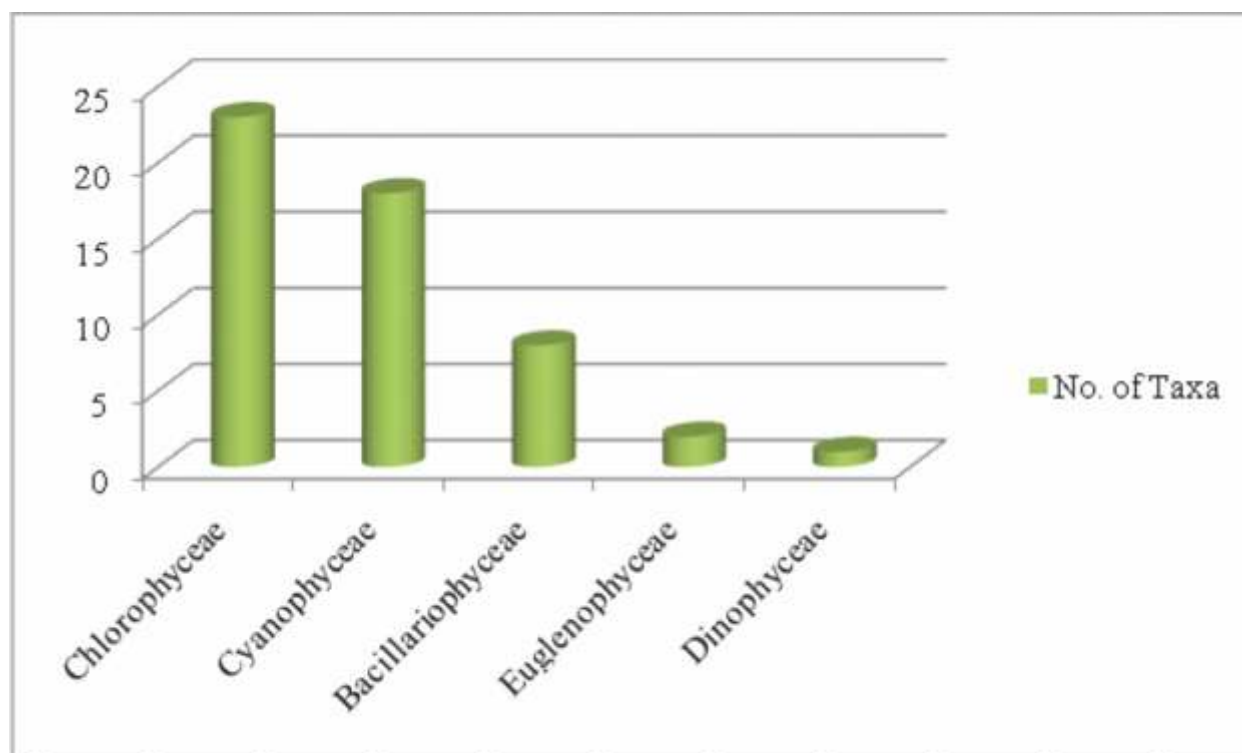


Figure 2 : Showing number of algal taxa in different classes.

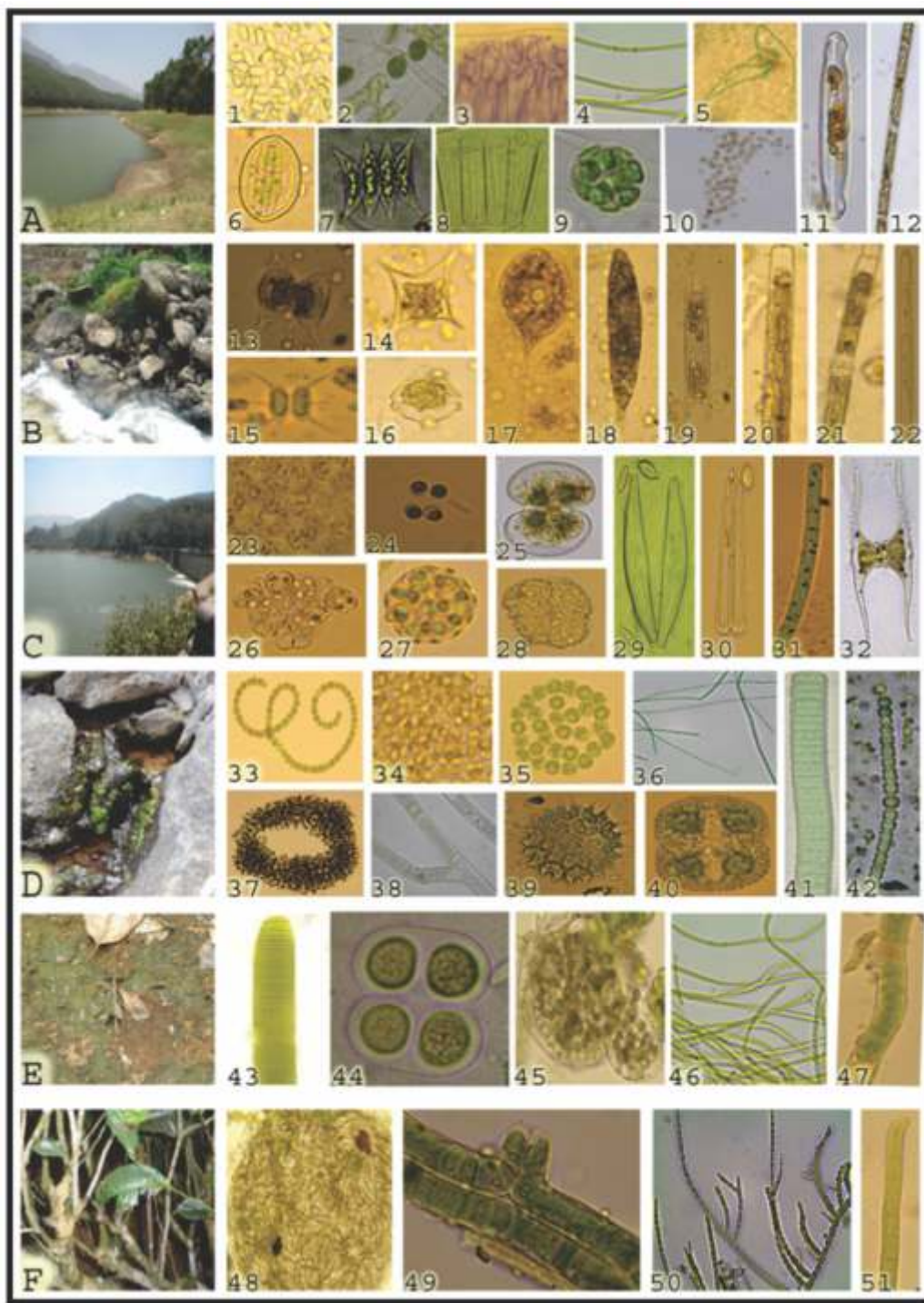


Plate 1 (A to F) : Showing algal diversity in various habitats in Idduki District, Kerala, India.

A. Periakanal Waterfall: 1. *Aphanothece nidulans*, 2. *Spirogyra plena*, 3. *Nostoc punctiforme*, 4. *Phormidium ambiguum*, 5. *Calothrix thermalis*, 6. *Cocconeis placentula*, 7. *Scenedesmus obliquus*, 8. *Fragilaria pinnata*, 9. *Botryococcus braunii*, 10. *Microcystis aeruginosa*, 11. *Pinnularia amabilis*, 12. *Spirogyra* sp., **B.** Chinnakanal Dam: 13. *Staurodesmus omeareae*, 14. *Tetraedron regulare*, 15. *Scenedesmus abundans*, 16. *Peridinium inconspicuum*, 17. *Phacus longicauda*, 18. *Euglena viridis*, 19. *Melosira varians*, 20. *Pleurotaenium coronatum*, 21. *Oedogonium* sp., 22. *Gyrosigma eximium*, **C.** Kundala Dam: 23. *Nostoc calcicola*, 24. *Chroococcus minor*, 25. *Cosmarium tenue*, 26. *Crucigenia crucifera*, 27. *Coelastrum cambicum*, 28. *Botryococcus braunii*, 29. *Cymbella perparva*, 30. *Gomphonema diminutum*, 31. *Oscillatoria quadripunctulata*, 32. *Staurastrum longibrachiatum*, **D.** Rocks & Pebbles at Anayirankal Dam: 33. *Anabaena circinalis*, 34. *Aphanothece saxicola*, 35. *Asterococcus limneticus*, 36. *Phormidium ambiguum*, 37. *Microcystis aeruginosa*, 38. *Scytonema coactile*, 39. *Pediastrum boryanum*, 40. *Cosmarium reniforme*, 41. *Oscillatoria limosa*, 42. *Anabaena constricta*, **E.** Soil at Echo Point: 43. *Oscillatoria curviceps*, 44. *Chroococcus cohaerens*, 45. *Nostoc punctiforme*, 46. *Phormidium ambiguum*, 47. *Scytonema coactile*, **F.** Tea Stem at Munnar: 48. *Nostoc punctiforme*, 49. *Scytonema alatum*, 50. *Stigeoclonium polymorphum*, 51. *Oscillatoria formosa*,

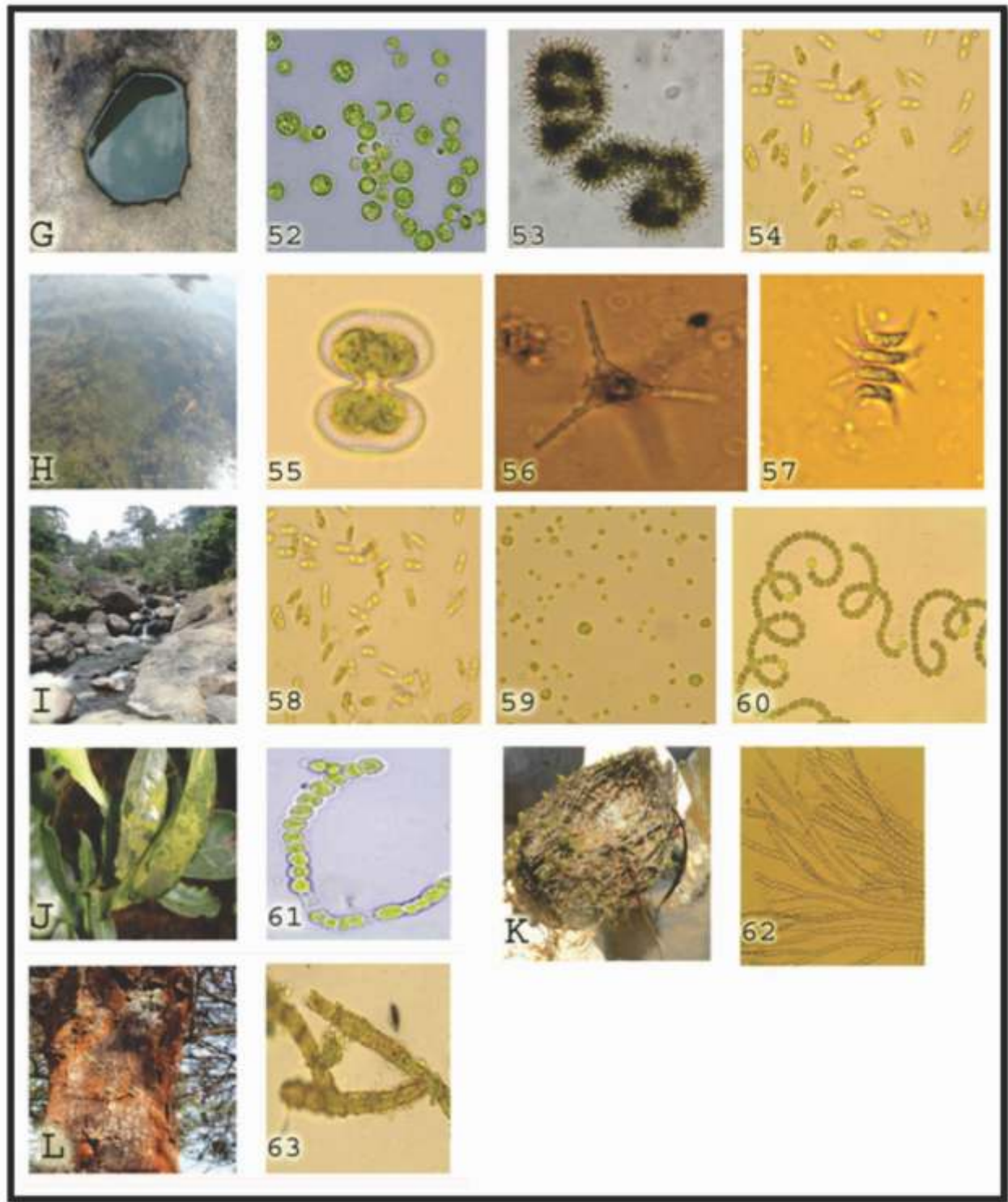


Plate 2 : (G to L) : Showing algal diversity in various habitats in Idduki District, Kerala, India.

G. Ditches at Mattupetty Dam : 52. *Chlorella vulgaris*, 53. *Microcystis pseudofilamentosa*, 54. *Cylindrocystis brebissonii*, **H.** Submerged Plants at Adimali: 55. *Cosmarium contractum*, 56. *Staurastrum gracile*, 57. *Scenedesmus dimorphus*, **I.** Kallar Waterfall: 58. *Cylindrocystis brebissonii*, 59. *Chlorella vulgaris*, 60. *Anabaena circinalis*, **J.** Tea Leaves at Munnar: 61. *Trentepohlia aurea*, **K.** Coconut Shell at Devikulam: 62. *Draparnaldia plumose* and **L.** Tree Bark at Top Station, Periyar: 63. *Trentepohlia aurea*.

[illegible]

24.	<i>Anabaena circinalis</i> Rabenhorst	-	++	-	+	-	-	-	-	++	-	-	-
25.	<i>Anabaena constricta</i> (Sz-afer) Geitler	-	++	-	+	-	-	-	-	-	-	-	-
26.	<i>Aphanothece nidulans</i> Richter	++	-	-	-	-	-	-	-	-	-	-	-
27.	<i>Aphanothece saxicola</i> Nag.	-	++	-	+	-	-	-	-	++	-	-	-
28.	<i>Calothrix thermalis</i> (Schmidle) Hansg.	++	-	-	+	-	-	-	-	-	-	-	-
29.	<i>Chroococcus cohaerens</i> (Breb.) Nag.	-	-	-	+	+	-	-	-	-	-	-	-
30.	<i>Chroococcus minor</i> (Kuetz.) Nag.	-	-	++	-	+	-	-	-	-	-	-	-
31.	<i>Microcystis aeruginosa</i> Kuetz	++	-	-	-	-	-	-	-	-	-	-	-
32.	<i>Microcystis pseudofilamentosa</i> (A.Br.) Lemm.	-	-	-	+	-	-	-	-	-	-	-	-
33.	<i>Nostoc calcicola</i> Breb.	-	-	+++	+	-	-	-	-	++	-	-	-
34.	<i>Nostoc punctiforme</i> (Kuetz.) Hariot	++	-	-	-	-	-	-	-	-	-	-	-
35.	<i>Oscillatoria curviceps</i> forma (after Rao)	-	-	-	-	+	-	-	-	-	-	-	-
36.	<i>Oscillatoria formosa</i> Bory	-	-	-	-	-	+	-	-	-	-	-	-
37.	<i>Oscillatoria limosa</i> (Roth) (A. Agardh)	-	-	-	+	-	-	-	-	-	-	-	-
38.	<i>Oscillatoria quadripunctulata</i> Bruhl&Biswas	-	-	++	-	-	-	-	-	-	-	-	-
39.	<i>Phormidium ambiguum</i> (Menegh.) Gomont	-	-	-	+	-	-	-	-	-	-	-	-
40.	<i>Scytonema alatum</i> (Carm.) Borzi	-	-	-	-	-	+	-	-	-	-	-	-
41.	<i>Scytonema coactile</i> Montagne	-	-	-	+	-	-	-	-	-	-	-	-
III.	Class BACILLARIOPHYCEAE												
42.	<i>Cocconeis placentula</i> Ehren.	++ +	+	-	-	+	-	-	-	+	-	-	-
43.	<i>Cymbella perparva</i> Krammer	+	+	+	-	+	-	-	-	+	-	-	-
44.	<i>Fragillaria pinnata</i> Ehren.	++	+	+	-	+	-	-	-	+	-	-	-
45.	<i>Gomphonema diminutum</i> Karthick & Kociolek	++	++	++	-	+	-	-	-	++	-	-	-
46.	<i>Gyrosigma eximium</i> (Thwaites) Boyer	+	++	+	+	-	-	-	+	+	-	-	-
47.	<i>Melosira varians</i> Agardh	+	++	+	+	+	-	-	+	+	-	-	-
48.	<i>Pinnularia amabilis</i> Krammer	++	+	+	+	+	-	-	-	+	-	-	-

49.	<i>Pleurotaenium coronatum</i> (Breb.) Rab	-	++	-	+	+	-	-	-	-	-	-	-
IV.	Class EUGLENOPHYCEAE												
50.	<i>Euglena viridis</i> (O.F. Muller) Ehr.	++	++	+	-	-	-	-	-	-	-	-	-
51.	<i>Phacus longicauda</i> (Ehrenb.) Dujardin	+	+	+	-	-	-	-	+	-	-	-	-
V.	Class DINOPHYCEAE												
52.	<i>Peridinium inconspicuum</i> Lemm.	-	++	-	-	-	-	-	+	-	-	-	-

***Habitats** A. Periakanal Waterfall, B. Chinnakanal Dam, C. Kundala Dam, D. Rocks & Pebbles at Anayirankal Dam, E. Soil at Echo Point, F. Tea Stem at Munnar, G. Ditches at Mattupetty Dam, H. Submerged Plants at Adimali, I. Kallar Waterfall, J. Tea Leaves at Munnar, K. Coconut Shell at Devikulam, L. Tree Bark at Top Station, Periyar.

+++; Dominant; ++; Common; +; Rare; -; Absent.

tapioca, coconut, and rubber have canals filled with water which supports algal growth. Dripping rocks, especially during monsoon season, have algal flora especially members of the Cyanophyceae. There is a special association of Nostocaceae members with the shaded side of coconut, and areca nut palms during rainy season. Tree trunks and barks, wet rocky surfaces and soils were also found to inhabit 16 algal taxa. Organic pollution have proliferated algal growth in these streams. Forest streams with no or minimum human interference were very poor in algal population.

Algae like *Cephaleuros parasiticus* and *C. Virescens* (Trentepohliaceae, Chlorophyta) have been reported from (Munnar) Kerala and (Chennai) Tamil Nadu, India from upper and lower leaf surfaces of Clove tree and Mast tree or Cemetery tree respectively (Suto *et al.* 2014). A total number of genera 41, and species 61 belonging to Chlorophyceae (Genus 20, Species 37), Bacillariophyceae (Genus 9, Species 10), Euglenophyceae (Genus 2, Species 2) and Cynophyceae (Genus 10, Species 12) were recorded from a study carried out on algal biodiversity from temple tanks of Kerala (Pathmanapan *et al.* 2010). Previous study by John and Francis 2012 from western Ghats of Idukki district has reported *Botryococcus protuberance* W. *et* G.S. West, *Tetraedron trigonum* (Naeg) Hansg. fa. *gracile* (Reinsch) De Toni, *Trentepohlia umbrina* (Kütz) Bornet, *Stigeoclonium faciculare* Kützing, *Spirogyra*

longata (Vauch.) Kutz., *Staurostrum tohopekaligense* Wolle var. *trifurcatum* West & West, *Pleurotaenium ovatum* Nordst var. *interminus* Mobius, *Pinnularia crucifera* A. Cl. var. *subcapitata* A. Cl., *Pinnularia braunii* (Grun.) Cleve var. *amphicephala* (Mayer) Hustedt, *Phacus ankylonoton* Pochmann and *Euglena kanthallorensis* sp. nov. Same genera were reported from present study of northern region of Idukki district but the species were different i.e. *Botryococcus braunii*, *Tetraedron regulare*, *Trentepohlia aurea*, *Stigeoclonium polymorphum*, *Spirogyra plena*, *Staurostrum gracile*, *Pleurotaenium coronatum*, *Pinnularia amabilis*, *Phacus longicauda* and *Euglena viridis*.

In the present study the green algae order Chlorococcalean members like *Scenedesmus*, *Chlorella*, *Crucigenia*, *Botryococcus*, *Coelastrum*, *Asterococcus* were most common form in waterfall and dam. Some Cyanophyceae like *Anabaena*, *Nostoc*, *Scytonema*, *Oscillatoria*, *Hapalosiphone* *Trentepohlia*, *Phormidium*, *Scytonema*, *Anabaena*, *Calothrix*, were very common form present in leaves, stems, barks and tree trunks and rocks. Desmids like *Cosmarium*, *Arthrodesmus*, *Staurostrum* and *Cylindrocystis* were reported from dam, waterfalls and streams.

The wide morphological diversity of algal population under some ecological and environmental conditions needs further investigation for conservation of algal species.

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