International Journal of Water Resources and Environmental Engineering Vol. 3(13), pp. xx-xx, December 2011
Available online at http://www.academicjournals.org/ijwree
ISSN 1991-637X ©2011 Academic Journals

*Full Length Research Paper*

# Species richness and diversity of chlorophyceae and bacillariophyceae in Cauvery River, Mysore, India

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Accepted 1 December, 2011

**Selected physico-chemical parameters and a taxonomic survey of fresh water algae in lotic water bodies of river cauvery in and around Mysore district were carried out between 2008 and 2009. The quantitative and qualitative analyses of chlorophyceae and bacillariophyceae have revealed the presence of 21 taxes respectively. The maximum chlorophyceae and bacillariophyceae species were found at stations $D_1$ and $R_1$ and minimum at stations $BD_2$ and $BD_3$ respectively. Decreased diversity of chlorophyceae and bacillariophyceae were noted at sites receiving urban waste and agricultural effluents. Higher pH, Turbidity, COD, chloride, and Iron coupled with low concentration of Total alkalinity, Total hardness and heavy metals favours growth of chlorophyceae and bacillariophyceae species. The environmental variables seem to play an important role in determining the species richness and diversity in the Cauvery River.**

**Key words:** Chlorophyceae, bacillariophyceae, environmental variables, Cauvery River, Mysore.

## INTRODUCTION

The monitoring of water quality can be done either by direct measurement of physic chemical properties of water or by analyzing the inhabiting biota. The quality of an aquatic ecosystem is dependent on the physico chemical qualities of water and the biological diversity of the system (Irfanullah, 2006). Algae are very important sources of food and serve as an early step in the food chain of large aquatic animal especially fish (Krishnamurthy, 2000; Easa, 2004). Algae serve as bioindicators of water quality and pollution (Mondhare and Panagle, 1995). Phytoplankton is the floating algae. They are often used as indicators of environmental and aquatic health, because of their high sensitivity to environmental change and short life span. The density and diversity of phytoplankton are influenced by the quality of water. Diversity indicates the degree of complexity of community structure .It is the function of number of species and abundance diversity has often been related to environmental characteristics of water mass and energy within community (Nath and Ray, 2006). Most of the Indian rivers are polluted to a great extent by domestic sewage and industrial wastes (Singh and Mishra, 2008; Chanu and Devi, 2008). The present investigation was carried out to study the species richness and diversity of the chlorophyceae and Bacillariophyceae in relation to nutrient status in the Cauvery River in and around Mysore District.

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### Study area

Cauvery River originates at Talakavery in the Western Ghats in the state of Karnataka and flows generally south and east through Karnataka. The river has many tributaries, before dams there is confluence of three main rivers namely, Cauvery, Hemavathi and Laxmana theertha. The study area is situated at elevation about 600 MSL and lies between latitude 12° 21$^1$30" NL and longitudes 76° 34$^1$ 34" EL. It serves as a major source of domestic, irrigation and industries water supply. Subsequently, it receives untreated domestic wastewater. The research work is focused on the KRS dam and it's upstream.

The sampling location are spread throughout the study

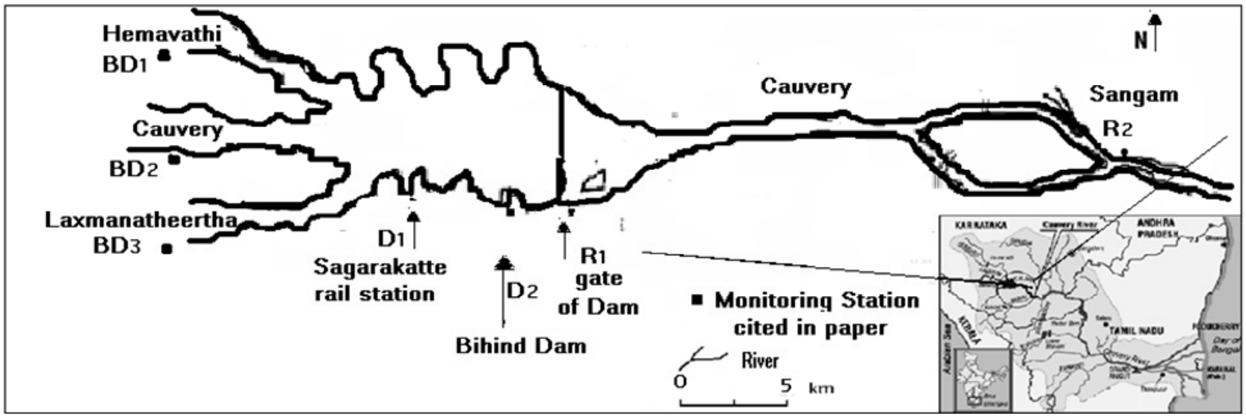


**Figure 1.** Map of the different stations in KRS dam and Cauvery River.

area and divided into as upstream of KRS dam was selected as in (Figure 1). Two different sampling stations of upstream namely BD, $BD_2$, $BD_3$ and KRS reservoir $D_1$, $D_2$ and down stream $R_1$, $R_2$ were selected.

## MATERIALS AND METHODS

Samples for the present investigation were collected at monthly interval from seven different sites of Cauvery River during the period of (2008 and 2009). Temperature, pH, and Total dissolved solids (TDS) were recorded at the site with the help of portable equipments. Dissolved oxygen (DO) was fixed on the spot using Winkler's reagent. Analysis of physico-chemical parameters temperature, total dissolved solids, turbidity, pH, alkalinity, chloride, hardness, dissolved oxygen, biochemical oxygen demand, chemicaloxygen demand, nitrate, phosphate, potassium and sulphate were carried out according to the standard methods APHA (1999), Trivedy and Goel (1986), Hood and Kaur (1999) and NEERI (1991).

### Phytoplankton study

Separate water samples were collected for phytoplankton study was fixed with Lugol's solution. The identification of algae species was done with the help of standard books and keys (Ward and Whipple, 1996; Palmer, 1980; Anand, 1998). The phytoplanktons were counted by differential count drop sedimentation method (Adoni, 1985). Relative frequency and density (RFD) of species were estimated following Pandey et al. (2000). Species richness index (d), Margalef (1958) and Shannon Waiver, species diversity index (H), Shannon and Waiver (1963) and Evenness index (e) Pielou, (1966) were determined.

## RESULTS AND DISCUSSION

Water quality analysis revealed that the river is alkalinity in nature and the lowest value was observed at site $BD_3$. The site also recorded the minimum DO and highest BOD. Conductivity, TDS, hardness, chloride and sulphate were high at sites $BD_3$ and $BD_1$ (Table 1). Physico-chemical characteristics of the river were with in potable limit except for BOD at site $BD_3$. Relative frequency and Density (RFD) of Chlorophyceae and Bacillariophyceae are shown in Table 2. A total 21 members of chlorophyceaes and 21 species of Bacillariophyceae were recorded. *Ankistrodesmus, chlorella, Closterium, Scenedesmus* and *staurastrum* of chlorophyceae. *Melosira, Navicula* and *Synedra* of Bacillariophyceae were the dominant members. Lowest total number of species was recorded at $BD_2$ and $BD_3$ and highest species at $R_1$ (Table 3). Lowest percentage of diverse Bacillariophyceae and chlorophyceae were taken 10 and 9 respectively. The low species richness and comparatively high evenness index healthy habitat it maximum value is 1.00.

The site indicate that this habitat suffered due to sewage from domestic area and hence lost the sensitive species which created a niche that becomes available to more tolerant species **(**Pandey et.al., 2000). DO and nitrate supports the growth of Chlorophyceae and Bacillariophyceae.

Margalef index (species richness) of Chlorophyceae was highest is site $R_1$ and the order of the sites with respect to this index was site $R_1>D_2>R_2>D_1>BD_2>BD_1>BD_3$ Similar pattern was observed in the case of Bacillariophyceae indicated that site $BD_3$, $BD_1$, $BD_2$ supports the growth of both the groups. The higher index of the phytoplankton groups denotes the optimum conditions of growth at this area of the river. According Palmer (1980) poor quality of water supports only few numbers of species. Where as high number of species denotes the high quality of water. Presence of desmids, *Euastrum, staurastrum* and *Ulothrix*, which are clean water algae (Palmer, 1980) indicates that the site $R_1$, $R_2$ is less polluted, which receives clean water from river course. The sites $D_1$, $D_2$ are almost at the middle stretch of the river and the sewage and an Agricultural effluent from the area has meager effect on water quality at these sites of the river. One level of species diversity was observed at site $BD_1$ and $BD_3$, due to sewage and agriculture effluents discharged from surrounding area.

**Table 1.** Variation in physico–chemical and heavy metals parameters at seven stations.

| Parameters | $BD_1$ | $BD_2$ | $BD_3$ | $D_1$ | $D_2$ | $R_1$ | $R_2$ |
|---|---|---|---|---|---|---|---|
| Temperature (°C) | 23±1.26 | 22±1.41 | 25±1.6 | 25±1.4 | 23±0.6 | 23±1.2 | 25±0.7 |
| pH | 7.44±0.18 | 7.36±0.15 | 7.31±0.063 | 7.81±0.098 | 8.1±0.14 | 8.18±0.14 | 8.4±0.079 |
| Turbidity (NTU) | 4.4±0.56 | 13.44±0.60 | 13.8±0.79 | 9.96±0.71 | 0.3±0.182 | 0.47±0.121 | 6.3±0.695 |
| Total alkalinity (mg/l) | 48±2.28 | 40±2.78 | 40±2.63 | 40±1.78 | 48±3.03 | 48±2.31 | 74±3.16 |
| Total hardness (mg/l) | 64±3.66 | 80±0.23 | 56±1.41 | 89±2.60 | 88±2.60 | 84±2.60 | 64±2.48 |
| BOD (mg/l) | 1±0.36 | 1.6±0.23 | 1.1±0.27 | 1.6±0.37 | 1.8±0.25 | 0.8±0.14 | 1.3±0.21 |
| COD (mg/l) | 28.7±1.29 | 42.6±3.08 | 34.9±1.55 | 25±2.86 | 32.25±2.71 | 32±2.73 | 16±1.44 |
| Chloride (mg/l) | 78.1±2.16 | 71±4.50 | 58.4±2.76 | 64±3.17 | 92.3±2.11 | 85.2±1.61 | 59.64±2.27 |
| Nitrate (mg/l) | 6.5±0.57 | 7±1.71 | 21±2.82 | 14±1.41 | 4.5±0.87 | 1±0.52 | 0.2±0.094 |
| Phosphate (mg/l) | 1.25±0.12 | 1.14±0.26 | 1.6±0.209 | 1.3±0.167 | 1.42±0.25 | 1.35±0.18 | 1.15±0.26 |
| Fe(mg/l) | 3.535±0.48 | 8.154±0.49 | 5.697±0.21 | 0.024±0.005 | 0.104±0.004 | 0.101±0.004 | 0.017±0.001 |
| As(mg/l) | 0.558±0.09 | 0.21±0.07 | 0.676±0.08 | 0.062±0.010 | 0.245±0.079 | 0.11±0.029 | 0.0001±0.00008 |
| Cu(mg/l) | 0.06±0.020 | 0.057±0.017 | 0.094±0.004 | 0.0001±0.00008 | 0.018±0.002 | 0.013±0.002 | 0.0001±0.00006 |
| Ni(mg/l) | 0.221±0.011 | 0.229±0.008 | 0.255±0.002 | 0.017±0.004 | 0.138±0.13 | 0.131±0.008 | 0.02±0.007 |
| Mn(mg/l) | 0.943±0.037 | 0.484±0.061 | 0.366±0.042 | 0.0001±0.00006 | 0.107±0.023 | 0.106±0.024 | 0.0001±0.00006 |
| Pb(mg/l) | 0.23±0.12 | 0.203±0.025 | 0.219±0.023 | 0.005±0.004 | 0.125±0.019 | 0.12±0.019 | 0.0001±0.00006 |
| Zn(mg/l) | 0.146±0.009 | 0.148±0.007 | 0.118±0.004 | 0.0001±0.00008 | 0.055±0.016 | 0.051±0.014 | 0.0001±0.00008 |

Station $BD_1$- Hemavathi; Station $BD_2$ –Cauvery; Station $BD_3$ – Laxmanatheertha; Station $D_1$- KRS Reservoir sampling station-1; Station $D_2$- KRS Reservoir sampling station-2; Station $R_1$- Gate of KRS reservoir; Station $R_2$- Down stream of KRS.

**Table-2.** Distribution pattern expressed in terms of RFD of species of Chlorophyceae and Bacillariophyceae at different sites of river (org / drops).

| **Chlorophyceae** | $BD_1$ | $BD_2$ | $BD_3$ | $D_1$ | $D_2$ | $R_1$ | $R_2$ |
|---|---|---|---|---|---|---|---|
| *Ankistrodesmus falcatus* | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| *Coelastrum Scabrum* | 2 | 0 | 3 | 3 | 0 | 1 | 1 |
| *Coelastrum Microporum* | 1 | 2 | 0 | 1 | 2 | 3 | 2 |
| *Oedogonium oblongellum* | 0 | 0 | 4 | 1 | 2 | 3 | 1 |
| *Oedogonium striatum* | 1 | 3 | 0 | 0 | 0 | 2 | 0 |
| *Oedogonium anomalum* | 3 | 0 | 3 | 1 | 0 | 0 | 2 |
| *Oocystis gigas* | 0 | 2 | 0 | 0 | 0 | 3 | 3 |
| *Pediastrum simplex* | 1 | 1 | 4 | 0 | 2 | 1 | 2 |
| *Pediastrum tetras* | 1 | 0 | 0 | 0 | 0 | 2 | 1 |
| *Pediastrum duplex* | 0 | 0 | 0 | 0 | 0 | 3 | 1 |
| *Scenedesmus abundans* | 2 | 2 | 2 | 1 | 3 | 0 | 0 |
| *Scenedesmus armatus* | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| *Scenedesmus bijugatus* | 0 | 0 | 0 | 0 | 2 | 2 | 0 |
| *Scenedesmus acutiformis* | 0 | 0 | 0 | 2 | 1 | 0 | 0 |
| *Scenedesmus obliques* | 2 | 1 | 0 | 1 | 2 | 3 | 3 |
| *Tetraedron trioginium* | 0 | 0 | 5 | 2 | 3 | 0 | 1 |
| *Spirogyra borgeans* | 0 | 2 | 2 | 1 | 2 | 3 | 2 |
| *Spirogyra paludosa* | 2 | 0 | 0 | 0 | 3 | 2 | 0 |
| *Spirogyra micropunetata* | 2 | 0 | 2 | 0 | 2 | 0 | 0 |
| *Staurasturm* | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| *Zygnema Gangetium* | 0 | 2 | 0 | 3 | 3 | 2 | 0 |
| **Bacillariophyceae** | | | | | | | |
| *Cocoonies Placentula* | 2 | 0 | 0 | 2 | 1 | 2 | 2 |
| *Cymbella cymbliformis* | 0 | 0 | 4 | 0 | 2 | 0 | 0 |
| *Cymbella aspira* | 2 | 1 | 4 | 1 | 0 | 2 | 2 |
| *Cymbella straita* | 2 | 2 | 0 | 1 | 0 | 1 | 2 |
| *Cymbella turgid* | 3 | 1 | 0 | 1 | 2 | 1 | 2 |
| *Cymbella Simulate* | 0 | 2 | 0 | 2 | 0 | 2 | 0 |
| *Cyclotella catenata* | 2 | 0 | 4 | 3 | 2 | 2 | 0 |

**Table 2.** Contd

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Eunotia mondon* | 0 | 0 | 2 | 3 | 2 | 3 | 2 |
| *Gyrosigma accuminatum* | 4 | 0 | 0 | 2 | 2 | 1 | 2 |
| *Gyrosigma gracile* | 0 | 2 | 4 | 1 | 3 | 2 | 0 |
| *Gomphonema gracile* | 0 | 0 | 0 | 1 | 2 | 0 | 0 |
| *Gomphonema tenellum* | 0 | 3 | 4 | 1 | 0 | 0 | 3 |
| *Gomphonema sumatrense* | 0 | 0 | 0 | 0 | 1 | 2 | 2 |
| *Navicula Rhomboids* | 4 | 3 | 0 | 0 | 2 | 1 | 0 |
| *Navicula sphaerophora* | 4 | 0 | 0 | 0 | 4 | 1 | 0 |
| *Nitzschia palea* | 0 | 2 | 3 | 0 | 2 | 1 | 1 |
| *Pinnularia gibba* | 3 | 2 | 0 | 0 | 0 | 2 | 1 |
| *Stauroneis princeps* | 0 | 0 | 0 | 0 | 0 | 3 | 1 |
| *Synedra ulna* | 4 | 2 | 4 | 1 | 2 | 1 | 4 |
| *Synedra acus* | 4 | 0 | 4 | 2 | 3 | 2 | 2 |
| *Rhopalodia gibba* | 0 | 2 | 0 | 0 | 1 | 2 | 0 |

**Table 3**. Diversity indices of Chlorophyceae and Bacillariophyceae at seven sites of River Cauvery.

| Sampling Site | Total number of species observed | | | | Species richness Index (d) | | Species diversity Index (H) | | Evenness (C) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Chlo | Tot. pop | Bacil | Tot. pop | Chlo | Bacil | Chlo | Bacil | Chlo | Bacil |
| $BD_1$ | 12 | 10080 | 11 | 9240 | 13.98 | 10.48 | 0.96 | 2,248 | 0.882 | 0.860 |
| $BD_2$ | 9 | 7560 | 11 | 9240 | 12.94 | 10.48 | 2.098 | 2,248 | 0.905 | 0.860 |
| $BD_3$ | 9 | 7560 | 10 | 8400 | 12.94 | 9.96 | 2.098 | 2.101 | 0.905 | 0.880 |
| $D_1$ | 12 | 10080 | 13 | 10420 | 13.98 | 11.85 | 2.359 | 2.489 | 0.882 | 0.926 |
| $D_2$ | 15 | 12600 | 15 | 12600 | 23.47 | 14.94 | 2.633 | 2.651 | 0.927 | 0.944 |
| $R_1$ | 15 | 12600 | 17 | 14280 | 23.47 | 16.40 | 2.633 | 2.752 | 0.927 | 0.922 |
| $R_2$ | 13 | 10420 | 11 | 9240 | 16.10 | 10.48 | 2.415 | 2.248 | 0.860 | 0.860 |

Station $BD_1$- Hemavathi; Station $BD_2$ –Cauvery; Station $BD_3$ – Laxmanatheertha; Station $D_1$- KRS Reservoir sampling station-1; Station $D_2$- KRS Reservoir sampling station-2; Station $R_1$-Gate of KRS reservoir; Station $R_2$- Down stream of KRS; Chlo- Chlorophyceae; Bacil-Bacillariophyceae, Tot pop- Total population.

Physico-chemical variables also indicated closely similar nutrient status. Sites $BD_1$ and $BD_3$ that receive discharge from agricultural fields resemble in water quality characteristics and species composition. It has been suggested that variations in environmental factors taxes the adaptive abilities of most organisms, with the result only those species that have already adapted to these conditions may participate in community formation (Bradshaw, 1983).

## Conclusion

Fluctuations of various physico-chemical factors of water play a decisive role in altering the diversity and richness of species of chlorophyceae and Bacillariophyceae in the river.


## ACKNOWLEDGEMENTS

The authors expresses their thanks to UGC for financial assistance, Prof. S.P. Hosmani and Prof. Syeed Akheel Ahmed, also DOS in Environmental Science, DOS Chemistry Department for help and co-operation during the course of this investigation.


## REFERENCES


Adoni AD (1985). Workbook on Limnology, Indian MAB. Committee. Department of Enviornment, Government of India, New Delhi.

Anand N (1998). Indian Fresh water micro algae. Bisen singh Mahendra pal singh Publishers, Dehra Dun.

APHA (1999). Standard Methods for the estimation of water and waste water 20$^{th}$ Edn. American Public health Association Washington. D.C.

Bradshaw AD (1983). The reconstruction of ecosystem. Presidential address to the British Ecological Society. Dec. J. Appl. Ecol., 22: 1-7.

Chanu EK, Devi GAS (2008). Physicochemical characteristics in relation to pollution of water of Iril rine Manipur(India). Indian J. Environ. Ecoplan., 15(1-2): 225-228.

Easa PS (2004). Biodiversity documentation for Kerala part1; Algae, Keral forest Research Institute peechi.

Hooda S, Kaur S (1999). "Laboratory Manual for Environmental chemistry," (S. Chand LTD., Ram Nagar, NEW DELHI, India,).

Irfanullah HM (2006). Algal taxonomy in limnology; An example of the declining trend of taxonomical studies. Hydrobiol., 559(1); 1-9

Krishnamurthy V (2000). Algae of India and neighbouring countries,1.Chlorophycota. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Margalef R (1958). Temporal sucession and spatial heterogeneity in Phytoplankton In; Perspective in marine Biology. University of California press. USA.

Mondhare SB, Pangle(provide initials)(1995). Occurrence and Tolerance of some algae in Distillery waste. J. Aqua. Biol., 10(1); 31-33.

Nath D, Ray DC (2006). Plankton diversity in riverine ecosystem of South Assam and Tripura, India. J. Curr. Sci., 9(2); 655-658

NEERI (1991). Manual on water and waste water analysis. National Environmental Engineering Research Institute, Nagpur.

Palmer CM (1980). Algae and Water pollution castle house publications. England.

Pandey J, Pandey U, Tyagi HR (2000). Nutrition status and Cyanobacterial diversity of a tropical fresh water lake. J. Environ. Biol., 21(2); 133-138.

Pielou EC (1966). Species diversity and pattern diversity in the study of ecological sucession. J. Theor. Biol., (10); 370-383.

Shannon CE, Waiver W (1963). The Mathematical Theory of communication urban Illinois University of illinos press.

Singh J, Mishra RN (2007). Studies on the mobility of the heavy metals in the river Ganga at Varanasi. J. Purv. Acad.Sci.,13(B);53-56

Trivedy RK, Goel PK (1986). "Chemical and biological methods for water pollution studies", (Enviromedia, Karad, Maharashtra, India).

Ward HB, Whipple GC (1996). Fresh water biology 3$^{rd}$ Edn.John Wiley and son's Inc. Newyork.