JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

# DIATOM COMMUNITY STRUCTURE IN ECOLOGICAL ASSESSMENT OF TWO FRESHWATER TANKS OF KORATAGERE, KARNATAKA

**Shalini, B. R and Murulidhara,V. N.***

Department of Botany, University College of Science, Tumkur, Karnataka
* Department of Botany, YER Government First Grade College, Pavagada, Karnataka

## ABSTRACT

Monitoring and ecological assessment of fresh water ecosystems such as tanks is crucial as they provide plentiful services and wealth to aquatic biota and human. Wetlands are characterised by variations in depth and inundation time hence, it is difficult to make use of invertebrates as biological indicators. In such cases Diatoms, as they are microscopic, widely distributed with few habitat boundaries respond rapidly to environmental changes may be used for monitoring of fresh water ecosystems such as tanks. Therefore, the present study aimed to enumerate the Diatom community structure of two fresh water tanks situated in the foot hills of rural settlements of Koratagere in the state of Karnataka. Water samples for the examination of physico-chemical characters and enumeration of Diatomic population were collected from both the tanks during January 2020 to December 2020. Standard methodologies were fallowed during collection, preservation and analysis. From the results it is clear that the tanks had moderate Diatom diversity and periodicity. Total of 19 species were identified with seasonal maxima observed during summer and that of minimum during rainy. Diversity of Diatoms between the tanks exhibited narrow difference. Most pollution tolerant species such as *Cocconeis placentula, Navicula cuspidata, Navicula cryptocephala, Melosira granulata* and *Synedra ulna* were recorded in the present studies. Though the concentration of chemical parameters and nutrient elements found to be low, the presence of pollution tolerant species is an indicative of eutrophic nature of the tanks, hence need to introduce conservational strategies for balanced and sustainable ecosystem

**KEY WORDS***:* Tanks, Physico-chemical, Diatoms, Enumeration, Diversity, Periodicity

## INTRODUCTION

Wetlands such as tanks are found across the globe and account for more or less 6% of the earth's surface area (DWAF, 2004). Wetlands are significant ecosystems that provide several important ecological services such as storage of water, biogeochemical cycling and safeguarding aquatic biodiversity (Matlala et.al, 2011). Such ecosystems are also helpful to humans by extending goods and services (Kotze, 2010). Wetlands such as tanks act as 'sinks' for accumulation of water and sediment and are more vulnerable to pollution (Dalu and Froneman,2016) as a result such ecosystems become extremely susceptible to anthropogenic activities which potentially affect the water quality (Malan and Day, 2012). Hence, the importance of such water bodies can thus not be overlooked and periodical monitoring of such ecosystems is very important. The complete range of physico-chemical and biological information is required to monitor such wetland ecosystems (Li et.al, 2010) and they were also of the opinion that biological indicators as they regularly exposed to the environmental changes in their natural habitat can substitute conventional monitoring techniques. Bio-monitoring technique

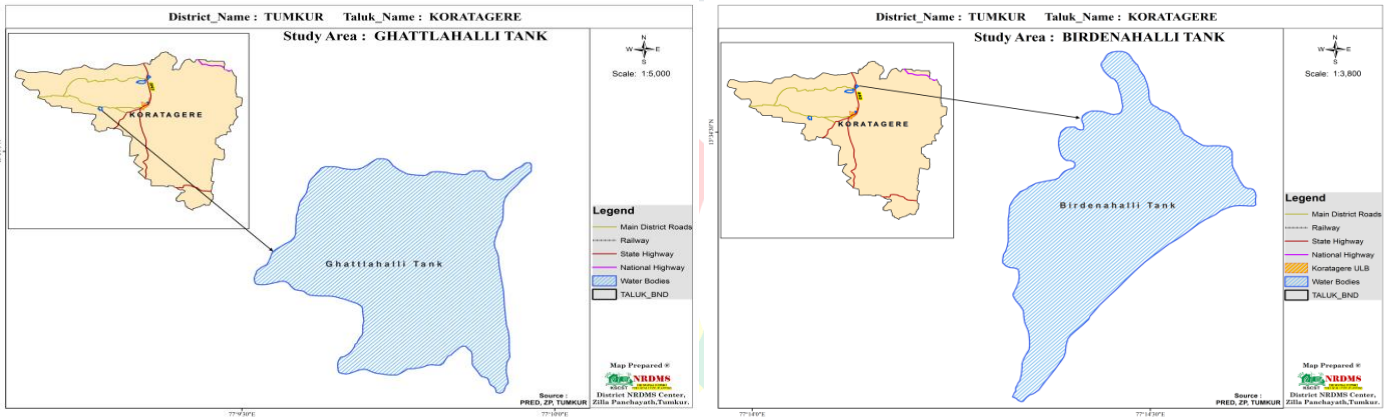
can effectively be used to serve in proper monitoring and management of wetlands (Dalu and Froneman, 2016). Diatoms are unique unicellular micro-organisms belong to the class Bacillariophyceae and act as primary producers in aquatic ecosystems (Round et.al, 1990). Responsiveness of Diatoms to organic matter and nutrient contamination make them appropriate organisms in evaluating the chemical status of the ecosystems (Pandey et.al, 2017) and as corroborated by them frustules of Diatoms due to their siliceous cell wall can be preserved for long time after cell death (Pandey et.al, 2017), which makes them unique from other phytoplankton. Being useful biological indicators they are found in all aquatic biotypes and respond rapidly to environmental changes and anthropogenic activities (Dixit et.al, 1992)

## MATERIALS AND METHODS

### Study area

Koratagere is one of the taluks of Tumkur district in the state of Karnataka situated 2660 feets above mean sea level. Tropical monsoon climate prevails in the taluk with an average annual rainfall 788 mm and an average mean temperature of $22^0$C. Three climate seasons such as rainy, winter and summer were noticed. Koratagere encompasses 118 tanks of which Gattlahalli tank situated at a distance 7 kms west of Koratagere town between $13^030^{11}$ North latitude and $77^010^{11}$ East longitudes (Figure-1). Second wetland Birdenahalli tank situated at 4 kms North of Koratagere town between $13^0$ $34^{11}$ North latitude and $77^0$ $10^{11}$ East longitude (Figure-1) were selected for the present studies.

**Fig.1. Map of Gattlahalli and Birdenahalli tanks indicating their position as well as the location of the sampling sites**




**Source**: NRDMS, Zilla Panchayat, Tumkur

### Sampling and analysis

Surface water samples were collected at an interval of 30 days from designated sites in each tank in black coloured poly-ethylene cans. Temperature of air, water and PH were measured on the spot at the time of sampling. Water samples were fixed on the spot for the estimation of dissolved oxygen and rest of the physico-chemical factors were analysed within 24 hours. Methods of (APHA, 2005) were fallowed during sampling, preservation and analysis. For species level identification and enumeration of Diatoms water samples were preserved in 2% Lugol's iodine solution for sedimentation and centrifugation. Camera lucida diagrams were drawn and species level identification was made using monographs. Density of Diatoms was calculated using Sedgwick-Rafter cell.

## RESULTS AND DISCUSSION

The status of aquatic ecosystems is determined based on the concentration of physico-chemical parameters present in the ecosystem. Concentration of nutrient elements in tanks acts as significant driving force and forms the basis for plant growth (Dallas and Day, 2004). Nutrients also causes eutrophication in aquatic ecosystems such as tanks that poses a threat to their sustainability (Tromboni and Dodds, 2017) Wetlands as they act as sinks are predominantly vulnerable to nutrient enrichment (Humphries and Nelson, 2013). However, aquatic macrophytes also have a control on the concentration of nutrient. Thus wetland ecosystems such as tanks become eutrophic even if the nutrient concentrations are low. The physico-chemical parameters

play a vital role in monitoring of wetland ecosystems, which results in the variations of community structure, diversity, periodicity and seasonality of aquatic life-forms (Fathi and Flower, 2005). Seasonal variation of physico-chemical parameters is presented in Table-1. The members of the class Bacillariophyceae are commonly referred as Diatoms which thrive in fresh and marine waters and have high Photosynthetic efficiency (Vincent, 1992).

Diatoms are unicellular ubiquitous, microscopic floating organisms characterized by silicious cellwall (Round, et.al, 1990). Distribution and abundance of Diatoms in aquatic ecosystem are influenced by physico-chemical parameters. Diatoms are very sensitive organisms subject to change in water chemistry in which they are found therefore even a minor change in the concentration of nutrient, pH and salinity influences the growth and reproduction of Diatoms. (Munawar, 1974; Desikachary, 1962; Nautiyal and Nautiyal, 1999; Hosmani, and Bharathi, 1980; Ramakrishnaiah and Sarkar, 1982) have worked on ecology of fresh water Diatoms and they are of the opinion that diversity and periodicity of Diatoms is determined by the internal physiology than the external factors.

**Table-1: Seasonal Variation of Physico-chemical parameters**

| Sl. No. | Physico-chemical Parameters | Gattlahalli tank | | | Birdenahalli tank | | |
|---|---|---|---|---|---|---|---|
| | | Summer | Rainy | Winter | Summer | Rainy | Winter |
| 1 | Air temperature | 32.75 | 30 | 29 | 34.25 | 31.75 | 30.25 |
| 2 | Water temperature | 29 | 28 | 26.75 | 32.75 | 30 | 27 |
| 3 | pH | 6.85 | 7.07 | 7.1 | 7 | 6.92 | 7.07 |
| 4 | Turbidity | 27.35 | 29.05 | 16.85 | 24.84 | 26.46 | 11.32 |
| 5 | Electrical conductivity | 99 | 148.75 | 86.75 | 123.75 | 165.75 | 88.75 |
| 6 | Dissolved oxygen | 4.82 | 5.67 | 5.71 | 5.34 | 5.75 | 7.34 |
| 7 | BOD | 2.29 | 2.51 | 2.35 | 1.34 | 1.52 | 1.25 |
| 8 | Calcium | 36.3 | 41.5 | 30.9 | 30.68 | 37.49 | 22.40 |
| 9 | Total hardness | 99 | 172.5 | 165.75 | 92 | 179.5 | 177.25 |
| 10 | Sulphate | 114.75 | 78.5 | 74.5 | 137.75 | 128.75 | 79.75 |
| 11 | Chloride | 67.35 | 42.32 | 47.2 | 69.05 | 49.47 | 44.44 |
| 12 | Phosphate | 1.26 | 0.92 | 0.86 | 1.3 | 1.15 | 1.09 |
| 13 | Silica | 0.11 | 0.25 | 0.042 | 0.33 | 0.28 | 0.05 |
| 14 | Nitrate | 2.7 | 2.87 | 2.42 | 2.92 | 3.47 | 2.42 |

P1- Air temperature, P2- Water temperature, P3- Ph, P4- Turbidity, P5- Electrical conductivity, P6- Dissolved oxygen, P7-BOD, P8- Calcium, P9-Total hardness, P10-Sulphate, P11-Chloride, P12-Phosphate, P13-Silica, P14- Nitrate

Water temperature of 20-30°C favours the growth of diatom population (Paerl, 2008). The seasonal average values of water temperature during present study ranged from 26.75°C to 32.75°C (Table-1) and supported moderate growth of Diatoms. Hence we are in partial agreement with the findings of above researchers. Present study recorded pH in the range of 6.85 to 7.1 and did not exhibit any remarkable differences during different seasons where, it is indicative of neutral level in both the tanks studied and it remained as an independent variable (Table-5). Similar observations have been made by (Murulidhar and Murthy, 2014). Acidic pH does not support the growth of Diatoms instead alkaline pH favours the growth of Diatoms (Patrick, 1977), where our findings are also in line with that of (Patrick, 1977). Turbidity in present studies had no role to play with Diatom population (Table-5). The values of Electrical Conductivity recorded more during summer and less during winter (Table-1) and emerged as independent variable in Birdenahalli tank where as it showed negative bearing on the Diatom population (Table-5). Ecological strength of tank depends on the concentration of dissolved oxygen, biological activities, temperature in the water and atmospheric gas on the surface of water (Taş and Taş, 2010). Dissolved oxygen seasonally ranged between 4.82 mg/l to 5.75mg/l (Table-1) did not establish any type of correlation with Diatom community (Table-5).

**Table-2: Density of Diatoms in tanks of Koratagere (Org /l)**

| Sl. No | Months | Diatoms | |
|---|---|---|---|
| | | Gattlahalli tank | Birdenahalli tank |
| 1 | Jan 2020 | 3134 | 1911 |
| 2 | Feb 2020 | 3848 | 1980 |
| 3 | Mar 2020 | 2951 | 2700 |
| 4 | Apr 2020 | 2729 | 2541 |
| 5 | May 2020 | 3549 | 2886 |
| 6 | Jun 2020 | 3269 | 2017 |
| 7 | Jul 2020 | 2246 | 967 |
| 8 | Aug 2020 | 2107 | 2316 |
| 9 | Sep 2020 | 2964 | 810 |
| 10 | Oct 2020 | 1980 | 1213 |
| 11 | Nov 2020 | 3142 | 2310 |
| 12 | Dec 2020 | 4316 | 2296 |

**Table-3: Seasonal abundance of Diatoms in tanks of Koratagere (Org / l)**

| Sl No | Tanks | Summer | Rainy | Winter |
|---|---|---|---|---|
| 1 | Gattlahalli tank | 3144 | 2677 | 2 820 |
| 2 | Birdenahalli tank | 2494 | 1902 | 2201 |

Shalini et.al, (2018) Corroborated seasonal maxima of BOD during rainy and minimum during winter where as present investigation has recorded higher concentration of BOD during rainy and that of minimum values showed variation among seasons hence we are in partial agreement with findings of Shalini et.al, (2018). Calcium emerged as independent variable. Chloride and phosphate appeared more during summer (Table-1) which may be due to high rate of domestic activities in comparatively less quantity of water where, Shalini et. al, (2018A) arrived at similar conclusion. Vaishya and Adoni (1992) Reported higher density of Diatoms in phosphorous rich waters. We are in agreement with this finding where Phospate is positively correlated to Diatom community (Table-5) at significant level in Birdenahalli tank with 12 species. Seasonally, sulphate is at its peak during summer and observed its lower peak during winter (Table-1). Sulphate concentration is directly correlated to Diatom composition in Birdenahalli tank (Table-5) where, similar observations were made by (Murulidhar and Murthy, 2014). Munawar (1974) established relationship between concentration of silica and periodicity of Diatoms. In the present investigation both silica and nitrate have direct bearing on the distribution of Diatoms in Birdenahalli tank hence we are in partial agreement with that of Munawar (1974). Diatom based water quality analysis of wetlands resulted with trophic status of wetlands and proved that, Diatoms are the suitable indicators of environmental changes (Meera et.al, 2010).

**Table-4: Diversity and distribution of Diatoms in tanks koratagere**

| Sl No | Diatoms | Gattlahalli tank | Birdenahalli tank |
|---|---|---|---|
| 1 | *Cocconeis placentula* | + | _ |
| 2 | *Cymbella cymbiformis* | ++ | _ |

| | | | |
|---|---|---|---|
| 3 | *Cymbella lanceolata* | + | _ |
| 4 | *Fragillaria voucheriae* | _ | + |
| 5 | *Gomphonema accuminatus* | _ | +++ |
| 6 | *Gyrosigma kutzingii* | + | ++ |
| 7 | *Melosira granulata* | ++ | +++ |
| 8 | *Navicula cuspidata* | + | + |
| 9 | *Navicula pupula,* | _ | ++ |
| 10 | *Navicula radiosa* | + | _ |
| 11 | *Navicula acicularis* | + | _ |
| 12 | *Navicula linearis* | _ | ++ |
| 13 | *Navicula cryptocephala* | +++ | + |
| 14 | *Pinnularia biceps* | ++ | _ |
| 15 | *Pinnularia major* | +++ | ++ |
| 16 | *Stauraneis anceps* | + | _ |
| 17 | *Surirella ovata* | + | + |
| 18 | *Synedra ulna* | +++ | + |
| 19 | *Synedra tabulata* | _ | ++ |

**Index**

| +++ | ++ | + | - |
|---|---|---|---|
| 100 to 500 Org / l | Between 50 to 100 Org / l | 50 to 100 Org / l | Absent |

**Table-5: Karl pearson's correlation between physico-chemical parameters and Desmids**

| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 | P14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gattla halli | .344 | .302 | .342 | -.23 | -.817** | -.379 | .02 | -.138 | -.630** | .257 | .181 | .071 | -.838** | -.099 |
| Birdena halli | .36 | .28 | .2 | .22 | -.18 | -.3 | .32 | -.05 | .601** | .457* | .667** | .557** | .591** | .422* |

## Periodicity of Diatoms

Physico-chemical parameters like phosphate, silica, nitrates, pH and calcium play a vital role in the periodicity and diversity of Diatoms (Jutshi and Khan 1998). A total of 19 species under 11 genera were identified from two tanks. 14 and 12 species were identified from Gattlahalli and Birdenahalli tanks respectively (Table-4). Higher density of Diatoms recorded during summer and that of lower values were found during rainy season in both the tanks. Diatoms in Birdenahalli tank is represented by 12 species. Minimum density of 810 org / l was recorded during September 2020 and that of maximum density of 4316 org / l recorded in the month of December 2020 (Table-2). With regard to distribution of Bacillariophyceae *Navicula* and *Synedra* represented by two species. Whereas, the other genera *Surirella* is represented by single species. All the species were less abundant where they recorded 50 org / l except *Synedra tabulata* where it abundantly distributed reaching up to 100 org / l.

## CONCLUSION

This study documented Diatom diversity with selected water quality variables for a period of one year in two wetlands such as tanks. From the study it is concluded that Very narrow difference was observed with respect to the diversity of Diatoms between the tanks. Most pollution tolerant species such as *Cocconeis placentula, Navicula cuspidata, Navicula cryptocephala, Melosira granulata* and *Synedra ulna* were recorded in the

present studies which indicated the nutrient status of the tanks. Based on the density and periodicity of Diatoms it is stated that the tanks are productive. Though the concentration of chemical parameters and nutrient elements found to be low the presence of pollution tolerant species is an indicative of eutrophic nature of the tanks, hence need to introduce conservational strategies for balanced and sustainable ecosystem

**Conflicts of interest**

Both the authors declare no conflict of interest

**REFERENCES**


1. American Public Health Association (APHA). Standard Methods for the Examination of Water and Waste water. 2005. (21st ed. 1220 p).Washington DC:
2. Dallas, H. F., Day, J. A. The effect of water quality variables on aquatic ecosystems. WRC Report No. TT 224 / 04. Water Research Commission. 2004. Pretoria.
3. Dalu,T., Froneman, P.W. Diatom-based water quality monitoring in southern Africa: challenges and future prospects. Water SA. 2016. 42, 551–559.
4. Department of Water Affairs and Forestry (DWAF).Development of a framework for the assessment of wetland ecological integrity in South Africa, Phase 1: Situation Analysis by MC Uys. Contributors, G Marneweck and P Maseti. Report 2004. No.0000/00/REQ/0904. ISBN No.:0-621-354740. Resource Quality Services. Depart -ment of Water Affairs and Forestry, Pretoria, South Africa.
5. Desikachary, T.V. The Diatoms. Current Science. 1962. Vol. 31(2): 43-45.
6. Dixit, S.S., Smol, J.P., Kingston, J.C., Charles, D.F. Diatoms: powerful indicators of environmental change. Environmental Science and Technology. 1992. 26, 23–33.
7. Fathi, A. A, Flower, R. J. Water quality and phytoplankton communities in Lake Qarun (Egypt). Aquat Sci. 2005. Vol. 67(3): 350-362.
8. Hosmani, S. P., and Bharathi, S. G. Algae as indicators of organic pollution. Phykos. 1980. Vol.19 (1): 23-26.
9. Humphries, M.S., Benitez-Nelson, C.R. Recent trends in sediment and nutrient accumulation rates in coastal, freshwater Lake Sibaya, South Africa. Marine and Freshwater Research 64, 1087–1099.Koenigstein. 2013. Pp: 85-100.
10. Jutshi and Khan. Comparative Limnology of Nine lakes of Jammu and Kashmir, Himalayas. Hydrobiologia. 1998.Vol. 72: 101-112
11. Kotze, D.WET-Sustainable use: A system for assessing the sustainability of wetland use. WRC Report No.TT 438 / 09. Water Research Commission, 2010. Pretoria.
12. Li, L., Zheng, B., Liu, L. Biomonitoring and bioindicators used for river ecosystems: definitions, approaches and trends. Procedia Environmental Sciences. 2010.2:1510–1524.
13. Malan, H.L., Day, J.A. Water quality and wetlands: defining ecological categories and links with land-use. WRC Report No. 1921/1/12. Water Research Commission, 2012. Pretoria.
14. Matlala, M.D., Taylor, J.C., Harding, W.R. Development of a diatom index for wetland health. WRC report no: KV 270/11. Water Research Commission, 2011. Pretoria.
15. Meera, D.S., Alakananda, B., and Ramachandra, T.V. Ecology and distribution of diatoms in Bangalore lakes. Paper presented in Lake 2010: 7th Biennial Lake Conference on Wetlands, Biodiversity and Climat Change. December 22-24, 2010. pP: 1-15.
16. Munawar, M. Limnological studies of freshwater ponds of Hyderabad-India. IV. The Bioscience. Periodicity and species composition of unicellular and colonial phyto -plankton in polluted and unpolluted environments. Hydrobiology. 1974. Vol. 45:1

17. Murulidhar, V. N., and Yoganandamurthy, V. N. Distribution and ecology of diatom communities in four lakes using Lange-Bertalot method. Int. Journal. Current. Microbiol. Appl. Sci. 2014.Vol. 3(4): 539-548.
18. Nautiyal, R., and Nautiyal, P. Altitudinal variations in the pennate diatom flora of the Alaknanda - Ganga river system in the Himalayan stretch of Garhwal region. In: Proceedings of 14th International Diatom Symposium. 1999. Koeltz Scientific Books,
19. Paerl, H.W. Huisman, J. Blooms like it hot. Science 320 (5872). 2008.57-58.
20. Pandey, L.K., Bergey, E.A., Jie, L., Park, J., Choi, S., Lee, H., Depuydt, S., Han, T. The use of diatoms in ecotoxicology and bioassessment: insights, advances and challenges. Water Research. 2017.118, 39–58.
21. Patrick, R. Ecology of fresh water diatoms and diatom communities. The Biology of Diatoms. (ed. by D. Werner) Bot. Monogr., 1977. Vol.13. Blackwell Sci. Publ., Oxford, London, Edin., Melbourne. Pp 284-332
22. Ramakrishnaiah, M., and Sarkar, S. K. Plankton productivity in relation to certain hydrobiological factors in Konar reservoir (Bihar). Journal of Inland Fisheries Society of India. 1982. Vol. 14:58-68.
23. Round, F.E., Crawford, R.M., Mann, D.G. The Diatoms: Biology & Morphology of the Genera. Cambridge University Press. 1990. Cambridge.
24. Shalini, B. R., K. V. Nagalakshamma, V. N. Murulidhara. Limnological profile of Gattlagollahalli wetland of Tumkur district, Karnataka. Journal of Emerging Technologies and Innovative Research. 2018. Vol.5 (11): 605-610.
25. Shalini, B. R., K. V. Nagalakshamma., V. N. Murulidhara. Dynamics of Cyanophy -ceae in lentic water bodies of Koratagere taluk of Tumkur district, Karnataka. Int. Jour. Creative. Res. Thoughts. 2018A. Vol. 6(1):1386-1391.
26. Taş B, Gonulol A, Taş E. Seasonal dynamics and biomass of mixotrophic flagellate Dinobryon sertularia Ehrenberg (Chrysophyceae) in Derbent reservoir (Samsun, Turkey). Turkish J Fish Aquat Sci 2010.10(3)
27. Tromboni, F., Dodds, W. K. Relationships between land use and stream nutrient concentrations in a highly urbanized tropical region of Brazil: thresholds and riparian zones. Environmental Management. 2017.60:1–11.
28. Vaishya, A. K., and Adoni, A. D. Phytoplankton seasonality and their relationship with physico-chemical properties in a hyper eutrophic Central Indian Lake. Proc. Indian Nat. Sci. Acad. 1992. B59 (2); 153-160.
29. Vincent, W. F. The daily pattern of nitrogen uptake by phytoplankton in dynamic mixed layer environments, Hydrobiologia. 1992. Vol.238: 37-52.