*Journal of Science and Technology*
*ISSN: 2456-5660 Volume 7, Issue 03 (MAY 2022)*

*www.jst.org.in* *DOI:https://doi.org/10.46243/jst.2022.v7.i03.pp30-41*

# PLANKTON BIODIVERSITY AND LIMNOLOGICAL CONDITIONS IN FRESHWATER PONDS

**Solamuthu Balamurugan[1],Raman Sivakami[2]and Muthaiya Palanisamy[3]**

*Assistant Professor,[1,2,]Research Scholar[3].P.G. and Research Department of ZoologyArignar Anna Govt Arts College, Musiri.621 211;Affiliated to Bharathidasan University,Tamilnadu, INDIA.*

**Corresponding Author: dr.s.balamurugan6@gmail.com;dr.s.balazoo.aagacmri@gmail.com*

***To Cite this Article***
Solamuthu Balamurugan ,Raman Sivakami and Muthaiya Palanisamy *"***PLANKTON BIODIVERSITY AND LIMNOLOGICAL CONDITIONS IN FRESHWATER PONDS***", Journal of Science and Technology, Vol. 07, Issue 03, May 2022.*

***Article Info***
*Received: 19-04-2022* *Revised: 15-05-2022* *Accepted: 15-05-2022* *Published: 22-05-2022*

***Abstract:*** Our goal was to determine the limnological differences and biodiversity of plankton in two separate lentic ponds in connection to aquaculture. From December 2020 to February 2021, water samples and plankton samples were collected and analysed.The obtained samples contained six distinct species of phytoplankton, including *Oscillatoria* sp., *Spirulina* sp., *Anabaena* sp., *Chlorella* sp., *Volvox* sp., *Spirogyra* sp., and eight different species of zooplankton, including *Cyclops vernalis*, *Oithona rigida*, *Eucyclops serrulatus*, *Oithona rigida*, *Eucyclops serrulatus*, *Oithona similis*, *Oithona nana*, *Daphnia duplux*, *Brachionus bruben*, *Branchionus* sp,were observed in the collected samples.The BOD values in the six samples ranged from 6.85 to 7.40 mg/L. This suggests that there is a significant amount of organic contamination. In December 2020, all limnological parameters were average, which is necessary for plankton growth and fish survival. In January and February 2021, the limnological parameters increased somewhat, and the level of plankton in both ponds increased.As a result, these two freshwater ponds might be suitable for aquaculture.

***Key Word****:* Biodiversity of phyto and zooplankton,limnology,freshwater ponds

## Introduction

Human pressures on freshwater ecosystems have expanded considerably over the last century, posing serious and escalating threats to biodiversity around the world [4]. As a result of this global disaster, documenting biodiversity losses, diagnosing their causes, and pursuing solutions has become a major element of current freshwater ecology[37]. Furthermore, because plankton abundance varies by location and aquatic systems within the same area with similar ecological conditions, determining the qualitative and quantitative abundance of plankton in a water body is crucial for implementing long-term management strategies[12]. Furthermore, in many lakes and reservoirs, the zooplankton population has been reported to show fluctuations in abundance of specific taxa from late spring to summer, notably in the tropics. Seasonal fluctuations in zooplankton groups in lakes and reservoirs are assumed to be influenced by a

combination of abiotic and biotic factors[18,25,38,11,9,] nutrients[39], and biotic variables such as competition[6,7,8,9,22,16,32,10,31,40]. As a result, the current research looked into the plankton population and limnological conditions in a lake in Tiruchirappalli, Musiri Taluk, Tamil Nadu, India.

## Material And Methods

### Description of the study area and context

In Musiri Taluk, Tiruchirappalli District, Tamil Nadu, India, the research area [Figure-1] comprises of two different fresh water ponds: Chinnakoduthurai Pond – 1 [Figure-2] – is located near a rice field and recieved rain water;Thiruthiyamalai Pond – 2 [Figure-3] – is positioned among rocks ,recieved rain water and is used for cattle,human beings.

**Fig.1 :** Geographical location of study are in Musiri Taluk,Tiruchirappalli District, Tamilnadu State, India.

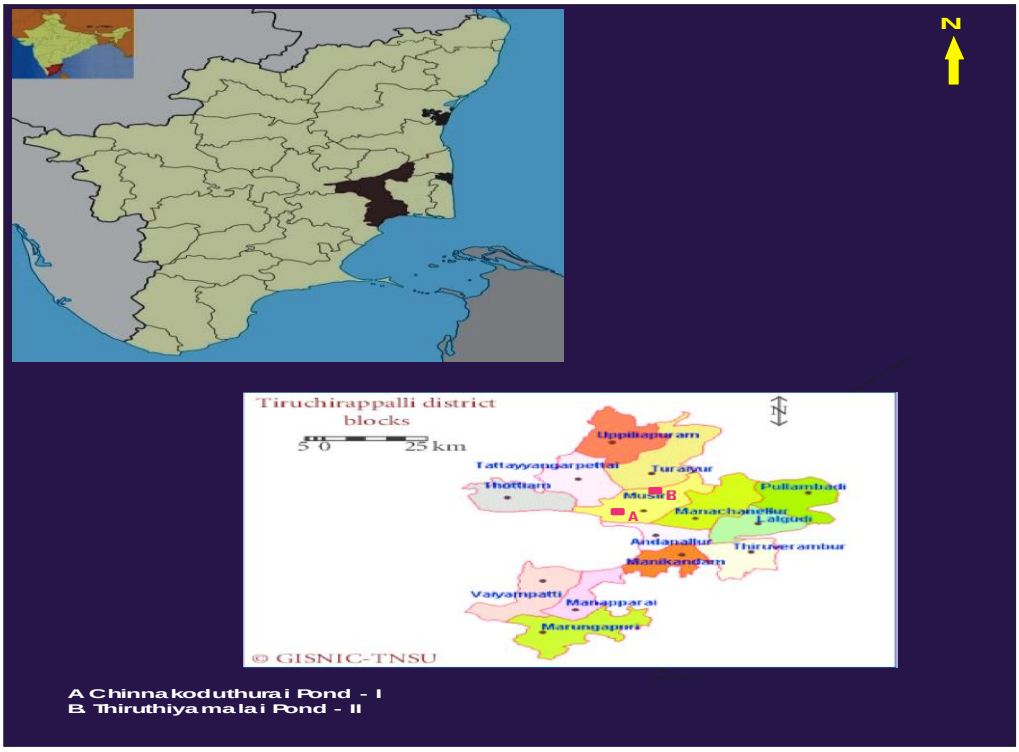


**Fig.2:**Chinnakoduthurai fresh water pond- 1.

**Fig.3:**Thiruthiyamalai fresh water pond-2

**Data collection**

The data for this study was gathered between December 2020 and February 2021. For the evaluation of water quality parameters, a surface water sample was collected from the ponds in a one-liter bottle during the morning hours between 9.00 AM and 10.00 AM.Temperature, pH, Transparency, Dissolved oxygen, Alkalnity, Calcium, Magnesium, Nitrate, Ammonia, Phosphate, Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) were among the primary physicochemical water quality indicators examined APHA[4].In this study, a 270 mesh (pore diameter 20-30 ) net was used to collect zooplankton. For further microscopic analysis, the zooplankton were promptly preserved in 4 percent formalin. Plankter identification was carried out[15,19,24,44,26,3,36.]

## III.RESULTS AND DISCUSSION

The limnological variations like Air, Water temperature,pH,Transparency,COD Alkalinity,DO,BOD, Ammonia, Phosphate,Chloride,Calcium of two ponds that were recorded and presented in Figures4 to 13 respectively. As seen from the figures,the maximum level air & water temperature was noted in February (33ºC) pond-2 water sample

compare than other month samples.The range of pH value has shown between 7.3-7.9. The maximum level of pH value (7.9)recorded in Dec,2020in pond-2 compare than other month sample.The level of transparency was ranged from 14.7 – 16.7 cm from December 2020 to February 2021.Among the two ponds, high level of transparency recorded Feb,2021 and Dec, 2020 in pond-2 and pond-1 respectively.DO values varied from 6.46 to 8.15 mg/L in both ponds.The maximum level of DO recorded in the month of Dec-2020 in pond-1 and minimum was recorded in Dec-2020 in pond -2.BOD varied from 6.85 to 7.40 mg/L.Maximum level of BOD (7.4 mg/L) observed in the month of December in pond-2 and minimum (7.2 mg/L)was recorded in the month of Feb2021in pond-1.The COD of water ranged from a minimum of 13.4 mg/L to 14.8 mg/L of both ponds. High level of COD 14.8 mg/L was observed in Dec-2020 in pond-1 and minimum was recorded 13.4 mg/L in Dec-2020 in pond-2.The maximum alkalinity 192 ppm was recorded in Dec-2020 in pond-2 and minimum 170 ppm was recorded in Dec-2020 in pond-1. Maximum calcium 1.2 mg/L in Dec-2020 in pond-2 and minimum 0.8mg/L inDec-2020 in pond-1.Maximum chloride recorded 75.00 mg/L in Dec-2020 in pond-2 and minimum 69.12mg/L in Dec-2020 in pond-1.Maximum ammonia recorded 1.20 mg/L in Dec-2020 in pond-2 and minimum 0.80 mg/L in Dec-2020 in pond-1.Maximum phosphate recorded 0.15 mg/L in Dec-2020 in pond-2 and minimum 0.08 mg/L in Dec-2020 in pond-1.

The biogeochemical processes in the aquatic environment are influenced by temperature, which is an essential component. Water temperature has a significant impact on all metabolic and physiological activities as well as life processes in aquatic species, such as feeding, reproduction, migration, and distribution. The temperature of the test samples in the current study ranged from 26 to 31°C in various month water samples. Temperature and plankton productivity are linked in a beneficial way. Variations in productivity were linked to changes in temperature and both were observed similar findings[34,35] observed similar findings. According to Wani and Subla[43], pH values above 6 in natural waters are caused by a photosynthetic rate that requires more CO2 than is supplied by respiration and breakdown. The pH of water is also affected by the relative amounts of calcium, carbonates, and bicarbonates in the water.DO levels in the current study ranged from 6.46 to 8.15 mg/L. The rate of aeration and photosynthetic activity determine the amount of dissolved oxygen[17]. The detected BOD levels range from 6.85 to 7.4 mg/L in all six samples. According to studiesWaziri[45], the River Yobe has high levels of nitrates and phosphates, causing rapid growth as well as the demise of plants and algae. As a result of the accumulation and decomposition of organic wastes, elevated BOD values arise.

Tables 1 and 2 show the phytoplankton and zooplankton screenings that were done in the two ponds. In total, five different types of phytoplankton were found in the two ponds, including *Oscillatoria sp.*, *Spirulina sp.*, *Anabaena sp.*, *Chlorella sp.*, and *Volvox sp*. The highest levels of phytoplanton were found in pond-2 water samples in January 2021 and December 2020. In both ponds, a constant level of all phytoplankton was found in February 2021. In the month of December 2020, *Anabaena sp*. and *Volvox sp*. were not present in pond-1. In the current study, phytoplankton species such as *Oscillatoria sp, Spirulina sp, Anabaena sp, Chlorella sp, Volvox sp,* and *Spirogyra sp* were found in the collected samples. The BOD values in the six samples used in this study range from 6.85 to 7.40 mg/L. This suggests that there is a significant amount of organic contamination. This observation is in line withAhmad[1];Vamoose[41]. According to Meshram[23], excessive nutrient and dissolved matter loading in water bodies has an impact on plankton. Ahmad[2], Vareethiah and Haniffa[42], and have reported similar observations. Grazing by zooplankton and fish may potentially be contributing to the low phytoplankton levels (Sivakumar and Karuppasamy [33]. COD values represent the amount of dissolved oxidisable organic matter in the environment, including non-biodegradable materials (Mahananda,*et al*.,[21].

The zooplankton that was screened in ponds 1 and 2 belonged to four different groups: Rotifera, Ostracoda, Cladacera, and Copepoda, as shown in the table. Eleven different zooplankton species were identified from the sample, including *Cyclops vernalis, Oithona rigida, Eucyclops serrulatus, Oithona similis, Oithona nana*, *Daphnia duplux, Brachionus ruben, Branchionus sp*.,*cyclops sp., Mesocylops sp*. and *Cypris subglossa*. When compared to other months, the highest level of zooplanktons was detected in January 2021 in Pond-2. In the month of February 2021, Pond-1 was kept at a steady level. Pond-2 was devoid of *Oithona similis, Oithona nana*, and *Brachionus*

*ruben* in December 2021. In comparison to other species, *Cyclops sp*. was found in abundance across the sampling region.

In natural waters and aquaculture ponds, zooplankton is an important food supply for larval vertebrates and invertebrates. It has been suggested that decreasing zooplankton is to blame for the failure of fishing in several countries (Rajasegar,*et al*[27]. According to Arcifa[5] the predator-prey interaction in reservoirs has a significant impact on plankton proliferation. According to Dadhick and Saxena[13], zooplankton plays an important part in bioindicators and is an excellent instrument for determining the status of water pollution. The zooplankton variety varies depending on immunological characteristics and the tropic state of freshwater bodies Jeppessen[20]. The *Cyclops vernalis* is considered a bioindicator of water quality Sladecek[30]; Sakesena[28]. A high rotifer density has been noted as a hallmark of eutrophic ecosystems Sendacz[29]. Similarly, pond-1 water had a higher percentage of rotifers in it than *Oithona rigida*.

**Fig .4:**Temperature of pond-1 water sample in variousmonths.

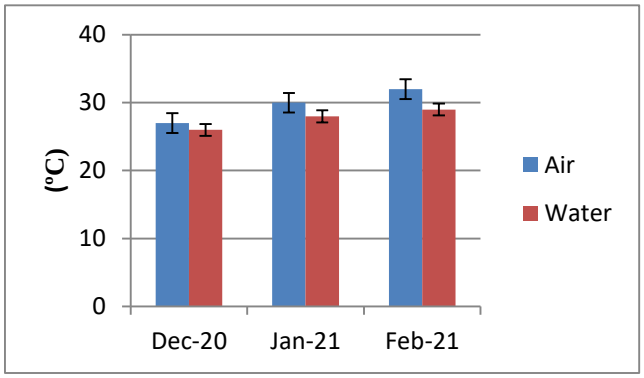


**Fig. 5:**Temperature of pond -2 water sample in various months.

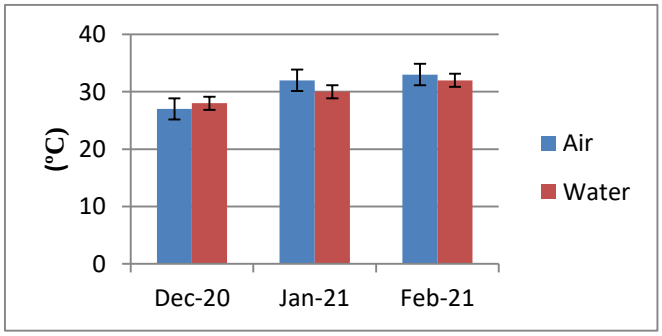


**Fig. 6:**pH of pond-1 and 2 water sample in various months.

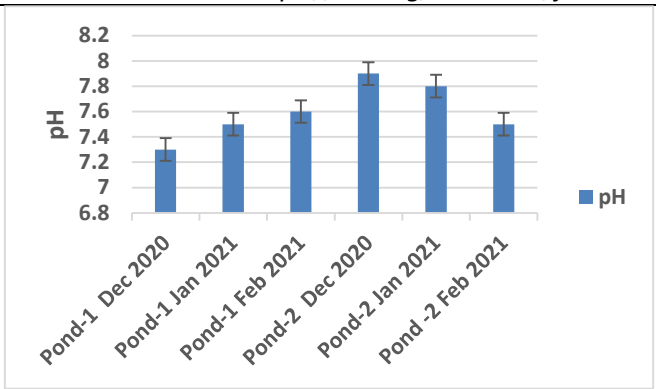


**Fig. 7:**Transparency of pond-1water sample in various months

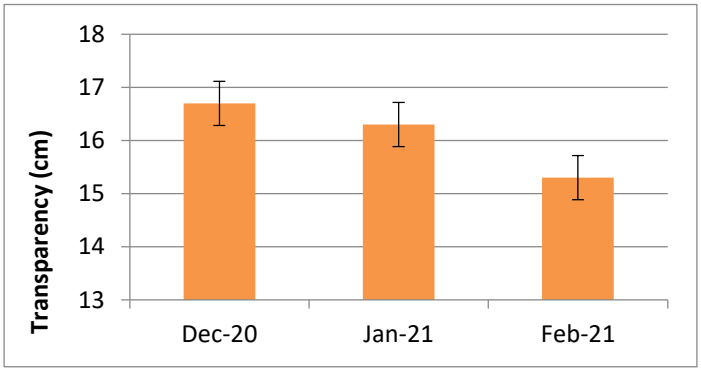


**Fig .8:**Transparency of pond-2 water sample in various months.

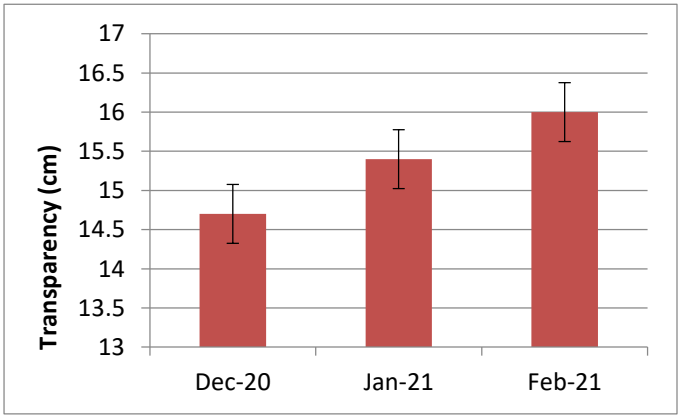


**Fig .9:**COD of pond-1 and 2 water sample in various months

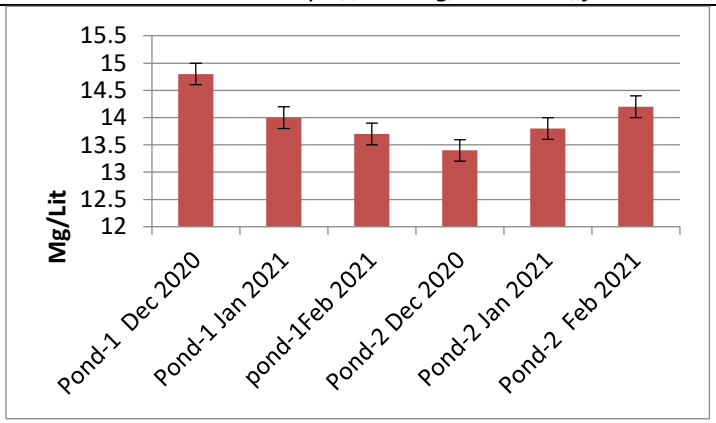


**Fig.10:**Alkalinity of pond-1 and 2 water sample in various months

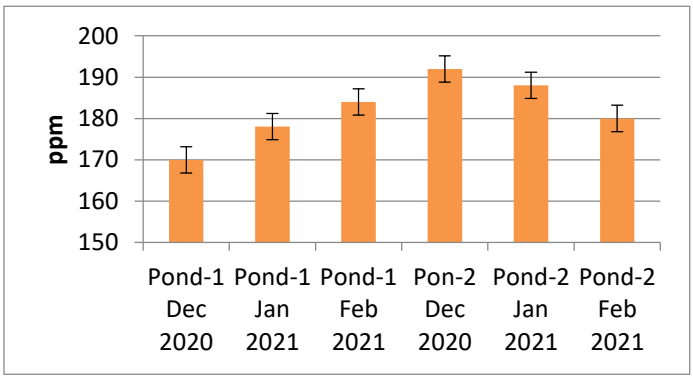


**Fig .11:**DO and BOD of pond -1 and 2 water sample in various months

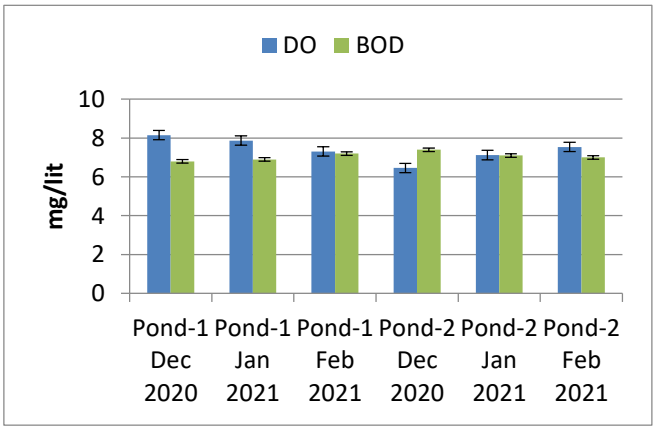


**Fig .12:**Ammonia and Phosphate of pond-1 and 2 water sample in various months

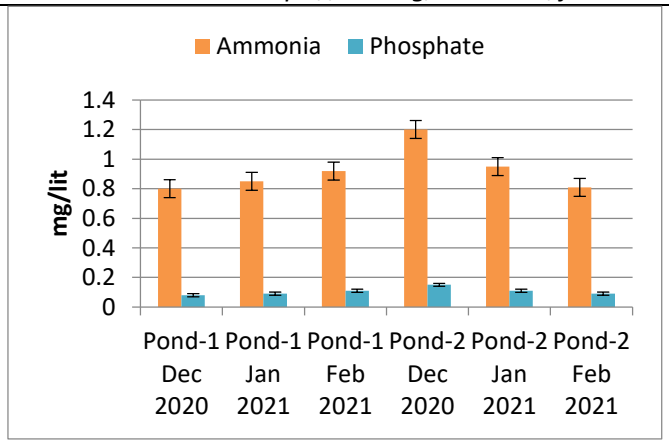


**Fig.13:** Magnesium and Nitrate of pond-1 and 2 water sample in various months.

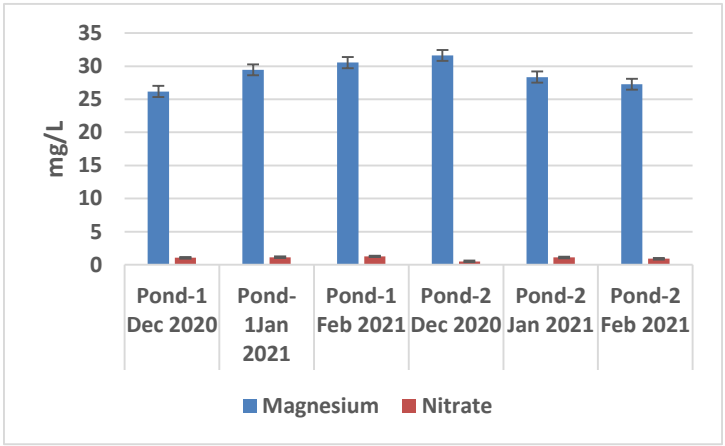


**Fig .14:**Chloride and Calcium of pond-1 and 2 water sample in various months

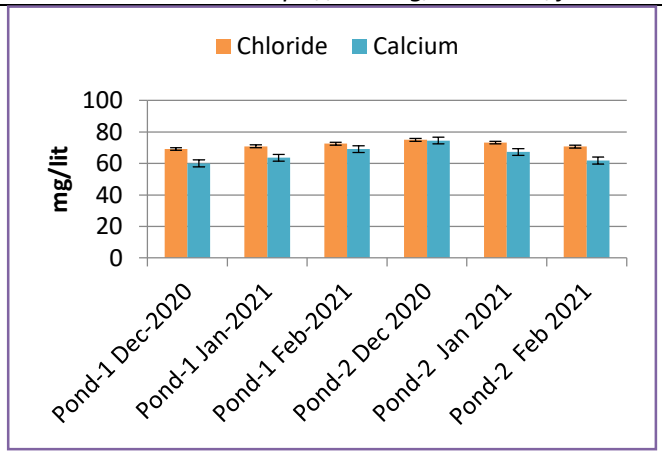


**Table.1:**Screening of phytoplankton in both pond.

| S.No | phytoplankton | Pond-1 | | | Pond-2 | | |
|---|---|---|---|---|---|---|---|
| | | Dec2020 | Jan2021 | Feb2021 | Dec2020 | Jan2021 | Feb2021 |
| 1 | Oscillatoria sp. | +φ | +♦ | +♦ | +0 | +0 | +♦ |
| 2 | Spirulina sp. | +φ | +♦ | +♦ | +0 | +0 | +0 |
| 3 | Anabaena sp. | - | +♦ | +♦ | +0 | +0 | +♦ |
| 4 | Chlorella sp. | +φ | +♦ | +♦ | +0 | +0 | +♦ |
| 5 | Volvox sp. | - | +φ | +♦ | +0 | +0 | +♦ |

**+Present, -Absent, +♦ Constant +φ Rare, +0 High level**

**Table.2:**Screening of zooplankton in both ponds

| S.No | Zooplankton | Pond-1 | | | Pond-2 | | |
|---|---|---|---|---|---|---|---|
| | | Dec2020 | Jan2021 | Feb2021 | Dec2020 | Jan2021 | Feb2021 |
| 1 | *Cyclops vernalis* | +φ | +♦ | +♦ | +0 | +0 | +♦ |
| 2 | *Oithona rigida* | - | +φ | +♦ | +♦ | +0 | +♦ |
| 3 | *Eucyclops serrulatus* | +φ | +φ | +♦ | +0 | +0 | +0 |
| 4 | *Oithona smilis* | - | +♦ | +♦ | +♦ | +0 | +0 |
| 5 | *Oithona nana* | - | - | +φ | +♦ | +♦ | +♦ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6 | *Daphnia duplux* | **+φ** | **+♦** | **+♦** | **+0** | **+0** | **+♦** |
| 7 | Branchionus ruben | - | **+φ** | **+♦** | **+♦** | **+0** | **+0** |
| 8 | Branchionus sp | **+φ** | **+φ** | **+♦** | **+♦** | **+0** | **+♦** |
| 9 | Cyclops sp. | +ϕ | +ϕ | +♦ | +♦ | +♦ | +♦ |
| 10 | Mesocylops sp. | +ϕ | +♦ | +♦ | +♦ | +♦ | +♦ |
| 11 | Cypris bubglossa | +♦ | +ϕ | +♦ | +♦ | +♦ | +♦ |

**+Present, -Absent, +♦ Constant +ϕ Rare, +0 High level**

## IV.CONCLUSION

The selected two freshwater ponds (Pond-1,Chinnakodunthurai and pond-2,Thiruthiyamalai showed good plankton biodiversity and limnological variations. Planktons play an vital role in the tropic dynamics of aquatic ecosystems.The event and diversity of planktonic organisms is almost in all aquatic habitats.Based on the limnological conditions these two ponds are organically polluted and it may be suitable for aquaculture

## ACKNOWLEDGEMENT

We also appreciate the support of Head,P.G. and Research Department of Zoology, Arignar Anna Govt Arts College, Musiri-621 211; Affiliated to BHARATHIDASAN UNIVERSITY Tamilnadu, INDIA to carry out this work.

## REFERENCES

[1]Ahmad, MS. Physiology of polluted ponds of Dharbhanga. Ph.D thesis, L.N. Mithila University, Dharbhanga 1989.

[2]Ahmad, MS. 1996. Ecological survey of some algal flora of polluted habitats of Dharbhanga. J. Environ. Poll., 3 (3-4):147-151.

[3]APHA.Standard methods for the examination of water and wastewater. American Public Health Association, Washington, USA,1989.

[4] APHA.Standard Methods for the examination of water and waste water AmericanPublic Health Association. 874pp,1998.

[5] Arcifa, MS, Northcote TG, Froehlich O.Fish-zooplankton interactions and their effects on water quality of a tropical Brazilian reservoir.Hydrobiologia, 1986;139, pp. 49-5

[6] Balamurugan,S, Gulam mohideen,BM, Subramanian,P. Biodiversity of zooplankton in Cauveri River at Tiruchirapalli, Tamilnadu.Journal of Aquatic Biology.1999;14 (1), 21-25.

[7] Balamurugan,S, Arivazhagan,R Subramanian,P.Seasonalvariation of zooplankton population in Ayyampalayam temple tank,Tiruchirappalli,Tamilnadu, India. J.Adv.Zool.2001;21 (1): 52-55.

[8]Balamurugan.S., Vishakan.R,Subramanian, P. Seasonal variation in non-marine ostracod (crustacea: ostracoda) population in Cauvery River near Tiruchirappalli. J. Exp.Zool.India.2002;5 (2):181-187.

[9] Benndorf, J, Kranich, J., Mehner, T. et al., Temperature impact on the midsummer decline of Daphnia galeata: an analysis of long-term data from the biomanipulated Bautzen reservoir (Germany). Freshwater. Biol. 2001;46: 199-211.

[10] Bhavan, PS., Selvi, A., Manickam, N, et al., Diversity of zooplankton in a perennial Lake at Sulur, Coimbatore, India. International Journal of Educational Research., 2015;5, 31–44.

[11.Bhuiyan, JR Gupta, S., A comparative hydrobiological study of a few ponds of Baral valley. Assam and their role as sustainable water resources. J. Environ. Biol., 2007;28: 799-802.

[12] Boyd, CE.Water Quality Management for Pond Fish Culture. Elsevier, Amsterdam, 1982;p. 318

[13] Dadhich, N Saxena, MM., Zooplankton as indicators of trophical status of some desert water near Bikanar. J. Environ. Pollut., 1999;6: 251-254.

[14] Dudgeon, D., Arthington, AH., Gessner, MO., et al., Freshwater biodiversity: importance, threats, status and conservation challenges. Biol. Rev., 2006;81: 163 182

[15] Edmondson, W.T.Freshwater biology (ed.). Wiley,1959.

[16] Ezhili, N., Manikandan R. Ilangovan, R., Diversity and seasonal variation ofzooplankton in ukkadam lake, Coimbatore, Tamil nadu, India. International Journal of Current Research., 2013;5 (08): 2091-2094.

[17] Gautam, A., Joshi, VP Sati, OP.Physico-chemical characteristics of sewage and its impact on water quality of Alkananda at Srinagar (Garhwal). J. Ecotoxicol. Environ. Monit., 1993;3:61-63.

[18] Gliwicz, Z.M. Pijanowska, J. The role of predation in zooplankton succession. In: Sommer, U. (ed.), Plankton Ecology: Succession in Plankton Communities. Springer- Verlag, New York, pp. 21989;53-295.

[19] Hutchinson, GE. A treatise on Limnology. I. Introduction to lake biology and limnoplankton. New York, John Wiley & Sons Inc., 1967;p. 1115

[20] Jeppesen E., Jensen JP. Søndergaard M. Response of phytoplankton, zooplankton and fish to re-oligotrophication: an 11-year study of 23 Danish lakes. Aquatic Ecosystem Health and Management, 2002;5, 31–43.

[21] Mahananda, MR., Mohanty, BP. Behera, NR. Physico-chemical analysis of surface and ground water of bargarh district, orissa, india. IJRRAS., 2010;2(3): 284-295.

[22] Manickam, N., Saravana Bhavan, P., Santhanam, P., et al., Seasonal Variations of Zooplankton Diversity in a Perennial Reservoir at Thoppaiyar, Dharmapuri District, South India. Austin J. Aquac. Mar. Biol., 2014;1(1): 7.

[23] Meshram, CB., Zooplankton diversity in relation to pollution of lake Wadali, Amaravathi. J. Ecotoxicol. Environ. Monit., 2005;15(1):55-59.

[24] Michael, RG. A guide to the study of freshwater organisms. J. Madurai Kamaraj University, India (Suppl.). 1973;pp. 1-186

[2] Moore, M. Folt, C. Zooplankton Body Size and Community Structure: Effects of Thermal and Toxicant Stress. Trends in Ecology and Evolution ,1993;8: 178-183.

[26] Pennak, RW. Freshwater invertebrates of the United States. 2nd ed. John Wiley and Sons, New York. 1978;p. 803.

[27] Rajasegar, M., Srinivasan, M. Rajaram, R. Phytoplankton diversity associated with the shrimp farm development in Vellar estuary, south India. Seaweed Res. Utiln., 2000;22: 125-131.

[28] Saksena, DN. Rotifers as Indicators of Water Quality. CLEAN,Soil Air Water.1987; 15(5), 481–485. doi:10.1002/aheh.19870150507

[29] Sendacz,S, Caleffi,S, Santos-Soares.J.Zooplankton biomass of reservoirs in different trophic conditions in the State of São Paulo, Brazil.Braz. J. Biol., 2002;66 (1B) , pp. 337-350
[30] Sladecek V. Rotifers as indicators of water quality. Hydrobiologia. 1983;100(1):169–201. http://dx.doi.org/10.1007/BF00027429.

[31] Sharma Riddhi, Sharma Vipul, Sharma Madhu Sudan, et al.,.Studies on Limnological Characteristic, Planktonic Diversity and Fishes (Species) in Lake Pichhola, Udaipur, Rajasthan (India).Universal Journal of Environmental Research and Technology.2011;Volume 1, Issue 3: 274-285.

[32] Sivakami, R., Arumugam, V., Premkishore, G., An analysis of Zooplankton in a Lake, Pudukkottai District, Tamilnadu, India. Int. J. Curr. Microbiol. App. Sci., 2015;4(5): 377-389.

[33] Sivakumar, K. Karuppasamy, R. Factors affecting productivity of phytoplankton in a reservoir of Tamilnadu, India. American-Eurasian Journal of Botany, 2008;1(3): 99-103

[34] Sondergaard, M Sand-Jensen, K. Physico-chemical environment, phytoplankton biomass and production in oligotrophic software lake Kalgaard, Denmark. Hydrobiologia., 1979;63: 241-253.

[35] Spencer, CN King, DL., Role of light, carbon dioxide and nitrogen in regulation of buoyancy, growth and bloom formation of Anabaena flos-aquae. J. Plankton Res., 1989;11 (2): 283-296.

[36] Sridharan, VT.. Phytoplankton and algae studies. Techniques of plankton methodology. Prepared for Training workshop on Integrated Environmental Research programme on Kaveri River. 1989;pp. 1-15.

[37] Strayer, D. Dudgeon, D. Freshwater biodiversity conservation: recent progress and future challenges. Journal of the North American Benthological Society, 2010;29: 344-358.

[38] Tiwari, A Chauhan, SV. Seasonal phytoplanktonic diversity of Kitham lak, Agra. J. Environ. Biol., 2006;27: 35-38.

[39] Urabe, J., Clasen, J. Sterner, RW. Phosphorus limitation of Daphnia growth: Is it real? Limnol. Oceanogr., 1997;42: 1436-1443.

[40] Uthirasamy, S., Chitra, T. Stalin, P., 2021. Zooplankton diversity of Cauvery river in Erode district, Tamilnadu. Asian Journal of Advances in Research.,2021;7(2): 1-5.

[41] Vamoose, R.The release of hydrogen sulphide from mud. J. Soil. Sci., 1994;15:103-109.

[42] Vareethiah, K Haniffa, M.A.Phytoplankton pollution indicators of coir retting. J. Environ. Pollut., 1998;3(2):117-122.

[43] Wani, IA. Subla.BA. Physico-chemical features of two shallow Himalayan lakes. Bull. Environ. Sci., 1990;8:33-49.

[44] Ward, HB. Whipple, GC. . Fresh-Water Biology. John Wiley & Sons; New York.1963.

[45] Waziri, M., Physicochemical and Bacteriological investigation of surface and groundwater of Kumadugu-Yobe Basin. PhD Thesis, University of Maiduguri, Nigeria. 2006;88-96.