PLANKTON DIVERSITY IN FRESH WATER ECOSYSTEM OF RIVER NONBAH, WEST KHASI HILLS, MEGHALAYA (INDIA).

FIDALIA WAHLANG
ROLL NO. S1903416
B.Sc. SIX SEMESTER, 2022

FIELD PROJECT REPORT SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR PRACTICAL IN ZOOLOGY

PAPER- 8B
(DEVELOPMENTAL BIOLOGY, ENVIRONMENTAL BIOLOGY AND BIOTECHNOLOGY)

NONGSTON COLLEGE, AFFILIATED NORTH-EASTERN HILL UNIVERSITY
West Khasi Hills, Meghalaya 793119

CONTENTS

i. PREFACE

ii. ACKNOWLEDGEMENT

iii. INTRODUCTION

iv. AIM and OBJECTIVE

v. MATERIALS AND METHODS

vi. RESULT AND DISCUSSION

vii. CONCLUSION

vii. REFERENCES

PREFACE

The diversity of plankton communities in natural freshwater has been shown to increaseecosystem stability and resource use efficiency. The fact that plankton species inhabit an open fluid environment places some particular constrains to aquatic ecosystems that are absent in their terrestrial counterparts.The positive effect of species diversity on the production and temporal stability of terrestrial plant communities has been studied extensively both theoretically and empirically. Plankton play a huge role in the food web. Plankton are incredibly important to the ocean ecosystem, and very sensitive to changes in their environment, including in the temperature, salinity, pH level, and nutrient concentration of the water.

ACKNOWLEDGEMENT

Our sincere thanks to the Principal Dr.I.Mawthoh for providing us with this wonderful opportunity to work on this project Plankton Diversity In Fresh Water Ecosystem of River Nonbah.We would like to convey our heartfelt gratitude to Dr. H.Kharbani Head of Department Zoology, Nogstoin College for his valuable initiative, keen interest and support in the preparation of this survey. Sincere thanks are also due to our respected teachers Dr.R.Nongrum, Dr. C.Thabah and Sir P. Marthong of the Zoology Department Nongstoin College for their moral support, constant encouragement, tremendous direction and assistance for preparing this valuable document and a special thanks to IQAC Cell for financial support and for making the entire thing within a very short time. This project would have not been complete without their help and insights.

INTRODUCTION

River ecosystems support a disproportional large fraction of its biodiversity, while acting as a significant corridors for the movement of flora, fauna and nutrients. Freshwater environments supply water for drinking, growing crops, manufacturing, energy and transport.Plankton and fish are the major biotic components that maintained the biodiversity and ecosystem functions (Ganie *et al*., 2018.).The productivity of any aquatic water body depends on the amount of plankton present in the said water body (Guy, 1992). The position they occupy in the trophic level makes them more vulnerable and highly sensitive to even a small degree of environmental changes, hence they act as indicators of water quality.

Phytoplanktons are considered as the basic members of aquatic ecosystems and hence their change of aquatic medium's water quality. The phytoplankton is mainly classified into four classes: *Bacillariophyceae, Chlorophyceae, Cyanophyceae* and *Eglenophyceae*(Manthri *et al.*, 2014). The number of species of phytoplankton serves to determine thequality of a water body (Bahura *et al.,* 1991). In water bodies, the seasonal qualitative and quantitative variations occur in the plankton communities and their densities vary according to the nature of water.

Zooplanktons constitute the *Protozoans, Rotifers, Cladocerans* and *Copepads.* Zooplankton act as a connecting link between primary producers (phytoplanktons) and higher consumers (mostly fishes) in aquatic food webs. They occupy in intermediate position in the food web and mediate the transfer of energy from lower to higher trophic level (Water *et al.,*1977*).* Zooplankton diversity is considered to be an important limiting factor in ecological water quality assessment.

AIM AND OBJECTIVES

1. **Qualitative and quantitative study on Plankton diversity in fresh water ecosystem**
2. **To determine the water quality of dwelling and non-dwelling water body**

MATERIALS AND METHODS

Study area: The study was conducted in one major river system that runs over Nongstoin town. This river runs a distance of approximately 5.6 Kms through the Nongstoin town which is the headquarter of the West Khasi Hills District, Meghalaya in the Eastern Himalayas during April, 2022. The topography of the basins is hilly, situated at an altitude of 1400m ASL. Three sampling sites, on river Nondein were selected for the present study. Selected locations are: Up stream (25.5307822N; 91.2559316E), Down stream (25.5127926N; 91.2606909E) and Town area (25.5196238N; 91.2635598E).

Major Drains contributing to Pollution in Nonbah River: There are 5 major drains which pass through Nongstoin town that discharge the untreated sewage and municipal wastes into the Nonbah River. The drains locations with GPS Co-ordinates are: Drain near fish market, New Nongstoin (N 25°31.121' E 91°15.897') , Drain near Market Complex, New Nongstoin (N 25°31.132' E91°15.878'), Drain near Govt. L P School, New Nongstoin (N 25°31.170' E 91°15.839'), Drain at Dong Speng Thawlang Mlah, New Nongstoin (N 25°31.232' E 91°16.021'), Stream near Bishop House, New Nongstoin (N 25°31.530' E 91°16.194'). Therefore we select this river to assess the water quality and diversity of plankton by comparing the upstream, downstream and town area of this river system. Map below indicated the catchment area of Nonbah River.

Figure: 1. Map showing study site

Site:1 **Site:2** **Site:3**

Figure: 2. Selection sites, Dated, 18-05-2022

Samplings method;

Samplings were made to record the physico-chemical, phytoplankton and zooplankton characteristics. Rainfall data was obtained from the local meteorological unit, Shillong. Field data like water temperature, Hardness, Alkalinity, free Carbon dioxide, Dissolved Oxygen and pH were measured.

Samplings of phytoplankton and zooplankton were carried out from the surface water, by towing the phytoplankton and zooplankton nets (mouth diameter 0.35 m) made up of bolting silk cloths (No. 30 and 10, Mesh size -48 and 158 μm), for half an hour. The collected samples were preserved in 5% neutralized formalin for further analysis. For the quantitative analysis of phytoplankton, the settlement method described by Sukhanova (1978) was adopted. Phytoplankton and zooplankton were identified using the standard works of Hustedt (1930), Venkataraman (1939), Prescott (1962), Desikachary (1959 and 1987), Hendey (1964), Steidinger and Williams (1970), Taylor (1976), Anand (*et al.*1989) and Santhanan *(et al.*1987), Davis (1955), Kasturirangan (1963), Newell and Newell (1986), Deboyd Smith (1977), Wimpenny (1966), Todd and Laverack (1991) and Perumal (*et al.* 1998)

Statistical analysis: For the quantitative analysis of plankton, 500 litre of water was filtered through a bag net of same mesh size and the numerical plankton analysis was carried out using a binocular microscope. Biodiversity indices were calculated following the standard formulae:

i. Diversity index: $H = -\Sigma\, pi \ln pi$

Where,

H = Shannon diversity index

S = Total number of species in the community

pi = proportion of S made up of the i species

ii. Richness:S = Number of species

iii. Evenness: $E_H = H'/H'_{max} = H/\ln S$

Where,

E_H= Shannon's equitability

H= Shannon diversity index

$H'_{max} = \ln S$

iv. Dominance index, $d = N_{max}/ N$

Where,

N_{max} = the number of individuals in the most abundant species,

N = the total number of individuals in the sample.

v. Sorensen similarity index, QS=2C/a+b+c

Where,

a, b and c= number of species in samples a and b, respectively

C= number of species shared by the three samples

QS = the quotient of similarity

(Shannon and Weaver, 1949; Gleason, 1922; Pielou, 1966).

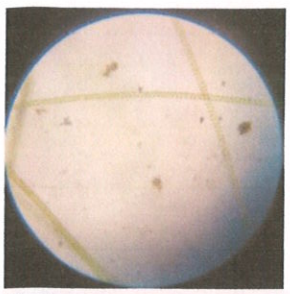
Analysis of Variance (F) tests were made for comparing among location sites. All these statistical analyses were performed statistically using Microsoft excel.

RESULTS AND DISCUSSION

Table :1. List of Plankton species collected from three sampling station.

Plankton Species	Down stream	Up stream	Town area
Phytoplankton			
Spirogyra sp.	10	3	0
Oscilatoria sp.	7	6	18
Microcystis sp.	1	0	0
Actinophys sp.	1	0	0
Microspora sp.	1	2	0
Amorpha ovalis	1	1	0

Dinobryon sp.	1	0	2
Docidium sp.	0	2	3
Stauroneis sp.	0	7	0
Diatoma sp.	0	13	4
Closterium.	0	3	0
Pedestrum sp.	0	2	0
Sirogonium sp.	0	0	7
Trichocerca sp.	0	0	4
Vorticella sp.	0	0	9
Politoma sp.	0	1	0
Zooplankton			
Keratella sp.	1	0	0
Naplius sp.	1	3	0
Brachionus sp.	1	0	0
Paramecium sp.	1	2	0
Bosmina sp.	0	7	4
Alona sp.	0	3	0
Porifera	0	2	0
Anuraeopsis sp.	0	0	3
Daphnia sp.	0	0	2
Frontonia sp.	0	0	4
Species richness	11	15	11
Number of individual	26	57	60

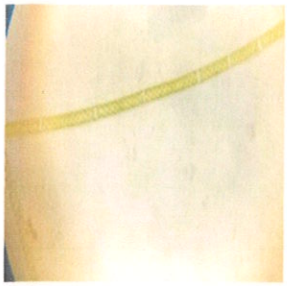


Spirogyra sp

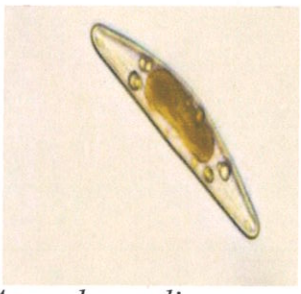
Oscillatoria sp

Microcystis sp

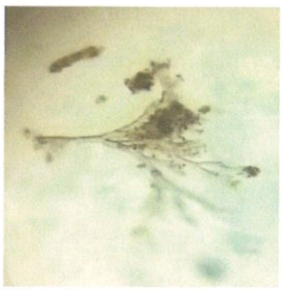
Actinophys sp



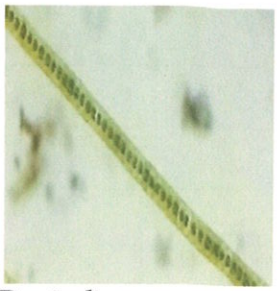
Microspora sp



Amorpha ovalis

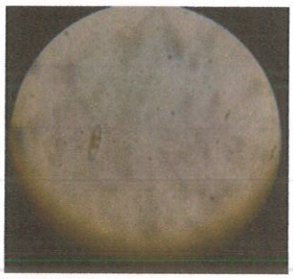


Dinobryon sp



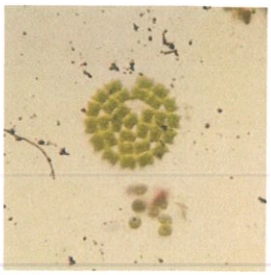
Dociadiu sp

Stauroneis sp



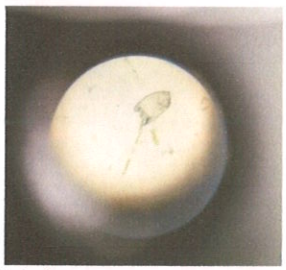
Diatoma sp

Closterium sp

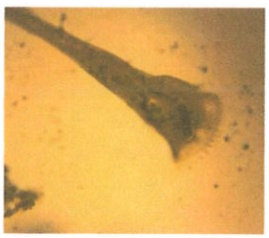


Pedestrum sp

Sirogonium sp



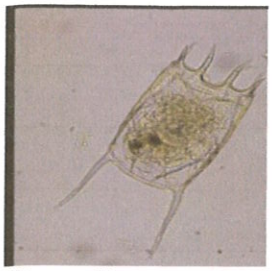
Trichocerca sp



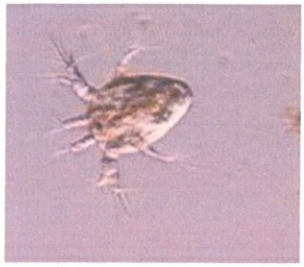
Vorticella sp

Politomasp

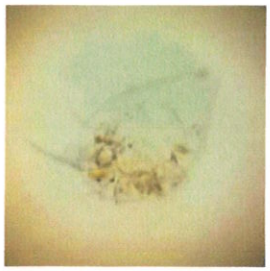
Figure:3. Species of Phytoplankton



Keratella sp



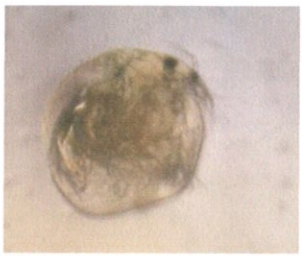
Naplius sp



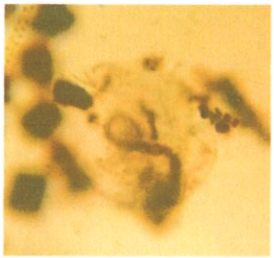
Brachionus sp

Paramecium sp

Bosmina sp.



Alona sp



Porifera sp

Anuraeopsis

Daphnia sp

Frontonia sp

Figure:4. Species of Zooplankton

Table: 2. Diversity measure comparing three sampling station.

	Up Stream	Town area	Down Stream
Species richness (*S*)	15	11	11
Shanon Weiner Index (H)	2.5	1	1.8
Eveness E_H	0.89	0.92	0.59
Dominance (D)	0.36	0.64	0.45

Table: 3. Physico-chemical parameters from three sampling sites

	Up Stream	Town area	Down Stream
pH	6.9	5.9	6
D.O mg/L	8	6.4	6.64
Free CO2 mg/L	2	6	4
Hardness mg/L	88	200	180
Alkalinity mg/L	14	12	13
Temperature˚C	14	18	16

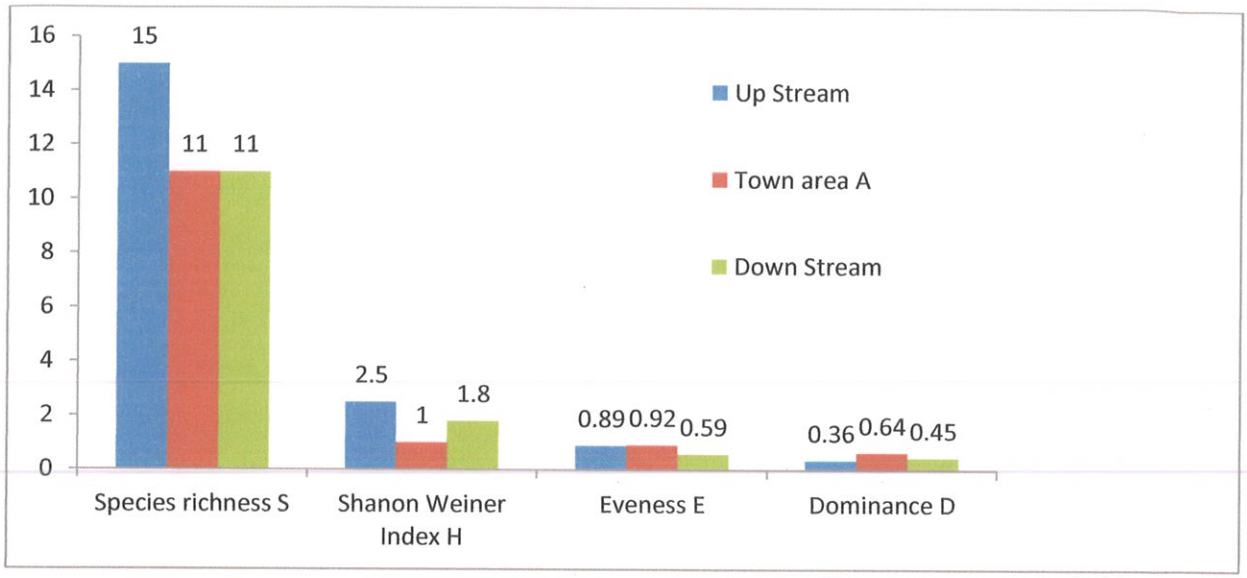


Figure: 4. Diversity measure comparing three sampling station.

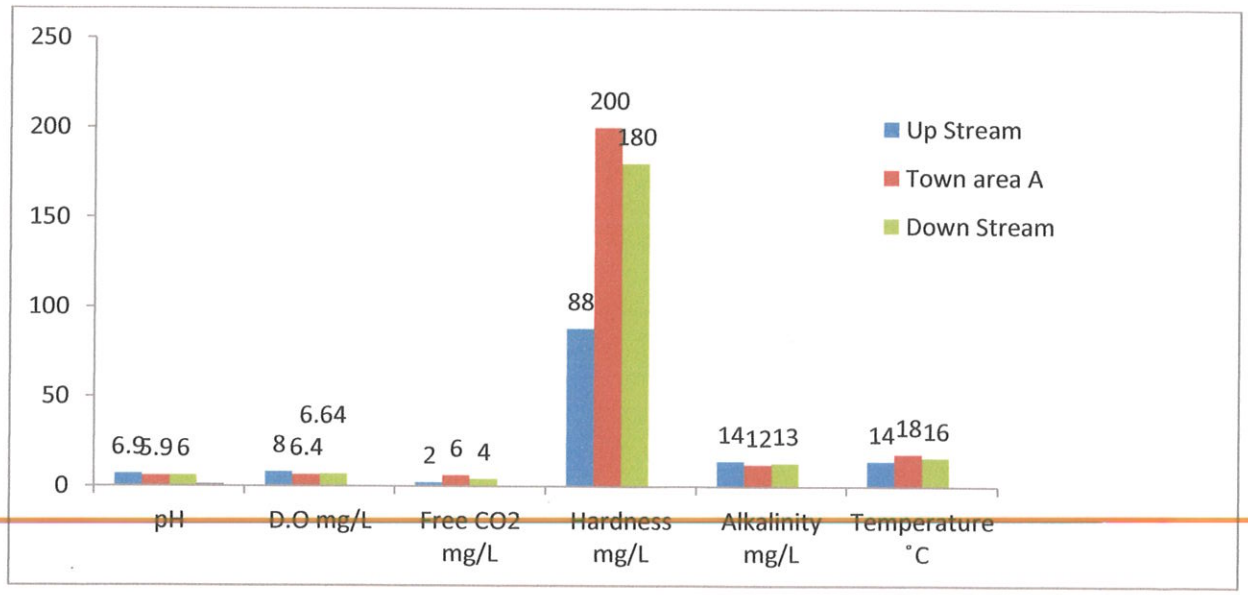


Figure: 5. Physico-chemical parameters from three sampling sites

Table: 4. Sorensen similarity index (Q)

Sorensen similarity index (Q)	Down stream	Up stream	Town area
Down stream	-	**0.4**	**0.2**
Up stream		-	**0.3**

Plankton species collected:

For any scientific utilization of water resources plankton study is of primary interest (Jhingran, 1985). A total of 26 planktons were identified from the Selected locations. 15 species were identified from Up stream, 11 from Down stream and 11 from Town Area.Phytoplankton forms the vital source of energy as primary producers and serves as a direct source of food to the other aquatic plants and animals (Battish, 1992).Out of 26 Plankton16 species were identified as Phytoplankton. Zooplankton are one of the most important biotic components influencing all the functional aspects of an aquatic ecosystem, such as food chains, food webs, energy flow and cycling of matter (Battish, 1992). Total number of 10 species of Zooplankton were identified in the comparative study.

Shannon Diversity Index:

The Shannon index is a diversity index, the higher the value of 'H' the greater is the diversity. The maximum value 'H' can be more than 1. Total diversity depend on:

1. The number of species or number of parts so called the velocity components.
2. The evenness component on the distribution of relative abundance higher over all the diversity occurs when the number of species and the evenness components are large (low dominance).

The diversity can be used as a good measure for measuring or studying the effects of individual pollution because individual waste and sewage always reduce the natural diversities of the system into which they are discharged.

From Table: 4. It was recorded that diversity of species in Up stream is higher compared to the diversity found in Town Area and Downstream. The reason could be the water is less polluted or pollution free and was suitable for different species to live in and reproduce. While on the other hand the water in the Downstream is polluted as waste material is thrown by people into it and it has made the environment of Downstream unsuitable for many other plankton to thrive in to as a result, the diversity of species is less.

Physico chemical parameters:

The physico chemical variables of water analyzed in each sampling stations is as presented in (Table 3 and Figure 3). pH is an important indicator for measuring the overall causes of habitat diversity. pH values recorded ranges between 5 to 6.9at different sampling stations. pH recorded in Upstream is 6.9, Town Area is 5.9 and Downstream is 6.Low pH < 5.0 can severely reduce aquatic species diversity. However, pH range recorded were at an apt for planktonic growth at all three stations thereby suitable for aquatic life. Dissolved oxygen (DO) is the sole source of oxygen for all the aerobic aquatic life. DO reflect the water quality status and physical and biological processes in waters and show the metabolic balance of a river system. DO is one of the important indicators of water quality and essential for the survival of aquatic organisms. The colder the water, the more oxygen it dissolved; warmer water, less oxygen is dissolved. DO recorded at different sampling sites varied between 6 to 8 mg/L.The DO recorded in Upstream is 8 mg/L, Town Area is 6.4 mg/L and Downstream is 6.64 mg/L. The higher DO level can be due to lower temperature and turbulent flow of rivers.

Here, we observed the water in Upstream is colder hence more oxygen dissolved compared to Town Area and Downstream. The reasons could be the water body in Upstream is less polluted compared to the other two stations. Free CO_2 is carbon dioxide that exists in the environment. It is present in water in the form of a dissolved gas. Free CO_2 recorded range between 2 to 6 mg/l at different sampling stations. The Free CO_2 recorded in Upstream is 2, Town Area is 6 and Downstream is 4. High CO_2 can severely reduce aquatic species diversity due to the disposal of wastes and sewage in the water body.Alkalinity is a measure of weak acid present in water and of the cations balanced against them.Alkalinity is also in important considering the treatment of wastewater and drinking water because it influences cleaning processes such as anaerobic digestion. It ranged between 12 to 14 mg/L at different sampling stations. Alkalinity ranges at 14 mg/L in Upstream, 12 mg/L in Town Area and 13 mg/L in Downstream. The Alkalinity in Upstream is high as the water body is pollution freeand it indicates thatThe Total Hardness is determined by cations that form insoluble compounds with soap and it correlated with calcium, alkalinity, and pH and it was recorded between 88 to 200 mg/L at different sampling stations. Town Area recorded the highest total Hardness of about 200 mg/L. This is because the water body of Town Area is exposed with waste product from different drainage system of the town.Water temperature plays a vital role to determine the biotic and abiotic characteristics of the aquatic ecosystem. Temperature is a critical factor for seasonal periodicity of phytoplankton (Chari,1980).In the present study water temperature fluctuated between 14 to 18°C across the sampling sites.The recorded temperature ranges 14 in Upstream, 18 in Town Area and 16 in Downstream.Lower water temperature was recorded in Upstream due to low waste disposal.

CONCLUSION

The Nonbah River rises from the uphill region of Nongstoin in West Khasi Hills District. The river is also joined by another source coming from Nondein and finally after passing the ravines and gorges joined the Kynshi River. As it is in the commercial areas, the waste, garbage etc generated from the local markets, shops, houses are ultimately discharged into the water body thereby deteriorating the water quality. There is no industrial estate; however there is isolated small scale industries located in the catchment of the river.

The terms biodiversity and ecosystem have a complicated relationship as the structure of the ecosystem is irretrievably linked to the species diversity and its distribution.The present study is providing baseline information concerning Plankton distribution, population density, species diversity, richness and evenness. It also alarms the constant track of Plankton diversity in the area.

REFERENCES

1. Guy, D. (1992). The ecology of the fish pond ecosystem with special reference to Africa. Pergamon Press. 220230.
2. Parvaiz Ahmad Ganie, D Baruah, K Kunal, R Posti, Garima and D Sarma, (2018). Phytoplankton diversity and abundance in upland streams of Kameng drainage, Arunachal Pradesh. *Journal of Entomology and Zoology Studies*; 6(6), 1166-1173., N.A., Dar, K. A., Khan, I.L., Sharma, R.K. and Sahaf, K.A. (2018) Sericulture- A viable option for sustainable livelihood and employment generation for rural population of J & K. Global Journal of Bioscience and Biotechnology, ??(1): 200-203
3. Battish, S.K. (1992). Fresh water zooplankton of India, Oxford and IBM publications.

4. Water, T.P. (1977). Secondary production in Inland Waters, Adv. in Eco. Res., 10:11-164.
5. Manthri Kumar Rajesh, A.; Selvin Samuel, A.; Martin, P. andNiveta, S. 2014. A comparative study on phytoplanktondiversity in river Tamiraparani and a man-made fresh waterbody. International Journal of Research in Science, 1(2), 80-82
6. Jyoti, S., Prahlad, D and Karra, V.D. 2018. A critical reviewof studies related to diversity and seasonal variation ofphytoplanktons. International Journal of EnvironmentalSciences, 7(3), 100-103
7. G.Venkataraman, A systematic account of some south Indian Diatoms, Proceedings Indian Academy Sciences, (1939)
8. N. Anand, Handbook of Blue-Green Algae, Bishen Singh Mahendra Pal Singh, Publishers, Dehra Dun, India, (1989)
9. G. W Prescott,Algae of the Western Great Lakes Area, Wm. C. Brown Co, Dubuque Towa (1962)
10. Jhingran, V.G. (1965) Fish and Fisheries of India. Hindustan Publishing Corporation India.
11. Davis R, Hirji R (2003). Water Quality: Assessment and Protection. Water Resources and Environment Technical Note D.I. The World Bank, Washington, DC, USA
12. Manickam, N., Santhanam, P., Muralisankar, T., Kumar, S.D., Balakrishnan, S., Selvaraju, A.and Devi. A.S 2020. Phytoplankton biodiversity in the two perrenial lake of Coimbatore, Tamil Nadu, India, Acta Ecological Sinica, 40, 81-89
13. Physico-chemical characteristics and phytoplankton biodiversity in Sulur lake of Coimbatore, South India November 2017 Research Journal of Biotechnology12(72) Authors: Narasimman Manickam Bharathidasan, University; P. Saravana Bhavan

,Bharathiar University; Perumal Santhanam, Bharathidasan University, Bhuvaneswari; Rajagopal Ayya, Nadar Janaki Ammal College.https://www.researchgate.net/publication/320843122

14. Phytoplankton biodiversity in the two perennial lakes of Coimbatore, Tamil Nadu, India February 2020 Act a Ecologica Sinica 40(1):81-89DOI:10.1016/j. chnaes .2019.05.014 Authors: Narasimman Manickam ,Bharathidasan University; P.Saravana Bhavan, Bharathiar University; Perumal Santhana ,Bharathidasan University; Thirunavukkarasu Muralisankar, Bharathiar University. https://www.researchgate.net/publication/291409012
15. Diversity of Phytoplankton from Inland Waters of Selected Districts in Tamil Nadu: A ReviewJune 2021International Journal of Ecology and Environmental Sciences 47(2):153-169Authors:Mohamed Tharik,Biodiversity Conservation Foundation, India Sai Saraswathi VIT University Dr Kumaraguru Arumugam Biodiversity Conservation Foundation (BCF INDIA) and Tamil Nadu Forest Department (TNFD). https://www.researchgate.net/publication/352848835

16. https://www.google.in/ retrieved on 29th. April. 2022. Revised Action Plan For Rejuvenation Of River Nonbah West Khasi Hills District, Meghalaya Identified As River Polluted Stretch Under Priority – IV. Prepared By River Rejuvenation Committee Government Of Meghalaya.