PHYTOPLANKTON AND ZOOPLANKTON DIVERSITY IN RURAL WETLANDS OF ANAND AND KHEDA DISTRICTS, GUJARAT INDIA

Neel Rajendrakumar Talati[*], Rita Nirmal Kumar[*], Dhara Ravikant Tuteja[*], Nirmal Kumar[**]

[*] Natubhai V. Patel College of Pure and Applied Sciences, Department of Biological and Environmental Science, Vallabh Vidyanagar, Gujarat, India
[**] Institute of Science & Technology for Advanced Studies & Research (ISTAR), P.G. Department of Environmental Science & Technology (EST), Vallabh Vidyanagar, Gujarat, India

corresponding author: Neel Rajendrakumar Talati, e-mail: neel7007@gmail.com

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ABSTRACT

Plankton diversity plays an essential role in aquatic wetlands. Phytoplankton and zooplankton communities were assessed in three permanent water bodies: Petli (S1), Deva (S2) and Heranj (S3) of the Anand and Kheda districts. Sampling was done from December 2020 to March 2021. Collection of plankton and identification of planktons was done using various published plankton manuals. A total of 32 phytoplankton have been recorded during the study period, from which 36 % belong to class Chlorophyta, 32 % belong to class Bacillariophyta, 16 % belong to Cyanophyta, 10 % belong to Charophyte, 3 % belong to Dinophyta, and 3 % belong to Euglenophyta. In addition, a total of 27 zooplankton species have been found, from which 46 % belong to Maxillopoda, 23 % belong to Monogononta, 19 % belong to Branchiopoda, 8 % belong to Eurotatoria, and 4 % belong to Hexanauplia. S1 has the maximum number of phytoplankton (24), followed by S3 with 18 and S2 with 15 species. Zooplankton were at the maximum in S1 (19), followed by S2 with 16, and S3 with 11 species. Results of the present study indicate that the studied wetlands have rich plankton diversity.

Keywords: *biodiversity, phytoplankton, zooplankton, freshwater ponds*

INTRODUCTION

Wetlands play an important role in both terrestrial and aquatic ecosystems. The freshwater ecosystem includes ponds, lakes, puddles, pools, and swamps, as temporary or permanent water bodies. The structural ecosystem is classified into two types of abiotic and biotic components [1]. Abiotic components include pH, light, temperature, oxygen levels, etc., and biotic components include plants, animals, and decomposers [2].

The primary water source controls various environmental factors and associated plants as well as animal life [3]. The community uses water for multiple reasons: aquaculture, washing utensils, agriculture, and livestock.

Ponds are small water bodies smaller than the lake containing both untreated sewage and organic waste of nearby towns or villages. Ponds also protect various indigenous species by giving shelter, food, water, and breeding place for birds, dragonflies, frogs, birds, and crocodiles [4]. The stagnant water body provides a suitable habitat for aquatic plants and animals. Many invertebrates are dependent on these dead and decaying organisms, which eventually become a part of the food chain [5]. In India majority of ponds are used for fish farming.

Planktons play a significant role in the wetland ecosystem and are a potential indicator of changing water quality. They are susceptible to ecological conditions and react promptly to adjust to the environment [6]. Phytoplankton, a primary producer of the ecosystem, is a major food source for zooplankton. Zooplankton species are the initial prey for most fish larvae and other plankton-eating fishes [7].

For the last many years, wetlands have been under pressure due to overgrowth of macrophytes, pesticides from agricultural runoff, domestic waste, sewage sludge, defecation around ponds, bathing for domestic animals, washing clothes, and utensils, etc [8]. The present study was performed to find various phytoplankton and zooplankton in three perennial sites of Anand and Kheda district, i.e., Petli (S1), Deva (S2), and Heranj (S3). Samples were taken from December 2020 to March 2021.

MATERIALS AND METHODS

Gujarat is located on the west coast of the Indian peninsula and has vast plains, rivers, ponds, hilly regions, and the gulf. Three villages, Petli (S1) (22.598647°, 72.757152°), Deva (S2) (22.620332°, 72.734993°) and Heranj (S3) (22.660040°, 72.696840°), which belong to the two districts of central Gujarat - Anand and Kheda, were included in this study (Figure 1). All three wetlands are rain-fed, and receive water through canals. Water is primarily used for irrigation, domestic usage, and rearing and stocking of Indian major carp.

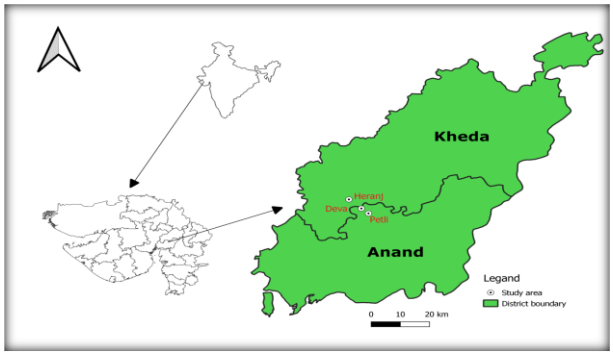

Figure 1. Studied area

Standard operating protocols are given in [9]. Surface water sampling was done at three different places, and 50 litres of water was filtered through plankton net with 20 µm mesh size. The filtered sample was fixed immediately in 4 % freshly prepared formaldehyde. Samples were brought to the laboratory and observed under the microscope to identify different phytoplankton and zooplankton (Figure 2). A checklist of phytoplankton and zooplankton was made. Identification was made with the help of the following online tools: an image-based key to the zooplankton of North America [10], AlgaeBase [11], and Keweenaw Algae [12]. Sampling was done between 8:00 a.m. and 1:00 p.m. from December 2020 to March 2021. Every month, each site was visited two times at an interval of 15 days. Maps of the studied area were prepared with the help of Quantum GIS Software, pictures of planktons were captured using LABOMED STC - HL light microscope. Graphs were made with the help of free software Excel and RStudio's.

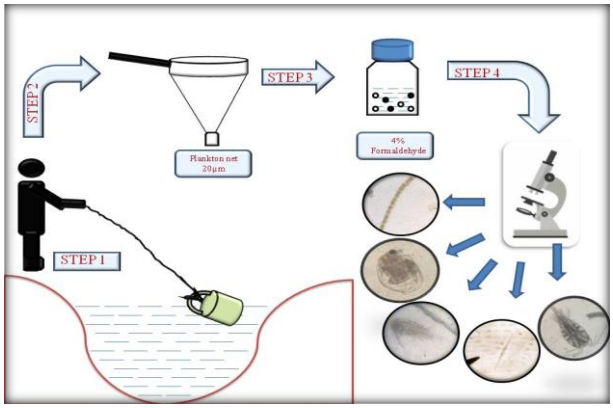

Figure 2. Sample collection

RESULTS AND DISCUSSION

Phytoplankton

A total of 32 phytoplankton species have been recorded in all the studied sites of Deva, Petli and Heranj during the studied period, from which 36 % belong to class Chlorophyta, 32 % belong to class Bacillariophyta, 16 % belong to Cyanophyta, 10 % belong to Charophyte, 3 % belong to Dinophyta, and 3 % belong to Euglenophyta (Figure 3). The identified phytoplankton species are shown in Figure 4.

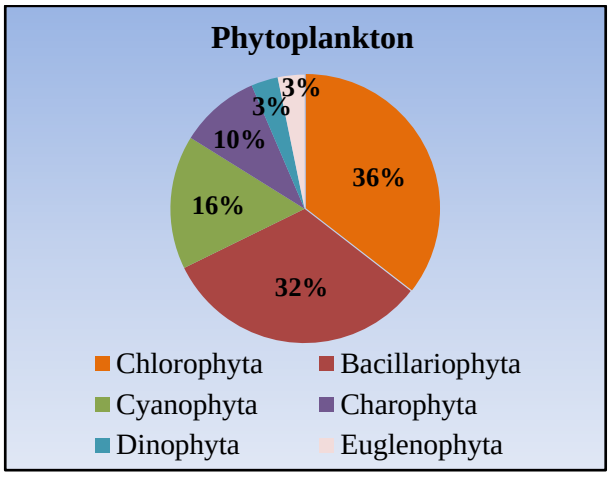

Figure 3. Percentages of individual phytoplankton species

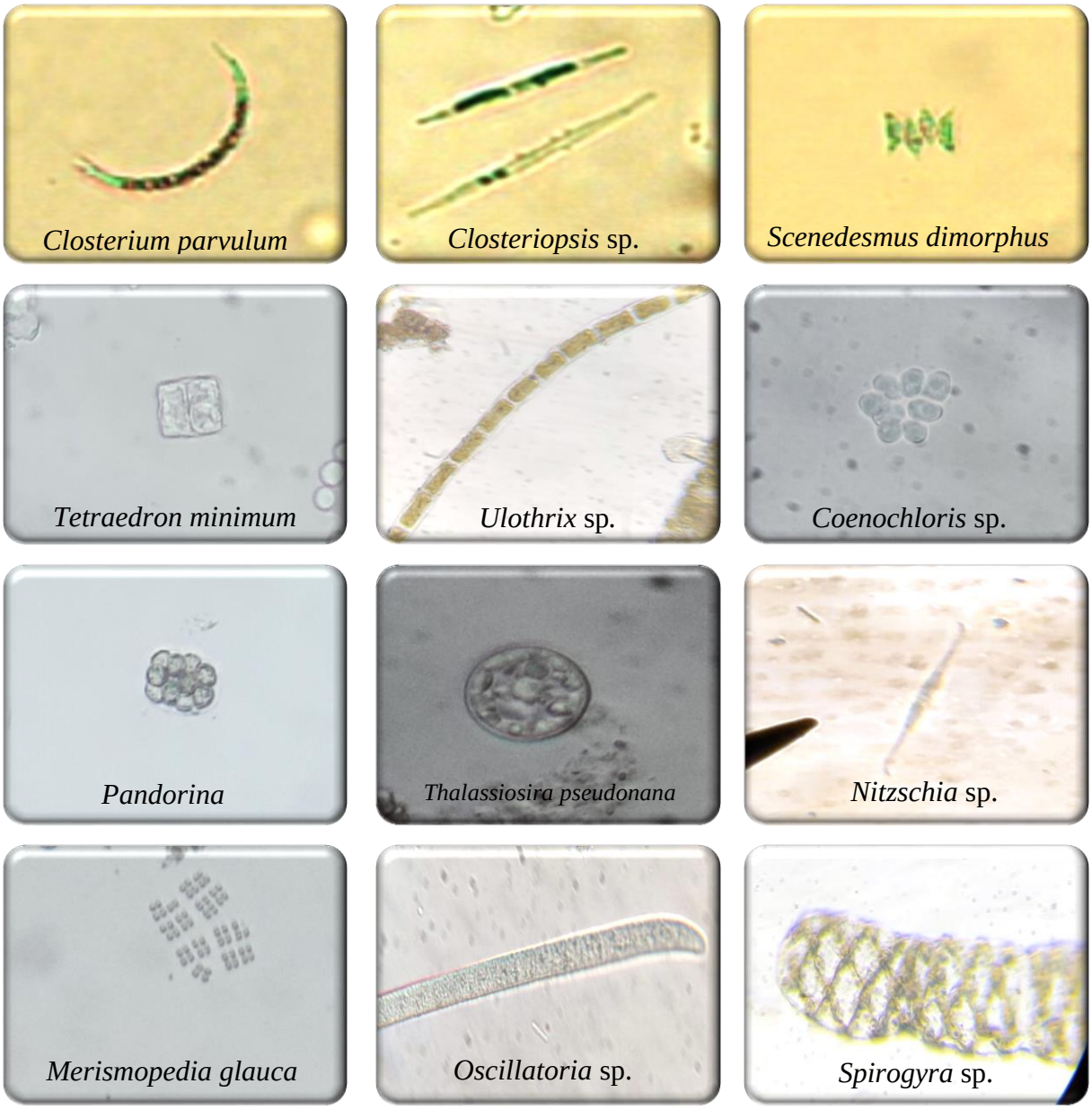

Figure 4. Identified phytoplankton species

Zooplankton

A total of 27 zooplankton species were found, from which 46 % belong to class Maxillopoda, 23 % belong to Monogononta, 19 % belong to Branchiopoda, 8 % belong to Eurotatoria, and 4 % belong to Hexanauplia (Figure 5). Based on the identification it was found that Maxillopoda and Monogononta were the maximal during the studied period. A checklist of identified zooplankton species is shown in Table 1. The identified zooplankton are shown in Figure 6.

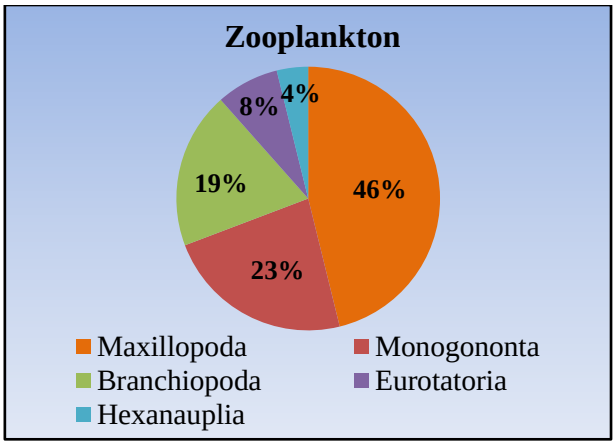

Figure 5. Percentages of individual zooplankton species

Table 1. Checklist of the identified zooplankton and phytoplankton at the studied sites

	S1	S2	S3		S1	S2	S3
Maxillopoda				**Chlorophyta**			
Cyclops scutifer	+	+	+	*Coelastrum* sp.	+	+	+
Diacyclops thomasi	+	+	-	*Crucigenia* sp.	+	-	+
Acanthocyclops robustus	+	+	-	*Coenochloris* sp.	+	-	-
Aglaodiaptomus leptopus	+	-	-	*Tetraedron minimum*	+	-	-
Microcyclops varicans	+	-	-	*Botryococcus* sp.	+	-	+
Heterocope septentrionalis	+	-	-	*Chlorella* sp.	+	+	+
Mesocyclops edax	-	+	-	*Crucigenia quadrata*	+	-	+
Diacyclops bicuspidatus odessanus	-	+	-	*Scenedesmus dimorphus*	+	-	+
Epischura nordenskioldi	-	+	-	*Tetraedron* sp.	+	+	+
Ergasilus sp.	-	+	+	*Ulothrix* sp.	-	+	-
Eucyclops agilis	-	+	-	*Chlamydomonas* sp.	-	-	+
Leptodiaptomus coloradensis	+	+	+	*Pandorina*	+	+	+
Monogononta				**Bacillariophyta**			
Brachionus calyciflorus	+	-	+	*Gyrosigma* sp.	+	-	-
Brachionus plicatilis	+	-	+	*Thalassiosira pseudonana*	+	-	-
Polyarthra dolichoptera	+	-	-	*Synedra* sp.	+	+	-
Keratella valga	+	-	-	*Cyclotella* sp.	+	-	-
Trichocerca rattus	+	-	-	*Navicula* sp.	+	+	+
Kertella testudo	-	+	-	*Pleurosigma* sp.	+	+	+
Branchionus variabilis	+	+	+	*Nitzschia* sp.	+	+	+
Notholca labis	+	+	+	*Amphipleura sp.*	-	+	-
Branchiopoda				*Melosira* sp.	-	+	-
Ceriodaphnia reticulata	+	+	+	*Epithemia* sp.	-	-	+
Moina Macrocopa	+	-	-	**Cynophyta**			
Daphina magna	+	-	+	*Merismopedia glauca*	+	-	-
Moina sp.	+	-	-	*Coelosphaerium* sp.	+	-	+
Ceriodaphnia Dana	-	+	+	*Chroococcus* sp.	+	-	-
Eurotatoria				*Oscillatoria*	-	+	+
Proalides tentaculatus	-	+	-	*Oscillatoria limnetica*	-	+	+
Hexanauplia				**Charophyta**			
Copepod nauplii	+	+	+	*Spirogyra porticalis*	+	+	+
Total	19	16	11	*Closterium parvulum*	+	-	+
				Spirogyra sp.	-	+	-
				Dinoflagellata			
				Ceratium sp.	+	-	-
				Euglenozoa			
				Euglena sp.	+	-	-
				Total	24	15	18

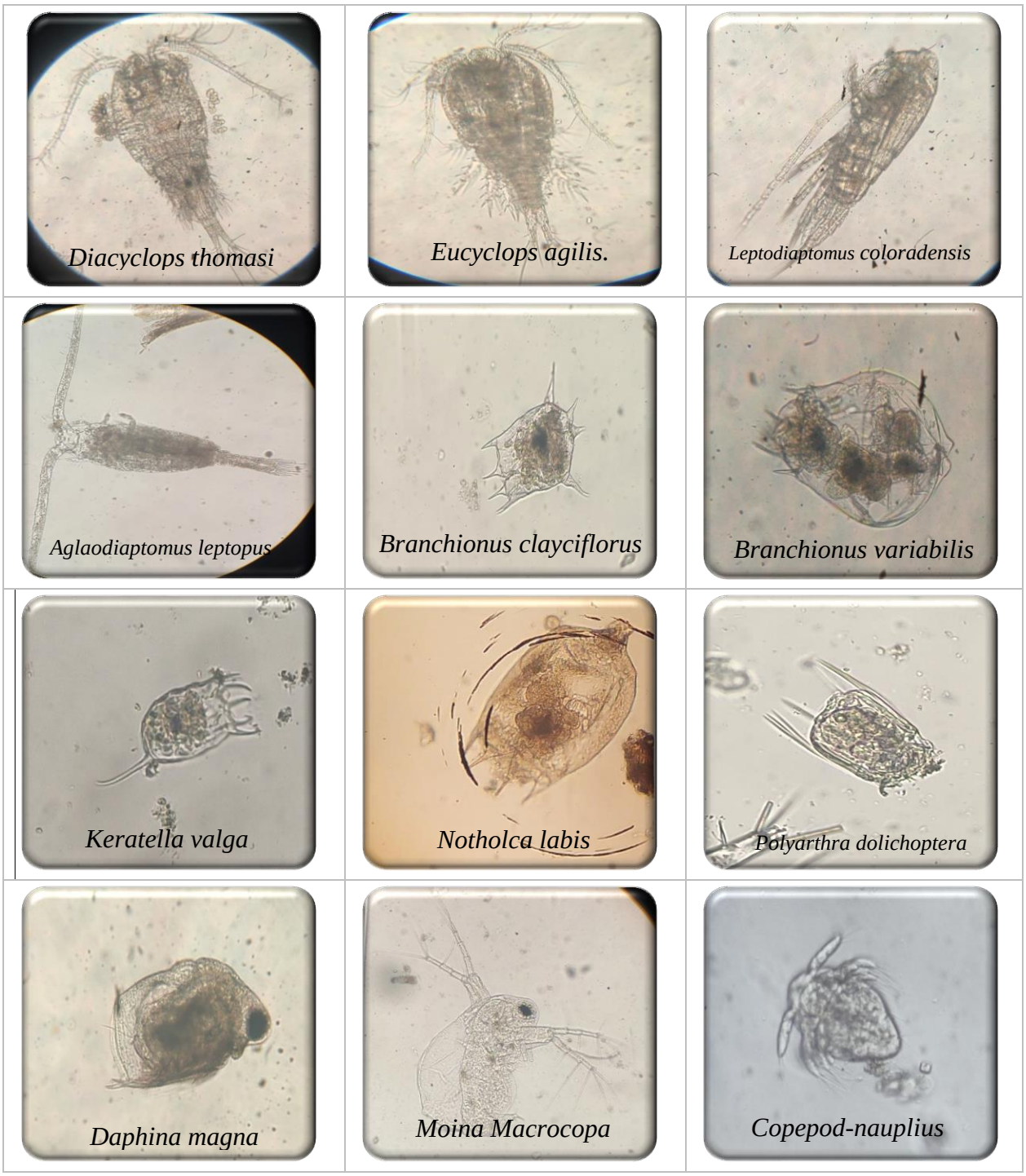

Figure 6. The identified zooplankton species

According to Table 1, the maximum number of zooplankton was identified in S1 (19), followed by S2 (16), and S3 (11). Phytoplankton diversity was also found at all locations. S1 has the most species documented (24), followed by S3 with 18 and S2 with 15. All three sites have a total of 6 common zooplankton species. There are 8 unique species in S1 and 6 distinct species in S2. Two common species are found in S1 and S2, 2 common species are found in S2 and S3, and 3 common species are found in S3 and S1 (Figure 7). Seven phytoplankton species were found to be common to all three sites. S1 had 9 separate species, S2 had 4 distinct species, and S3 had 2 distinct species. S1 and S2 have one common species, S2 and S3 have 2 common species, and S1 and S3 have 6 common species (Figure 8).

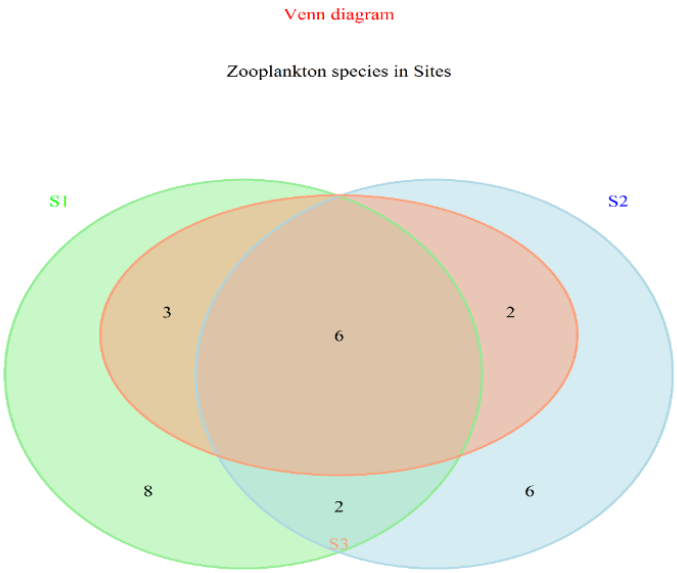

Figure 7. Venn diagram of zooplankton species occurrence at all sites

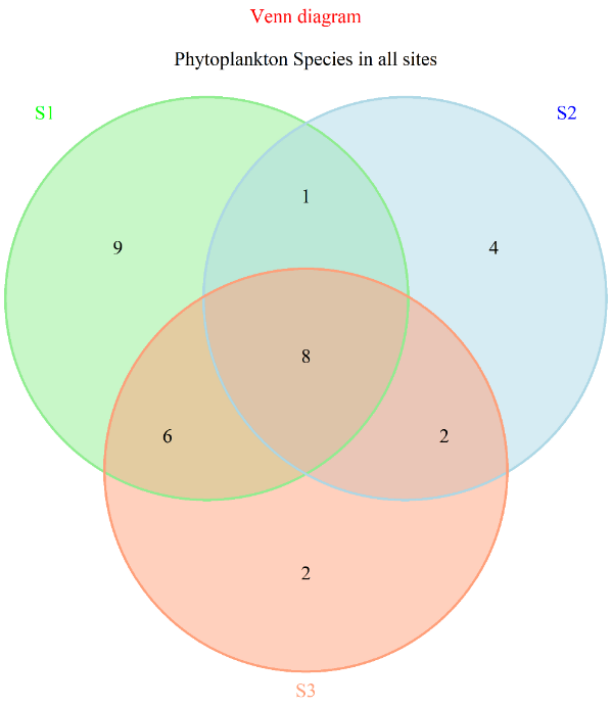

Figure 8. Venn diagram of phytoplankton species occurrence at all sites

As a result, the data show a wide range of phytoplankton and zooplankton in the rural ponds of Anand and Kheda. The water quality and climatic conditions in the area may play a key role on the region's variety. This shows that the ponds' ecosystem is in good shape. Roy et al. [13] conducted similar research in rural ponds in Raipur, Chhattisgarh. Their results were strikingly similar to previous findings.

CONCLUSION

In the aquatic ecosystem, phytoplankton and zooplankton are the most critical organisms. They are the primary and important step of the food chain; that is why it is crucial to understand them. Zooplanktons are greatly dependent on phytoplankton for survival and are key linkers for food web formation.

The current study in some selected sites helps us generate basic data on the diversity of phytoplankton and zooplankton, which helps us learn more about the health and biodiversity of the aquatic ecosystem. A total of 32 phytoplankton and 27 species of zooplankton were recorded. S1 has the highest number of zooplankton (19), followed by S2 (16) and S3 (11). Phytoplankton diversity was also found at all locations. S1 has the most species documented (23), followed by S3 with 17 and S2 with 14. Moreover, the presence and absence of specific genera or plankton populations can also be related to the agro-climatic conditions in a particular area.

REFERENCES

[1] S. Ibrahim, A survey of zooplankton diversity of Challawa river, Kano and evaluation of some of its physico-chemical conditions, Bayero Journal of Pure and Applied Sciences 2(2009) 1, 19-26. https://doi.org/10.4314/bajopas.v2i1.58450

[2] F.S. Martins, A. Moutinho, J. Espinha Marques N. Formigo, S.C. Antunes, Plankton characterization of alpine ponds: a case of study for the assessment of water quality in Serra da Estrela (Portugal), International Journal of Limnology 56(2020), Article number: 4. https://doi.org/10.1051/limn/2020001

[3] A. Bera, M. Bhattacharya, B.C.H. Patra, U.K. Sar, Phytoplankton density in relation to physico-chemical parameters of Kangsabati reservoir, West Bengal, India, International Journal of Current Research 6(2014) 6, 6989-6996.

[4] S. Parveen, H.R.A. Mola, Comparison of physico-chemical parameters and zooplankton diversity in two perennial ponds at Aligarh, India, Journal of Environmental Biology 34(2013) 4, 709-716.

[5] A.K. Verma, Limnological Studies of Muntjibpur pond of Prayagraj (U.P.) in relation to planktons, International Journal of Fauna and Biological Studies 7(2020) 4, 27-30.

[6] P. Kumar, A. Wanganeo, F. Sonaullah, R. Wanganeo, Limnological study on two high altitude Himalayan ponds, Badrinath, Uttarakhand, International Journal of Ecosystem 2(2012) 5, 103-111. http://dx.doi.org/10.5923/j.ije.20120205.04

[7] T. Gupta, M. Dey, Hydro biological Characteristics of Some Semi-intensive fish culture ponds of Lumding town of Nagaon district, Assam, Current World Environment 8(2013) 1, 107-115. http://dx.doi.org/10.12944/CWE.8.1.15

[8] S. Majumder, R.P. Dhua, S. Kar, T. Mishra, S.S. Mahapatra, S. Shit, A. Patra, Zooplankton diversity influenced by hydro biological parameters in some ponds of south eastern part of Bankura town of WB, India, International Journal of Advanced Research 3(2015) 5, 354-368.

[9] R.N. Kumar, R. Solanki, N.J.I. Kumar, Spatial variation in phytoplankton diversity in the Sabarmati River at Ahmedabad, Gujarat, India, Annals of Environmental Science 6(2012), 13-28.

[10] An image-based key to the zooplankton of North America. http://cfb.unh.edu/cfbkey/html/index.html, Accessed: March 14, 2021.

[11] AlgaeBase: Listing the World's Algae. https://www.algaebase.org/search/images/, Accessed: March 7, 2021.

[12] Keweenaw Algae. https://www.keweenawalgae.mtu.edu/, Accessed: February 9, 2021.

[13] K. Roy, S. Gupta, S.K. Nandy, Checklist of Commonly Occurring Phytoplankton and Zooplankton Genera of Urban and Rural Ponds of Raipur, Chhattisgarh, International Journal of Research in Biological Sciences 6(2016) 1, 1-6.

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