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Zooplankton Diversity and Hydrochemistry of Desert Pond Ecosystem at Olvi Village, Jodhpur, Rajasthan (India).

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ABSTRACT

The present study has been carried out on Olvi pond of Jodhpur district in Rajasthan. Olvi village is situated 62 km on the East South of Jodhpur district and it's characterized by the most typical arid conditions. Olvi pond has the greatest importance for domestic purpose and irrigation. The paper highlights the studies of zooplankton diversity and selected physico-chemical parameters. The study was conducted for the year March, 2017 – February, 2018. Different parameters were taken in the study such as Water Temperature, pH, Dissolved Oxygen (DO), Free Carbondioxide, Total Hardnes, Total Alkalinity, Chloride, Phosphate and Total Dissolve Solids (TDS). Therefore this pond has a rich number of zooplankton species. During the study period, total 25 species of zooplanktons was identified in five main groups such as Protozoa (3 sp.), Rotifera (8 sp.), Cladocera (9 sp.), Ostracoda (2 sp.) and Copepoda (3 sp.). The zooplankton numbers were recorded maximum in summer season followed by winter and lowest in monsoon. The aim of the present study helps in undertaken to assess the quality status of zooplankton diversity and better understanding for the management of the Olvi pond for drinking, irrigation and fish culture. The water body is getting agrarian run-off prompting a lot of supplement contributions to the biological system which demonstrates the eutrophic status of the pond.

KEYWORDS: Physico-chemical parameters, Zooplankton diversity, Water quality, Olvi Pond.

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INTRODUCTION

An ecosystem has components of two major Abiotic and biotic factor, which are interdependent. Plankton is part of the biotic factor of an aquatic ecosystem, which is composed of free-living organisms. Zooplanktons are free floating and tiny aquatic organism found in both freshwaters and marine waters ecosystem. These are one of the important biotic components that influence the food chain, food web and energy transfer in an aquatic ecosystem. It occupies a central position between the autotrophs and other heterotrophs and forms an important link in aquatic food webs. Zooplankton plays a significant role in converting plant food to the animal. In ecology, zooplankton are standout amongst the most significant biotic components impacting all the functional features of an aquatic ecosystem, such as food chains, food webs, energy flow and cycling of matter.[1,2] Zooplanktons are usually considered to be good bioindicators because they are sturdily affected by environmental conditions & respond quickly to changes in water quality. In an aquatic system, zooplankton plays a vital role not only in converting plant food to animal food but also provides an important food source for higher organisms including fish.[3] Zooplankton diversity, density and abundance are directly governed by physic-chemical factors, nutrient status and trophic state of any water body. The major zooplankton groups belong to Protozoa, Rotifera, Cladocera, Copepoda, and Ostracoda. The distribution of zooplankton community depends on a complex of factors such as change of climatic conditions, physical and chemical parameters and vegetation cover.[4] Most of the species of planktonic organisms are cosmopolitan in distribution.[5]

The occurrence and abundance of zooplankton in a water body depend on its productivity, which understudy is impacted by the physico-chemical parameters and the level of nutrients.[6] Zooplankton species are cosmopolitan in nature and they have all freshwater territories of the world, including dirtied mechanical and city waste waters.[7] The fluctuation observed in the distribution of zooplankton is due to abiotic parameters (e.g. climatic or hydrological constraint) and biotic parameter (predation, competition) or combination of both.[8,9] The vacillation of abiotic factors i.e., the concentration of dissolved oxygen, temperature, total alkalinity, total nitrogen, phosphate and pH can influence the growth zooplankton.[10] The object of the present work is to study the zooplankton communities in olvi pond, analyzing the zooplankton diversity in all seasons with correlate physico-chemical parameters with the aim of contributing to the knowledge of freshwater biodiversity in the Jodhpur region.

MATERIALS AND METHODS

Study Area: Olvi pond is situated outside of Olvi village. This village lies on the right side of National Highway 12 between Jodhpur- Bilara, Jodhpur district of Rajasthan at Latitude 26°11'54"

N and Longitude 73°27'11" E at an elevation of 291 m above sea level. The catchment area of Olvi pond is 9.83 sq. km. in which water spread area of the pond is 0.7 Km^2. The length of the pond is 2.7 km and average depth is 2.1 meter. Water storage capacity is about 410 million litres. The pond is anthropogenic and its water used for domestic purpose and irrigation. The pond is mostly surrounded by agriculture area.

Three different sites were elected for the purpose of water sampling and collection of zooplanktons. These sites oscillate in their characteristics, location, fauna and flora

Site-1: This site is used for animal bathing only.

Site-2: This site is represented by a slanty wall which is made up of soil, concrete mud. There are frequent anthropogenic activities due to the need for domestic and dirking water.

Site-3: This site is used as a grazing field for local cattle and wildlife. There is more bird activity also.

Figure1. Google satellite view of Olvi Pond with sampling sites.

Physico-Chemical Analysis: During the study, a water sample was collected at monthly in the early morning intervals from March 2017 to February 2018 from pre-selected three study sites (Figure 1). Some physico-chemical characteristics of pond water were studied at the site such as Temperature and pH, which were determined by Thermometer and Digital pH meter respectively, while remaining parameter like DO (Dissolve Oxygen), free carbon dioxide, Total Hardnes, Total alkalinity were analyzed by Titrimetry method in laboratory and other parameters like Chloride, Phosphate and Total Dissolve Solids were analyzed as per the procedure is given in APHA.[11,12] After that seasonal analysis work was also done, measurement of seasons was taken according to India Meteorological Department.

Biological Analysis: For zooplankton study, Water samples (1litre) were collected for quantitative analysis from approximately 20 cm underneath the water surface at each site. Zooplankton Samples filtering through standard plankton net made of silk bolting cloth No. 25 (Mesh size 50). The concentrated sample was preserved in 4 % formalin and few drops of glycerine

were added to it. Zooplankton was conveyed by recommended keys given by Edmondson[13] and Battish[14]. Identification of zooplankton species was performed under the light source microscope by utilizing keys and monographs of standard References; Pennak[15] and Adoni.[16] The quantitative investigation of zooplankton was carried out using Sedgwick Rafter plankton counting cell in accordance with Welch.[17]

RESULTS AND DISCUSSION

The results of the physico-chemical analysis of Olvi pond water are given in Table 1.

Water Temperature: Water temperature showed the lowest value (17°C) during winter and the highest value (36°C) during summer. Low water temperature was accompanied with high dissolved oxygen due to the fact that as temperature increases the dissolved gases get released from the water. Water temperature specifies an important function in influencing the periodicity, occurrence and abundance of zooplankton. Good synchronization between temperature and dissolved oxygen was seen. Temperature showed an important inverse relationship with dissolved oxygen.

pH: The pH of the pond water varied from 7.3 to 8.3. Minimum pH was recorded during summer in the month of April, and maximum during winter in the month of December. Maximum pH can be due to the quick development of algae. During the day algae use the sunlight and carbon dioxide for photosynthesis. The higher pH may be attributed to anthropogenic activities like washing of garments with detergents. Monsoon decrease in pH may be attributed to the inflow of rainwater.[18] Approximately Similar finding of temperature in this region was reported by Vyas and Nama [19] and Verma and khan [20]

Dissolved Oxygen: The dissolved oxygen was found minimum value 8.23 mg/L during summer in the month of April and maximum value 18.03 mg/L during winter in the month of December. The rising temperature diminishes the oxygen carrying capacity of water which explains the lower dissolved oxygen values during summer. Lower values can be correlated with the high decomposition rates of organic matter.[21] The similar dissolved oxygen was reported by Abbasi.[22]

Free Carbon Dioxide: Carbon dioxide was irregularly absent for several month. The minimum value 1.2mg/L of free CO_2 was recorded during winter in the month of March and a maximum of 4.26 mg/l during monsoon in the month of October. The free carbon dioxide in pond varies somewhat rapidly due to biological and non-biological activity. Increase in free carbon dioxide during monsoon can be ascribed to the rapid decomposition of carbonic material during the season and the favorable air and water temperature.

Total Hardness: The value of Total hardness ranged between 125 mg/L to 216 mg/L. The minimum Total hardness was recorded during monsoon in the month of August and maximum

recorded during summer in the month of Jun. This increase in total hardness during summer period is because of higher photosynthetic activity, free carbon dioxide is utilized and bicarbonates are changed over into carbonates and precipitated as calcium salts thus increasing hardness.[23] Decrease in the value of total hardness during winter in the month of Jun may be attributed to a higher rate of deposition of calcium and magnesium salts. Mishra et al.[24] reported slightly higher value (146-268 mg/L) in pond of Varanasi. Hujare[25] reported total hardness was high during summer than rainy season and winter season.

Total Alkalinity: The value of total alkalinity ranged between 104 mg/L to 152 mg/L. The minimum Total alkalinity was recorded during summer in the month of April and the maximum recorded during Monsoon in the month of September. The ability to resist changes in pH is alkalinity which is due to the presence of carbonates, bicarbonates hydroxides, phosphates and other compounds in water.[26] Evaporation and decomposition of organic matter, photosynthesis, denitrification, etc are the main factors for increasing alkalinity whereas nitrification, respiration, etc are the main factors for decreasing alkalinity.[27]

Chloride: The value of Chloride ranged between 21.02 mg/L to 46.98 mg/L. The minimum Chloride was recorded during monsoon in the month of July and the maximum recorded during summer in the month of Jun. Increase in the value of chloride concentration due to vaporization of water in the presence of high temperature in summer. The decrease value of chloride concentration in the pond due to run off water from the surrounding agricultural fields.

Phosphate: The value of total Phosphate ranged between 0.28 mg/L to 0.96 mg/L. The minimum Phosphate was recorded during winter in the month of November and the maximum recorded during monsoon in the month of july. The maximum value of phosphate during monsoon in the months of may be attributed to surface runoff during rainy season getting an immense quantity of domestic cattle dung and detergents from the surrounding catchment territory. Catchment areas activities are improving phosphate in the pond.[28] Total phosphates in water include both organic and inorganic phosphates. Organic phosphates are part of living and dead plants and animal over 85% of total phosphorous is usually found in organic form.[29] Nama and Dhan Raj[30] Reported similar value of phosphate in palasani pond.

Total Dissolved Solids: *The value of total dissolved solids ranged between 126 mg/L to 452 mg/L. The minimum total dissolve solids were recorded during winter in the month of December and maximum recorded during summer and Monsoon in the month of Jun and July respectively. The higher concentration of TDS due to the discharge organic matter, soil, silt by runoff water from agriculture field the interference of human and domestic cattle in summer whereas low concentration of TDS due to the rate of evaporation and settling of organic matter, soil, silt, etc.*

during winter in the month of December. Tripathy & Pandey[31] reported the maximum concentration of total dissolved solids during summer.

Table 1. Physico-chemical values of Olvi pond water during March, 2017- February, 2018.

MONTH		W.T. (˚C)	pH (pH Unit)	D.O. (Mg/L)	Free CO_2 (Mg/L)	T. Hardness (Mg/L)	T. Alk. (Mg/L)	Chloride (Mg/L)	PO_4^{-3} (Mg/L)	T.D.S. (Mg/L)
Site -1										
March	SUMMER	23	7.9	12.71	0	150	124	32.67	0.43	164
April		29	7.5	10.45	1.3	168	115	34.67	0.34	215
May		31	7.3	8.56	2	145	129	37.12	0.45	352
Jun		33	7.9	5.37	2.2	205	137	46.98	0.65	452
July	MONSOON	27	7.6	9.14	3.6	165	128	33.23	0.96	356
August		28	7.5	11.73	0	125	136	23.68	0.56	254
September		27	7.6	12.6	3.9	145	129	24.69	0.26	441
October		25	8.2	8.9	4.1	175	102	23.78	0.65	152
November	WINTER	24	8.1	14.35	4.4	165	119	43.16	0.95	356
December		20	8	19.8	0	139	143	39.27	0.69	256
January		18	8.2	15.48	0	138	139	35.67	0.34	154
February		21	8.1	17.05	10	156	124	41.56	0.59	256
Site -2										
March	SUMMER	22	7.8	14.23	0	145	122	38.46	0.84	237
April		26	7.4	12.45	1.5	175	120	35.14	0.23	136
May		30	7.4	13.82	1.9	146	136	40.13	0.27	156
Jun		32	7.9	14.62	2.1	196	148	39.35	0.36	194
July	MONSOON	28	8	8.23	2.4	165	145	21.02	0.59	201
August		29	7.9	15.78	3.2	173	132	33.68	0.43	268
September		27	7.6	9.68	4.3	168	152	26.49	0.76	167
October		26	8.1	11.34	4.6	153	133	39.36	0.38	261
November	WINTER	23	8.1	16.15	0	167	125	38.94	0.28	312
December		20	8.2	18.07	0	146	122	41.58	0.95	126
January		18	8	9.15	2.2	132	138	43.19	0.73	196
February		19	7.9	12.49	0	140	126	32.69	0.65	258
Site-3										
March	SUMMER	22	8.1	14.29	1.2	145	125	32.96	0.56	346
April		29	7.9	14.31	2.4	162	104	35.46	0.36	297
May		31	7.4	15.19	2.9	198	119	33.46	0.59	234
Jun		36	7.7	16.44	3.4	216	135	40.59	0.43	452
July	MONSOON	33	7.6	10.81	3.6	152	149	24.49	0.86	167
August		30	7.9	13.67	4.1	136	135	27.14	0.62	295
September		28	7.7	11.26	4.5	154	129	29.67	0.71	345
October		26	8.1	9.16	4.6	174	139	35.16	0.51	178
November	WINTER	23	7.9	17.12	0	151	122	41.58	0.39	236
December		19	8.3	17.36	0	146	119	37.15	0.91	269
January		17	8.1	16.56	0	173	132	39.16	0.29	315
February		19	8	12.61	2.5	147	141	36.64	0.36	181

Zooplankton:

Zooplankton collected from Olvi Pond has been identified up to species level and the major groups are given in Table 2.

Zooplankton, collected and recorded during the present investigation from different sites, belong to Protozoa, Rotifera and Arthropoda. In all, about 25 different species were collected from the Olvi pond. Zooplankton is the microscopic free-swimming animals and acts as a component of an aquatic ecosystem which is the primary consumer of phytoplankton. They provide main food to fishes and can be used as indicators of the trophic level of a water body. Nayer[32], Saxena[33], Srivastava and Rukasana[34], Viyas and chouhan[35] studied Zooplankton diversity in different water bodies of Rajasthan. In the present study zooplanktons was identified in five main groups such as Protozoa (3 sp.), Rotifera (8 sp.), Cladocera (9 sp.), Ostracoda (2 sp.) and Copepoda (3 sp.). Zooplankton diversity fluctuated according to climatic condition and chemical parameters during the study periods.

Protozoans: In the quantitatively investigation of Protozoan have identified as *Amoeba* sp., *Arcella discoides, Vorticella* sp. *Amoeba* sp. was more dominant among the protozoa at all the sites in summer followed by monsoon and winter.

Rotifers: In the present investigation 8 species belonging to rotifera has been identified in Olvi pond. *Keratella tropica* and *Brachionus calyciflorus* were more dominant among the rotiferans. High population was observed during winter season followed by summer season and lowest population observed during monsoon season. Fluctuations in zooplankton density have been attributed to turbidity. Welch[36], Roy[37], Tandon and Singh[38] have shown a direct relationship between rotifera population and water temperature.

Cladocerans: In the present investigation the cladoceran populations of Olvi pond were maximum during in summer season followed by winter season and lowest during monsoon season. The total 9 species of cladocera were identified in the present study. *Alonella* sp. and *Dapnia* sp. were more dominant. Micheal [39] noted the highest peaks of cladocerans during dry season. Srivastava and Saxena[40] and Kumar[41] reported the maximum peaks of cladoceran during summer.

Copepods: In the present investigation only 3 species of copepoda as *Diaptomus* sp., *Cyclops* sp. and *Eucyclops* Sp. have been identified in Olvi pond.

Ostracods*:* In the present investigation only 2 species of Ostracoda as Cypris sp., Cyclocypria sp. have been identified in Olvi pond.

Table 2. Seasonal species diversity of Zooplanktons in Olvi pond during March, 2017- February, 2018.

S. NO.	*Name of Species*	Year 2017 -18		
		SUMMER	**MONSOON**	**WINTER**
1	**PROTOZOA**			
	Amoeba sp.	14	11	8
	Arcella discoides	10	8	5
	Vorticella sp.	9	6	8
	Total	**33**	**25**	**21**
2	**ROTIFERA**			
	Filinia terminalis	6	4	11
	Filinia longiseta	1	4	3
	Keratella sp.	11	8	7
	Keratella tropica	13	11	15
	Brachionus calyciflorus	12	10	11
	Brachionus sp.	3	6	8
	Brachionus falcatus	11	4	9
	Monostyla closterocerca	5	11	2
	Total	**62**	**58**	**66**
3	**CLADOCERA**			
	Alonella sp.	16	8	12
	Bosmina sp.	7	3	4
	Daphnia carinata	5	6	2
	Daphnia pulex	2	4	1
	Daphnia sp.	9	5	10
	Ceriodaphnia sp.	5	7	4
	Diphanosoma sp.	9	6	5
	Moina sp.	9	5	6
	Alona sp.	2	6	8
	Total	64	**50**	**52**
4	**OSTRACODA**			
	Cypris sp.	2	1	2
	Cyclocypria sp.	1	1	0
	Total	**3**	**2**	**2**
5	**COPEPODA**			
	Diaptomus sp.	2	1	4
	Cyclops sp.	8	6	13
	Eucyclops sp.	0	0	1
	Total	**10**	**7**	**18**

CONCLUSION:

The physico-chemical and zooplankton study is very useful to get a fairly perfect idea for the quality of pond water by determining some parameters experimentally. Overall averages of these parameters were found to be within the permissible limits. The present study exhibits the non-pollutant nature of the Olvi pond water which is useful for human utilization and aquaculture activities. The zooplankton community was mainly represented by four groups i.e. protozoan, rotifer, copepod, cladocera and ostracoda. The growth of the zooplankton was impacted by the physical and chemical parameters of water body along with the seasonal variations. This study also explains that olvi pond is in the rich biodiversity of plankton, fishes and need to conservation in the future. We have to use it securely and shield it from all unwanted things and we could handover the protected and healthy environment to the coming generations.

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