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LIMNOLOGICAL VARIATIONS OF TWO KRISHNA RIVER TRIBUTORIES IN KHAMMAM DISTRICT, TELANGANA STATE

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INTRODUCTION

Wyra and Palair lakes are two small tributaries of Krishna river, located in Khammam District of Andhra Pradesh, and these two are located respectively at northern and southern sides of Khammam town of the district, each at approximately of 30 kms on either side. Khammam town is situated at about 225 kms from Hyderabad in its northern side.

Some of the notable contributions on limnology in the state include Zafar (1966), Venkateswarlu (1969), Munawar (1970), Venu (1981), Ratna Rao (1984), Jaya Devi (1985), Chandrasekhar (1966, 2006), Chandrasekhar and Nageswara Rao (2006), Patil and Panda (2003), Malathi *et al.* (2003) Anitha *et al.* (2005), Siddiqi and Khan (2002). In an aquatic ecosystem, water quality influences its biotic components like diversity, biomass and distribution. The physico-chemical parameters exert their influence both individually and collectively and their interaction produces abiotic environment which conditions the origin, development and finally succession of biotic communities. Further, biotic communities in turn, continuously goes on in a dynamic ecosystem.

The Present study was undertaken to assess the physico-chemical and biological conditions of two Deccan tributaries of Krishna river *viz*., Wyra lake (17° 15´N & 80°25´E) with 19.16 sq. kms. of water spread area and Palair lake (17° 15´N & 80°25´E) in Andhra Pradesh, which has got water spread area of 19.16 and 17.25 sq. kms respectively, which also differed significantly in their limnological aspects and trophy (nutrient status) with emphasis on the structure and composition of zooplankton particularly Rotifera and Cladocera.

MATERIAL AND METHODS

The studies on Wyra lake have been carried out during 2006-07, while on Palair lake it was 2009-10 (July, 2009-monsoon; January, 2010-winter; April, 2010-summer). In order to have a complete limnologic scenario of the two water bodies 9 localities on Wyra and 8 on Palair lake have been chosen, undertook the surveys, and the results were given in the tables 1-3 in detail. For the analysis of Dissolved Oxygen, water samples were collected in DO bottles of 300 ml. capacity and brought to the field laboratory after fixation, together with water samples in 1000 ml PVC containers for the analysis of titrimetric parameters and analysed there itself. Water samples in separate 1000 ml PVC containers were brought to the Head Quarters (Hyderabad) and were given to the local private laboratory for analyzing the rest of the parameters *i.e.,* nutrients and some light metals. Plankton samples were collected by diving the plankton net (No.25) on the sub-littoral regions of the lake waters and the preserved in 4 % formaldehyde solution and the identification of rotifer and cladoceran fauna was done with the aid of standard literature on these two groups.

Table 1. Showing the over all ranges and mean values of physico-chemical parameters of two tributaries

Sl. No	Parameter	Wyra lake		Palair Lake	
		Range	Mean	Range	Mean
1.	pH	7.0 – 8.7	7.57	7.1-8.4	7.8
2	EC (micro siemens/cm)	360-700	542	350-940	563
3	Turbidity (NTU)	5 -184	53	1-120	15
4.	DO (mg/L)	1.0 – 8.0	4.55	1-5.4	2.9
5	Total Alkalinity (-do-)	145- 485	272	122-397	183
6	Chloride (-do-)	27 - 110	64	24-105	62
7	Total Hardness (-do-)	95 – 245	149	100-320	148
8	Calcium (-do-)	21 – 88	29	24-92	35
9	Phosphates (-do-)	0.01 -0.28	0.86	0.02-1.45	0.15
10	Nitrates (-do-)	1.0 – 10.0	3.7	0.1-3.39	0.4
11	Silicates (-do-)	3.0 – 16.0	10.5	3.4-20	9.4
12	Sulphates (-do-)	16 – 97	39.1	29-87	52
13	Sodium (-do-)	30 – 92	61.3	27-108	59.5
14	Potassium (-do-)	2.0 -7.0	3.1	1-6	2.6

RESULTS AND DISCUSSION

Limnological investigations were restricted to the three major seasonal surveys *i.e.*, November–January (winter), March–April (summer) and July-August (monsoon) on both the tributaries. The ranges and mean station-wise / overall values of different physico-chemical parameters of all the stations of both the water bodies during the study period (s) have been tabulated.

The **pH** values during the study periods varied between 7.0–8.7 with mean value of 7.57 at Wyra lake where as in Palair, it was 7.1-8.4 with mean value of 7.8 indicating the general alkaline tendency of waters. The higher pH values may be attributed to the carbonates/ bicarbonates and higher photosynthetic activities. Both the higher and lower values of pH of Wyra lake were found at Reddygudem while its higher (8.4) was noticed at Palair and the lower one (7.1) was at Annarigudem and Thummalagudem. Locality-wise the lower mean value (7.3) was noticed at Siddikhnagar of Wyra lake and Narasimhulugudem of Palair lake (7.7). Its higher mean values (7.8 and 8.0) were observed respectively at Reddigudem/ Brahmanapalli of Wyra and Neredvai of Palair. The **electric conductivity** was observed with a range of 360-700 micro siemens / cm and 350-940 with mean values 542 and 563 in Wyra and Palair lakes respectively. Locality wise the lower and higher mean valueS (290 & 660) of Wyra lake was noticed respectively at Narayanapuram and Siddikhnagar of Wyra lake where as it was 492 (lower) at Nayakangudem and 678 (higher) at Neredvai of Palair lake. The **turbidity** values of Wyra lake fluctuated between 5-184 NTU with mean value of 53, where as in Palair lake it was 1-120 with a mean value of 15. Locality wise the mean value was minimum (18) at Lallurugudem and maximum (82) at Siddikhnagar of Wyra lake where as its minimum (10.2) was at Palair and maximum (29.5) in Neredvai of Palair lake. Its higher values are known to affect the primary productivity by restricting the light penetration and photosynthesis. The **Dissolved Oxygen** (DO) profile revealed a variation between 1.0 and 8.0 with average value of 4.55 in Wyra while it was 1 to 5.4 with a mean value of 2.9 in Palair lake. The lower one (1.0) was observed at Singarayapalem

and the higher one was (8.0) at Mallavaram of Wyra lake where as it was Narasimhulugudem (1.5) and Palair (5.4) of Palair lake. Here the higher values of Dissolved Oxygen may be due to comparatively clear zones and increased photosynthetic activity by phytoplankton. In the case of Wyra lake **total alkalinity** has fluctuated between 145 (Lallapuram) and 485 mg/L (Singarayapalem) with an average of 272 when it was between 122 (Annarigudem) and 397 (Kotturu) at Palair lake with mean value of 183. The **chloride** content at different stations of Wyra lake it was 27- 110 with an average value of 64, while at Palair lake it was 24 to 105 with a mean value of 62. Locality-wise the minimal value (27) in Wyra lake was noticed its Wyra locality and the maximum 110 was observed in Reddigudem. Similarly, the lower one (24) was found at Neredvai and higher (105) at Annarigudem. The peak in chloride values may be related to evotranspiration and high evaporation due to the prevailing high temperature. The chloride content further indicates the presence of organic matter of animal origin. Lower chloride values in the water body were probably due to its distant location and natural elevation that gives protection from inflows of domestic wasters and cattle feeding. The values of **total hardness** varied between Wyra lake it was between 95 (Narayanapuram) - 245 mg /L (Singarayapalem) with a mean value of 149 where as it was 100 (Nayakangudem) to 320 (Neredvai) with the4 mean value of 148 in the case of Palair lake. The ranges of hardness values recorded were comparatively lesser in the case of Wyra lake, than the other, indicating the presence of other ions and therefore all excess hardness can be termed as **carbonate** hardness and bothe lake water may be classified as moderately hard to hard and indicate no physico-chemical deterioration. The **calcium** hardness in the case of Wyra lake it was between 21 – 88 (29) while it was 24-92 in Palair lake (mean 35). Higher concentration of calcium was observed was at Lallurugudem of Wyra lake in monsoon. and Neredvai of Palair. In general, aquatic ecosystems receive excess of **nutrients** through untreated domestic sewage and agriculture run off. **Phosphate** acts as a limiting nutrient responsible for the process of eutrophication and leads to ultimate degradation of an aquatic ecosystem. During the course of study on Wyra lake it was 0.01 to 0.28mg/L with a mean of 0.86 and at Palair the range was 0.02-1.45 with a mean value of 0.15 was observed. The minimal value was noticed at at Wyra locality of Wyra lake and several localities of Palaiar lake and the maximums were at Siddikhnagar and Narasimhulugudem of Wyra and Palair lakes respectively. The higher phosphate content indicate the loading in of domestic sewage and agricultural run off from the surrounding colonies and agricultural fields respectively. The **Nitrate** quantity of Wyra lake is ranged from 1.0 – 10.0 mg /L with a mean value of 3.27, but the minimum was found at Wyra locality and maximum was at Siddikhnagar of Wyra lake where as at Palair lake the range was 0.1 (several localities) to 3.39 mg/L (Narasimhulugudem) with a mean value of 0.4. The **silicate** values were more or less equal in both Wyra and Palair lakes with mean values respectively 10.5 and 9.4. High concentration of **sulphates** stimulates the action of sulphur reducing bacteria, which produce hydrogen sulphide, a gas highly toxic to fish life. Sulphates of Wyra lake water was observed from 16 – 97 mg /L with an average value of 39.1, and of Palair it was 29 - 87 mg/L with a mean value of 52. **Sodium** which can also be called as conservative metal, showed its variation in Wyra lake between 30 and 92 with a mean value of 61.3 while in the case of Palair it was between 27 and 108 with a mean value of 59.5. The quantity of **potassium** in Wyra lake was between 2.0 – 7.0 with a mean value of 3.1, where as it was from 1 to 6 with an average of 2.6. The minimal concentration of both the lakes were observed in several places, but the higher 7.0 and 6.0 mg/lit. were found at Siddikhnagar and Annarigudem of Wyra lake and Palair lake respectively.

Table 2. showing the ranges of physic-chemical parameters and its mean values in each locality

Localities	pH		EC		Turb.		DO		Total Alk.		Chloride		T.Hardness		Calcium		Phosphates		Nitrates		Silicates		Sulphates		Sodium		Potassium	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
WYRA LAKE																												
Siddikinagar	7.2-7.6	7.3	580-510	660	15-170	82	2.2-5.5	4.5	180-500	328	44-93	64	100-160	137	21-50	32	0.03-0.28	0.21	2-10	4.9	5.7-28	12	34-97	53	64-90	73.4	3-7	4
Lallapuram	7.3-7.7	7.6	520-700	603	12-128	56	2.5-5.5	3.7	145-310	249	43-65	57	140-200	157	21-40	27	0.04-0.13	0.7	3-8	4.8	3.3-22	11	16-46	32	46-92	69	3-5	3.5
Wyra	7.1-7.9	7.5	420-590	507	6-61	27	1.3-6.0	4.1	170-235	248	27-88	54	140-255	184	21-53	32	0.01-0.12	0.06	1.0-6.2	3.1	5.2-14	9	19-43	33	30-79	60	2-4	3.2
Singarayapalem	7.1-7.9	7.6	490-620	513	15-184	54	1-6	4.3	230-485	318	43-73	54	125-245	171	25-50	32	0.03-0.1	0.06	2-3.15	2.8	5-16	8	25-42	34	38-68	58	2-3	2.2
Lallurugudem	-	-	-	-	18	18	3.3-5.2	3.3	195-365	262	40-48	44	140-260	200	26-88	63	0.02-0.07	0.04	2-6	4.0	9-10	10	40-46	43	55-75	65	2-3	2.5
Mallavaram	7.4-7.7	7.5	440-560	333	12-64	31	5-8	5.6	185-310	245	44-98	58	105-210	152	21-48	30	0.02-0.13	0.06	2-6	3.8	5-13	9.25	30-46	38	30-68	59	3-4	3.5
Narayanapuram	7.3-7.6	7.4	360-510	290	15-54	30	1.8-5.8	4.3	175-325	306	38-95	54	95-200	150	27-55	32	0.02-0.09	0.05	2-8	4.3	4-12	8.5	13-48	32	40-68	60	3-4	3.5
Reddygudem	7.0-8.7	7.8	440-600	523	6-57	25	3.8-5.4	4.5	200-295	256	43-110	68	125-200	163	25-50	36	0.02-0.11	0.05	2-5	3.2	3-15	10	18-90	45	42-69	61.4	2-4	2.8
Brahmanapalli	7.3-8.2	7.8	440-580	513	5-24	15.4	3.9-5.6	4.4	175--250	239	38-65	47	125-160	143	28-50	36	0.02-0.11	0.05	2-3	2.4	6-14	9.6	23-45	34	40-67	59	2-3.2	2.6
PALAIR LAKE																												
Annarigudem	7.1-8.3	7.8	350-840	552	3-62	15	2.3-4.4	3.2	122-213	167	30-105	53	105-270	151	24-76	40	0.03-0.77	0.2	0.1-1.03	0.1	3.8-15	10	32-87	58	32-67	57	1-6	3
Nayakangudem	7.5-8.3	7.8	360-590	492	2-28	8.3	2-4	2.8	128-189	154	30-55	44	100-165	133	26-32	30	0.02-0.15	0.1	0.1-0.67	0.4	3.8-15	8	30-60	52	36-69	52	1-3	2
Palair	7.5-8.4	7.9	460-580	512	1-43	10.7	1.6-5.4	3.3	146-192	166	35-54	47	110-140	129	28-38	31	0.02-0.21	0.1	0.1-0.67	0.3	4.5-16	10	29-61	51	47-67	57	1-3	2
Narasimhulugudem	7.3-8.1	7.7	490-670	547	1-40	12.8	1.5-4.4	2.7	140-250	180	35-65	50	115-205	144	24-44	32	0.02-1.45	0.3	0.1-3.39	0.8	3.7-13	8	32-63	49	49-69	58	2-3	3
Kotturu	7.4-8.3	7.8	380-850	555	1-25	10.2	2.0-4.8	2.9	134-397	204	32-52	47	105-265	148	28-52	36	0.03-0.22	0.1	0.1-0.9	0.4	3.4-12	8	26-65	45	38-73	58	1-4	3
Erragadda Thanda	7.4-8.3	7.9	480-590	520	2-33	12.4	1.8-4.8	3	134-183	162	38-75	53	115-160	131	28-36	32	0.03-0.21	0.1	0.1-0.5	0.3	4.4-16	10	36-66	50	38-69	58	1-3	2
Neredvai	7.6-8.3	8	530-890	678	3-120	29.5	1.8-3.8	2.3	128-311	210	24-90	60	110-320	181	24-92	40	0.02-0.29	0.1	0.1-1.12	0.6	4-20	10	38-79	61	27-99	64	1-4	3
Thummalagudem	7.1-8.2	7.8	500-940	650	4-50	21.3	1.8-4.2	2.7	159-354	223	47-74	61	120-235	167	24-56	36	0.02-0.5	0.2	0.1-1.35	0.6	4-16	11	30-65	52	49-108	72	1-5	3

I – Ranges, II – Mean values [EC is expressed in micro mhos/cm and all the other values are in mg/L except pH]

BIOTIC PROFILE

While going through the rotatorian and cladoceran diversity of the two tributaries, the following results have been observed.

Table 3. Showing the occurrence of Zooplankton communities (Rotifera and Cladocera) :

S. No.	Species	Wyra Lake	Palair Lake
	ROTIFERA		
1	*Brachionus angularis* (Gosse,1851)	-	+
2	*B. calyciflorus* var. *dorcas* Gosse, 1851	+	+
3	*B. calyciflorus* var. *hymani* Dhanapathi, 1974	+	+
4	*B. caudatus* Barrois, 1894	+	+
5	*B. diversicornis* (Daday, 1883)	+	+
6	*B. durgae* Dhanapathi, 1974	-	+
7	*B. falcatus* Zacharias, 1898	+	+
8	*B. forficula* Wierzeski, 1898	+	+
9	*B. patulus* (Muller, 1786)	+	-
10	*B. quadridentatus* Hermann, 1783	+	+
11	*Keratella tropica* Apstein, 1907	+	+
12	*Platiyas quadricornis* (Ehrenberg, 1832)	-	+
13	*Euchlanis dilate* Ehrenberg, 1832	-	+
14	*Mytilina ventralis* Ehrenberg, 1832	+	+
15	*Macrochaetus sericus* Thorpe, 1893	+	-
16	*Lepadella ovalis* (Muller, 1786)	+	-
17	*Lecane (Monostyla) bulla* (Gosse, 1851)	+	+
18	*L. (M) clostocerca* (Schmarda, 1898)	+	+
19	*L. (M) eswari* Dhanapathi 1976	-	+
20	*L. (M.) obtuse* (Murray, 1851)	+	-
21	*L (M) papuana* (Murray, 1913)	-	+
22	*L. (M) tethis* Harring & Myers, 1921	+	-
23	*Lecane (Lecane) curvicornis* (Murray, 1913)	+	-
24	*L. (L) leotina* (Turner, 1892)	+	+
25	*L. (L) luna* (Muller, 1776)	-	+
26	*Cephalodella forficula* (Ehrenberg, 1832)	+	-
27	*C. hiulca* Myers, 1924	-	+
28	*Scaridium longicaudum* (Muller, 1786)	+	-

Table 3. contd.

29	*Filinia longiseta* Ehrenberg, 1834	-	+
30	*F. opeliensis* (Zacharias, 1898)	-	+
31	*F. pejleri* Hurchinson, 1964	+	+
32	*Testudinella patina* (Hermann, 1783)	+	-
33	*T. mucronata* (Gosse, 1786)	+	+
34	*Trichocerca rattus* (Muller, 1776)	-	+
CLADOCERA			
1	*Pseudosida bidentata* Herrick, 1884	-	+
2	*Diaphanosoma sarsi* Richard, 1895	+	-
3	*D. excism* Sars, 1885	-	+
4	*Ceriodaphnia cornuta* Sars, 1885	+	+
5	*Scapheloberis kingi* Sars, 1903	+	-
6	*Moina micrura* Kurz, 1874	-	+
7	*M. brachiata* (Jurine, 1820)	-	+
8	*Macrothrix spinosa* King, King, 1853	+	+
9	*M. laticornis* (Jurine, 1820)	+	-
10	*Echinisca triserialis*	+	-
11	*Chydorus sphaericus* (Muller, 1776)	+	+
12	*C. barroisi* Richard, 1894	+	+
13	*C. ventricosus* Daday, 1898	+	-
14	*Alona rectangula rectangula* Sars, 1862	+	+
15	*A. rectangula richardi* (Stingelin, 1895)	+	-
16	*A. davidi davidi* Richard, 1895	+	-
17	*A. davidi punctata* (Daday, 1898)	+	+
18	*A. pulchella* King, 1853	+	+
19	*Ilyocryptus spinifer* Herrick, 1882	+	-
20	*Camptocercus rectirostris* Schoedler, 1862	+	+

Detailed studies have been carried out on the diverse rotifer and cladoceran faunal assemblage in Wyra lake and Palair lake during the study periods and given in a Table -4 wherein the occurrences of the species of these two groups were compared. The shallow littoral regions and also near by limnetic zones play a host to a wide variety of the two zooplankton communities under study *viz.,* Rotifera and Cladocera. Rotifera (34 species) ranked one in order of abundance followed by cladocerans (20 species) in both the lakes. There are 34 species belonging to 13 genera of Rotifera and 20 species belonging to 11 genera in both the lakes. In Wyra lake 20 species belonging to 10 genera of rotifers and 16 species belonging to 9 genera of cladocera were

noticed where as in the case of Palair lake it was 25 species belonging to 16 genera spread over 8 families in 2 orders of rotifers and 12 species belonging to 8 genera in 5 families of Cladocera were observed. There are also 14 species of Rotifers and 8 species of cladocerans that are commonly available in both the lakes. Nine species of rotifers 8 of cladocera are exclusively available in Wyra lake while 11 species of Rotifera and 4 of Cladocera are exclusively available in Palair lake. It is showing their uniqueness and its adaption to the water quality of these two water bodies.

As is quite obvious from the above results that these two impoundments differed significantly in their limnological attributes and these two can be categorized as oligotrophic lakes but it is slightly getting polluted. In general, these two lake waters showed seasonality in most of the physico-chemical factors which mainly depend on the monsoon *i.e.,* insufficient rains or heavy rains in the preceding periods. The physico-chemical parameters of both the lakes are also indicating that these two are clean waters, but abnormal values of the nutrients indicate that these are slightly polluted and the reason can be attributed to agricultural run off or anthropogenic activities. Both the lakes were characterized by highly alkaline, soft to hard, moderate turbidity and the chloride content of these two water bodies are indicating their potability.

Among the physical parameters, pH of both the water bodies is more or less equal while Electric Conductivity is slightly at higher side in Palair lake while the turbidity is at Wyra lake. Among the chemical factors, DO, Total Alkalinity Nitrates, Nitrates, Sulphates are comparatively at higher side in Wyra lake whereas the rest of the parameters are either to some extent more or profoundly more in Palair lake.The reasons for the variations in the levels of ranges of physico-chemical parameters of both the lakes, can be attributed to the differences in the quantum of rain fall, domestic sewage that is letting into the water bodies, agricultural run off, anthropogenic activities at the lake basins… *etc.,* during the study periods. The authors intends to concludes that not much variation is involved in these two tributaries with minor exceptions both biotic and abiotic factors, but the quantum of nutrient and light metals indicate that these two are slightly getting polluted and the reason may be attributed to either agricultural run off or anthropogenic factors.

SUMMARY

Studies on the comparative study on physico-chemical and biological characteristics with special reference to Rotifera and Cladocera of two deccan wetlands *viz.,* Wyra and Palair lakes which are the tributaries of Krishna river located in Khammam District of Telangana state during 2006-2007 and 2009-10 respectively. These studies were conducted on seasonal basis *i.e.,* winter, summer and monsoon during the periods. The studies have indicated that, not much variation is involved in these two tributaries with minor exceptions in both biotic and abiotic factors, but the quantum of nutrient and light metals indicate that these two are getting slightly polluted and the reason may be attributed to either agricultural run off or anthropogenic factors. The studies on biotic factors revealed the presence of 34 species of rotatorians and twenty of cladocerans.

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