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ASSESSMENT OF ZOOPLANKTON DIVERSITY OF NAGARAL DAM, CHINCHOLLI, KALABURAGI

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ABSTRACT: Zooplankton occupies a vital role in the trophic structure of an aquatic ecosystem and plays a key role in energy transfer. The present work has been carried out on Zooplankton diversity of Nagaral dam of Chincholli taluk at Kalaburagi. Water samples were collected for the period of two years in monthly sampling from December 2015 to November 2017. A total of 31 speciess belongs to four groups such as rotifer (12 species). Cladocera (11 species), Copepoda (6 species) and Ostracoda (2 species). From the study,the physico-chemical parameters of the Nagaral dam was positively correlated with the zooplankton. Rotifera was the dominant group throughout the study period among the groups of zooplankton.

KEYWORDS: Nagaral Dam, Zooplankton, Chincholli, Physico-chemical parameters, Kalaburagi, Karanataka

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1.INTRODUCTION

The study of zooplankton has been a fascinating subject for a long time. In the two decades much attention has been paid to tropical countries towards the study of biology, ecology, toxicology of zooplankton due to their important role in the rapidly emerging concepts in Environmental Impact Assessment (EIA) bio-indication of pollution and biological monitoring [1]. Freshwater zooplankton is an important component in aquatic ecosystem, whose main function is to act as primary and

secondary links in the food chain. The productivity of the aquatic ecosystem is directly correlated with the density of zooplankton. Biodiversity of zooplankton is essential to keep one ecosystem healthy because each species plays a specific role (recycling of nutrients, food for another and maintaining of soil fertility) in the ecosystem and some species may allow natural ecosystem to functional a healthy manner. [2]. Abiotic and biotic influences exert a control on the structure and dynamics of zooplankton so as to determine the distribution and abundance of the species [3]. The most significant feature of zooplankton is its immense diversity over space and time, thus, similar aquatic system may have dissimilar assemblages of organisms varying in space, composition and biomass. Further in spite of convergent similarities, zooplankton species have different types of life histories influenced by seasonal variation of abiotic factors, feeding ecology and predation pressure [4]. Zooplankton is good indicator of the changes in water quality because they are strongly affected by environmental conditions and respond quicklyto changes in water quality. Therefore, plankton has been used recently as an indicator to monitor and realize changes in the ecosystem. Thus, water quality influences zooplankton abundance, clustering and biomass. Water quality assessment generally involves analysis of physiochemical parameters and reflects on abiotic and biotic status of the ecosystem [5].The objective of the investigation is to zooplankton diversity of the Nagaral dam. With particular focus on the zooplankton, exploring the seasonal and spatial difference in those assemblages in response to the present environmental conditions. Zooplankton composition and abundance are excellent indicators of trophic status. Studying the taxonomic composition and abundance of zooplankton population will provide a basis for sustainable development of fisheries resources and water quality

2. MATERIALS AND METHODS

Study Area

Nagaral dam (Fig. 1) is located 5 km away from Chimmanchod village of ChincholiTaluk, Kalburgi district, situated in the northern part of Karnataka state, which falls 77^0 25’48” E longitude and 17^0 28’ 12” N latitude. The distance from Kalbaurgai city is 105 kms.

Zooplankton Collection

Zooplankton collections were made employing a modified Haron-trantor net with a squre metallic frame of area 0.0625 m^2 area. The filtering cone was made up of nylon bolting silk plankton net (No. 25 mesh size 50 µ) was used for collection of zooplankton. Care was taken to avoid trapping of floating debris while towing the net . The net was hauled for a distance of 10 meters. Collected samples were transferred to labeled vial bottles containing 4 % formalin.

Physico-chemical Parameters

Every month water samples were collected from the study area from December 2015 to November 2017. The Atmospheric and water temperature pH and free CO_2 were measured in the field and

samples collected for further physico-chemical analysis according to APHA [6] [7]. The data of zooplankton and physico-chemical characteristics were subjected to correlation and linear regression using IBM SPSS (v20.0)

3. RESULTS AND DISCUSSION

In the present study the air and water temperature values varied from lowest 26 ^{O}C and 22^{O}C in November 2016. Highest recorded 39 ^{O}C and 32 ^{O}C in May 2016 respectively. It is observed that pH minimum was recorded 7.3 in July 2016 and maximum was noted 8.2 in May. The minimum concentration of dissolved oxygen was 3.8 mg/Lwas noticed in August while, the maximum values noticed 8.8 mg/L. in March 2016. The maximum free Carbondioxide recorded was 1.8 mg/L in June 2016. Minimum value 0.4 mg/L in Novemberwas recorded. The TDS was maximum 288 in July and minimum noticed was 120 mg/L in February 2016. The Total hardness values highest recorded 360 mg/Lin April 2016 and lowest observed was 152 mg/L in October. Calcium and Magnesium hardness concentration was lowest in 82 mg/L. and 28 mg/L. in November and highest values 168 mg/L and 68 mg/L in the month of May respectively. Chloride concentration was maximum recorded 114 mg/L in March and minimum concentration was 56 mg/L in June. Nitrate concentration was noted maximum is 34.5 mg/L in july and minimum recorded is 12.4 mg/L.In the present study, 31 species of zooplankton were identified whereas Rotifera (12 sp), Cladocera (11sp), Copepoda (6 sp) and Ostracoda(2 sp) were recorded. The values of rotifer density in the present study are shown in the Table No.3. The highest zooplankton density was recorded 1748 ind/L in January 2017. Lowest density was noticed 77 Ind/Lin June 2016. Throughout the study period the values of cladocera population was highest 1724 Ind/L in December 2016 and lowest number noticed was 49 Ind/Lin June 2016. Similarly copepod population was highest observed 746 Ind/L in February and lowest 59 Ind/L in August 2016.The highest number of rotifers were are *Brachionus rubens* (1984 Ind/L), *Keratella tropica* (1176 Ind/L) from cladocera dominant species were *Daphnia carinata* (1660 Ind/L*), Daphnia pulex* (1680Ind/L)and *Macrothrix laticornis* (2137 Ind/L). Similarly *Neodiaptomous strigelipes* was dominant in Copepoda and *Hemicypris* spwas dominant from Ostracoda. The seasonal diversity and abundance was done the highest values observed in NEM season (12903 Ind/L) and followed by Summer season (9197 Ind/L) and SWM season (4009 Ind/L.) respectively. The maximum density of cladocera was observed in winter due to the favourable conditions of abiotic factors and availability of abundant food.[8] [9] have observed the maximum density of cladocers in winter compared to other season on temple pond Birpur India. In the present study the maximum populations were recorded. Copepoda represents 6 species. The copepod population dominated by *Neodiaptomus strigilipes.* The correlation coefficient of various physic-chemical parameters and zooplankton group indicates their dependence with each other. It is concluded statistically that the density of rotifer, cladocera, copepod and Ostracoda have shown significant correlation with WT, AT,

TA, TH, pH, Cl_2 DO. However various physico-chemical parameters shows either significant positive or negative correlation with density of different zooplankton groups at the level of P<0.01 and P<0.05.The diversity indices of zooplankton were analysed seasonally and results are given table 4. The dominance of the species found to be maximum 0.0621 in cladocera. Based on the Shannon wiener index the aquatic environment is classified as very good when H' >4, good at 4-3, moderate at 3-2, poor at 2-1 and very poor at <1. The Shannon diversity index is good and moderate in Nagral dam. [10]has described the scale of pollution regarding species diversity and reported the values as 3.0 to 4.5 (slight), 2.0 to 3.0 (light), 1.0 to 2.0 (Moderate) and 0 to 1.0 (Heavy pollution). In the present investigation, the range of Shannon diversity index (H') values is 3.126 in NEM season and 3.055 in summer and 3.056 in SWM season. The species evenness was noticed maximum 0.7349 NEM season and lowest 0.685 in summer season. The distribution of individuals over species is called evenness and makes it sense to consider species richness and species evenness as two independent characteristics of biological communities that together constitutes its diversity [29].

Fig 1: Showing the Study area of Nagral dam of Chincholli taluk

Table 1: Monthly average values of Physico-chemical parameters of Nagaral dam

Months	At. Temp ^{O}C	Water Temp ^{O}C	pH	Alkalinity	DO	Free CO2	TDS	Total Hardness	Ca	Mg	Cl_2	No_3
Dec2015	24	21	7.9	210	5.2	0.6	202	198	98	32	86	20.2
Jan 2016	27	22	7.8	252	6.2	0.8	198	202	102	44	92	20.4
Feb2016	33	28	7.9	305	7.2	0.8	120	316	152	56	98	15.7
Mar 2016	36	29	8.0	328	8.8	0.9	132	292	156	48	114	14.2
Apr2016	38	32	8.1	358	8.2	1.2	142	360	164	65	104	12.4
May2016	39	33	8.2	362	7.8	1.6	152	338	168	68	110	13.4
Jun2016	36	30	7.3	193	3.0	1.8	256	264	120	58	56	29.6
Jul2016	33	27	7.3	158	4.2	1.5	266	286	124	48	58	34.5
Aug2016	31	27	7.6	130	3.8	0.6	232	254	108	46	62	26.7
Sep2016	29	26	7.6	151	3.9	0.5	205	188	122	38	62	23.4

Oct2016	30	26	7.6	282	4.6	0.6	260	152	88	32	72	19.6
Nov2016	26	22	7.8	290	5.8	0.4	256	166	92	28	76	18.6
Dec 2016	25	21.8	8.0	210	6.0	0.6	210	182	88	56	96	26.8
Jan 2017	32	26.6	7.9	278	6.4	0.8	122	190	92	54	112	32.4
Feb2017	35	29.2	7.8	368	7.2	1.0	128	385	112	56	102	22.0
Mar 2017	36	30.5	8.3	372	8.2	1.2	102	302	134	72	110	21.2
Apr2017	38	30.1	8.2	396	8.4	1.4	114	312	138	60	125	18.4
May2017	39	30.3	8.4	354	8.0	1.4	138	342	142	68	132	19.6
Jun2017	36	30.3	8.3	182	4.0	1.6	256	310	116	42	144	32.4
Jul2017	32	26.3	7.7	156	4.4	1.2	332	265	114	48	72	35.8
Aug2017	31	27.6	7.2	142	4.6	0.8	346	322	98	44	78	36.8
Sep2017	29	26.3	7.3	158	4.4	0.6	310	165	98	36	52	32.2
Oct2017	27	22.7	7.8	172	4.6	0.8	204	142	76	38	55	24.8
Nov2017	26	21.8	7.8	262	5.5	0.6	212	166	70	32	62	20.2

Note: All Values are expressed in mg/L. Except Atmospheric and water temperature and pH.

Table: 2. Seasonal variation of Zooplankton of Nagral dam (Ind. /L)

SI	Species	NEM	Summer Season	SWM Season	Total
	Rotifera				
1	*Brachionus forficula*	440	223	138	801
2	*B. quadridentatus*	482	53	96	631
3	*B. calyciflorus*	621	133	214	968
4	*B.caudatus*	213	223	43	479
5	*B.kostei*	312	62	61	435
6	*B.rubens*	1240	710	34	1984
7	*Keratalla tropica*	509	507	160	1176
8	*K.cochlearis*	280	409	100	789
9	*Euchlanis oropa*	192	148	59	399
10	*Asplancha brightwelli*	436	302	130	868
11	*A.priodonta*	250	193	58	501
12	*Filinia longiseta*	103	92	23	218
	CRUSTACEA CLADOCERA				
13	*Ceriodaphnia corunata*	89	117	28	234
14	*Coronatella rectangula*	53	56	15	124
15	*Alona pulchella*	178	79	44	301
16	*Indialona globulosa*	176	256	57	489
17	*Daphnia pulex*	790	795	95	1680
18	*D. carinata*	1112	427	121	1660
19	*Diaphanosoma sarsi*	843	317	278	1438
20	*Macrothrix laticornis*	1220	761	156	2137
21	*Moina brachiata*	339	126	170	635
22	*M. macrocopa*	125	22	138	285
23	Cladocera neonates	373	321	104	798
	COPEPODA				
24	*Mesocyclops leuckarti*	186	62	47	295
25	*M. hyalinus*	186	62	51	299
26	*Heliodiaptomus viduus*	84	757	279	1120
27	*Neodiaptomus strigilipes*	1120	1364	456	2940
28	Cyclopoid copepodite	278	256	72	606
29	Cyclopoid nauplii	117	88	33	238
	OSTRACODA				
30	*Hemicypris*sp.	184	290	651	1125
31	*Spirocypris*sp.	372	486	118	97
	Total	**12903**	**9697**	**4009**	**26629**

Table No. 3: Seasonal variation of diversity indices during the study period

INDICES	NEM	SUMMER	SWM	TOTAL
Taxa_S	31	31	31	31
Individuals	12903	9697	4029	26629
Dominance_D	0.05482	0.06113	0.06564	0.05077
Shannon_H	3.126	3.055	3.056	3.179
Simpson_1-D	0.9452	0.9389	0.9344	0.9492
Evenness_e^H/S	0.7349	0.6845	0.6853	0.7749
Menhinick	0.2729	0.3148	0.4884	0.19
Margalef	3.17	3.268	3.614	2.944
Equitability_J	0.9103	0.8896	0.89	0.9257
Fisher_alpha	3.815	3.974	4.57	3.465
Berger-Parker	0.0961	0.1407	0.1616	0.1104

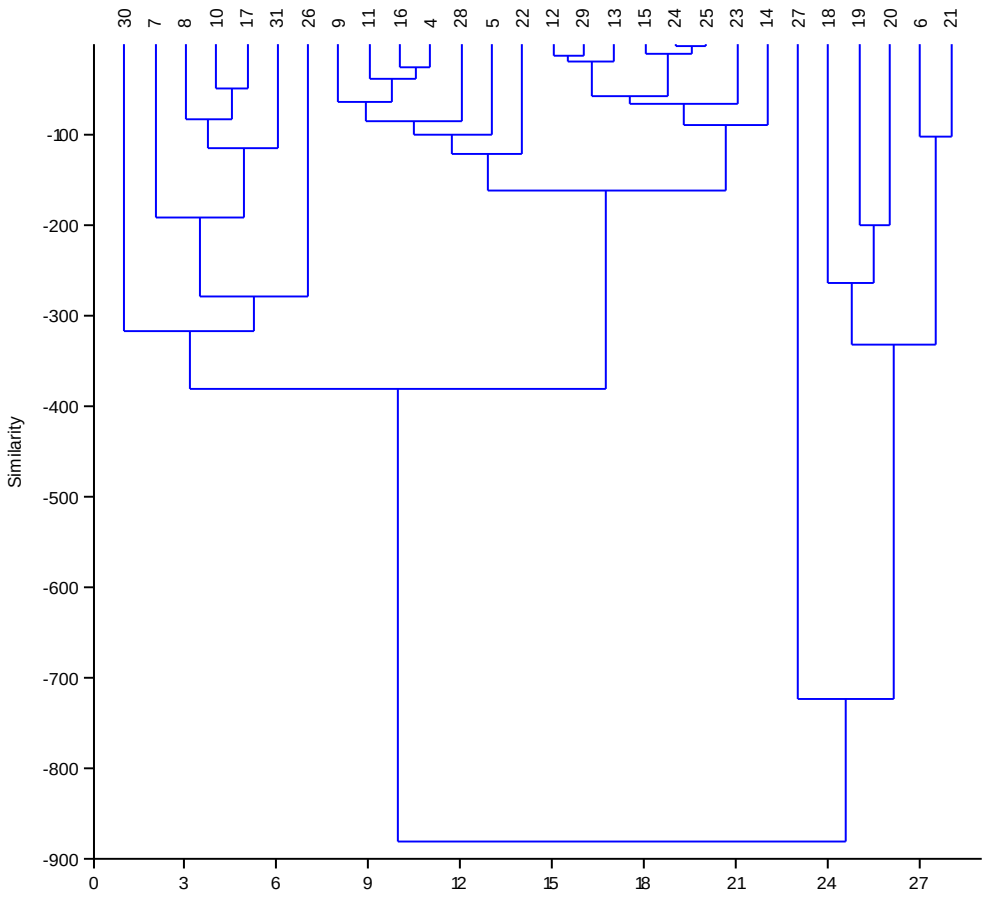

Fig No 2: Depicting cluster analysis of Seasonal variation of Zooplankton of Nagaral dam

Table 4. Monthly variation of Zooplankton groups of Nagral dam (No. Individual/l.)

MONTHS	ROTIFERA	CLADOCERA	COPEPODA	OSTRACODA	TOTAL
Dec 2015	1273	1632	643	72	3620
Jan 2016	1296	1592	630	92	3610
Feb 2016	1047	1597	744	111	3499
Mar 2016	770	1315	631	253	2969
Apr 2016	589	647	557	327	2120
May 2016	346	237	595	285	1463
Jun 2016	77	49	333	192	651
Jul 2016	122	193	107	198	620
Aug 2016	243	225	59	132	659
Sep 2016	379	375	72	119	945
Oct 2016	980	1062	122	87	2251
Nov 2016	1603	1484	187	68	3342
Dec 2016	1727	1724	310	69	3830
Jan 2017	1748	1663	647	112	4170
Feb 2017	1320	1317	746	192	3575
Mar 2017	896	809	657	329	2691
Apr 2017	656	345	656	194	1851
May 2017	342	126	504	188	1160
Jun 2017	129	119	476	197	921
Jul 2017	129	249	224	199	801
Aug 2017	163	453	118	182	916
Sep2017	531	663	57	261	1512
Oct 2017	934	850	271	230	2285
Nov 2017	1175	1224	427	162	2988
TOTAL	**18475**	**19950**	**9773**	**4251**	**52449**

Table 5: Statistical analysis for table 3 monthly variations of Zooplankton

INDICES	ROTIFERA	CLADOCERA	COPEPODA	OSTRACODA
Taxa_S	24	24	24	24
Individuals	18475	19950	9773	4251
Dominance_D	0.06133	0.0621	0.05595	0.04937
Shannon_H	2.922	2.906	2.979	3.084
Simpson_1-D	0.9387	0.9379	0.944	0.9506
Evenness_e^H/S	0.7743	0.7621	0.8195	0.9099
Menhinick	0.1766	0.1699	0.2428	0.3681
Margalef	2.341	2.323	2.503	2.753
Equitability_J	0.9195	0.9145	0.9374	0.9703
Fisher_alpha	2.72	2.694	2.962	3.36
Berger-Parker	0.09461	0.08642	0.07633	0.07739

Table 6. Monthly variations of Zooplankton population in Nagral dam (Individuals/l.)

SI	Species	Dce 2015	Jan2016	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan2017	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Avg
	Rotifera																									
1	*Brachionus forficula*	130	50	81	50	-	-	-	48	59	50	280	390	293	185	142	29	-	-	-	56	68	88	113	147	2259
2	*Brachionus quadridentatus*	15	30	23	32	-	-	-	34	28	44	15	13	10	15	30	72-	-	-	-	39	41	52	14	23	458
3	*Brachionus calyciflorus*	161	187	53	22	-	-	-	38	84	115	12	135	192	121	80	12	-	-	-	28	31	99	121	152	1643
4	*Brachionus caudatus*	54	62	89	92	104	32	12	-	-	-	37	64	87	97	102	85	41	-	-	-	-	31	43	54	1086
5	*Brachionus kostei*	98	102	44	-	-	-	-	02	06	21	38	87	93	117	18	-	-	-	2	6	11	38	45	67	795
6	*Brachionus rubens*	340	362	280	132	74	102	22	-	-	-	160	296	350	396	276	220	192	52	12	-	-	-	252	286	3804
7	*Keratalla tropica*	98	111	133	156	187	98	10	-	-	-	152	129	257	301	132	146	138	144	70	-	-	80	130	170	2642
8	*Keratella cochlearis*	82	86	96	98	110	102	33	-	-	-	72	85	82	96	120	130	128	91	29	-	-	38	52	60	1590
9	*Euchlanis oropa*	65	51	58	22	2	-	-	-	28	35	45	77	65	84	90	72	15	-	-	-	12	24	35	41	821
10	*Asplancha brightwelli*	132	140	86	60	32	-	-	-	38	64	86	102	126	160	192	92	86	24	-	-	-	66	72	92	1650
11	*Aspalancha priodonta*	72	83	67	54	68	12	-	-	-	42	64	196	132	140	83	95	54	31	16	-	-	-	36	59	1304
12	*Filinia longiseta*	26	32	37	52	12	-	-	-	-	8	19	29	40	36	55	15	2	-	-	-	-	15	21	24	423
	CRUSTACEA CLADOCERA																									
13	*Ceriodaphnia corunata*	25	32	41	15	12	11	2	-	-	3	7	10	28	37	52	47	39	13	12	10	2	11	15	17	441
14	*Coronotella rectangula*	14	17	22	28	21	-	-	-	-	15	18	19	15	24	26	29	18	8	-	-	-	-	9	13	296
15	*Alona pulchella*	65	38	48	56	17	-	-	-	18	33	82	94	102	87	31	32	11	-	-	-	-	11	42	33	800
16	*Indialona globulosa*	50	65	77	86	42	22	11	2	7	9	18	46	75	101	122	96	48	35	26	16	6	11	15	46	1032
17	Cladocera neonate	121	129	145	152	75	52	10	-	-	50	60	98	165	175	102	72	54	22	9	-	-	35	45	78	1649
18	*Daphnia pulex*	251	277	284	396	250	115	-	-	-	51	75	256	233	341	382	112	52	14	-	-	22	44	105	157	3417
19	*Daphnia carinata*	302	298	302	201	112	11	-	-	-	-	313	377	410	218	114	79	12	-	-	-	-	121	182	330	3382
20	*Diaphanosoma sarsi*	282	201	181	113	-	-	-	132	141	132	232	292	291	213	136	121	-	-	-	-	182	146	152	208	3155
21	*Macrothrix laticornis*	396	408	402	216	101	26	-	-	-	-	132	156	296	418	333	221	111	-	-	132	142	156	189	227	4062
22	*Moina brachiata*	86	92	77	52	17	-	-	31	42	57	89	97	64	34	15	-	-	34	41	54	61	72	82	79	1176
23	*Moina macrocopa*	40	35	18	-	-	-	26	28	17	25	36	39	45	15	4	-	-	-	31	37	38	56	14	36	540
	COPEPODA																									

24	*Mesocyclops leuckarti*	41	52	32	44	15	2	-	-	-	24	37	41	51	42	28	12	-	-	-	-	22	23	39	54	559
25	*Mesocyclops hyalinus*	41	52	32	44	15	2	-	-	-	24	37	41	51	42	28	12	-	-	-	-	22	27	39	54	563
26	*Heliodiaptomus viduus*	22	13	132	156	162	235	120	12	27	03	9	15	12	22	148	152	192	242	155	84	13	1	24	25	1976
27	*Neodiaptomus strigilipes*	432	392	410	301	292	302	181	77	13	3	-	-	56	402	441	392	392	211	272	118	57	--	92	204	5040
28	Cyclopoid copepodite	75	82	96	74	65	52	32	12	5	-	10	52	96	102	69	62	57	39	40	17	4	-	59	62	1162
29	Cyclopoid nauplii	32	39	42	12	8	2	-	6	14	18	29	38	44	37	32	27	15	12	9	5	-	6	18	28	473
	OSTRACODA																									
30	*Hemicycypris* sp.	-	-	-	92	148	167	192	198	132	119	87	41	-	-	-	77	96	123	148	199	182	192	132	52	2377
31	*Spirocypris*sp.	72	92	111	161	179	118	-	-	-	-	-	27	69	112	192	252	98	65	49	-	-	69	98	110	1874
	Total	3620	3610	3499	2969	2120	1463	651	620	659	945	2251	3342	3830	4170	3575	2691	1851	1160	921	801	916	1512	2285	2988	52449

DISCUSSION

Knowledge on hydrobiology of any lake essential for proper utilization, physic-chemical parameters and nutrient quality of water play a significant role in the distribution pattern species competition of plankton [11] [12]. Zooplankton community structure is influenced strongly by biotic –abiotic factor (water temperature, competition and predation in freshwater ecosystem [26] [27] [28][13] The maximum population of rotifer is recorded in NEM season. Rotifer was found to be dominant group and has higher diversity among zooplankton community. The rotifers are most important animal group belonging to the ecological niche of small filters. [16] considered the peak of rotifer being coinciding with higher water temperature, pH and nutrient concentration[13]. The present results agree with the previous report of [14]. [15] reported that zooplankton were abundant during summer season, where as minimum is during rainy season in the Nagral dam during study period. The summer season zooplankton population was found to be higher, it might be attributed to favourable environment conditions and availability of food (phytoplankton) in the lake ecosystem. Also rich in nutrient loading may support to zooplankton abundance Population [24]. In the present study overall population density found to be minimum in monsoon season and this might be due to high turbidity. Low light intensity, cloudy sky, besides high rain fall. Similar results have been reported by earlier works [17] [18] [19][20] [24].The Zooplankton population shows sudden decrease in monsoon months and indicates the fact that the prevailed physico-chemical conditions were not supported for the growth of zooplankton due to lentic water system. These effects may also be due to the over predation of zooplankton by higher trophic members like planktivorous fishes which regulate the zooplankton population in water body [21]. The population of Zooplankton falls during the monsoon due to dilution of dam by rainfall. The zooplankton population showed an increasing trend during winter because of favorable environmental conditions which include temperature, DO, availability of rich nutrient in the form of bacteria, nano-plankton and suspended detritus. The elevated level of zooplankton in winter season due to favourable environmental factors has also been reported by [22] [23].According to [25] and [26], warmer temperature could negatively affect zooplankton in unproductive ecosystem, because of the influence of strong synergetic interactions between thermal stress and food limitation on the growth of reproduction of mainly the cladocera.

4. CONCLUSION

The physic-chemical study of Nagral dam shows different seasonal fluctuations among various parameters. The results of the water quality of Nagral dam shows that most of the parameters were within the desirable limit and while some parameters are higher than desirable limit but within permissible limit of BIS and WHO. This indicates that the water is not polluted. The presence of some species of zooplankton lie Brachinous sps. Keretella sps. Moina sps. Indicates the possibility of eutriphication in future. The status of water quality of Nagral dam should be protected and

conserved by raising the awareness among the people of near by area. The given preliminary knowledge of information can be useful to scientific community, policy maker for the effective conservation and management measures to improve the water body in the lakes ecosystem.

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CONFLICT OF INTEREST

Authors have no conflict of interest.

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