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DIVERSITY AND SEASONALITY OF ZOOPLANKTONS OF PERRINEAL POND (JONU) IN DISTRICT, UDHAMPUR

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Abstract:

Present study deals with the study of lentic water source of district Udhampur, J&K to record its inhabiting invertebrate fauna .The present study recorded a total of 47 genera which included 5 genera of protozoans, 12 genera of rotifers, 13 genera of cladocerans, 16 genera of copepods and 2 genera of ostracods. The hierarchical order of dominance of zooplanktons was recorded in summers to be Cladocera > Copepoda > Rotifera > Protozoa from the pond and the seasonal dominance among these zooplanktons varied. In monsoons the dominance order was Copepoda > Rotifera > Cladocera > Ostracoda > Protozoa while in winters the dominance order was Cladocera > Copepoda > Rotifera > Ostracoda. Statistical analysis revealed positive correlation of group protozoa with copepods, cladocerans, DO, FCO_2, Mg, and a negative correlation with the HCO_3, CO3, pH, water temperature. Group Cladocera showed a positive correlation with the protozoans, copepods, air temperature, DO, FCO_2, Mg and a negative correlation with Cl^-, Ca^{2+}, HCO_3^- , CO_3^{2-}, rotifers and ostracods. Rotifers showed appositive correlation with copepods , ostracods , air and water temperature , DO, Ca^{2+}, Cl^- and a negative correlation with Mg^{2+}, HCO_3^-, CO_3^{2-}, FCO_2, pH, cladocerans, and protozoans.

Key Words: Seasonal Dominance, Hierarchical Order & Diversity

Introduction:

The pond is a shallow standing water body which can be either man-made or natural and is smaller than a lake and may have seasonal or perennial vegetation. Udhampur district of Jammu and Kashmir state is situated between, 32 °55 ' latitude and 75° 09' longitude at an elevation of 1045m above the sea level in the foot hills of Shiwalik range. Water availability in this district is restricted to few lotic sources and good number of lentic sources including man-made of natural ponds and no lakes. Present water sources of interest are a lentic perennial pond .This is a temple pond with well embanked cemented sides and thus have very less macrophytic vegetation. Being a perennial pond this has been used for about more than 80 years as a source of water for domestic purposes. Present line of interest has been to enlist the inhabitant species mainly planktonic, to know the trophic status of this pond. Presently 5 groups of zooplankton were recorded belonging to family

Study Area:

Jonu pond is one of the oldest domestic ponds of the jonu area approximately more than 50 years old and is situated at the foothills of shiwalik range, between 32° 55' latitude and 75° 09' longitude at an elevation of 1045m above the sea level in the sub tropic region of Jammu division of Jammu and Kashmir.

Materials and Methods:

Zooplankton Sampling and Analysis:

For the present study monthly sampling was done for the qualitative analysis of zooplankton by filtering water through plankton net (made of bolting silk with mesh size 70mm). 50 liters of water was filtered through planktonic net and the filterate was collected in 100 ml plastic bottles and preserved in 5% formalin. The identification was done using the standard books and manuals viz: Edmondson (1959), Adoni (1985), Pennack. The quantitative estimation was done by using the formula:

N = A*1/L*n/V

Where: N= Zooplankton no. per litre of water, A= Total no. of zooplanktons counted per drop,

V= Volume of a drop (ml)
L= Volume of original sample in litres.
N= Total volume of concentrated sample
Statistical analysis was also done using SPSS Programme.

Analysis of Physico-Chemical Parameters:

Water samples were collected once in every month and estimated for physico-chemical parameters viz: water temperature, air temperature, pH, dissolved oxygen, free carbon-dioxide, carbonates, bicarbonates, calcium, magnesium, chloride, sulphates, nitrates, and phosphates as per standard methods of APHA.

Results and Discussion:

Present investigations for a study period of one year when tabulated showed the Seasonal variation in the physico-chemical parameters.

Table 1: Showing monthly variation for 12 months (Jan-Dec, 2015) for Jonu pond

Parameters	Units	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
AIR TEMP.	^{0}C	16.5	28	28	29	28	30	30	30	25	20	19.5	25
WATER TEMP.	^{0}C	10.5	21	19	20	20	26	28	28	20	18	17	17
Ph		8	7.1	7.1	7	7	7.5	7.4	6.8	6.8	7.5	7.4	7.5
DO	Mg/l	1.6	2.4	3.6	6	3.2	4.8	4.8	8.4	5.2	5.6	5.6	4
FCO_2	Mg/l	-	2	4	8	4	2	2	6	2	4	4	10
CO_3^-	Mg/l	144	0	0	0	0	0	0	0	0	0	0	0
HCO_3^-	Mg/l	119.56	85.4	73.2	41.48	73.2	85.4	85.4	61	63.44	61	61	61
Ca^{2+}	Mg/l	42.91	21.03	15.98	12.62	15.14	37.85	25.23	42.05	45.44	50.46	50.46	51.30
Mg^{2+}	Mg/l	565.12	767.25	224.02	587.39	184.86	95.29	35.18	38.38	47.28	60.60	77.64	76.96
Cl^-	Mg/l	13	13	15	15	20	78	20	10	12	15	15	15
PO_4^{2-}	Mg/l	0.0109	0.0106	0.0344	0.5335	0.0663	0.1312	0.00175	0.0883	0.380	0.040	0.040	0.040
SO_4^{2-}	Mg/l	0.0029	0.0018	0.0019	0.0019	0.0020	0.0017	0.00187	0.0064	0.00	0.002	0.002	0.002
NO_3^-	Mg/l	0.0001	0.5724	0.5725	0.5726	0.5726	0.5725	0.573	0.5725	0.573	0.573	0.573	0.573

Temperature is one of the major abiotic factors which controls most of the bio-chemical parameters and thus the density of organisms depends on the water and air temperature (Ingole et al,2011, Akhtar et al 2007,Battish,1992,Frenando,1980 etc). Presently the air temperature ranged between 16.5^0 to 30^0. The pH varied between 6.8(Aug., Sept) and 8 (jan) and showed variation from slightly acidic to alkaline. The alkaline nature may be contributed due to the agricultural run-off from the surrounding fields, human activities and microbial decomposition of organic matter (Mohan V C and K K Sharma 2013). Dissolved oxygen ranged between 1.6mg/l (jan) to 8.4mg/l (aug). DO showed decreased concentrations during summers due to decreased solubility at high temperature; (Jalilzadeh et al, 2008). FCO also showed variation being absent in (jan) to 10mg/l (dec) and the concentration increased during summers. While calcium, magnesium, chloride, sulphates, phosphates and nitrates showed seasonal variations and different peaks in different months. Nitrates and phosphates showed peaks during summers.

Table 2: showing zooplankton community throughout the study period (jan-dec, 2015)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
PHYLLUM : PROTOZOA												
CLASS :SARCODINA												
ORDER : AMOEBAE												
GENUS: *Astroamoeba sps.*	-	-	-	+	+	-	+	-	+	-	-	-
ORDER : TESTACIDA												
FAMILY : DIFFUGIDAE												
GENUS : *Diffugia lebes*	-	-	-	+	+	+	+	+	+	+	-	+
D. acuminata	-	-	-	-	+	-	+	+	+	-	-	-
FAMILY : CENTROPYXIDAE												
GENUS : *Centropyxis ecornis*	-	-	-	-	+	-	-	-	-	-	-	-
ORDER : PERITRICHIDAE												
FAMILY : VORTICILLADAE												
GENUS: *Vorticella sps.*	-	-	+	-	-	-	-	-	-	-	-	-
GENUS: *Arcella sps.*	-	-	-	-	-	-	-	+	-	+	+	+
ORDER : CILLIOPHORA												
GENUS: *Euplotes sps.*	-	-	-	-	-	-	-	-	-	+	+	+
PHYLLUM : ROTIFERA												
CLASS : MONOGONONTA												
ORDER : PLOIMA												
FAMILY : ASPLANCHIDAE												
GENUS : *Asplanchna sps.*	-	-	-	-	-	-	+	+	+	-	+	+
FAMILY : BRACHIONIDAE												
GENUS : *Brachionus sps.*	-	-	-	-	-	-	-	-	-	+	-	-
Platiyas patulus	-	-	-	-	-	-	+	+	+	-	+	+
FAMILY : EUCHLANIDAE												
GENUs: *Euchlanis sps.*	-	-	+	-	+	+	-	-	-	-	-	-
FAMILY : MYTILINIDAE												
GENUS: *Mytilina sps.*	-	-	-	+	-	-	-	+	-	-	-	-
Monostyla sps	-	-	-	-	+	+	+	-	+	-	-	+
FAMILY : COLURELLIDAE												
GENUS : *Colurella sps*	-	-	+	+	-	+	-	-	-	-	-	-
Lepadella sps	-	-	-	+	-	+	-	-	-	+	-	-
L. ovalis	-	-	-	-	-	+	-	-	-	-	-	-
FAMILY : LECANIDAE												
GENUS : *Lecane luna*	-	-	-	-	-	+	+	+	+	-	+	+
CLASS : DIGONONTA												
ORDER : BDELLOIDEA												
FAMILY : PHILODINIDAE												
GENUS : *Philodina*	-	-	-	+	+	+	+	+	-	+	-	-
PHYLLUM : ARTHROPODA												
CLASS : CRUSTACEA												
ORDER : CLADOCERA												
FAMILY : CHYDORIDAE												
GENUS: *Alona sps.*	-	+	+	-	-	-	+	-	-	+	-	-
A.monocantha	-	-	-	+	+	+	+	-	-	+	-	-
A.affinis	-	+	-	+	-	-	-	+	+	-	-	-
A.excise	-	-	-	-	-	-	-	+	+	-	-	+
Chydorus sps.	+	+	+	+	-	+	+	-	-	-	-	-
C. ovalis	-	+	-	+	-	-	-	+	-	-	-	-
FAMILY : DAPHNIDAE												
GENUS *: D. Longifermis*	-	-	-	-	-	+	-	-	-	-	-	-
D. similis	-	-	+	+	+	+	+	-	-	-	-	-
D. laevis	-	-	-	-	+	-	-	-	-	-	-	-
D.pulex	-	-	-	-	-	-	-	-	-	-	+	-
Ceriodaphnia sps.	-	-	-	-	+	-	-	+	+	-	+	-
C. lacustris	+	-	-	-	-	-	+	+	-	-	-	-
Moinodaphnia	-	+	-	-	-	-	-	-	-	-	-	-
SUB-CLASS : COPEPODA												
ORDER : EUCOPEPODA												
FAMILY : CYCLOPIDA												
GENUS : Cyclop sps.	-	+	-	-	-	+	+	-	-	+	-	-
C. bicolour	-	-	+	+	+	-	+	-	-	+	-	-
C.insignis	-	+	-	-	-	-	-	-	-	-	-	-
C.scutifer	-	-	-	-	-	-	-	-	-	-	+	+
C.jeanneli	-	-	-	-	-	-	+	-	-	-	-	-
Helicyclop sps.	+	-	-	+	+	+	+	-	+	-	+	+

Mesocyclop sp.	-	-	+	+	+	-	+	+	-	+	-	+
Mesocyclop hyalinus	-	-	-	-	-	+	-	-	-	-	-	-
M.leukartii	-	-	-	+	+	+	+	+	-	-	-	-
M.tenuis	-	-	-	+	+	+	+	+	+	+	+	+
Tropocyclop sp.	+	+	+	+	+	+	+	+	+	-	-	+
T.prasinus maxicanus	-	-	-	-	+	-	-	-	-	-	+	+
Eucyclop prasinophorus	-	-	-	-	-	-	+	-	-	+	-	-
E. agilis	-	-	+	+	+	+	+	-	-	+	-	-
Nauplius larva	+	+	-	+	+	+	+	+	+	+	-	+
Family Diapotomidae												
Genus*: Diapotomus sp.*	-	-	-	-	-	+	+	-	-	-	-	-
Order : Ostracoda												
Genus*: Ostracoda sp.*	-	-	-	-	-	-	+	+	+	-	-	-
Stredensia sp.	-	-	-	-	-	+	+	+	+	-	-	-

Among the zooplankton extreme variations were seen during the different seasons. Quantitatively five groups of zooplanktons were presently recorded viz: protozoa, Rotifera, Cladocera, Copepoda and Ostracoda and quantitatively the hierarchy was as Cladocera > rotifers > protozoans > ostracods. All groups were found during each month except the ostracods which prevailed from June to September.

Table 3: showing various diversity indices for present study.

	Protozoa	Cladocera	Rotifera	Copepoda	Ostracoda
Simpson index	0.197	0.23	0.2	0.1	0.5
Dominance index	0.80	0.76	0.75	0.8	0.4
Reciprocal-Simpson Index	5.06	4.2	4.0	8.6	1.9
Shannon index	1.9	2.5	2.4	3.2	1.26
Menhinnich iindex (richness)	0.3	0.5	0.3	0.19	0.46
Equitability index	0.76	0.7	0	0.89	0.35

Protozoans:

The protozoans were present during all the months but were found highest during the summers and minimum numbers was seen during winters and were seen in moderate number in monsoons showing significant value for carbon-dioxide and bicarbonates. Among all the groups protozoans had comparatively less quantitative pressure which may be contributed to their combined feeding behaviour of all zooplanktons on the protozoans. Class protozoa contributed 5 species while the cladocerans were represented by 12 species which is a heavy load as predators for the protozoans.

Cladocerans:

Table1,2,3 and fig:4 showed that this group showed its quantitative abundance in summers and the least number was seen in the monsoons and the reason for its less number in monsoons was contributed to the dilution of water due to heavy rains but were less than rotifers as they were natural competitors as they feed on same algae (Gilbert, 1988). Quantitatively only few species of Cladocera like Alona sps and Chydorus sps. Showed dominance in warm temperature while sps of Daphnia and Alona exice dominated the cold water of winters. It showed a negative correlation most of abiotic factors except Mg, DO, FCO_2 which favoured their growth.

Rotifers:

Rotifers: the wheel animalcules are small microscopic animals which showed seasonal variation in their abundance and were quantitatively least in the summers due to very high temperature. The correlation among the zooplanktons and the physico-chemical parameters was applied and it revealed positive correlation among copepods,

ostracods, DO, nitrates, sulphates, phosphates(Arora and Mehra, 2003), chlorides, calcium, water and air temperature. Qualitatively common species which were found were Lecane luna, Platiyas patulus, Monostyla sps, Asplanchna sps, Philodina sps, Brachionus sps, Mytillina sps, lepadella sps. Quantitatively slight, increase was seen in the month of July and this might be due to the rise in the evaporation process and thus increasing the number of organisms per litre.

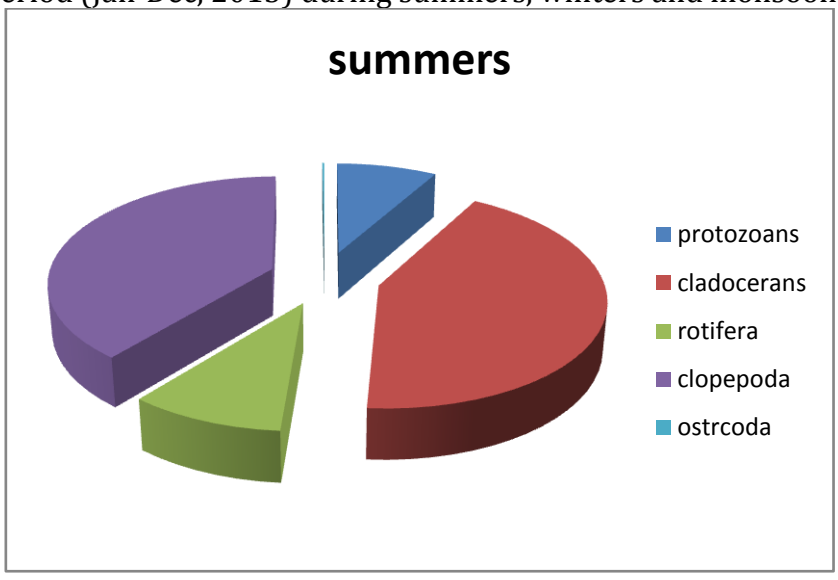
Copepods:

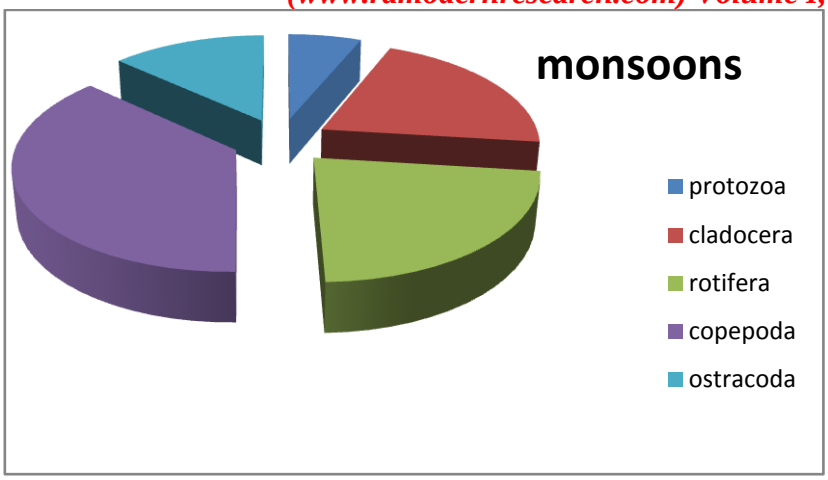
Table1, 2, 3 and figure 4 showed that **C**opepods are the sub class of arthropods and this groups showed its quantitative abundance in summers with a density of 24.48mg/l. Qualitatively most of the species of copepods were seen from the month of April to August and in rest of the months very few species were seen. Copepods are able to resist the harsh conditions of high temperature and even the flushing with water due to its comparatively bigger size. Also they prefer warm conditions to flourish and multiply in number. This is well seen from the study which showed significance with water temperature at 0.05 and showed positive correlation with the dissolved oxygen, bi-carbonates, magnesium, chloride and air and water temperature. They also showed significant correlation with chlorides. Qualitatively *Helicyclop sps. , Tropocyclop sps. and Mesocyclop tenius* were very common for most of the studied period. *Nauplius* larvae was also available throughout the year except in the months of March and November, this can be due to presence of egg stage of this group.

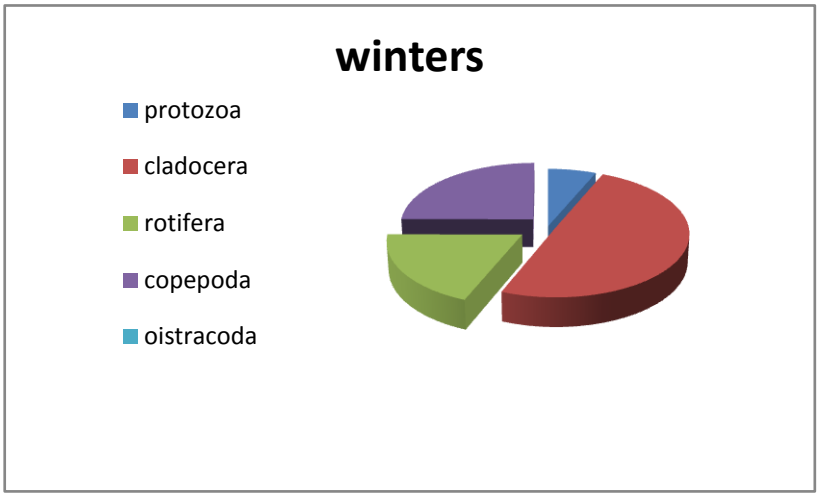
Ostracods:

Table1, 2, 3 and fig: 4 showed that Ostracods are also the sub group of the class arthropods and they quantitatively dominated the monsoon seasons. Their higher number during the monsoons is due to their heaviness and big size which is not easy to flush out with the water. Also they might have come on the surface to feed on the nutrients brought down from the runoff that help them to flourish well. The density was 6.44mg/l. They were completely absent during winters and seen in few number in summers and dominated in monsoons and thus can be concluded that they prefer warm temperature for their survivorship. Stastically the significant positive correlation at 0.05 with water temperature also supports that warm water is preferred by the ostracods for their existence.

Figure 4: Pie-charts showing quantitative analysis of various groups for the study Period (Jan-Dec, 2015) during summers, winters and monsoons.







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Conclusion:

The zooplankton presently recorded showed a dynamic approach to the changing environment as their growth and distribution depends on some abiotic factors (temperature, salinity, pollutants) and biotic parameters (eg. Food, predation, competition etc) (Marzolf, 1990; Ferdous and Muktadir, 2009). This may be due to short life span and thus these communities respond more quickly to the changed environment. The persistence of high density of copepods and cladocerans during summers depicts that these organisms can tolerate high temperatures and are hardy in nature but the contradictory results of cladocerans dominance can be seen in both summers and winters showing its wide range of temperature as well. The mean average for 12 month quantitative study for all groups of zooplanktons showed a value of 4.83

for cladocerans and least for ostracods with 0.54. The correlation showed a negative value for the rotifers with the cladocerans and the copepods which showed their competition for the common food. From the stastical approach for study of correlation among different groups recorded presently, it was revealed that a negative value for Rotifers with cladocerans and copepods. This may be due to competition as they share the same niche.

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