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STUDY OF MONOGONANT ROTIFERS WITH RESPECT TO DIVERSITY INDICES AND PEARSONS CORRELATION COEFFICIENT

PRIYANKA DUBE*, SATISH MOKASHE[1] AND SHAILENDRA SHELAR[2]

Department of Zoology,
*[1]Dr.Babasaheb Ambedkar Marathwada University,
AURANGABAD-431 004 (M.S.) INDIA
[2]L.B.S.Senior College, Partur, Tq.Partur,
Dist.Jalna (M.S.) INDIA
Email: priyankadube13@gmail.com

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ABSTRACT

The present study aims to focus the population density of rotifer from 'U[illegible] Dudhana Dam' of Jalna district, (M.S.), India by using diversity indices (Simpson's, Shannon-Weiner, Evenness and Richness). Diversity indices provided important information about rarity and commonness of species in a community. The rotifer density was correlated by using 'Pearson's Correlation Coefficient' (r) with physico-chemical parameters (Temperature, pH, Transparency, Alkalinity, Chloride, TDS, Hardness, Ca, Mg, DO and BOD) of water. Result showed that the Simpson index (D) was maximum (0.566) in January and minimum (0.077) in February. Shannon-Weiner index (H) was maximum (2.370) in January and minimum (1.07) in February. Evenness index (E) was maximum (0.741) in February and minimum (0.335) in January. Richness index (S) was maximum (11.5) in November and minimum (8.5) in July and August. Pearson's correlation coefficient clearly indicated that the rotifers was significantly, positively correlated with water temperature (r=0.439). It is concluded that the high diversity values were for stable community while the unstable ones had low values due to environmental degradation. Hence environmental reliability has been highlighted in the present investigation.

Figures: 00 References: 24 Table: 03

KEY WORDS: Correlation, Diversity indices, Physico-chemical parameters, Rotifer.

Introduction

Rotifers are commonly designated as the 'wheel animalcule' and are common in all water habitats. Rotifers are small

metazoans with over 2000 species described. There are about 2000 species of rotifers divided into two classes, *viz.* Monogononta and Digononta. Monogononta is the largest group with around 1500 different species. Digononta is a particular note because of the absence of males and ability of cryptobiosis[8].

Rotifers form an important link in the food chain with phytoplankton and other aquatic animals and also occupy an intermediate position in the aquatic food web[1]. These organisms are exposed to a variety of changes in the physical, chemical and biological characteristics of the environment in which they live. Since rotifers play an important role in the ecosystem, the ecological investigations on them gain importance[16].Rotifer fauna plays significant role in the food chain and biological production of water such as aqua pollution indicators[3].

Every water body is an ecosystem with a network of various physico-chemical parameters and its biota. The physicochemical parameters and zooplankton communities together form comprehensive ecosystem and as in any ecosystem, there are interaction between the zooplankton and the water quality parameters. These interactions are directly or indirectly subjected to the complex influences, some of which resulted in quantitative change *e.g.*, increase or decrease of size of the population[24]. Early researchers interpret their results as the number of species per sample or per liter as an index of their diversity. However, such a procedure does not help in distinguishing the relative abundance in terms of community structure of the different species besides other characteristics. The diversity cannot be estimated just by one index[10, 20].

Therefore, to overcome this limitation, different diversity indices such as Simpson (D), Shannon-Weiner (H), Evenness (E) and Richness (S) have been used in the present investigation. The correlation between monogonant species and water parameters was made by using Pearson's Correlation Coefficient (r) for the significance of study.

Material and Methods

Study area: Upper Dudhana dam is situated near village Somthana of Badnapur tehsil in district Jalna (M.S.) on the river Dudhana. The dam is located at 19°55'11.8"N longitude to 75°41'39.9"Elatitude. This is an earth fill dam and has a height of about 18mand 2.46 km in length, wherein the width is 2km.

Collection and analysis of sample: Zooplankton (Rotifer)and water samples were collected at fortnightly interval from

the study sites of dam during February 2013 to January 2015. Samples were collected by filtering 100 lit. water using plankton net (40µ mesh size) and concentrating the same to 50 ml and transferred to plastic container and preserved with 4% formalin. Then samples were brought to the laboratory for further analysis. Concurrently, water samples were taken for measuring selected physico-chemical variables. At the time of sampling, we measured the surface water temperature by using thermometer. pH was measured by pH probe (HANNA made). Transparency was measured with the help of *Secchi* disc. Dissolved oxygen (DO), BOD, total alkalinity, chloride, hardness and salinity were determined by titrimetric method[2, 22].

The identification of rotifers was done by using taxonomic keys[1, 6, 7, 19]. Rotifers were counted by using '*Lackey's Drop* count method'[12].The density of rotifers were expressed as organisms per liter by using formula, **N= n*v/V**

Where, N= Total number of org/lit.
n = number of organism counted in 1 ml of sample.
v = volume of concentrated sample in ml.
V = Volume of total water filtered in lit.

Statistical analysis:

1) Simpson's Index (D)

$$D = \sum_{i=1}^{s} (ni/n)\,2$$

Where, D = Simpson's index
ni = Total population of i^{th} species in community
n = Total population of all species in community

2) Shannon-Weiner Index (H)

$$H = \sum_{i=1}^{s} [\,(ni/n)\,\ln(ni/n)]$$

Where, H = Shannon-Weiner index
S = Number of individuals of each species
ni = Total population of i^{th} species in community
n = Total population of all species

3) Evenness Index (E)

E = H/ ln(S)

Where, E = Evenness index
H = Shannon-Weiner index
S = Number of individuals of each species

4) Richness Index (S)

S = N – 1/ln (n)

Where, S = Richness index
N = Total no. of species in a community

Results and Discussion

The present study revealed the correlation of monogonant rotifers with physico-chemical parameters of the Upper Dudhana dam water. During the study variation were noticed between the water parameters which are depicted in Table.1,

diversity indices of monogonant rotifers in Table.2 and Pearson's correlation coefficient between rotifers and water parameters in Table.3.

Diversity indices are important statistical measure used to characterize richness (the number of species) and evenness (how uniform abundant species are in a sample) of the species in the community[13] and isused as a tool for determining the health of an ecosystem[9, 17].It is evident from the results that all the physico-chemical characteristics of water under study affected the diversity and distribution of rotifers either positively or negatively throughout the period of study. Similar report has been made earlier[5].Average of monthly records of rotifer group population density during study period was maximum (209.15 org/lit) in the month of April and minimum (20.63 org/lit) in the month of February. Diversity of any species is directly related to abundance or equitability. The amount of predation greatly affects the diversity and density of prey population [18].

Generally, Simpson's index ranges from 0 to 1. High value of Simpson index indicates high diversity. Mature and stable communities have high diversity value (0.6 to 0.9), while the communities under stress conditions, exhibiting low diversity, usually show close to zero value. Diversity indices of rotifers during study period showed that, Simpson index was maximum (0.566) in January and minimum (0.077) in February. In the present study, the density and diversity of rotifers showed significant positive correlation with water temperature because both got enhanced with rise in temperature of water of the dam. These results agreed with the earlier[4, 14, 15].

In biological communities, Shannon-Wiener diversity index (H)varies from 0 to 5. According to this index, values less than 1characterize heavily polluted condition, and values in the range of 1to 2 are characteristics of moderate polluted condition while the value above 3 signifies stable environmental conditions. In the present investigation Shannon-Weiner index was maximum (2.370) in February and minimum (1.07) in January, *i.e.* all the values of Shannon-Weiner index of rotifers were in between 1 to 2, it means water of Upper Dudhana Dam was moderately polluted.

Evenness index was maximum (0.741) in February and minimum (0.335) in January. Present study showed that, whenever Simpson index increases towards higher value, the evenness index goes in antagonistic directions or vice versa. [23]supported the given result.

Richness index was maximum (11.5) in November and minimum (8.5) in July and August (Table.2). Richness index (S) is a measure of the number of different kinds of organisms present in a particular area. Highest value of rotifer species richness is observed in winter and lowest value in monsoon; it showed that the rotifer density was high in winter and low in monsoon. It might because of the inflow of rain water into the reservoir along with many nutrients which changed the water quality.

Statistical computation of monogonant rotifers and water parameters has been done by using Pearson's correlation coefficient (r). It showed that, rotifers was significantly positively correlated with water temperature (r=0.439) at 5% level and had no significant correlation with other water parameters. The water temperature which has shown a considerable increase during summer accelerated the evaporation rate and in turn influenced a hike in the concentration of all these parameters. This resulted in influencing the growth of primary producers and availability of more food for zooplanktons. Hence, highest incidence of rotifer was recorded in summer season in the precent study when temperature was also highest. There were the same findings in the work on the zooplankton diversity of Wan reservoir, Nagpur, Maharashtra. The availability of food is more due to production of organic matter and decomposition[11]. None of the species from class Digononta was recorded during the present investigation.

TABLE-1: Monthly Rotifer population density (org/lit) during June 2013 to May 2015.

Study period	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
June 2013 to May 2014	99.13	72.7	62.26	71.07	43.75	37.38	46.51	59.29	9.74	16.1	399.05	141.21
June 2014 to May 2015	81	59.25	54.88	61.26	51.78	77.75	34.05	100.17	31.51	28.88	19.25	50.88
Average	90.07	65.98	58.57	66.17	47.77	57.57	40.28	79.73	20.63	22.49	209.15	96.05

*Monthly values are average of four sites.

TABLE-2: Diversity indices of Rotifers from Upper Dudhana Dam during study period.

Diversity Indices	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Simpson's Index (D)	0.388	0.443	0.232	0.383	0.176	0.214	0.178	0.566	0.077	0.127	0.306	0.393
Shannon-Weiner Index (H)	1.560	1.421	1.938	1.617	2.268	2.120	2.223	1.070	2.370	2.262	1.688	1.637
Evenness(E)	0.488	0.445	0.606	0.506	0.709	0.663	0.695	0.335	0.741	0.708	0.528	0.512
Richness(S)	9.000	8.500	8.500	9.000	10.500	11.500	11.000	10.000	9.500	9.000	9.000	10.000

*Two years data represented as monthly mean.

TABLE-3: Pearson's correlation coefficient of physico-chemical parameters with Rotifers during study period.

Parameters	WT	pH	WTr	TA	TDS	TH	Ca	Mg	Cl	DO	BOD	RO
WT	1											
pH	-0.319	1										
WTr	0.545*	-0.032	1									
TA	0.116	0.383	0.259	1								
TDS	0.224	0.446*	0.289	0.580**	1							
TH	0.075	0.137	-0.026	-0.015	0.633**	1						
Ca	-0.560**	0.417*	-0.618**	-0.134	0.267	0.642**	1					
Mg	-0.543**	0.471*	-0.505**	0.113	0.326	0.638**	0.947**	1				

Cl	0.142	0.344	0.351	-0.031	0.596**	0.676**	0.333	0.309	1			
DO	-0.650**	0.011	0.101	0.218	-0.029	-0.177	0.031	0.145	-0.091	1		
BOD	-0.776**	0.186	-0.426*	-0.043	-0.285	-0.220	0.443*	0.441*	-0.260	0.523**	1	
RO	0.439*	0.114	0.331	0.275	0.177	0.084	-0.077	0.075	0.265	-0.206	-0.322	1

** = significant 'r' value at 1% ($p < 0.01$), * = significant 'r' value at 5% ($p < 0.05$), (– indicate negative correlation). **Abbreviations : WT** = Water Temperature, **pH** = Hydrogen ion concentration , **WTr** = Water Transparency, **TA** = Total Alkalinity, **TDS** = Total Dissolved Solids, **TH** = Total Hardness, **Ca^{++}**= Calcium, **Mg^{++}**= Magnesium, **Cl^-** = Chloride, **DO** = Dissolved Oxygen, **BOD** = Biochemical Oxygen Demand, **RO** = Rotifera.

Conclusion

It was obvious that the diversity indices are the exact measure for Upper Dudhana Dam or any water body. The correlations exhibited between rotifers and water parameters are not uniform because of sudden rain in odd season or drying up of the water body.

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T. C.

Lecturer
Lalbahadur Shastri Sr College
PARTUR Dist. Jalna (M.S.)

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Effect of Organophosphate Pesticides on The Oxygen Consumption of A Freshwater Leech, Hirudo Birmanica (Blanchard)

Vijay J. Kharat[1], S. D. Shelar[2] and Nilesh B. Pakhare[3]

[1,2]Department of Zoology, L. B. S. Sr. College, Partur, Tq. Partur, Dist. Jalna, Maharashtra, India

[3]Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra, India

ABSTRACT

The present study was conducted to track changes in the rate of oxygen consumption freshwater leech *Hirudo birmanica* exposed to sublethal concentration of malathion (0.98 ppm at 96 h) and monocrotophos (1.2 ppm at 96 h). The gradual depletion was observed in oxygen consumption rate after initial couple of hours.

Keywords : *Hirudo birmanica*, Malathion, Monocrotophos, Oxygen consumption.

I. INTRODUCTION

The pollution of aquatic ecosystem with chemical contaminants has become critical environmental concern. The freshwater animals including medicinally important leeches are adversely affected by agricultural pesticides. Pesticide is defined by United Nations Environment Programme (UNEP, 2005) as any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. The health of aquatic ecosystem is being adversely affected due to indiscriminate use of pesticides. Such pesticides reach to aquatic ecosystem through rains, wind and surface runoff.

Malathion (O,O-dimethyl phosphorodithioate of diethyl mercaptosuccinate) and monocrotophos are synthetic organophosphate, non-systemic, broad spectrum insecticides are extensively used in agriculture and household practices for pest eradication. These organophosphates are highly toxic to non-target organisms. Both represent major source of environmental pollution. Organophosphate pesticides are highly soluble in water and can therefore easily contaminate aquatic ecosystem, thereby increasing the exposure risk of aquatic flora and fauna (Agdi *et al.*, 2000). Once malathion is introduced into the environment, it may cause serious intimidation to the aquatic organisms and is notorious to cause severe metabolic disturbances in non-target species (USEPA, 2005 Ojha *et al.*, 2011).

Leeches are medicinally important animals which are adversely affected by pesticide pollution in freshwater ecosystem. Leeches are hermaphrodite which carries both the male and female reproductive organs. For the present study, *Hirudo birmanica* were selected as a test animal.

Assessment of rate of oxygen consumption is an important parameter to assess and understand the physiological state of metabolic activity of an organism and the toxicants stress on aquatic organisms. Since it is also an index of energy expenditure to fulfill the demands due to environmental and biological alterations (Nagabhushnam and K[illegible]arni, 1981; Kale and Kulkarni, 2003).

The present work is aimed to observe changes in oxygen consumption of a freshwater leeches *Hirudo birmanica* exposed to malathion and monocrotophos.

II. METHODS AND MATERIAL

The freshwater leeches *Hirudo birmanica* (length 10 ± 1 cm and weight 8 ± 0.5 gm) were procured from freshwater ponds around Partur Dist. Jalna. These leeches were acclimatized to the laboratory conditions in wet mud for 10-15 days at a room temperature(27 ± 2°C) prior to the experiment.10 leeches were exposed to 96 h LC50 (0.98 ppm) concentration of malathion and moncrotophos (1.2 ppm) to quantify their oxygen consumption rate by standard Winkler's method (Welsh *et al.*, 1968). The quantity of oxygen consumed was calculated in relation to the unit wet weight of animal and the values obtained were expressed as the rate of oxygen consumed in µl/h/l/g body weight. The data was statistically analysed using student 't' test

III. RESULTS AND DISCUSSION

In general ,the rate of oxygen consumption of poikilotherimc animals is highly complex process and it is subjected to the influence of various extrinsic and intrinsic factors. The respiration rate of animal is an indicator of environmental stress (Capuzzo, 1977). The results of the present study show oxygen consumption rate was decreased in both organophosphate pesticides exposure after initial couple of hours. In exposure of malathion it shows depletion in 4 h 6 h 8 h 10 h and 12 h for -09.86% -14.75%, -23.65%, -36.43%, -44.29% respectively in compare to control, where in initial two hours it shows elevation in oxygen consumption viz. +41.13% and +63.92% for 1 h and 2 h respectively. Similar depletion was observed in monocrotophos exposure for 4 h 6 h 8 h 10 h and 12 h at -12.21% -15.68%, -19.84%, -32.54%, -38.86% respectively in compare to control and elevation in first couple of hours was also observed 31.62% as and +45.94%). The observed values of oxygen consumption rate are presented in Table no. 1.

Leeches increase their respiration by undulating movement while adhering to the vegetation with the posterior sucker. They have haemoglobin in the haemoaelomic fluid and use oxygen normally. The present study showed that the normal respiratory rate of *Hirudo birmanica* was affected due to sublethal exposure of Malathion (0.98 ppm) and Monocrotophos (1.2 ppm). Oxygen consumption rate of *Hirudo birmanica* was constantly decreased from 4 h to 12 h of exposure to both the pesticides which shows as the period of exposure is increase the rate of oxygen consumption is decrease.

The pesticides alter the rate of respiratory metabolism in invertebrates are reported in somewhat detail. Mane *et al.*, (1984) observed decrease in the respiratory activity, when freshwater bivalve molluscs exposed to cythion-malthion. *Metapenaeus monoceros* a marine prawn was exposed to phosphomidon, DDT and fenvalerate, showed significant reduction in oxygen consumption rate (Reddy 1987). Sagar (1989) noted that malathion produced a significant hike in the rate of oxygen consumption for the first couple of hours and after that it reduced when another freshwater leech was *Poecilobdella granulosa* exposed to malathion. Jaiswal *et al.*, (1990) reported constant decline in the rate of oxygen consumption of a crab *Barytelphusa cunicularis* after exposure to the organophosphate pesticide. Chaudhari (1997) reported the significant decline in oxygen consumption rate in *Hirudo birmanica* when exposed to endosulfan. Changes in respiration rate indicate the probable modulations in the metabolism of the animals (Kondekar, 1998). There was an elevation in the rate of oxygen consumption for the first two hours when *H. birmanica* exposed to malathion and monocrotophos, as the exposure period increase the rate of oxygen uptake gradually decreased with a severe fall after four hours and continued till the animal death. This variation in oxygen consumption is due to impaired

oxidative metabolism and stress caused by toxicants (Pakhare, 2017).

Table 1 : The rate of oxygen consumption (µl/g/h/l) of *H. birmanica* exposed to sublethal exposure of Malathion and Monocrotophos at 96 h.

Concentration (in ppm)	% change after.....hours						
	1	2	4	6	8	10	12
Control	22.23 ± 0.40*	22.28 ± 0.36*	22.39 ± 0.34*	22.46 ± 0.25*	22.51 ± 0.20*	22.56 ± 0.17*	22.59 ± 0.14*
Malathion 0.98 ppm	+41.13	+63.92	-09.86	-14.75	-23.65	-36.43	-44.29
Monocrotophos 1.2 ppm	+31.62	+45.94	-12.21	-15.68	-19.84	-32.54	-38.86

[* Values are the original values in µl/g/h/l] [Values are significant at $p<0.05$]

IV. CONCLUSION

The present study reveals that malathion and monocrotophos interfere in respiratory metabolism leading to lowering of oxygen consumption rate which causes death of leeches.

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Lalbahadur Shastri Sr.College,Partur.

(Arts,Commerce & Science)

Tq Partur Dist Jalna(M S) NAAC Accredited B
Web www.lbscpartur.co.in Email-lbsc_ptr@rediffmail.com/lbscptr@gmail.com M.8275520365

Ashabai Babasaheb Akat
Presidant

Dr.Bhagwan Dirange
Principal

CERTIFICATE REGARDING VARIOUS COMMITTEES

This is to certify that Dr. S. D. Shelar Associate Professor (Zoology) have been worked for following committee during the academic year 206-17 to 2018-19.

Sr. No.	Academic year	Committee name	Designation
01	2016-2017	Student Seminar	Member
		Dicipline	
		Time Table	
		Faculty Day celebration	
		Tree Plantation	
02	2017-2018	Tree Plantation	Member
		Faculty Day celebration	
		Discipline	
		Time Table	
		Student Seminar	
03	2018-2019	Time Table	Member
		Student Seminar	
		Discipline	
		Tree Plantation	
		Faculty Day celebration	

Hence Certified

Principal
Lal Bahadur Shastri Sr. College
Partur Dist. Jalna (M.S.)

T. C.

Lecturer
Lalbahadur Shastri Sr. College
PARTUR Dist. Jalna (M.S.)

THE INDIAN SCIENCE CONGRESS ASSOCIATION

(Professional Body under Department of Science & Technology, Ministry of Science & Technology, Government of India)

14, Dr. Biresh Guha Street, Kolkata - 700 017

Paper Presentation Certificate

This is to certify that Prof./Dr./Shri/Smt. Shailendra Shelar of L.B.S. Sr. College Partur. has presented a Paper (Oral/~~Poster~~) entitled Animal, Veterinary and Fishery sciences in the Section of Organic Pesticide Induced changes in protein during the 104th Indian Science Congress held at S. V. University, Tirupati from January 3 to 7, 2017.

His/Her Membership Number is L48520

Date 7-01-2017

T.C. Dashaki
Lecturer
Lalbahadur Shastri Sr. College
PARTUR Dist. Jalna (M.S.)

104th ... 2016-17
Chancellor, Davangere University
DAVANGERE - 577 002.

Office Seal

Sectional President
(Signature)

THE INDIAN SCIENCE CONGRESS ASSOCIATION

(Professional Body under Department of Science & Technology, Ministry of Science & Technology, Government of India)

14, Dr. Biresh Guha Street, Kolkata – 700 017

Paper Presentation Certificate

This is to certify that Prof./Dr./Shri/Smt. Shailendra Shelar of L. B. S. Sr. College Partur has presented a Paper (Oral/Poster) entitled Effect of heavy metal Pesticides in the Section of Animal, Veterinary and Fishery Science during the 105th Indian Science Congress held at Manipur University, Imphal from March 16 to 20, 2018.

His/Her Membership Number is L18520

Date 20-March 2018

Lecturer
Lalbahadur Shastri Sr. College
PARTUR Dist. Jalna (M.S.)

Office Seal

105th Indian Science Congress-2018
SECTION
Animal, Veterinary & Fishery Sciences
Manipur University, Imphal

(Signature)
Sectional President