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Biodiversity of littoral benthic community and shorebirds of Sirpur Lake, Indore

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Abstract

Sirpur Lake located in the south west area of Indore city, is mainly surrounded by large trees on half its shoreline and the rest, by shrubs and open agriculture land. The lake receives considerable amount of domestic sewage from the city and is the bathing place of its human inhabitants. The main source of water of this lake is rain water. The shoreline of Sirpur Lake has a dense population of benthic communities and shorebirds. The shoreline area of this shallow tropical lake is not only an ideal habitat for the shorebirds and the benthic community but it also plays an important role in the exchange of allochthonous and autochthonous food cycles in the lake ecosystem. Whereas the benthic community serves as major component of secondary production in the lake, the shorebirds act as "biological filters" particularly in the shoreline zone. In homothermal and polymictic tropical lakes the plankton communities and benthic organisms are reported as main components of the food chain, but the shorebirds which are an integral part of this cycle is not mentioned in previous reports. It was therefore, thought worth while to make inventory of shorebirds, and benthic species diversity. The present study is focused on biodiversity of the benthic community and the shorebirds of Sirpur Lake, Indore.

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Introduction

The littoral area of lake is an interspace of land and water. Its fauna is poorly studied (Belsare, 1979). The investigations have not gone a great deal beyond necessary descriptive analysis of their types and distribution within freshwaters. The population dynamics and trophic

interrelationships of the benthic fauna are poorly understood (Hynes, 1970, Belsare, 1979, Sharma, 2002). Much of the difficulty in studying benthic fauna is due to their heterogeneous distribution of the diverse fauna in littoral waters in relation to their requirements for feeding, growth and reproduction. These requirements interact with and are altered by changes in the substratum and overlying water on a seasonal basis e.g. changes in oxygen contents, and in the input of living and dead organic matter for food. These organisms either possess adaptive mechanisms to cope up with their changes, enter relatively dormant stages until more physiological amenable conditions, return more or die. Within their limits, the adaptive capacity of the benthic animals of the dynamics of environmental parameters and food are basic to their distribution, growth and productivity, and reproductive potential.

The littoral region is an important interface between land and pelagic zone of water body. It is occupied by rooted plants, micro and macro-invertebrates and demersal fish species. The studies on benthic communities of shallow tropical lakes of India are reported by several authors (Shrivastava 1956, 1957; Krishnamurthy 1966, Michael 1968; Mandal and Moitra, 1975, Belsare & Oommachan, 1979, Oomachan & Belsare 1979, 1985; 1986; Pahwa 1979; Sarkar 1989; Kaushal and Tyagi 1989;; Malhotra et al 1990; Jaiswal & Singh 1994; Singhal, 1991). Gupta and Pant (1983) reported energy content of macro-invertebrates and their seasonal changes in Indian sub-tropical lake water body which explains rich biodiversity of the region.. The present study was undertaken to discover macro-invertebrate diversity in littoral zone of a shallow tropical lake which receive waste water from domestic sewage and agricultural effluent.

Materials and Methods

After survey of Sirpur lake for the benthic biodiversity and nature bottom, there four sampling stations are selected for the study in shore line of lake. Monthly sampling were made from March 2000 to October2000.a rod net was used in collecting samples and sieving them for isolation .the bigger animal species picked by hand where the smaller forms were isolated by sugar isolation method and studied them under low power (X 50) microscope. They were preserved by narcotizing them by methanol and chloral hydrate and later 70% alcohol. The benthic organisms were identified with help of standard books and keys. Counts were expanded to standard units of numbers per square meter by a conversion factor, which was taken from the area sampled by the grab. The conversion factor is the ratio of 1 m2 to the surface area sampled by the grab. Counts were multiplied by the conversion factor to estimate the number per square meter present in the lake

The birds were observed with the help of field binocular from a distance of 100 meters and were identified with the help of Collins birds of India by martin woods cock 1980 and artificial key prepared by belsare (1997).

Results and Discussion

The macroinvertebrate benthic fauna mainly constitute of Oligochaeta, Mollusca and Arthropoda groups. Their distribution at various stations of littoral region is summarized in table 1, 2, 3 & 4. The most common species are *Tubifex tubifex, Limmodrilus hoffmeisteri, Telmatodrilus multispinosus, Dero dorsalis, Stylaris fissciarrs, Branchiodrillis hartensis, Tubifex albicola, Limnaea aluminata, Unio sp. Bellamiva bengalensis, Digoniostoloma punchella, Melanoides tuberculatus, M. lineatus, Thira scabra, Indoplanorbis exustus, Pissidium clarkeanum, Vivipara bengalensis, Chironomus sps., Chaborus sps. Prociadius sps.* etc.

The oligochaetes decrease in number during monsoon. They reappear in the beginning of post monsoon and continue to remain dominant during hot period. Among molluscs, except *Digoniostroma punchella, Malenoides tuberculatus* and *Vivipara bengalensis,* the other species remain at their lowest level. However the arthropods dominated the macro-benthic invertebrates during post monsoon and cold period. It is surprising that the molluscs species *Thira scabra* was absent at station I & IV, whereas it was present in large number at other stations examined.

The most dominent species among oligochaetes were, *Tubifex tubifex, Limmodrilus hoffmeisteri* and *Telmatodrilus multispinus* at station I. At station II *L. hoffmeisteri* is dominant during August to December and at station III the other species such as *Dero drosalis, Stularia fissuaris,* were abundant. *Tubifex albicola* was the dominant species at station IV.

Among molluscs all species except *M. lineatus, T. Scabra* and *P. clarkanum* were dominent at all stations , whereas *L. aluminate* was abundant in number at station II and station IV. Similarly *Vivipara bengalensis* was large number at station III .*Unio sps.* appear in large number during September to February period .

The arthropod benthic species were observed in more number at all stations, although there is slight fluctuation during monsoon, but increase in large number during post-monsoon season.

The shore bird species observed are Black winged Stilt (*Himantopus himantopus*), Common Sandiper (*Aclitus hyoleuces*), Black-tailed Godwit (*Limosa limosa*), White-winged Black Tern (*Chlidorias hybrida*), Wiskered Tern (*Chliodorias* sp), Little Tern (*Sterna albifrons*), Black-headed Gull *(Larus hemtorichii*), Avocet *(Recurviorostra*

avosetta), Indian Skimmer (*Rhynchops albicollis*), Red -wattled Lapwing (*Vanellus indicus*) and Pond Heron (*Ardiola grayii*). The grebs, coots, Mergansers (pond ducks) restrict themselves to pelagic region of lake and rarely visit littoral region. Their seasonal distribution is summarized in table 5. It is seen that they are abundant during cold season (late post – monsoon and beginning of summer).The migratory species vanish from shoreline area during onset of monsoon rains.

OLIGOCHEATES	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Tubifex tubifex	15	17	21	19	11	5	10	15
Limmodrilus hoffmeisteri	7	8	9	6	5	3	4	7
Telmatodrilus multispinosus	11	12	13	13	5	5	7	13
Dero dorsalis	4	10	7	5	15	10	7	9
Stylaria fossularis	8	7	4	2	5	8	3	5
Branchiodrillus hortensis	9	8	10	9	8	4	8	6
Tubifex albicola	13	17	20	12	13	4	7	13
MOLLUSCS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Limnaea auricularia	24	23	39	37	17	11	10	8
Bellamva bebgalensis	19	14	9	20	14	3	4	9
Digoniostoma punchella	55	45	65	60	80	75	32	25
Melanoides tuberculatus	25	35	45	55	40	20	15	35
M.lineatus	2	3	4	7	5	2	4	5
Thira scabra	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Indoplanovbis exustus	13	18	15	11	5	6	7	8
Pissidium clarkeanum	6	5	4	6	9	10	7	6
Vivipara bengalensis	21	32	25	19	9	5	45	36
Unio sp.	19	17	12	10	8	9	6	19
Pila sp.	6	8	5	9	7	8	10	12
ARTHROPODS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
chironomus sp.	27	23	27	7	9	10	69	74
Chaoborus sp.	21	25	32	27	7	4	60	71
Procladius sp.	19	12	32	30	4	2	54	75

Table 1: Seasonal Variation in Benthic Fauna at Station - 1 (2000)

OLIGOCHAETES	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT
Tubifex tubifex	22	19	16	14	27	38	45	60
Limmodrilus hoffmeisteri	7	08	08	15	12	8	10	09
Telmatodrilus multispinosus	17	18	17	11	08	2	09	11
Dero dorsalis	27	10	17	14	7	06	06	13
Stylaria fossularis	14	19	13	11	13	16	18	21
Branchiodrillus hortensis	11	18	12	9	15	13	11	15
Tubifex albicola	12	10	10	12	NIL	2	3	5
MOLLUSCAN	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Limnaea auricularia	54	31	32	19	17	3	12	32
Bellamva bebgalensis	25	24	24	18	16	4	3	21
Digoniostoma punchella	17	25	22	12	11	8	5	19
Melanoides tuberculatus	11	27	21	14	12	6	7	14
M.lineatus	27	10	13	15	2	5	5	11
Thira scabra	7	14	12	13	12	8	4	18
Indoplanovbis exustus	24	18	14	15	13	4	3	7
Pissidium clarkeanum	9	11	12	11	3	6	6	3
Vivipara bengalensis	10	14	12	7	6	5	10	7
Unio sp.	17	20	11	9	7	9	8	21
Pila sp.	8	7	9	5	7	6	12	14
ARTHROPODS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
chironomus sp.	29	30	29	31	2	4	60	77
Chaoborus sp.	26	17	31	32	8	7	51	72
Procladius sp.	20	17	31	35	9	8	52	61

Table 2: Seasonal Variation in Benthic Fauna at Station - 2 (2000)

OLIGOCHAETES	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Tubifex tubifex	22	31	24	17	28	47	59	63
Limmodrilus hoffmeisteri	9	12	14	16	2	13	16	NIL
Telmatodrilus multispinosus	18	14	12	9	2	3	9	NIL
Dero dorsalis	17	24	10	19	44	56	47	34
Stylaria fossularis	21	17	7	14	29	23	33	39
Branchiodrillus hortensis	31	26	19	9	26	36	51	43
Tubifex albicola	10	8	9	14	3	3	2	6
MOLLUSCAN	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Limnaea auricularia	35	46	42	37	28	23	13	10
Bellamva bebgalensis	24	23	10	23	17	5	7	13
Digoniostoma punchella	51	46	62	60	89	79	36	28
Melanoides tuberculatus	42	48	79	61	49	17	9	26
M.lineatus	7	4	8	4	6	7	3	4
Thira scabra	9	19	13	16	2	2	6	19
Indoplanovbis exustus	29	21	19	15	1	1	2	9
Pissidium clarkeanum	12	14	24	18	9	12	5	2
Vivipara bengalensis	88	57	53	65	72	50	43	37
Unio sp.	20	23	11	12	9	7	5	20
Pila sp.	13	9	8	9	6	4	2	12
ARTHROPODS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
chironomus sp.	31	26	29	32	2	4	61	73
Chaoborus sp.	33	18	39	32	5	8	51	71

Table 3: Seasonal Variation in Benthic Fauna at Station - 3 (2000)

OLIGOCHAETES	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT
Tubifex tubifex	13	19	27	28	19	7	9	18
Limmodrilus hoffmeisteri	9	5	7	5	3	5	3	7
Telmatodrilus multispinosus	11	17	14	7	3	3	11	16
Dero dorsalis	7	19	5	2	3	7	12	11
Stylaria fossularis	9	9	7	3	4	2	9	6
Branchiodrillus hortensis	11	7	13	2	2	2	8	8
Tubifex albicola	16	24	24	15	2	2	7	15
MOLLUSCAN	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
Limnaea auricularia	29	26	49	40	19	12	2	3
Bellamva bebgalensis	29	19	7	22	4	3	4	7
Digoniostoma punchella	53	46	69	61	82	76	37	28
Melanoides tuberculatus	29	30	45	57	42	25	15	NIL
M.lineatus	3	NIL	2	9	1	1	1	1
Thira scabra	14	17	9	7	6	6	5	5
Indoplanovbis exustus	5	18	16	7	6	3	2	7
Pissidium clarkeanum	23	5	5	18	9	12	9	9
Vivipara bengalensis	24	38	32	13	10	10	45	39
Unio sp.	20	17	14	12	8	9	7	20
Pila sp.	9	9	7	7	6	10	13	11
ARTHROPODS	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**
chironomus sp.	24	25	25	28	7	5	61	77
Chaoborus sp.	22	21	29	31	9	4	67	71
Procladius sp.	17	12	33	32	7	3	53	67

Table 4: Seasonal Variation in Benthic Fauna at Station - 4 (2000)

NAME OF SHOREBIRDS	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Black winged stilt [*Himantopus himantopus*]	23	24	13	12	NIL	NIL	8	10
Common sand piper [*Aclitus hyoleuces*]	10	8	4	1	1	NIL	NIL	5
Black tailed Gadwit [*Limosa limosa*]	18	12	13	14	4	5	9	14
White Winged Black Tern [*Chlidorias hybrida*]	20	22	25	16	12	NIL	NIL	17
Whiskered Tern [*Chlidorias hybrida*]	24	26	14	13	NIL	8	14	19
Little Tern [*Sterna albifrons*]	25	24	25	14	2	2	3	16
Black headed Gull [*Larus hemtorichii*]	28	10	4	3	NIL	NIL	NIL	15
Avocet [*Recurviorostra avosetta*]	32	12	5	3	NIL	NIL	NIL	NIL
Indian skimmer [*Rhynchops albicollis*]	21	10	6	2	NIL	NIL	NIL	NIL
Red Wattled lapwing [*Vanellus indicus*]	36	22	13	14	NIL	NIL	NIL	17

Table 5: Average Number Of shorebirds (2000)

There is difficulty in studying benthic macroinvertebrate diversity due to their heterogenous distribution in littoral water in relation to their requirements for feeding, growth and reproduction. They cope up with these changes with their adaptive mechanisms, return or die. Another major problem encounters in effective analysis of these organisms is the difficulty of sampling them quantitatively because of substrate heterogeneity which leads to a patchy and nonrandom distribution. Furthermore

taxonomy of many groups is confusing and in some cases incomplete. In spite of these difficulties the present investigation has generated quantitative evaluation of populations of oligochaetes, mollusks and arthropods.

Due to greater number of different microhabitats in littoral region of Sirpur Lake, they are abundant in hot as well as cold climates. Their abundance at station III of the lake is due to organic matter of domestic sewage effluent and run-off water from agricultural fields. During cold season the diversity of oligochaete populations and their abundance, even though shore birds, which feed on them, are abundant, probably indicate interacting mechanism permitting coexistence in the habitat. The population of these worms is regulated by selective breeding and adaptive regulatory mechanism.

The littoral region of lake is much influenced by shore birds, which feed on fish, variety of benthic communities and also control vector population of water borne diseases (Morris, 1994; Batzer and Resh, 1994; Carlson *et al*, 1994; Belsare *et al*, 1999). Belsare (1994) mentioned important role played by fish and shorebirds in maintaing trophic relationship of littoral aquatic food chain. However, limnologists in studying productivity and water quality of topical lake neglected these important communities. Belsare (1981) reviewed the work done on tropical lakes the New as well as of Old world and reported that there is no information on benthic communities and the role played by them in maintaining aquatic ecosystem of tropical region. The present observations indicate that the population of oligochaetes is increased during cold period, which might be due to their breeding habit and adaptability to organic waste and has nothing to do with abundance of shore birds which feed on them. The decreased population of oligochaetes during summer is probably due to their dormancy period rather than reduced organic matter from domestic waste and run off water from catchments area which is a source of food to them. On the contrary littoral mollusk population depends on dissolved oxygen and suitable substratum. The littoral benthic fauna of insects is influenced by detritus mass and recycled organic matter. The presence and absence of shore birds which feed on them do not limit insect biodiversity.

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