Macro-Invertebrates Associated with Macrophytes in various Freshwater Bodies of Kashmir

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ABSTRACT

The study pertains to the association of macroinvertebrates with fifteen common macrophytic species growing in two lakes (Dal and Anchar), one wetland (Hokarsar) and one Pond (Sonwar) in Kashmir. The composition and number of fauna inhabiting the macrophytes have been analysed for a period of 4 months (August 2000 – November 2000). Lymnaidae; Hirudinae; Pleidae; Zygoptera; Chironomidae; Coleoptera were regularly present on all the macrophytes. A note on the ecological relations between invertebrates and macrophytes is also given.

Keywords: Macrophytes, invertebrates, periphyton, lakes, Kashmir

INTRODUCTION

The invertebrates in general and insects in particular make decisive proportions of the secondary production in freshwater ecosystems of Kashmir (Pandit, 1980). In view of the ecological role of macroinvertebrates in lakes and wetlands ecosystems (Soszka, 1975; Pandit *et al.*, 1985; Pandit, 1991) a comparative study of structural components of invertebrates in two lakes, one wetland and one pond of Kashmir, with different ecostatus under almost similar edaphic and climatic conditions, was undertaken during August to November, 2000.

STUDY SITES

The diverse fresh water bodies, comprising two lakes (Dal and Anchar), a wetland (Hokarsar) and a pond (Sonwar), are spread throughout the valley at an altitude of 1584-86 m (a.s.l) and are probably of fluvial origin and of post-glacial age (Wadia, 1947), having been formed from the Ox-bows of River Jhelum which flows through the valley leaving alluvial deposits. The Dal Lake is a multibasined

lake with Hazratbal, Boddal, Gagribal and Nagin as its four basins, while all the other three water bodies are monobasined. A detailed description of lakes and the wetlands is given elsewhere (Kaul 1977, Pandit, 1980, 96, 99) while Sonwar pond is located within the city of Srinagar at the foothills of Zabarvan mountains and Shankarcharya hill and acts as a sewage receiving pond. A brief description of these water bodies is given in Table 1.

Table 1. Description of the four water bodies.

Name	Location with respect to Srinagar	Area (km)	Maximum Depth (m)	Source of Water
Dal Lake	2 km Northeast of Srinagar	10.45	6.0	Telbal Nallah and other streams besides springs in the lake bed
Anchar Lake	12 km Northwest of Srinagar	6.60	2.75	Mainly River Sind and Nallah Amir Khan
Hokarsar Wetland	11 km Southwest of Srinagar	7.5	0.80	Mainly Doodganga flood channel
Sonwar Pond	13 km Southeast of Srinagar	0.60	0.90	Rain water

MATERIAL AND METHODS

Quadrants of different sizes were used for collecting the aquatic macro-fauna at random from different sampling stations differing in water depth, vegetation and food supply etc. In each study site the appliance was gently lowered on the vegetation stand and in open water well into the sediments. The entire mass of vegetation plus animals were carefully lifted from water. The samples were gently pulled into bags under water. In the laboratory the fauna was collected macroscopically and after proper identification the number of each species was expressed as individuals /m^2. The collected and carefully washed plants were identified, separated and counted. The invertebrates inhabiting above ground vegetation were collected by a variety of entomological nets like sweep

net, kite net and drag net (Dowdeswell, 1959) the relatively less mobile insect larvae were sampled by quadrant method. Immediately after collection a large number of individuals of each species were preserved in 70% alcohol with a few drops of glycerine. The egg-masses on stem and leaves were counted and the number of organisms mining in submerged macrophytes were also estimated. Two methods were employed to assess the trophic relations, the first consisting in the direct feeding observation and second the analysis of gut contents. The faeces were also analyzed, especially when examining the food composition of snails.

RESULTS AND DISCUSSION

Species Composition and Distribution

The great diversity in the macrofauna of fresh water bodies is mainly due to the species rich class Insecta, a combination of different adaptive forms belonging to orders namely (i) Odonata (Anisoptera and Zygoptera), (ii) Ephemeroptera, (iii) Plecoptera, (iv) Hemiptera (*Coraxia*; Notonectidae; Gerridae; Pleidae and Aphididae), (v) Coleoptera (*Dytiscus marginalis*, *Hydrophilus* sp., Noteridae, Elimidae, Heleidae), and Diptera (Culicidae, Chironomidae, Rhagionoidae, *Tipula* sp. *Ephydra* sp. and Syrphidae. Aphids belonging to Hemiptera are host specific. They spent much of their life cycle on host plants (*Hyalopterus prunii*, on *Phragmites australis*, *Rhopalosiphum nymphae* on *Nelumbium nucifera*, *Nymphaea* sp. and *Nymphoides peltata* and *Rhopalosiphum myadis* on *Hydrocharis dubia*).

An analysis of distribution of invertebrates on macrophytes revealed only five animal groups (Lymnaeidae, Hirudinae, Aphididae, Coleoptera, Chironomidae) were common to most of the aquatic plants. On an overall basis, submerged macrophytes harboured greater number and greater taxonomic diversity than other hydrophytes.

A comparison of two lakes, one wetland and a pond, on the basis of average epifaunal population, revealed Sonwar pond harbouring the maximum population (629 ind./m^2) , followed by Anchar Lake (622 ind./m^2), Hokarsar wetland (326 ind./m^2) and Dal Lake (180 ind./m^2) in a decreasing order (Table 2). However, the maximum contribution in Anchar Lake was made up by leeches. In Sonwar pond decisive proportions to the total animal population were due to the significant contributions made by Tubificidae, especially during August and

Table 2. Monthly variations in the population density (ind./m^2) of aquatic macroinvertebrates in four varied freshwater bodies of Kashmir.

Animal Kindgom	DAL LAKE				ANCHAR LAKE				HOKHAR-SAR WETLAND				SONWAR POND			
	Months				Months				Months				Months			
	A	S	O	N	A	S	O	N	A	S	O	N	A	S	O	N
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
I. MOLLUSCA																
Lymnaea spp.	2.25	29.25	33.75	186.75	22.5	4.5	78.75	13.5	13.25	15.75	36.0	29.25	11.25	4.5	42.75	40.5
Planorbis sp.	-	-	2.25	27.0	11.25	4.5	27.0	15.75	-	-	-	-	33.75	9.0	18.0	56.25
II. ANNELIDA																
i) Hirudinea	-	6.75	13.5	13.5	641.25	119.25	585.0	112.5	-	24.75	2.25	-	22.5	40.5	4.5	15.75
ii) Oligochaeta					-	9.0	4.5	22.5	-	-	-	-	110.25	60.75	4.5	9.0
III. ARTHROPODA																
A) Crustacea (*Gammarus* spp.	-	-	-	29.25	123.75	56.25	31.5	6.75	-	6.75	-	-	-	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
B) Arachnida																
i)Acari (w.mite)	2.25	-	-	-	-	-	-	-	-	-	-	-	2.25	-	-	2.25
ii) Unidentified	-	-	-	-	-	2.25	-	2.25	2.25	2.25	2.25	-	-	40.5	2.25	-
C) Insecta																
i)Odonata																
a) Anisoptera	-		-	-	-	-	33.75	-	2.25	11.25	2.25	-	-	20.25	6.75	-
b) Zygoptera	-	15.75	4.5	51.75	18.0	22.5	33.75	85.5	9.0	22.5	4.5	-	29.25	24.75	6.75	18.0
ii) Ephemeroptera	-	-	-	-	24.75	-	-	2.25	9.0	-	2.25	-	24.75	2.25	-	-
iii) Plecoptera	2.25	-	-	-	-	-	4.5	-	-	-	-	-	9.0	4.5	-	-
iv) Hemiptera																
a) Coraxidae	-	-	-	1.5	-	-	-	-	-	50.0	10.0	-	-	20.0	200.5	10.0
b) Notonectidae-	2.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c) Gerridae	-	-	-	-	-	-	-	-	-	-	-	2.25	-	-	-	-
d) Pleidea	-	-	-	11.25	40.5	-	11.25	9.05	4.5	27.0	-	-	45.0	94.5	238.5	252.0
e) Aphididae	-	-	49.5	4.5	-	-	-	24.75	-	-	-	-	6.75	11.25	-	51.75

Table 2 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
v) Coleoptera																
a) Dytiscidae	-	2.25	-	-	-	-	-	-	4.5	69.75	-	-	4.5	-	-	-
b)Hydrophilidae	4.5	4.5	-	-	-	69.75	4.5	-	4.5	-	-	-	11.25	58.5	11.25	15.75
c) Noteridae	-	-	2.25	0.75	-	-	-	-	-	204.25	41.75	-	-	40.75	427.25	188.0
d) Elimidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
e) Heleidae	2.25	-	33.75	29.25	2.25	-	-	4.5	4.5	-	-	2.25	4.5	-	-	-
f) Unidentified	-	-	2.25	-	-	-	6.75	2.25	-	-	9.0	-	-	-	2.25	18.0
vi) Diptera																
a) Culicidae	-	-	-	-	2.25	-	4.5	9.0	-	-	-	-	-	-	-	-
b) Chironomidae	18.0	13.5	33.75	74.25	24.75	-	4.5	146.25	6.75	4.5	-	33.75	18.0	2.25	4.5	22.5
c) Rahagionidae	2.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d) Tipulidae	2.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
e) Syrphidae	-	-	-	-	-	-	-	2.25	-	-	-	-	2.25	-	-	-
f) Ephyridae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**36**	**74.25**	**175.5**	**429**	**911.25**	**288**	**830.25**	**459**	**60.5**	**438.75**	**110.25**	**67.5**	**335.75**	**434.25**	**969.75**	**699.75**

September, Pleidae and Noteridae, the last two dominating the scene from September to November. In Hokarsar wetland Noteridae Lymnaeidae, Dytiscidae and Chironomidae dominated during various months of the study period. Dal Lake showed a different pattern of dominance being Chironomidae in August, Lymnaeidae in September, Aphididae, Chironomidae and Lymnaeidae in October and Lymnaeidae followed by Chironomidae and Zygoptera in November.

A comparison of species composition shows a majority of euryecious species occurring in all the water bodies, while only a few invertebrate groups like *Gammarus* sp., Acari, Plecoptera, Gerridae, Dytiscidae, Rhagionoidae, Tipulidae, Syrphidae and Ephydridae are restricted to only one or the other of the four aquatic biotopes. Odonata prefer organic matter and nutrient rich environment, the nymphs of some species being present only along the plant debris, a fact well corroborated by the studies of Kaushik *et al* . (1991) and Pandit (1992) who further believe that these insects can live in both polluted and unpolluted waters, but the algal abundance and luxuriant growth of macrophytes are prerequisite. The capacity of bugs to migrate appears to be an important factor causing fluctuations in their monthly variation. Hutchinson (1933) observed that local migrations play an important part in the bionomics of many species of Hemiptera especially Notonectidae and Corixidae. In the present study also, the density of Hemiptera in all the water bodies excepting Sonwar pond was less due to their migration, which is in agreement with the study of Kaushik *et al.* (1991). The nature of sediment also plays an important role in the distribution of chironomid larvae as substrate with rich organic matter and good epipelic algal growth favoured chironomid populations. Chironomids are invariably the inhabitants of polluted waters with low oxygen content and high organic nutrients. Similar results have also been obtained by Bay *et al.* (1966), Hilsenshoff (1966), Pandit *et al.* (1985), Kaushik *et al.*(1991) and Pandit (1992). The maximum development of insect community in general and snails in particular in terms of density and growth can be explained on the basis of better trophic conditions, provisions of suitable breeding and sheltering sites by profused growth of varied macrophytic species. Further, the shallow water bodies (Sonwar pond and Hokarsar wetland) tend to warm up quickly to relatively high temperatures, the very fact resulting in the enhancement of reproduction. This hypothesis of excessive food coupled with warm water conditions seems to be the most plausible explanation for the existence of high numbers of individuals during warm water period.

Ecological Relations of Invertebrates and Macrophytes

The ecological relations between invertebrates and macrophytes especially submergeds are reciprocal and manifold. In addition to their food, macrophytes also provide the suitable places for hiding, sheltering, breeding and egg laying, anchorage and rich oxygen supply for various animal species (Table 3). The most favourable sites being stems and leaves of macrophytes. Thus the dissected leaves

Table 3. Ecological relations between invertebrates and macrophytes in water bodies of Kashmir.

	Use of macrophytes as					
Taxonomic Groups/Species	**Food**	**Place for egg laying**	**Wintering place**	**Mining place**	**Material for building cases**	**substrate**
Lymnae stagnalis	M	M	-	-	-	M
Planorbis sp.	W	W	-	-	-	M
Hirudinea	-	VS		-	-	-
Gammarus sp.	W	-	-	-	-	-
Hydrophilus sp.	-	VS	-	-	-	-
Dytiscus Marginalis	-	M	-	-	-	W
Coraxia sp.	M	-	-	-	-	-
Aphididae	VS	VS	VS	W	-	VS
Odonata	-	W	-	-	-	-
Culididae	W	-	-	-	-	-
Chironomidae	M	W	W	VS	-	VS

Use of Macrophytes: VS = Very Strong M = Medium W = Weak

and stems of the plants show more egg deposition. The largest number of eggs of invertebrates in general was deposited on the two species of macrophytes, i.e., *Potamogeton pucillus* and *Myriophyllum spicatum*. *Potamogeton lucenus* rarely showed any deposition of egg masses probably because of its marl encrustation. Coleopteran eggs were mostly deposited on the ventral surface of floating-leaf types like *Nymphoides peltata, Nymphea caudida, Nymphea alba, Potamogeton natans* and *Hydrocharis dubia*. Chironomidae and Odonata laid their eggs only sporadically. The largest number of egg masses were counted on *Nymphea* sp., *Nymphoides peltata* and *Potamogeton* sp. in July and August. Among the mining fauna the most abundant are the chironomid larvae which settle mainly in the stems, and are less abundant on leaves and petioles.

Tissues of vascular plants, detritus, plankton, periphyton and fauna associated with macrophytes and benthos are potential food for invertebrates in the lake

littorals. The variety of potential food and variety of groups of fauna living on plants suggest the very much complex and variable nature of trophic relations, which with the analysis of more and more material, turn to be complex food web.

The trophic relations of macroinvertebrates are also influenced by the utilization of the periphyton colonizing the plant surface (Soszka, 1974). The food habits of snails indicate that the macrophytes with periphyton are more preferred than macrophytes without periphyton and also dead or partly decomposed plants are preferred over live plants (Soszka, 1975; Kaul *et al.*, 1980; Pandit, 1983). Westlake (1965) also found the majority of phytophagous animals like snails occurring on periphyton and dead plant material and only a few species on the leaves of plants.

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