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Benthic marobiota in Teesta River of sub Himalayan region

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Abstract- The density of benthic macro-biota in number over weight of biomass at three sampling stations of Teesta river sub Himalayan region has been studied, it was found that the Caddis fly larvae was the most dominant component and contributed 52.41% in the macro-biota. These animals were abundant in Teesta river when benthic algae were abundant, water is well oxygenated, alkaline and contains sufficient nutrients but observed to be less abundant during high velocity of water, high river depth and higher turbid waters.

Keywords : Benthic, Macrobiota, Odonata, Teesta

INTRODUCTION

Aquatic ecosystem is one of the most productive ecosystems in the world that inhabits a large proportion of the earth's biodiversity.[1,2] Numerous plants and animals, ranging from microscopic algae to large plants, from protozoan to mammals, exhibit a variety of adaptations which allow them to survive and grow in water.[3] In the past, 'Water' the basic amenity for living organisms was pure, virgin, undisturbed, uncontaminated and basically most hospitable for living organisms but the situation is just the reverse today because progress in science and technology is also leading to pollution of environment and serious ecological imbalance which in the long run, may prove disastrous for mankind,[4] thereby affecting its ecological integrity to a greater extent. Macrobenthic invertebrates refer to the organisms that inhabit the bottom substrates (sediments, debris, logs, macrophytes, filamentous algae etc.) of aquatic habitats, for at least part of their life cycle. The density of aquatic macrobenthic invertebrate species and communities is controlled by a variety of environmental factors such as habitat characteristics sediment quality,[5] sediment grain size and by biological factors such as competition and predation. Stream flow, nature of substratum and organic pollution generally regulates the species composition and dominance of different taxa in various stretches of rivers and thus, macrobenthic invertebrates constitute the most popular and commonly used group of freshwater organisms in assessing water quality. Benthic invertebrates have been favoured in environmental effects monitoring because they are sessile or limited in their range of movement and therefore

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cannot avoid pollution. They are generally abundant and can be found year round so are easily sampled. Since, many aquatic species have a life span in water of approximately a year, they provide an indication of water quality conditions over that period. Thus, benthic invertebrate monitoring data provides a link between the effects of human activities on the physical and chemical properties of water and aquatic ecosystem health.[6]

MATERIALS AND METHODS

The samples of macro-benthic animals were collected on monthly basis by "the kick net method" in which 1 m 2 stream bed areas was enclosed with net fabricated from fine mesh, soft and flexible monofilament material. The entire fauna collected and preserved in 5-10% formalin for further detailed analysis.

RESULTS AND DISCUSSION

Several investigations have been made on the nature, density and ecology of the macro-benthic animals of Indian rivers and streams. Singh and Nautiyal (1990)[7] studied benthic fauna of river Ganga. In the whole stretch of river, 30 taxa of macro invertebrates dominated by Ephemeroptera followed by Diptera and Trichoptera. Mohan and Bisht (1991)[8] recorded species of insects belonging to 37 families from River Bhagirathi and Bhilangana. Sehgal (1991)[9] recorded 57 genera of insects from 11 rivers of North-Western Himalaya. Joshi (1991)[10] observed 50 genera of insects from Sherkhad stream in Himachal Pradesh. Bhatt and Pathak (1992)[11] recorded 68 genera of insects from various rivers of Kumaon region and 37 taxa from Teesta river.

Table 2 :Average annual percentage contribution of various macro-benthic animals at three sampling sites of River Teesta.

Groups		Site 1	Site 2	Site 3
Ephemeroptera				
	Epeorus	26.47	30.77	33.57
	Heptagenia	11.34	10.99	7.00
	Rhithrogenia	15.97	7.14	12.59
	Caenis	4.20	6.59	2.80
	Baetis	16.39	14.84	11.19
	Ephemerella	7.98	13.19	7.00
	Echdyonurus	8.40	1.54	7.68
	Iron	5.88	3.85	9.08
	Leptophlebia	2.10	1.09	-
	Ameletus	1.27	-	8.40
	Paramelatus	-	-	0.69
Odonata				
	Argus	3.92	4.26	11.63
	Gomphus	45.10	25.53	37.21
	Octogomphus	15.68	8.51	-
	Agrion	15.69	21.28	32.56
	Ophiogamphus	-	4.25	13.95
	Ischnura	19.61	36.17	4.65
Plecoptera				
	Perla	32.76	28.12	21.43
	Chloroperla	27.59	18.75	28.57
	Nemoura	36.21	50.00	45.24
	Leuctra	3.44	3.13	4.76
Hemiptera				
	Micronecta	100.00	81.82	100.00
	Corixa	-	18.18	-
Coleoptera				
	Psephenus	72.84	83.33	85.56
	Elmis	17.28	11.54	6.67
	Ectopria	8.64	-	3.33
	Eubrianex	-	1.28	4.4
	Hydrena	1.24	2.57	-
	Dysticus	-	1.28	-
Trichoptera				
	Hydropsyche	61.52	63.86	62.80
	Rhyacophylla	21.77	18.52	27.68
	Phyllopotamus	15.70	17.32	9.52
	Mystacids	0.38	0.70	-
	Ithytrychia	0.63	-	-
Diptera				
	Chironomus	40.58	47.34	63.53
	Atherix	14.50	17.55	14.12
	Dixa	1.93	1.06	-
	Tabanus	16.91	9.04	3.52
	Chaoborus	14.01	8.52	8.23
	Cullicoides	1.45	-	-
	Simulium	8.70	14.36	10.59
	Pentaneura	1.44	2.13	-
	Psychoda	0.48	-	-

During the present investigations, a total of 48 genera of macro-benthic animals were recorded. Sehgal (1990)[12] reported univoltine type of life cycle in may flies and stone flies but caddis larvae exhibit multivoltine type of life in upper reaches of River Beas in Himachal Pradesh. During the present studies in Teesta river, may flies exhibited peak in November, February and May of which the peak in February was strongest due to the addition of new arrivals in the population. In the case of caddis fly, clear peak was seen in their numerical density during November, February and May in which newly entrants to population were prominently observed in November and May along with larger sized cohorts. Among the midge larvae, *Chironomus* had its peak density in September just at the end of Southwest monsoon when newly hatched (almost transparent) *Chironomus* were collected not only inmacro-benthic samples but also in zooplankton and epiphytic algae samples. The second peak was observed in January at Station 3 and third peak in May. This indicates that other than may flies which appear to lead univoltine type of life, caddis fly and midge larvae indulge in multivoltinism in Gaula river.

The great variability of a stony stream, bed which offers numerous different microinhabitat is the most important factor which determines the distribution and abundance of macrobenthic animals. The substratum acts directly as a medium for their existence and indirectly as modified of their microenvironment (Minshall, 1984)[13]. There may be many types of these habitats within even a small portion of stream. They are partly determined by the speed of the current but often varies considerably according to the kind, size and shapes of the stones, over or round which the water flows. In India, Hora (1936)[14] conducted premier investigations on benthic invertebrates and considered substratum as an important factor in the ecology of torrential fauna.

Sehgal (1988, 1991)[15,9] dealt with this aspect in detail and provided authentic explanations Negi and Singh (1990)[16] dealt with substratum in relation to bottom fauna of river Alaknanda in Garhwal Himalaya. In Gaula river, substratum near Herakhan comprised of big and small stones and boulders; at Station 2 near proposed Jamrani Dam site has small and big stones and sandy; at Station 3 near Ranibagh, the site is mostly of sand, small pebbles and small stones. The average annual numerical density at Station I was estimated at 80.27 ind./m^2, at Station 2, 67.5 ind./m^2 and at Station 3, 41.94 in d./m^2· This indicates that macro-benthic fauna in Teesta river prefer river bed substratum comprised of small and big stones and boulders where average density of fauna was almost double when compared with sandy habitats at Station 3. A good number of *Epeorus* (15 no./ m^2) were collected by washing clusters of filamentous green algae *Zygnema* and *Tribonema* in September 1993 at Station 1 and in October 1993 at Station 2. The nymphs of *Rhithrogenia* (17 ind./m^2) and *Baetis* (13 ind./m^2) were collected from small crevices of submerged stones with the help of a dropper. But midge larvae particularly *Chironomus* in their early larval forms were found accumulated (26 ind./m^2). at Station I and 37 ind./m^2 at Station 2) along with lesser density of *Atherix* (10 ind./m^2 at Station 2) under a thin algal biofilm near the bank of river in the month of September 1993 when water velocity at these two sampling stations was considerable. The omnivore *Hydropsyche, Rhycophilla* and *Phyllopotamus* were mostly collected by kicking stones as they were mostly available in between these microhabitats and only few of them were attached to stones.

Water penny *Psephenus* and *Elmis* were collected by washing stones as they remain attached to them. In Indian waters, Khan and Tandon in their study on reappearance of benthic invertebrates in River Beas observed that on an average period taken by the upland river fauna to reappear after complete wash off is about 63 hours during March compared to 138 hours in October. In Gaula river may flies were least available in August and September 1992 may be due to thus wiping out completely. In the first week of September, 1992, a big part of landslides containing large and heavy boulders blocked Teesta river between sampling stations, II and III. This persisted for about a week when Irrigation Department Engineers blasted off the blockade.

When sampling was done at Stations II and III after weather conditions returned to normal, very low density of benthic invertebrates was recorded. But a good number of *Epeorus* (15 units/m^2) were observed. After this main physical disturbance of flash floods which increased the depth of the river, water velocity and finally turbidity subsequently brought down numerical density and wet biomass of benthic animals. The settlement of may flies started and attained their first peak (24 units/m^2) in November. Their density came down in December and January but again got colonised in good quantity (48 units/m^2) at sampling Station I, Again a minor peak (11 units/m^2) in may fly density was observed in May. Almost the same trend was observed at other two sampling stations. It appears that caddis larvae are farquicker in colonising process than others. At sampling station I, only 6 units/m^2 of caddis fly larvae recorded rising to 44 units/m^2 in

October and 101 units/m2 in November which was the numerical maxima. Like many flies, their density came down in December and January but regrouped again in February (88 units/m^2). Subsequently their density came down in March and April and due to increase in *Rhycophilla* density established their third peak (61 units/m^2) in May. Midge larvae (Diptera) showed their maximum density in September 1993 at Station I (45 units/m^2) and Station II (69 units/m^2) and in January 1993 at Station III (20 units/m^2). It is surprising that average annual number of midge larvae came down from 11.5 units/m^2 at Station I to 10.4 units/m^2 at Station II to 4.7 units/m^2 at Station III. Few studies have established correlation between enhanced ionic concentrations and benthic animals and their biomass. In Scottish highland streams, Egglishaw and Morgan (1965)[17] fixed certain limits in values of alkalinity. They concluded that low benthic densities occurred in streams with alkalinity less than 20 mg whereas benthic invertebrates density was quite high in streams with alkalinities higher than 20 mg. Feldman and Connor (1992)[18] observed a threshold of alkalinity at 50 mg. They observed that alkalinities below 50 mg may create physiological problems in some genera especially *Ephemeroptera* and *Plecoptera*. Perhaps these groups are more prone to changesin temperature and also to dissolved oxygen.

Krueger and Waters (1983)[19] suggested that secondary production was greatly affected by chemical nature of water. These studies suggested that macro benthic invertebrates density may increase directly through elevated periphyton standing crops or productivity. Other studies have demonstrated positive relationship between alkalinity and macroinvert~brate density. Krueger and Waters (1983)[19] found significant correlation between drift density and alkalinity in 13 Alaskan streams. Krueger and Waters (1983)[19] also found a positive relationship between alkalinity and macro-invertebrate biomass in five Minnesota streams. Hershey *et al.* (1993)[20] found reduced drift from enriched sections of streams. Koetsier *et al.* (1996)[21] observed that macro invertebrates biomass showed a significant positive relationship with alkalinity.

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