Macrophytic Associations in the Lotic Habitats of Kashmir Himalaya

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ABSTRACT

A study of the macrophyte associations in River Jhelum during 2006 revealed appreciable spatial variations. 20 species of macrophytes were recorded in the river system with maximum number of 12 species in the Lidder Nalla, while a single species was recorded in Nambla nallah and in the Uri section (Dachhi) in the Jhelum. In general, the tributaries depicted higher species diversity than the main river. Data on the physico-chemical nature of water and bottom sediments indicated that the occurrence of macrophytes was greatly influenced by type of bottom substrate, current velocity, transparency and overall gradient of stream.

Key Words: River Jhelum, tributaries, macrophytes, ecology.

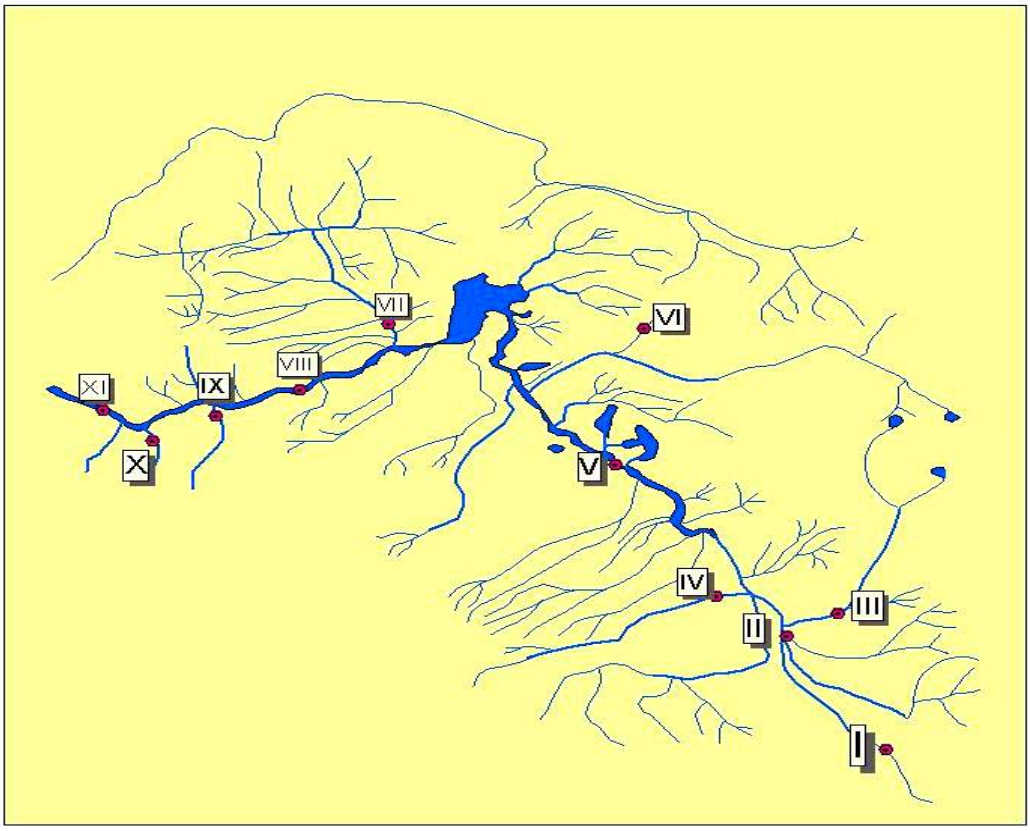
INTRODUCTION

Higher aquatic plants, also termed as macrophytes, form an important component of biota of shallow lentic ecosystems especially nutrient-rich waters of lakes and wetlands, where they not only contribute towards primary production but also influence the hydro-chemical processes and also serve as a substrate for the development of periphyton and phytophilous invertebrates (Raspapov *et al;* 2002). In contrast to lentic systems, the role of macrophytes in running waters is very limited and only a few species of macrophytes are adapted to lotic habitats (Hynes, 1970) which generally produce sparse cover on the streambed. The fast water currents and the shifting substrate of the streambed are the two main factors responsible for the scarcity of these life forms in lotic systems. Although there are a number of studies on different aspects of macrophytes of lakes and wetlands of Kashmir Himalaya (Kaul and Zutshi, 1967; Kak, 1978; Handoo and Kaul 1982; Kaul *et al* 1978; Pandit 1984; Rather and Pandit, 2005; Pandit and Ravinder 2006), the lotic systems have completely been ignored. In the present communication, an attempt has been made to list the macrophytic species commonly encountered during 2006 in the slow flowing zones and pool sections of various streams associated with the Jhelum River System in Kashmir Himalaya.

MATERIAL AND METHODS

A survey of the macrophytes occurring in the river Jhelum and its important tributaries in Kashmir Himalaya – Sundran, Lidder, Rambiara, Wangat Nalla, Pohru, Buniyar and Nambla Nalla – was conducted during 2006. Eleven main sites were selected along the course of the river and its tributaries (Fig. 1). The various ecological parameters like vegetation cover, bottom texture and chemical characteristics of water at the sites were also worked out. The bottom texture and physico chemical parameters of underlying water and habitat was done in accordance of Welch (1948), Mackereth *et al.* (1978) and APHA (1998). The macrophytes were collected from the shallow peripheral areas as well as the pool areas and the identification of the collected hydrophytes was done with the standard taxonomic works of Kak (1978) and Fasset (2002).

Fig. 1. River Jhelum and its tributaries in Kashmir Himalaya



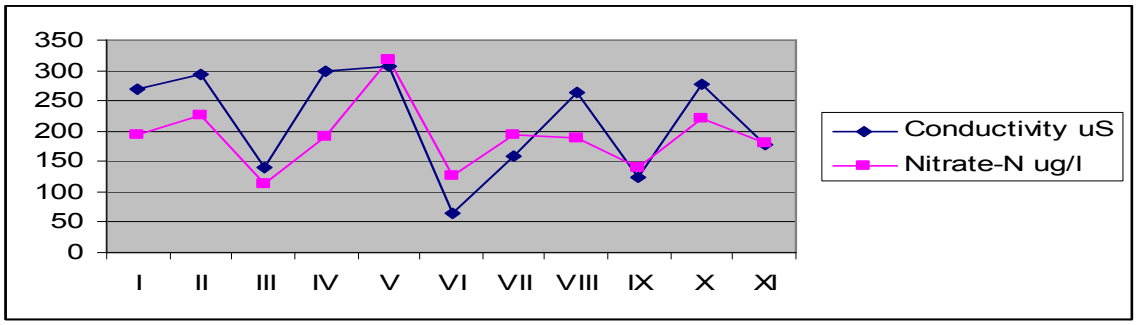
I= Sundran site, II= Khanabal site, III= Lidder site, IV= Rambiara site,

RESLTS AND DISCUSSION

A perusal of the limnological data indicated significant variations in the physico-chemical characteristics of water at different sites (Fig. 2). The main River Jhelum and Pohru Nalla depicted greater depth than the other streams of the system but the water at these sites was much turbid (transparency < 20% of the total depth) than that of the other tributaries of the system. In the lotic systems occurrence and prevalence of the components of bicarbonate system and the pH conditions are determined primarily by water velocity, biological processes and chemical nature of substrate (Reid, 1961). Moyle (1945) classified the water bodies on the basis of total alkalinity as soft water type (less than 40 mg/L), from 40 mg/L to 90 mg/L as medium hard and those with values over 90 mg/L as hard water types. According to above definition the river Jhelum, Sundran, Rambiara, Pohru and Haji Pir streams having average value of total alkalinity above 100 mg/L fall under hard water type, Lidder and Buniyar Nalla as medium hard water type, while the Wangat Nalla contained all through soft water.

The source of nitrogen in river system includes precipitation, nitrogen fixation in water and sediments as well as inputs from agricultural wastes (Wetzel, 1983). The total inorganic nitrogen levels in the main Jhelum were comparatively higher than its tributaries. The river segment through the Srinagar City in particular recorded the maximum values throughout the year due to large quantities of untreated sewage and waste water from catchment.

Phosphorus is a critical factor in the maintenance of biogeochemical cycles on which the productivity of water bodies depends. In general, the total phosphate phosphorus depicted clear spatial variations and fluctuated between 40 µg/l in Wangat Nalla and 228 µg/l in the Srinagar segment of the Jhelum. A comparison of the present data with the reports of Vass *et al.* (1977) reveals that there has been a significant change in the water quality in the Jhelum River system during the past thirty years. This change is directly related to the increased human population vis-à-vis anthropogenic activity in the river catchment.



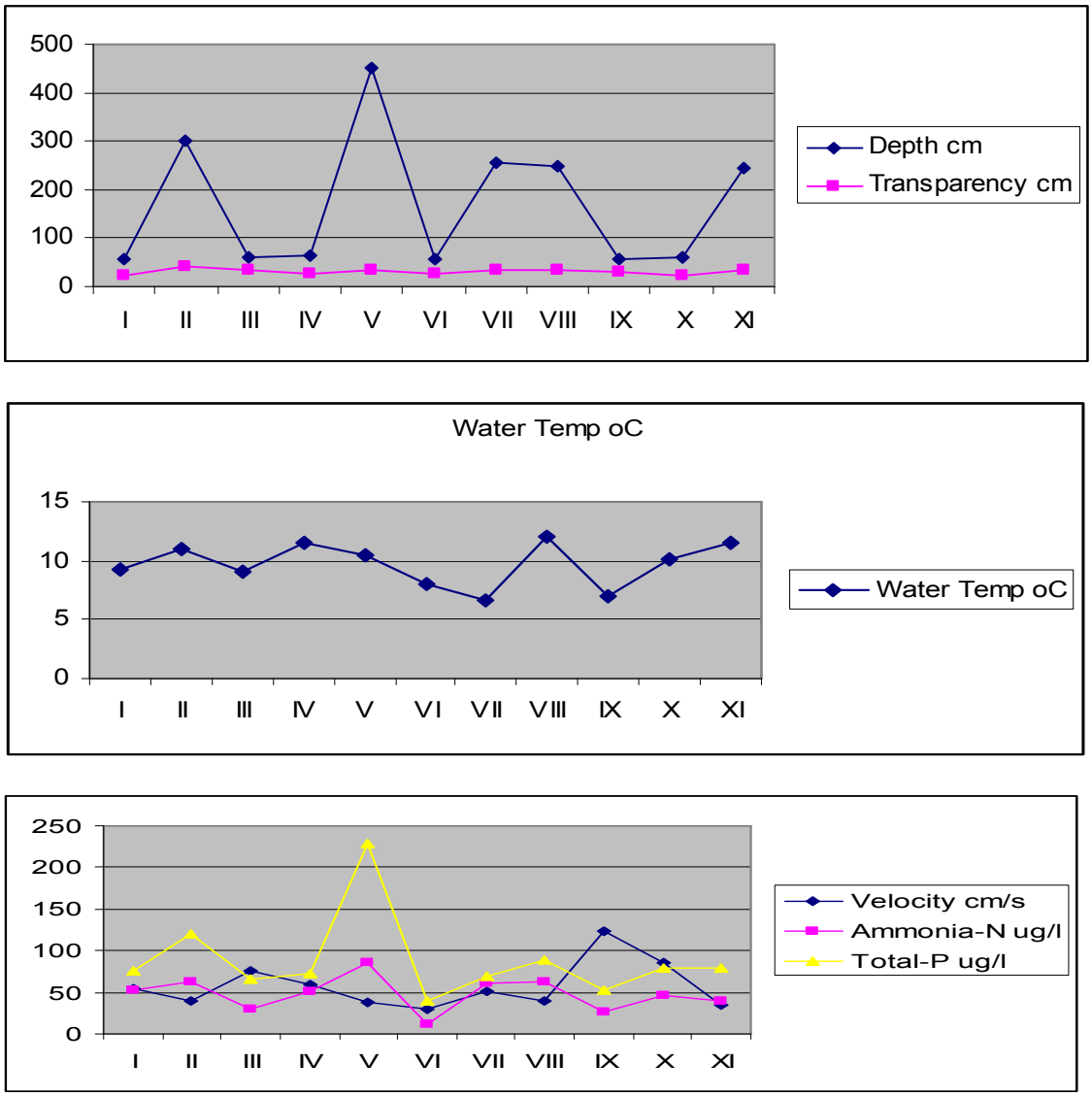


Fig 2. Changes in physico chemical parameters at various study sites (I - XI)

Table 1: Species composition of macrophytes at various study sites in the lotic habitats

	SPECIES	Sites										
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI
A.	**EMERGENTS**											
1	*Cyperus difformis*	-	-	+	-	-	-	-	-	-	-	-
2	*Eleocharis palustris*	-	-	++	-	-	+	-	-	-	-	-
3	*Lycopus europus*	-	-	+	-	-	-	-	-	-	-	-
4	*Myriophyllum verticillatum*	-	-	+	-	+	-	-	-	-	-	-
5	*Nasturtium officinale*	++	+	++	+	-	+	+	-	+	+	+
6	*Polygonum amphibium*	-	-	+	-	-	+	-	-	-	-	-
7	*Sparganium erectum*	-	-	+	-	-	-	-	-	-	-	-
8	*Sium latijugum*	+	+	++	+	+	+	-	-	+	-	
B.	**ROOTED FLOATING LEAF TYPE**											
1	*Hydrocharis dubia*	-	-	-	-	-	-	-	+	-	-	-
2	*Marsilea quadrifolia*	-	-	-	-	-	-	+	-	-	-	-
3	*Trapa natans*	-	-	-	-	-	-	-	+	-	-	-
C.	**SUBMERGEDS**											
1	*Ceratophyllum demersum*	-	-	++	-	-	-	+	++	-	-	-
2	*Myriophyllum spicatum*	+	-	-	-	+	-	-	-	-	-	-
3	*Potamogeton crispus*	++	-	++	-	+	-	-	+++	-	-	-
4	*P. pucillus*	-	-	-	-	+	-	+	++	-	-	-
5	*Potamogeton* sp.	-	-	++	-	-	-	-	-	-	-	-
6	*Hydrilla vercilliata*	-	-	-	-	+	-	-	-	+	-	-
D.	**FREE FLOATING**											
1	*Azolla* sp.	-	-	-	-	-	-	-	++	-	-	-
2	*Lemna* spp.	-	-	++	-	-	-	-	++	-	-	-
3	*Salvinia natans*	-	-	-	-	+	-	-	++	-	-	-

- = absent, + = present, ++ = dominant

Macrophytes constitute an important link in the aquatic food chains especially in lentic ecosystems. The presence of higher aquatic plants, especially the submerged, has

been advocated to be of great importance as far as fish food is concerned (Yousuf and Firdous 1997, 2001). They not only serve directly as fish food, but also serve as substrate for development of periphyton and phytophilous invertebrates (Pandit, 1984; Raspapov *et al*., 2002). Although lotic systems do not support luxuriant growth of macrophytes due to fast water current and sediment texture, the siltation and consequently decreased flow at places, however, create conducive conditions for the establishment of this plant community. During the present investigation the study sites located in the Jhelum and its tributaries varied considerably in their macrophytic composition. In all 20 species of macrophytes were recorded from the sampling sites (Table 1). These included 8 emergents, 3 rooted floating-leaf types, 3 free floating types and 6 submergeds. The maximum number of 12 taxa was recorded at site III located in the Nambal Nalla, one of the main branches of the Lidder stream, at Nambal village in Anantnag at an altitude of 1752m ASL (33^o 50.5'N and 75^o 14.2'E), with 8 emergents, 3 submergeds and one free floating type. Second place with respect to macrophyte number was taken by site VIII located in the Jhelum at Gantamulla in district Baramulla at an altitude of 1570m ASL (34^o 10.9'N and 74^o 18.2'E). Here 8 species were recorded (Table 1). Site X, located in Nambla Nalla 1km ahead of its confluence with the Jhelum at an altitude of 1310m ASL (34^o 04.5'N and 74^o 03.8'E), and site XI, located in the main Jhelum adjacent to the Dachhi Bridge below Uri town at an altitude of 1215m ASL (34^o 05.8'N and 74^o 01.4'E), recorded the presence of only one macrophyte species each. On the whole, the macrophytic association of the tributaries was more diverse than that present in the Jhelum river.

Among emergents, *Nasturtium officinale* was widely distributed in the system, being absent only at sites V and VIII. It was recorded in fair numbers at sites I and III. At the latter site *Eleocharis palustris* and *Sium latijugum* also occurred in good numbers. The rooted floating leaf types were recorded only at sites VII and VIII and even at these sites they recorded only low population. Among submergeds, *Potamogeton crispus* was recorded at four sites – I, III, V and VIII – with good population at the Gantamulla site (VIII) in the Jhelum. *Ceratophyllum demersum* and *Potamogeton pucillus* were recorded at three sites each, with higher populations of the former at site III and VIII and that of the latter at site VIII. *Myriophyllum spicatum* was restricted to sites I and V only, while *Hydrilla vercilliata* was restricted to sites V and IX.

The free floating type (*Salvinia natans*, *Azolla* sp. and *Lemna* sp.) were restricted in their distribution to sites III, V and VIII only. While all the three taxa were present at site VIII, *Lemna* sp. was dominant at site III. In general, emergents were represented at maximum sites i.e., 10 out of 11 sites, whereas submergeds were recorded at 5 sites (I,

III, V, VII and VIII). On the other hand, rooted floating leaf type and free floating species were represented at two sites (VII and VIII) and 3 sites (III, V and VIII) respectively.

Among various environmental variables that influence the occurrence and distribution of macro-vegetation in running waters, current velocity, depth, bottom substrate, transparency and the overall gradient are the important ones. The maximum diversity of macrophytes at site III (Nambal distributary of Lidder River) seems top be attributable to the sandy substratum and low depth in the area. Conversely, the low abundance and diversity of macrophytes can be related to deeper turbid waters, flowing at a high velocity and carrying high silt load, and bottom characterized by rubble stones. This type of habitat is found at sites II, IV, VI, X and XI and these sites harbour only low diversity of macrophytes. The Gantamulla section of the Jhelum river (site VII) also recorded an appreciable macrophytic diversity which is attributable to silty – clay substratum towards the river banks and also to low current velocity. Besides, the site is downstream of the Wular lake, wherefrom the propagules are transported in to the main river. The submerged vegetation is usually found in sandy or silty substrates **(**Schierup *et al*., 2002**)**. In general, there was low abundance of rooted floating-leaf type species. This seems to be related with the morphological adaptation of the species to lentic habitats, while in running waters their broad-floating leaves are unable to resist current velocity. It may be concluded that the macrophytic associations in the lotic habitats of Kashmir Himalaya are very limited in distribution and are mainly governed by the current velocity of water and the bottom feature.

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