Appendix - III

Publications


**Abstract:**

The present study was carried out in the lower Middle Western Himalayan streams in the Indian state of Himachal Pradesh of the three river basins namely the Ghaggar, the Sutlej and the Yamuna. The main aim was to study fish assemblage structure/composition, fish diversity in different habitats and habitat preference of the fishes. The different habitats like pools, riffles, runs and rapids were sampled over a 2 km stretch at all the sites with the help of cast net of 1 cm mesh size having a diameter if 1 – 2 meter on a fixed day every month between mid morning and late afternoon. All the sites when broadly delineated at the levey fall into type – B except site – II that is an F – type stream. A total of 23 species belonging to four orders were recorded of which the cyprinids were the most dominant group. According to Shannon – Weaver diversity index, the pool habitat supports greater diversity (*H'* = 0.72 – 0.97). Runs (*H'* = 0.24 – 0.87) and riffles (*H'* = 0.22 – 0.81) have diversity very near to each other at all the sites whereas rapids have significantly lower fish diversity (*H'* = 0.00 – 0.58). The pool is the preferred habitat for most of the cyprinid fishes recorded in the present study especially the minnows.

**Key words:** Western Himalayas, stream fish assemblage structure, species richness, fish diversity, fish habitat.

VII
Abstract:
Clean water is the need of the day. The water quality of rivers varies from time to time and place to place due to local factors. This paper gives an overview of major changes to stream morphology and water quality in the Western Himalayan streams. Clearing and construction on the riverbed and flood-prone area directly alter the stream morphology. Most of rivers have been unmindfully used for disposal of domestic and industrial waste; for example the river Ganges that was considered as the embodiment of purity today is amongst the most polluted rivers of the world. The Himalayas are rich in water resources and it has been observed that the habitat in the streams/rivers of Himalayas has been degraded due to several factors e.g. construction of dams, canalization, tourist activities, extensive road construction and industrialization (especially in the foothills). The consequences of human activities are a change of quality and surface water characteristics. One of the most anthropogenic effects on the river is the modification of natural flow (Praser, 1972; Ward and Stanford, 1983) and resulting degradation of habitat (Bain et al., 1988). The impact of physical changes in river basin by channelization and water withdrawal has also been studied by Pett and Calows, 1996a,b. Calows and Welcombe (eds.) (1998) has categorized human impacts into two categories: Direct Impacts and Indirect Impacts. Direct impacts are dams and barrages, land drainage, industrial and urban use, recreation and transport. Indirect impacts are agriculture, forestry, civil works, extraction industry, manufacturing industry and urbanization.
Abstract:

The Himalayas are the main watersheds in the Indo-Gangetic region having numerous river/stream, lakes and reservoirs. The western Himalayas faces a serious water crisis on account of lowest snowfall received this season (2001). This may well possibly be the endorsement of global warming. The China’s dam project due to begin in 2009 by nuclear explosions in the Himalayas will seriously disturb the ecology and also the fate of large dams like Tehri in the fragile and seismically active Himalayas. The dams whether big or small lead to the loss of endemic fish fauna, the classic example being the Gobindsagar reservoir where the catch of the exotic silver carp have risen from a mere by 2% in 1978 to almost 84.73% in the year 1997 – 98. The paper also stresses the need of fish ladders in all the dams.

Abstract:

The number of fish species in a particular kind of stream is considered to be related to a definite habitat, e.g. pool, run, riffle, rapid or cascade. Information is available on the fish communities in different kinds of hill stream habitats and there is an agriment that the fish diversity occurs in the descending order of pool, riffle, run and rapids.

For the present study, twenty-three of four river systems, namely the Beas, the Sutlej, the Yamuna and the Ghaggar (each having a stretch of...
3 – 4 km.) were sampled at monthly intervals to study the fish diversity during the period August 1998 to September 1999.

During the period of study a total of 36 species were recorded. Of these Barilius spp., Puntius spp., Crossocheilus latius diplocheilus, Garra gosyla gosyla, Tor putitora, Schizothorax richardsonii, Schistura spp., Salmo trutta fario and Salmo gairdnerii are very common. High correlation between species richness and the factors like water temperature, total alkalinity, TDS and conductivity have been observed. There is moderate correlation between species richness on the one hand and total hardness and pH, on the other. Altitude, water current and D.O. showed negative correlation with species richness, whereas the factors like turbidity and chlorides showed very poor negative correlation. On the other hand, nitrates and phosphates exhibit very poor positive correlation with species richness.

A decline in the number of fish species occurs with the increase in altitude. It has been observed that those streams, which are rich in Tor putitora, have an abundance of various species of Barilius, because these constitute the food of the fish. Exception to the above classification may occur. It is, thus considered that the level of species richness is dependant on the abiotic factors like temperature, total alkalinity, TDS, conductivity, total hardness, pH, altitude and water current. However, the importance of habitat type, pollution level and human activities cannot be ruled out.

Abstract:

Glyptothorax garhwali is an extremely specialized fish inhabiting the fast flowing hillstreams of western Himalayas. The most important characteristics in response to the harsh water current coupled with a variety of substrate is the integumentary modification in the form of an adhesive disc which have become a life saving kit for this fish. Very few attempts have been made by workers to describe these modifications. Light microscopic investigations were done on Glyptothorax telchitta, Pseudochensis sulcatus and Glyptothorax pectinopterus. In the present case, lateral folds of skin just above the adhesive disc and a portion of the adhesive disc were subjected to SEM investigation. Numerous mucous pores with mucous glands which were placed quite randomly were observed in the lateral folds of the skin. The primary purpose of these being the secretion of mucous. The mucous pores have a highly porous mucous gland. These spread their secretion over the whole surface with the help of a complex system of canaliculi.

The adhesive disc under SEM shows numerous long hook shaped spiny structures (LHS). These are all epidermal growths. These aggregations of LHS’s are present all around the central pit, interspersed with mucous pores. These spiny structures get entangled themselves with the rough surface of the small boulders/stones. The hooked spiny structures along with mucous glands present the most advanced case of morphological adaptations. What seems to be the case here is that mucous is secreted on receiving the necessary stimuli from surroundings, providing a sort of platform in the form of a feeble adhesion for a secondary adhesion of spines with the rough surface of the substratum. There may quite well be possibility that these two (Mucous glands and LHS’s) may be complementing each other simultaneously.
Abstract:
The streams have been classified into A, B, C, and F types based on channel slope (gradient), shape, pattern, and bed material. The habitat structure varies from predominating riffle-pool morphology in the lower reaches to the dominating rapids in the upper reaches where water current and the water volume are tremendous. However, the narrow channels with high gradient and less of water volume have typical step-pool morphology. The lower reaches have further two types of channels: entrenched and those with large flood prone area. The dominance of a particular kind of habitat i.e. pools, rapids, runs, riffles and cascades determines the type and diversity of fish species.

Abstract:
Himachal Pradesh is a land of perennial rivers/streams, which receive their water from one or the other source. In the lower ranges the streams are moderately entrenched with a moderate gradient. On the basis of these characters these can be classified as of ‘B’ type. In this communication efforts have been to discuss the behavior of these streams.


Abstract:
The Himalayas have been declared as ‘hot spot’ based on the fish endemism. Though various aquatic bodies located in the Himalayas support extensive fish fauna, yet there is no information available on the fish life in the hillstreams, which provide breeding grounds or nurseries for most of the fish species, which constitute fishery of the large waterbodies. So far, the studies on the ecology of hillstreams especially in relation to fish communities have not been taken up. The present paper describes the morphology of 25 streams (28 sites) of the rivers Beas, Satluj, Yamuna and Ghaggar in Himachal Pradesh and the occurrence of fish communities in...
them. The stream type has largely been based upon Rosgen (1996) and Armantrout (1998). A, B, C and F type streams have been encountered. Gradient, bed features, current velocity and landscape have been taken into consideration. Streams, which are 'A' type in the higher altitude, support very little fish life. The 'B' type, commonly seen in the valley, supports a variety of fish. 'C' type streams under report have marginal fish communities because of shallow water and sandy basin. 'F' type streams are transitional and exhibit maximum fish diversity. It has been inferred that altitude and bed material have profound impact on the fish biodiversity. The other factors e.g. conductivity, alkalinity, water temperature, total dissolved solids (TDS), hardness, water current, depth and width have great influence on the fish communities in the streams besides several other geomorphological factors. It has been concluded that pH has no direct bearing on the fish community in the streams under report.