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Bio-accumulation and risk assessment in fresh water fishes from rivers Jhelum in Kashmir province

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Abstract
Various researches were performed on the fishes along the course of river Jhelum, Kashmir, India. The study shows that the concentration of heavy metals varied significantly among fish species, seasons, sites and organs. The concentration of pH, NO_3-N, Total Dissolved Solids, BOD and COD recorded increasing values towards the downstream sections of the river whereas DO, Ca and alkalinity recorded decreasing values towards the downstream areas of the river. This change in water quality results in un-even distribution and diversity of fishes. Apparently, the fishery resource of the River Jhelum has thus declined over a period of time indicating some stress or abnormal external influences which are altering the health of this vital economic-ecologic lotic water body.

Keywords: fishes, river Jhelum, BOD and COD

Introduction
River Jhelum is the west flowing river which originates from a magnificent spring called "Chashma Verinag". The river also known as 'Vyeth' in Kashmiri, 'Vetesta' in Sanskrit and 'Hydaspes' in Greek, is the main waterway of the Kashmir valley [1].
The valley of Kashmir is famous throughout the world for its fresh waters, and has tremendous potential for the development of fisheries especially in the cold water sector. Fish forms an important item in the food of the Kashmiris, and those who dwell near the lakes; and the floating population of boatmen depend for a considerable part of their sustenance on the prey of their nets or lines [5].
But with the enormous amounts of sewage, faecal matter, run off from the agricultural fields, effluents from the small scale industries, encroachment etc. the quality of river water is deteriorating day-by-day which results in un-even physicochemical parameters in different regions.
The present study shows the outcomes of various examination of the water quality and fishes of River Jhelum.

Methods
Central Water Commission is set up for monitoring water quality in India. They monitor the water Quality by maintaining a three tier laboratory system for analyzing various parameters at 390 key locations covering all the major river basins of India. Sampling was mostly done in morning hour. Fish samples were then preserved in a solution of formalin. Fishes less than 10 cm were immersed in a formalin solution without any incision, while fishes 10 - 30 cm in length were given a narrow cut one side of mid ventral line ventrally through abdominal wall. Fishes longer than 30 cm were injected with undiluted concentrated formalin in several places and the belly was incised at two or three places. Then the samples from each station were packed separately with appropriate labels indicating the date, time and locality. Finally the specimens were taxonomically identified on the basis of morphometric characters using the standard taxonomic keys.

Result & Discussion
Fish species abundance and distribution appear to be determined by water quality and food availability factors [4].
Bioaccumulation is the accumulation of substances, such as pesticides, or other chemicals in an organism. Bioaccumulation occurs when an organism absorbs a substance at a rate faster than that at which the substance is lost by catabolism and excretion.
Heavy metals have long been known as one of the most vital pollutants in the river waters because of being toxic, mutagenic and carcinogenic to biotic system. Nearly all heavy metals are toxic in higher concentrations but Pb is usually considered to be the most dangerous toxicant [6]. Aquatic organisms have the capability to accumulate heavy metals from numerous sources comprising water, sediments, and air depositions of dust, aerosol and discharges of waste water [7, 8]. Once entered into the aquatic ecosystem, most of the heavy metals persist in sediments, from where get slowly released into the overlying water and ultimately reach the body of aquatic organisms [9]. Heavy metals can participate in various biochemical processes, have significant mobility, can affect the ecosystem through bioaccumulation and bio-magnification processes and are potentially toxic for human life [10]. Aggravated concentrations of these heavy metals like arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb) etc could be hazardous to riverine ecosystem wherein they can pose toxicity to fish and imbalance water chemistry as well. Heavy metals can interact with other elements and can cause severe toxicity at tissue level. Some trace elements like zinc (Zn), manganese (Mn) etc have been reported to be biologically important for human beings. However, some other heavy metals like Pb and Cr have no known significance in human

physiology and biochemistry and intake of these heavy metals even at very low concentrations can be toxic. Even for those that are biologically important, dietary intake needto be within regulatory limits as excess may result in harming or toxicity [11, 12]. The tissues selected for examination were muscle, liver, and gill. Liver is the major storing chamber and bio-transforming organ for heavy metals and gills are the main route of exposure to trace elements from water to fish.

Studies from the field and laboratory experiments revealed that bioaccumulation of heavy metals in a tissue is mainly dependent on water concentrations of heavy metals and exposure period; although some other environmental factors such as salinity, pH, hardness and temperature play significant roles in heavy metal accumulation [13, 14]. Environmental needs, size and age of fishes, their life history and life cycle, feeding habits and the season of capture were found to affect experimental results significantly from the tissues. Low levels of contamination may have no apparent impact on the fish, which might not show signs of illness, but may lead to decrease in fecundity of fish populations [3].

The fishing effort is a measure of the amount of fishing and the recent study shows that fish population is reducing rapidly over past few decades because of various threats on riverine ecosystems as on whole, the mean fishing is calculated as something around 130.26 – 290.46 g/man-hour.

According to Dudgeon [15] the major threat to riverine ecosystems of India is the intense human interventions resulting in habitat loss and degradation and as a consequence many fresh water fish species have become endangered.

Variation in bioaccumulation may be due to differences in heavy metals concentrations and physicochemical properties of water from which fishes were sampled, ecological requirements, metabolic rate and feeding habits of fish and also the season in which investigation was carried out.

Pb is non-essential element and higher concentrations can occur in aquatic organisms close to anthropogenic sources. It is toxic even at low concentrations and has no known function in biochemical processes [5].

The increase of Pb level is due to the discharge of industrial, agricultural and sewage wastes in the investigated area. The significant level of Pb may be attributed to sufficient Pb concentration in water and sediment of the river. Fe is an abundant and important element, unparalleled by any other heavy metals in the earth's crust. The increase in Fe accumulation in fish liver in this study may be related to the increase of total dissolved Fe in Jhelum water and consequently increase the free metal Fe concentration and thereby lead to an increase in Fe uptake by different organs. Yacoub (2007) [16] observed accumulation of Fe ligand protein (Hemosiderin) scattered in liver section of fish exposed to very high Fe concentration [16].

The test fish species tend to bio-accumulate some heavy metals in their gills. Gills are the main route of heavy metal exchange from water as they possess a very large surface area which facilitates rapid diffusion of heavy metals. Therefore, it can be suggested that heavy metals accumulated in gills are mainly transported from water [5].

As expected, muscle tissue was found to accumulate lowest concentrations of all heavy metals. In most of the studied fish samples, liver was found as the main target organ for heavy metal accumulation. Inter and intra specific variation of heavy metals was interpreted for the contribution of potential factors that were found to affect heavy metals uptake, size and weight, geographical distribution and species-specific factors. Generally recorded heavy metal concentrations were found well below the permissible limit of FAO/WHO, 1982. The concentration of heavy metals in fish muscle tissue was found significant but safe for human consumption.

Conclusion

The Concentration of heavy metals results in the reduction of fish diversity in river Jhelum. Due to various factors like overexploitation, industrial wastes, etc. the river system is not getting the sufficient time to recover. In order to manage the river water and fish diversity immediate steps need to be undertaken like there must be controlled and managed entry of sewage, agricultural wastes and solid wastes.

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