CHAPTER – 1

INTRODUCTION

Water, the most precious natural resource is essential to the livelihood of both aquatic and terrestrial animals. More than two third of the earth's surface is covered with water. Most of it is the ocean, while the total freshwater in lakes and rivers make up less than one percent (Hutchinson, 1967). The State of Jammu and Kashmir is famous for its natural freshwater lakes and rivers which due to their rich ichthyofauna invited the attention of J. Heckel in 1838, who later on described sixteen species of fish from the collection of Von Hugel which were new to science. The icthyological study of Heckel proved to be the milestone for new workers and researchers. The valley of Kashmir abounds in numerous water bodies, both lentic and lotic. The lentic habitats are represented by tarns, lakes, ponds, wetlands and roadside ditches and similar other aquatic systems. The lotic habitats on the other hand consist of river Jhelum and numerous cold water hill streams which directly or indirectly join the river Jhelum.

1.1. Dal Lake

The Dal Lake is one of the beautiful lakes in the world situated at about 10 km in the north east of Srinagar city with a mean latitude of $34^{0}7'$ north and longitude of $74^{0}52'$. It is surrounded on the east by Mahadev mountain range and the south by the Kohisulaiman. On the northern and

western banks (Map I) lies the Srinagar City. A total water spread of the lake at the turn of 20th century was 25 km^2 but due to encroachment and siltation, the lake has been reduced to 12.4 km^2. It is a shallow lake with a depth of 1.5-2.0 meters, but at certain places like Sonalank and Rupa Lank the depth exceeds 3.5 meters. The depth of the lake varies seasonally due to amount of rainfall and stream flow. On its north the lake receives water from Dagwan nallah, which joins it at Tailbal that brings water from Mansar Lake and from the agricultural fields. On the southwestern side the lake discharges water into the river Jhelum through a channel called Tsutikol which leaves from Gagribal basin at Dalgate.

1.2. River Jhelum

Jhelum- the Hydaspes of the ancient Greeks and Romans, the vetesta of the Hindus and 'Veth' in Kashmir arises from a beautiful spring called Verinag (Map-II). The river Jhelum orginates from Pir Panjal about one kilometer ahead of Verinag. The Jhelum river is navigable from Khanabal to Baramulla, a distance of about 170 Kms. It flows in loops through the valley till it enters the Wular. Emerging from the Wular it takes a southwestern direction which it pursues up to Baramulla. It finally passes into Pakistan through the Baramulla- Uri gorge. On the right bank above Khanabal, the river Jhelum is joined by the Sandran, Bringi, Arapatkol, Lidder, Arapal, Harwan, Sindh, Erin, Madhumati, Pohru and Viji- Dakil. The other important tributaries of the river include: Vishav, Ramsiora, Sarsara, Romushi, Doodganga, Sukhnag, Ferozepur Nirgal, Uroosa, Nambla (Haji-pir nallah), Rambiara, Pohru and Boniyaar etc.

The oldest economic activity lined with the river Jhelum and Dal Lake is fishing and as the home of all indigenous fish fauna, the Jhelum and Dal Lake are of great economic importance. After Heckel (1838, 1844) who listed

16 species of fishes in Kashmir Valley and surrounding areas, Silas (1960), Das and Subla (1963, 1964), Saxena and Koul (1966), and Nath (1986) summarized most of the collection and provided new checklists which contain increasing number of species. Both the water bodies serves as an important source of indigenous (*Schizothorax* spp.) as well as exotic fishes (*Cyprinus carpio* spp.). The fish catch for previous some years from Dal lake and river Jhelum is shown in Table 1.1 (Department of Fisheries, Kashmir).

Table I: Fish catch in kgs for the year 2004-05; 2005-06.

Water body	Fish	Year	No. of Fishermen	Total fish captured
Dal lake	*Schizothorax niger*	2004-05	783	4071qtls
		2005-06	786	
	Cyprinus carpio spp.	2004-05	783	45265 qtls
		2005-06	786	
River Jhelum	*Schizothorax niger*	2004-05	303	3169 qtls
		2005-06	317	
	Cyprinus carpio spp.	2004-05	303	3010 qtls
		2005-06	317	

Source: Mr.G. Q. Chilloo, Assistant Director (Planning)
Department of Fisheries.Kashmir

1.3. Economic importance

Freshwater fish form one of the important food sources in both the developed as well as under-developed countries. Fish remain the major source of protein, whereas processed fishmeal plays a prominent though indirect role as an important component in the production of meat in human nutrition (Braunbeck *et al.,* 1993). The recreational value of angling is also important in most developed countries (Lloyd, 1992). The natives of Kashmir valley divide all types of fishes broadly into two categories of local (Kashmiri) and non-local (Punjabi) fish, zoologically known as endemic and exotic fish spp. Important ichthyofauna of two water bodies under study comprises of the family Cyprinidae.

Family Cyprinidae

Fish Species	Local Name
Shizothorax niger (Heckel)	Ale-gaad
Cyprinus carpio communis (Linn.)	Scale carp
Cyprinus carpio specularis (Linn.)	Mirror carp

Concern

As a cultural symbol of Kashmir, river Jhelum is as healthy as ever, but as a river it is fast losing its significance. Its water is today repugnant. The source of pollution in the river is sewage and effluents. The problem assumes greater dimension due to dense human settlement along the banks dispensing and dumping the whole municipal garbage into the river. The Jhelum flows besides the capital city of Srinagar through three major cities, Anantnag, Sopore and Baramulla. It is through these stretches that the river receives maximum of its pollutants.

1.4. Threat to the aquatic life - Pollutants

The fish population, especially the local fish *Schizothorax* has been experiencing a continuous and considerable reduction both in Dal lake and river Jhelum over the last decade (Department of Fisheries, Kashmir, Report 2004-2005). The species being sensitive can not withstand unclear waters. Since the water quality in the river and lake has deteriorated over the years, the *Schizothorax* finds it difficult to thrive in water with depleted oxygen levels (Hussain, 2003).

A fish's condition reflects its ability in finding and storing energy under prevailing environmental condition. Condition not only reflect the health, growth and reproductive state of a fish, but also reflects environmental characteristics such as habitat quality and prey availability (Busacker *et al.*, 1990). Condition indices have been widely used as indicators of relative health (Brown and Murphy, 1991; Childress, 1991), since these provide relatively simple and rapid indicators of how well the fish cope with their environment (Goede and Barton, 1990).

Aquatic organisms are often exposed to high levels of pollutants through bioconcentration and/or bioaccumulation. Currently, it is difficult to find any source of water that does not carry fingerprints of human activity (United Nations Environment Programme, 2004). Acid precipitation causing leaching of metals from surrounding soils (Norton, 1982) and increasing numbers of synthetic organic compounds and metabolized pharmaceuticals finding their way into surface waters in unlikely places (Huang and Xia, 2001), and makes their identification by untargeted chemical analysis prohibitively expensive. As a result, fish have become an indispensable model system for the evaluation and/or measurement of the extent of aquatic pollution.

Public concern regarding pesticides, fertilizers, agricultural products and metals in recent years have escalated, particularly following major fish kills (Heath and Claassen, 1999).

Modern agricultural practices significantly contribute towards polluting the aquatic habitat. The rapidly increasing use of pesticides, chemicals and fertilizers poses a serious threat to the fisheries, especially to the *Schizothorax* species. Increasing agro-chemical pollution of the Dal lake and River Jhelum has become a matter of great concern. Pesticides are used in agricultural fields and enter the river through land drainage or with surface run-off during floods and excessive rains. These include herbicides, rodenticides, fungicides, wormicides, insecticides, etc (like chlorinated hydrocarbons, organophosphates, carbamates and phenols etc). These are lethal to fish if they exceed the tolerable limits.

Siltation in the river Jhelum is another threat to fish life. The run-off from agricultural fields, denuded forests and spent mine areas results in siltation of the riverbed. At various sites the River Jhelum is gradually becoming narrower. Siltation of the river, besides diminishing the flow of water, results in destruction of breeding grounds of fishes and the benthic fauna, migration of fishes and decline in overall productivity of the river. Siltation has affected the *Schizothorax* species in the Dal lake near Telbal area where the shoals of fish used to migrate. Metals enter the aquatic food chain through direct consumption of water or biota and through non-dietary routes such as uptake through gills in the case of fish.

On the other hand trace metals are introduced into the environment by a wide spectrum of natural and anthropogenic sources. There has been a general global increase in industrial activity over the past few decades,

resulting in significant application of metals in various processes, in turn causing a great escalation of metals in the environment. Industrial activities as well as agriculture and mining make up potential source of heavy metal pollution in aquatic environment (Gumgum *et al.*, 1994; Unlu *et al.*, 1996; Leland *et al.*, 1978; Corbett, 1977; Mance, 1987; Langston, 1990; Kouadio and Trefry, 1987; Ajmal *et al.*, 1987). Contamination of a river with heavy metals may have devastating effects on the ecological balance of the aquatic environment and the diversity of aquatic organisms becomes limited with the extent of contamination (Suziki *et al.*, 1988). It is well known that heavy metals accumulate in tissues of aquatic animals and their measurement in tissues of aquatic animals can reflect past exposures (Canli and Atli, 2003; Kalay *et al.*, 1999; Yilmaz, 2003, 2005). Sub lethal effects of heavy metals are of concern as they accumulate and are transferred through food chain to humans. The impact of pollutants on aquatic ecosystems is either acute (due to exposure to immediate lethal dose) or insidious/chronic (due to gradual accumulation of lethal concentrations in body tissues) (Heath and Claassen, 1999). Metals like lead and cadmium may present a health risk even at extremely low concentration, since they may influence enzymatic activity in living systems (Brock and Madigan, 1991). A disease known as plumbism has been known to be caused by acute lead poisoning (Stofen, 1974). Cadmium has also been regarded toxic at very low concentrations (Bryan, 1971) and with hazardous effects on humans (Hagino and Yoshioka, 1961). Biomonitoring of trace metal pollutants has been gaining attention since different organisms can accumulate these substances and transfer them in large concentration to animals or human beings, when consumed (Fadrus *et al.*, 1979).

Due to scanty information regarding the metal toxicity in water bodies of Kashmir valley and their effects on the aquatic fauna, the present study was designed with the following objectives:

1) To study the toxicity of some metals *viz.* copper, zinc, iron, and manganese in Dal lake and River Jhelum.

2) To study the concentration of these metals through Atomic absorption spectrophotometer in various organs/tissues viz. gills, liver, kidneys, and muscles of *Schizothorax niger* and *Cyprinus carpio* spp.

3) To study the subsequent effects of metals on biochemical parameters *viz.* total protein, albumin, globulin, blood glucose, urea, serum creatinine and cholesterol in both the fishes.

4) To study the subsequent effects of these metals, on the histomorphology of gills, liver, kidney and muscles of both the fishes.