PREFACE

Fishes are a major component of most aquatic habitats and water pollution affects all aquatic organisms including fish. As important source of protein rich food for humans, sport and commercial fisheries are considered more significant. Now-a-days fisheries of non-fish organisms, for example crustacean (prawn) and molluscan fisheries, and aquaculture of frog and other organisms are also assuming importance to meet the demand of fishery products. As a prominent component of aquatic ecosystems, on the one hand, fish and fisheries have an impact on the physico-chemical characteristics of the system, plankton, periphyton, macroinvertebrates, macrophytes, and other aquatic organisms. On the other hand, natural or man made changes in pH, temperature, turbidity, flow regime, dissolved oxygen, pollution loads of water bodies also affect changes in fish populations and fisheries components. Because fish are conspicuous, they often are the primary indicators of pollution of lakes and rivers. In extreme cases of water pollution, the presence of moribund or dead fish may adversely affect the use of waters, create foul odours, and several other problems.
Of all the factors that influence the existence of fisheries in stream and rivers, pollution is the most important. Besides pollution from industrial, agricultural, and municipal wastes, several other factors such as water abstraction, construction of dams and barrages, siltation, soil erosion in the catchment areas have had devastating effects on the fish stocks of inland water bodies Jhingran, (1991). Pollution has also affected the estuarine and marine fisheries, since man has used oceans “as a dumping ground to waste material” Qasim, (1990). Some pollutants have no direct effects on individual organisms, but still have considerable ecological consequences Moriarty, (1983).

During the last few decades parallel with rapidly developing technology, increasing population and urbanization have been adversely affecting the environment. Growing urbanization has affected the atmosphere, hydrosphere and lithosphere in various ways (oil products, chemical wastes, domestic sewage, sanitation, power consumption etc.). Urbanization has resulted in the emergence of industrial centers without a corresponding growth in civic amenities and pollution control mechanisms. Realization of importance of water to human well being led to the studies on water pollution which during the
early phase of study programs were motivated primarily in public health consideration. The physical, chemical, microbiological and biological changes that occur in unpolluted water bodies and those polluted by domestic wastes are adequately, if not completely understood. Many industrial wastes proved to be complicated mixtures of metals, organic substances, greases and oil derived from lubricants used for plant machinery. Polluted water and inadequate sanitation are generally the leading factors of diseases and death of living organisms and these are directly attributed to the lack of proper management.

Toxic metals are often described as the heavy metals, and these includes iron, lead, mercury, cadmium, zinc, copper, nickel and arsenic. Very small quantities or traces of some metals are required for normal growth and metabolism, for example, copper, iron, nickel and zinc. However, if the threshold limit value (TLV) is exceeded, these metals may cause variable deleterious effect on plants and animals. The TLV is used as a pollution monitoring standard, and WHO values for toxic metals, some other chemical substances and other parameters.

Effects of water pollution on the different components of the biosphere are too many as are the sources of water pollution.
According to Dix (1981), the general effects of water pollution may be considered under the following six headings, such as Turbidity, Heat, Oxidization effect, Toxic chemical, Metallic pollution and pesticidal pollution. However, many factors including the quantity and composition of the effluent, the value of water, and weather conditions govern the overall effects of pollution.

It has been known for several decades that trace quantities of certain elements exert a positive or negative influence on plant, animals and human life. However, more recently greater interest has been taken with regard to the specific role of these elements.

The fact that the metal ions have a biological significance is contradictory to the classical concept that inorganic chemistry is restricted to nonliving chemical systems, whereas the living world falls within the realm of organic-and-biochemistry. Modern research has led to a broader understanding of the inextricability of overlapping concepts in the field of applied chemistry, such as occur in nature, and stresses the need to diverge from artificial compartmentation. It has been borne out by experimental evidence that the role of heavy metal ions of living
systems follows the pattern of natural availability and abundance of the same metals occurring in nature.

At metal concentrations that are within ranges common to natural waters, fishes are generally effective bio-accumulators of metals. The principal generation that can be drawn from this research is that bioaccumulation and toxicity are extremely situation dependent; hence, it is difficult to extrapolate results from any particular study to other situations when the biological species or environmental conditions are different. Even within one species, individual characteristics such as size, life stage, sex, and genotype can have significant effects on response to contaminant. The bioavailability of the metal is highly variable. Bioaccumulation of metals in biota is function of both uptake and depuration. However, such a comparisons should be interpreted with caution because metals tend to be non-uniformly distributed among different organs in fish. Bioaccumulation and acute and chronic toxicity are dependent on metal speciation. Mainly because of this influence of metal speciation toxic and bioaccumulation do not have a consistent relation to each other. The toxicity of individual metal in a relation to different fresh water fishes has been studied before but the mixture of heavy metals in binary or
tertiary combination have not been fully evaluated. Hence, this heavy metals and metal combinations was chosen for study on the toxicity and physiology of the freshwater fish *Rasbora daniconius* inhabiting Van river 10 Km. away from Parli-Vaijnath.

The study of effects of pollutants like heavy metals is important. Environmental parameters play a very important role in controlling physiological activities of the aquatic animals especially fish. Moreover, changes in the environment due to increasing urbanization include the obsolescence of the infrastructure, the pollution of city atmosphere, the lack of good quality drinking water and water pollution due to municipal waste and industrial effluent, which result in health hazards.

The first chapter comprises review of the literature for last 10-15 years. Such a review is warranted in order to understand the status of state of the art of research on toxicity of heavy metals to the freshwater fishes. The comprehensive review of literature has pinpointed the lacunae to be investigated.

The second chapter documents effects of heavy metal exposure on the acute toxicity to the freshwater fish *R.daniconius*. The toxicity of three metals lead, zinc and nickel singly and in combinations has been planned to be determined. The impact of
pollutant on physiology of fish is an important aspect of toxicity studies.

The third chapter has been charted out to study the impact of heavy metal exposure on the rate of oxygen consumption of *R. daniconius*.

Fishes have extremely good nutritive value; therefore, chapter fourth deals with biochemical composition of freshwater fish *R. daniconius* in terms of glycogen protein, and lipid.

The chapter fifth lists the bibliography of the reference reported throughout the thesis. It is hoped that the present work would strengthen the concept of use of freshwater fishes as bioindicators of heavy metal pollution of aquatic bodies.