INTRODUCTION

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Vital natural resource which forms the basis of all kinds of life is water. Water is also key resource in all economic activities right from agriculture to industries. Water is revered as mother of life as it forms a medium in which physical and chemical transformation especially, those of biological significance, takes place. For both, natural ecosystem and human development, water resources have critical importance. It is a vital factor of life and is considered as a precious compound on the earth. It is essentially required for maintaining a healthy state by every group of creatures. A large number of plants and animals of different groups flourish under aquatic environment.

Out of all available water resource, 97 % of water is present in oceans, 2 % is in polar ice caps and fresh water lakes constituent 1 % of water. Total earths surface comprises approximately 510million sq km. About ¾th of the earth's surface (71 %) is covered with hydrosphere, the main component of which is water. In addition, up to 2.5 million sq km or ½ % of the earths surface is occupied by inland water bodies (Nikolsky, 1999).

Water has vital importance since times immemorial to man, Environment and man are linked, interacts with each other. From earliest times communities have been established along river banks, as the river provided a water supply and also a convenient means for the disposal of waste products. Uncontrolled growth of world population and serious hazards of environmental pollution are the two inseparable problems confronted by mankind. These major problems cause alteration in our environment which leads to pollution. Pollution is mainly caused due to deforestation, civilization, urbanization, population explosion, and the result of our technological society with high living standards. The water is used for domestic purpose, washing, agriculture and for industries. The water is polluted when it changes its quality or composition, directly or indirectly by human activities, it becomes less suitable for drinking, domestic use, agriculture purpose, fisheries and for other purposes for which it would otherwise be suitable in its natural state (Odum, 1971).

One of the important natural resources is water, it has many conflicting demands. The skilful management of water bodies is required if it is to be used for diverse purpose as domestic and industrial supply, fisheries, transport, irrigation, recreation, sport, commercial power generation and for waste disposal. Water pollution is generally associates with the discharge of effluents from drains, sewage treatment plants, and factories to the different water bodies such as of lakes, rivers, and seas. Elevated level of toxic metals can make the water unfit to drink, accelerate the corrosion of equipments coming in contact with water, and harm fish and other aquatic life. Various types of metals such as lead, nickel, cadmium, zinc, copper, cobalt, mercury, etc are arising from the industrial wastes and agricultural run-off.

Now a day's it is assumed that to survive mankind as today's way of life it is necessary to increase our knowledge about the environment and acquire concomitant behaviour patterns to safeguard the proper functioning of the ecosystem. First of all the analysis of aquatic network is the measure of the healthiness of the surrounding area. Water pollution becomes most evident when it involves poisoning of drinking water or causes the death of a large number of fish or other aquatic organisms, which could be caused by sewage and industrial effluent. Disposal of sewage wastes and industrial effluents into a large volume of water could reduce the biological oxygen demand to such a great level that the entire oxygen may be removed. This would cause the death of all fish species (Water facts, 1997).

Some of the toxic chemicals such as Pb, Cu, Zn, Hg and CN are released into the rivers and seas which will cause the death of fish and algae at very low concentrations. These are related to occupational hazards and constitute elements of environmental pollution especially with respect to pollution by heavy metals. Such incidents had been reported in the past. For example, the Minamata and Nirgeta epidemics in Japan in 1950s and 1960s, respectively. The Minamata epidemic was a case of mercury poisoning caused by consumption of fish from the Minamata Bay of Japan which was heavily contaminated by mercury compounds discharged by a nearby plastic industry. The outbreak of cadmium poisoning occurred in Japan in the form of itai itai or "Ouch ouch" disease. Suffers bones from this disease, became fragile. At higher level cadmium causes anemia, kidney problem and bone marrow disorders. In Japan at Minamata Bay more then100 people died and many thousands were permanently paralyzed because of eating mercury contaminated fish. Genetic defects were seen in nearly 50 babies whose mothers had consumed the contaminated fish from Bay. The sea fish in the Bay were found to be containing 27 - 100 ppm of Hg in the form of methyl mercury. The sources of mercury were effluents discharged into Bay from Vinyl Chloride Plant, Minamata chemical company (Kulo and Miyahara, 1991).

The quality of water deteriorates mainly because of human activities. Such activities possibly lead to water pollution, such as urbanization, industries, mining, agriculture, power stations and transport (Van Vuren, *et. al.,* 1999). Various chemicals including pesticides and metals are released into the environment which are transported and redistributed among the different compartments in the environment (Heath and Claassen, 1999).

Most important problems being faced by developed and developing countries is water pollution. Water pollution restricts the availability of water for diverse human use such as for drinking, cleaning, recreation, cooking, aquaculture and industry. 70 % of India's water resources are declared as to be polluted (Agarwal, *et. al.,* 1982). Many industrial, urbanization programs are likely to have qualitative and quantitative effects on surface and ground water due to increasing demands of water for domestic use, irrigation and industry. This has considerable impact on aquatic fauna, flora and aquatic ecosystem. Diverse and complex industrial wastes released in aquatic bodies impair the quality of environment and pose a threat to human health. The liquid wastes may permeate into the ground or find their way into surface water causing severe water pollution problem. In industrial wastes the toxic substances are present which can affect aquatic life and disturb whole ecosystem. Pesticides, heavy metals, are bioaccumulating substances, can adversely affect the biota and abiota (Anjaneyulu, Y., 2002).

Different kinds of pollutants are discharged into the environment every day. Of these; heavy metals are one of the most serious pollutants of aquatic environment. They show their environmental persistence and tendency to concentrate in aquatic organisms (Harte, *et al.,* 1991; Schuurmann and Markert, 1998). In the aquatic environment heavy metals are natural trace components but their levels have increased because of agricultural, industrial, and mining activities. So the aquatic animals are exposed to elevated levels of heavy metals continuously (Kalay and Canlı, 2000; Unlu and Gumgum, 1993).

Due to industrial and domestic discharge, a variety of chemicals have been monitored in aquatic environment. These chemicals have been known to be teratogenic, mutagenic, neurotoxic and biocidal to various types of organisms including man (McKee and Wolf, 1971). In the industrial pollutants toxicants occupy prime importance as they release heavy metals into marine environment. Many physical properties of metals are common but their chemical reactivity is quite different. Their toxic effects on biological systems are even more diverse. The metal which injures the growth and metabolism of cells, when present in higher concentration is regarded as toxic metal. Some are severe poisons even at low concentration. When the optimum range for a metal is narrow, the risk of toxicity increases. So the minor environmental injury can be serious. The toxic range of metals depends on several circumstances. Soil may itself contain large quantities of metals. The contamination may occur either from the presence of metals near the soil surface or from mining ores.

The alarm of metal pollution in sea, started with tragedy of Minamata and Nirgeta in Japan (Preston, *et. al.,* 1972; Thurberg, *et. al.,* 1977; Saxena, *et. al.,* 1982; Ayyadurai, *et. al.,* 1983; Dhanekar, *et. al.,* 1985; Dean, *et. al.,* 1986; Szefer, *et. al.,* 1985; Denton, *et. al.,* 1986; Mahyaoui, *et. al.,* 1987; Krishnaraja, *et. al.,* 1987; Kulkarni, *et. al.,* 1985; Regoli, *et. al.,* 1992).

Geochemical alteration with industrialization caused a major threat to environmental pollution. The persistent non degradable trace metals are the most pressing problems of the present day. They are the most insidious pollutants because of their property to affect all forms of ecological systems and non-degradable nature. There are many industries such as pharmaceuticals, fertilizers, sugar, distillery, paper, tannery, pesticide, antibiotics, textiles, petrochemicals, etc in India. A wide variety of inorganic and organic pollutants are present in the effluents of common industries such as sugar mills, distilleries, paper and pulp industries, textiles, tanneries, breweries, steel industries, mining operations etc. Such industries cause pollution of terrestrial and aquatic ecosystems due to untreated effluents. The kinds of effluents generated by the industries are also numerous. The industrial effluents contain most of the pollutants including oils, grease, plastics, metallic wastes, such as arsenic, copper, mercury, lead, zinc, cadmium, chromium etc. Industrial waste causes high concentration of BOD, COD, and low or high pH. The wide variety of organic substances and minerals including cyanides, arsenic, mercury, cadmium, carcinogens, toxic heavy metals, oil and grease cause gross pollution of Indian rivers and other sources.

Now a day's, the anthropogenic contribution of heavy metals into the environment far exceeded than natural inputs (Nriagu and Pacyna, 1988). The impact of pollution by heavy metals to the coastal and estuaries could be substantial because of the variety of inputs to these areas. Potential land-based sources of heavy metals include local runoff, river inputs and atmospheric deposition (Galloway, 1979). The estuarine environment is the last area for the removal of trace metals in their passage from the terrestrial to the marine environment. Bottom sediments are long-term integrators of geochemical processes; hence information from sediments can establish the long term behaviour of trace metals in estuaries (Scott, *et. al.,* 1988).

The heavy metals cause serious impairment in physiological, metabolic and structural systems when exposed to high concentrations (Tort, *et. al.,* 1987).They may affect organisms directly by accumulating in their body or indirectly by transferring to the next trophic level of the food chain. The most adverse impact is of their persistence as biological amplification in the food chain (Unlu and Gumgum, 1993), from where they are easily taken up by aquatic animals and accumulate in their tissues (Hadson, 1988; Kargın, 1996a). Accumulation of heavy metals in the tissues of organisms can result in chronic illnesses and cause potential damage to the aquatic population (Barlas, 1999).

In natural aquatic ecosystems, metals occur in low concentrations normally at the nano-gram to microgram per liter level. Recently the heavy metals occur in excess of natural loads which becomes a problem of serious concern. This situation arose due to increased urbanization, rapid growth of population and expansion of industrial activities. The greedy nature of human beings has explored and exploited the natural resources, extension of irrigation and other modern agricultural practices as well as the lack of environmental regulations (FAO, 1992).

Major types of toxic chemicals concerned for fishes are heavy metals, chlorine, cyanides, ammonia, detergents, acids, pesticides, polychlorinated biophenyls, petroleum hydrocarbons, various effluents and other miscellaneous chemicals. Heavy metals (i.e. Zinc, Copper, Lead, Cadmium, etc.) rank as major polluting chemicals in both developed and developing countries (Lloyd, 1992). Metal pollution is one of the major sources of toxic pollutants in the world. For normal physiological functioning in animals, trace metals are required but only in trace concentrations. Their concentrations vary between different species. The important trace metals are copper, zinc, iron, iodide, manganese, cobalt, selenium, tin and chromium. The raised levels of trace metals may lead to toxic effect on aquatic animals (Van Vuren, *et. al.,* 1999). Chromium, lead, nickel, arsenic, Copper, zinc, tin, cadmium, mercury, and aluminum are the metals which affect on fish physiology and is most concern for studies on the effect of metal pollution. These metals have altered physiological function in the organism at higher concentration (Heath, 1987).

Historically, heavy metals, other metals and minerals have been released from chemical compounds through various industrial activities. The bottom sediment analysis has been used to determine the extent and source of trace metal contamination in aquatic environment. They have the capacity of accumulating trace metals and other contaminants over time (Mark, *et. al.,* 1982). The sediments possess high metal retaining capacity, so the transport of metals through sediments is a very slow process (Yousef, *et. al.,* 1994). Discharge of industrial wastewater into the rivers has adversely affected the quality of streams and sediments in the river system. Heavy metals in sediment exist in different particle – binding phases or different chemical forms. Heavy metals bind with organic compounds, adsorbed in carbonates and oxide minerals and in the structure of primary and secondary minerals. In environmental studies, the determination of these gives more insight into the mobility, availability and toxicity for trace metals.

The heavy metals accumulation in an aquatic environment has direct consequences to the ecosystem and man. Metals such as Cu and Zn are generally regarded as essential trace metals as they have valuable role for metabolic activities in organisms. Other metals like Cd, Pb, Ni and Hg exhibit extreme toxicity even at trace levels (Merian, 1991). Heavy metal contamination in aquatic environments is of critical concern due to the toxicity of metals and their accumulation in aquatic habitats. In the aquatic fauna, fish is the most susceptible to heavy metal toxicants (Nwaedozie, 1998) so, are more vulnerable to metal contamination than any other aquatic fauna. Over 54 elements are known to have toxic effects on fish. The heavy metal pollution in freshwater fish first became an issue in the sixties when serious mercury contamination was detected in Sweden and later in Canada. Ibok, *et. al.,* (1989) reported elevated levels of Hg, Zn, Cu, Co, Sb, Cd, and Pb in fishes from some streams in Ikot Ekpene area of Nigeria. Fishes were considered as better specimens for use in the investigation of pollutant loads than the water samples because of the significant levels of metals they bioaccumulate (Atuma and Egborge, 1986; Ezemonye and Egborge, 1992), fish and shellfish of the Niger Delta (Kakulu, *et. al.,* 1987).

Aquatic organisms in nature are constantly exposed to metals. The types and concentrations of metals in water are mainly determined by geochemical processes and large scale anthropogenic activities (Wittmann, 1979). Industrial development and the use of different metals in production processes have been responsible for the increased discharges of heavy metals into the environment (Koli, *et. al.,* 1977). The incomplete biological degradation of heavy metals has harmful effects (Forstner and Prosi, 1979); these metals accumulate in the aquatic environment. Heavy metals are non-biodegradable can bio-accumulate in fish, directly from the water or by ingestion of food (Patrick and Loutit, 1978; Kumar and Mathur, 1991). After reaching sufficiently high concentrations in body cells the metals can alter the physiological functioning of the fish (Heath, 1987).

Contaminated water bodies by heavy metals may lead to bioaccumulation in the food chain of an estuarine environment. Generally, such contaminants are transported from its sources like river system and deposited downstream. Most of the pollutants may be mixed and became suspended solid and bottom sediment through sedimentation, therefore estuary is a potential sink for these pollutants for a long period of time (Morrisey, *et. al.,* 2003). Presence of heavy metals in sediments can lead to greater environmental problem when the contaminated sediments are suspended and such metals are taken up by filter feeder organisms and thus they have potential to accumulate toxic substances from water and sediment (Al-Madfa, *et. al.,* 1998).

Chemical elements with a specific gravity at least 5 times the specific gravity of water are the heavy metals (EPA, 1983 and ATSDR, 1999). The specific gravity is a measure of density of a given amount of a solid substance when it is compared with an equal amount of water. Some of the elements with specific gravity greater than 5 are Arsenic (5.7), Cadmium (8.65), Iron (7.9), Lead (11.34) and Mercury (13.5) (Lide, 1992). Heavy metals are present in the air brought through the gases released from factories and automobiles (ATSDR, 1999). Heavy metals are present in the soil by leaching of disposed chemicals from factory effluent, domestic disposals, leaching to stream, rivers etc (Canli, *et. al.,* 1998). Heavy metals discharge by industries posses a serious water pollution problem, due to the toxic properties of these metals and their adverse effects on aquatic life. According to the survey conducted by Central Inland Fisheries Research Institute (CIFRI,1981) these heavy metals are well known pollutants, which are often encountered in many rivers of India and there is every possibility of fishes, the important aquatic fauna , being subjected to stress caused by heavy metals.

The toxic metals occur in very small quantities in the earth crust hence called as "Trace Metals". They are subdivided on the basis of their densities, those having densities below 5 gm / cm^3 are called light metals and those with above 5 gm / cm^3 are heavy metals. Thus the heavy metals viz. mercury, lead, zinc, arsenic, iron, aluminum and their salts constitute the widely distributed groups of highly toxic and long retained substances. These groups of pollutants are commonly found in industrial water.

Toxicology, according to classical definition by Casarett and Doull (1975), is the "basic science of poisons" and the chief role of a toxicologist is it's "prediction". Toxicological studies on fish were made nearly a hundred and fifty years ago by Penny and Adams who in 1863 examined the river Leven, a tributary of the Clyde, which was then polluted by effluents from dye works. They made some laboratory tests on minnow and goldfish. In 1917, Powers published his paper, "The gold fish as a test animal on the study of toxicity". In 1919 Kathleen Capenter began studying the rivers of west Wales for effect of zinc and lead on fishes.

In aquatic ecosystem the source of heavy metals is natural as well as artificial in origin. Naturally introduced metals came primarily from soil erosion, rock weathering, or the dissolution of water soluble salts. Usually without any detrimental effects naturally occurring metals move through aquatic environments. Artificial sources include effluents of industries which cause non repairable damage to environment and on individual. Living organisms provide convenient full time monitor of all pollutants. The organisms do not react to a single factor but, all the environmental situations and reaction of organisms is a cumulative result of preceding as well as present conditions (Ravera, 1975).

Aquatic animals have been used in bioassays to monitor water quality (Carins, *et. al.,* 1975; Brugs, *et. al.,* 1977). The biological monitoring techniques based on fish offers the possibility of checking water pollution (Poele and Strick, 1975). Environmental pollutants show their action by changing biological functions or structure (Newman, 1998).

One of the main protein sources of food for human is fish. The main aquatic organisms in the food chain are the fishes; in which some metals may accumulate in large amounts. Fishes may assimilate the heavy metals through food materials, ingestion of suspended particulates and/or by constant ion-exchange process of dissolved metals across the gill membrane and adsorption of dissolved metals on tissue and membrane surfaces.

For the evaluation of health in aquatic organisms fishes are widely used, these pollutants build up in the food chains which are responsible for adverse effects and death in the aquatic systems (Farkas, *et. al.,* 2002; Yousuf and El-Shahawi, 1999). The various studies carried out on different fish species have shown that heavy metals may change the biochemical composition and physiological activities (Basa and Rani, 2003; Canli, 1995; Tort and Torres, 1988). The toxic effects of heavy metals have been reviewed, including bioaccumulation (Waqar, 2006; Aucoin, *et. al.,* 1999). The organisms exposed to xenobiotics and heavy metals develop a protective defense against the deleterious effects of non essential and essential heavy metals and xenobiotics to produce degenerative changes like oxidative stress in the body.

The fish exposed to high concentrations of trace metals in water may take up substantial quantities of these metals and it is a threat to fish fauna (Ganapati and Raman, 1976; Rao, Panduranga, *et. al.,* 1990; Sultana and Rao, 1994).

The direct discharge of industrial effluents into the rivers and runoff from the field into lakes, ponds and rivers are causing serious concern about water pollution. Our present knowledge of industrial effluent toxicity is still limited. Many studies on the effect of industrial effluents and other pollutants on fish fauna have been carried out so far. The major works are summarized below.

McLeay and Gordon, (1977); Williamson, (1981); Bilkhi, *et. al.,* (1987); Jana, *et. al.,* (1987); Mane, (1988); Dehadrai (1990); Alam, *et. al.,* (1991); Varadraj and Subramanian, (1991); Ambrose, *et. al.,* (1994); Vincent and Ambrose, (1994); Petanen, *et. al.,* (1996); Dehadrai and Poniah, (1997); Munkttrick, *et. al.,* (1998); Yousuf, (2000); Mahapatra and Mishra, (2004); Khan, (2005); Pailwan, (2005); Muley and Patil, (2006).

India is one of the ten most industrialized nations in the world. But industrialization has resulted in unplanned urbanization, pollution and increased level of risk to human health and safety. India's over 70 % of surface water is seriously polluted. River like Ganga, and Yamuna, which passes through Kanpur and Delhi, bear a heavy effluent load (India's Environment Action Programme, 1995).

For many purposes water is used by industries, such as processing, cooling and in this process water may become polluted. Such polluted water released by industries may directly or indirectly, reach water bodies. All major rivers in the country are being polluted by unchecked industrial effluents being discharged into them. A variety of industries such as coal washeries, coke - oven plants, the countries major iron, and steel plants, thermal power plants, glass and cement plant, fertilizers and chemical factories seriously pollute the rivers (Kumar and Thakore, 2004).

Indian coastline is over 8000 km long infringed with several rivers. Total catchments of these rivers are 3.02 x 106 km^2 and their estuaries have a water-spread area of 2.7 x 104 km^2. There are 14 major, 44 medium and 162 minor rivers together they discharges 1.56 x 1012 m^3 runoff every year. This greatly influences ecology of their estuaries and coastal areas. They are considered to generate 1.11 x 1010 m^3 of sewage annually, particularly from coastal cities and towns where sewage collection network exists, is released in estuaries and creeks. Medium and large industries generate roughly 1.35 x 106 m^3 d^{-1} of liquid effluents and about 34,500 t d^{-1} of solid waste. These liquid effluents are released to estuaries and creeks while the solid waste is generally stored in unsecured dump-sites and leachates which can be toxic and enter nearby aquatic areas via runoff during monsoon. Sabarmati, Mahi, Tapi, Mindola, Purna, Par, Ambika, Auranga, Kolak, Damanganga, Ulhas, Mahim, Savitri, Kundalika, Vashisti, Ashatmudi and Ennore estuaries and Kochi Backwaters which receive domestic and/or industrial effluents in their weak tidal zone(Zingde,2007).

Now a day's coastal waters of many countries became polluted. Indian Oceanographic Commission (I.O.C.) explained marine pollution as, the direct or indirect introduction of substances or energy by man, into the marine environment acts as deposit vault for pollutants from the biosphere. Most of the wastes are accumulated near the shore region and cause serious problem. Most of the pollutants have been detected in abiotic and biotic components of the environment (Doudoroff, *et. al.,* 1953 ; Bryan,1976 ; Zingade, *et. al.,* 1976 ; Mellanby, *et. al.,* 1980 ; Quasim, *et. al.,* 1980 ; Laws, *et. al.,* 1981 ; Mhatre, 1983 ; Aurbach, *et. al.,* 1983 ; Davenport, 1984 ; Ajmal, *et. al.,* 1984 ; Mahapatra, 1996).

Estuaries and coastal wetlands are diverse systems providing important habitats for flora and fauna (Stumpe and Haines, 1998); also, they act as filters for contaminants and sediments thus helping to maintain moderate water quality (Faulkner, 2004). However, estuaries and coastal wetlands are under pressure from rapidly increasing urban populations near coastal areas (Pauchard, *et. al.,* 2006). Continuous population growth within coastal regions ensures there will be ongoing impacts on coastal wetland ecosystems (Lee, *et. al.,* 2006). In densely populated urban regions nutrient supply is greater due to the entry of both domestic and industrial waste and urban drainage (Lee, *et. al.,* 2006). The increase of nutrient concentrations within coastal waters can create either positive or negative responses in the ecological health of systems, including abundance and alteration of species richness (Faulkner, 2004). Anthropogenic inputs of nutrients may lead to excessive eutrophication especially in bays and coastal lagoons where the circulation is restricted (Lin, *et. al.,* 2006). Alterations in chemical characteristics and water quality within coastal systems occur due to changes in biogeochemical flows (Pereira-Filho, *et. al.,* 2001).

An estuary is a semi-enclosed coastal body of water. The river meets the sea in shallow, protected bays. Millions of sea animals get their start in life feeding in the quiet waters of the estuary. They can find shelter in salt marshes, beds of slender eelgrass, or wide mudflats. Flush with nutrients and inhabited by resilient organisms, estuaries are among the most productive ecosystems on earth. They provide rich feeding grounds for coastal fish, migratory birds and spawning areas for fish and shellfish. They are also important in maintaining the quality of coastal waters.

In modern technological era, the relative improvement of water quality in many areas and the recognition that sediments may serve as sinks and secondary sources for many persistent chemicals (Harris, *et. al.*, 1996) has shifted the focus of ecotoxicological studies towards sediments and the potential deleterious effects persistent pollutants have on benthic ecosystems (Anderson, *et. al.,* 1996). One ecosystem that has attracted a significant amount of attention is estuaries. Generally, estuaries are areas of high productivity, which give them not only ecological significance but also attract economic interest. With the increasing pressure of anthropogenic activity from agricultural runoff, industrial effluent, airborne pollutant input, biocidal agents from antifouling paints etc., and the recent effects on mariculture industries, it is not surprising that many aquatic ecotoxicological studies have been aimed at monitoring the health of estuarine ecosystems (Langston, *et. al.*, 1990; Chapman and Wang, 2001).

India has 25 estuaries, which have rich flora and fauna. There are eight estuaries on the east coast of India belonging to different littoral states, Hooghly in West Bengal, Rushikulya in Orissa, Godavari in Andhra Pradesh and Ennore, Cooum, Adyar, Vellar and Cauvery in Tamil Nadu, all ending in the Bay of Bengal. On the west coast there are17 estuaries as Ashtamudi and Cochin Backwaters with Vembanad in Kerala, Kali in Karnataka; Mandovi-Zuari in Goa; Bombay Harbour/Thane Creek, Mahim and Amba in Maharashtra and Mahi, Narmada, Tapi, Mindhola, Purna, Ambika, Auranga, Par, Kolak and Damanganga in Gujarat, all are ending in the Arabian Sea.

Maharashtra is one of the coastal state in India, located on west coast has a coastline of 720 km with the west-flowing river mouths, creeks and bays. There are about 18 prominent estuaries along the coast; some of them have variety of floral and faunal species. Many of these inshore waters receive untreated or partly treated domestic wastewater. Significant industrial development in Maharashtra has taken place a few kilometers inland from the coastline because of which several industries have been releasing their effluents to inshore areas. The prominent examples of inshore water bodies receiving domestic and/or industrial effluents are Ulhas, Patalganga, Amba, Savitri, Kundalika and Vashisti estuaries as well as Thane, Mahim, Versova, Ratnagiri, Dahanu and Tarapur Creeks.

In India domestic sewage and industrial effluents are discharged in the water bodies in partially treated or untreated form. Natural environmental pollutants normally include certain toxic heavy metals and metalloids. The total volume of all discharges from Bombay is around 365 million tones (MT) per year (Sabnis, 1984). The discharges from Calcutta are around 350 MT every year (Ghose, *et. al.,* 1973).

Domestic wastes, sewage dumping, pollution sources from river discharge and coastal industrial pollution are posing a major problem to our costal waters. Lot of research work has been carried out on trace metal transportation and bioavailability in the estuarine and costal environment for trace metals in open sea or ocean. The main pollution sources came from the atmosphere and hydrothermal inputs, but they are relatively much lower and some non polluted organic trace metal concentration is taken as background concentrations (Chan, Tik- Yuen and Bharava, 1992).

In 1984, it has been estimated that 5 million tones of fertilizers, 55,000 tones of pesticides, and 1, 25,000 tones of synthetic detergents were used in India (Qasim and Sen Gupta, 1983). 25% of all these can be expected to end up in the sea every year. Few substances are biodegradable while others are persistent. Cumulative effect of these substances over a long period could be quite harmful to the coastal marine environment. From 1959 to 1974 phosphate-phosphorus concentration in the Bombay shore waters has increased from 0.82 to 1.13 μmol / l, i.e. by about 40 % (SenGupta and Sankaranarayanan, 1975). The concentration in 1984 was around 2 μmol / l, (Zingde, 1985). Most of the heavy metals are transported to the sea by this way.

West coast of India (between latitude 15^{0}. 30' to 18^{0}. 00 N, longitude 72 .^{0} 32' to 73 .^{0} 30' E) have not been studied in detail as compared to other areas along west coast of India. Opening of many small and big rivers makes the coastal belt of Maharashtra a unique biological habitat. Many coastal areas showed a high marine biodiversity with unique flora and fauna of Maharashtra (ANON, 1998; Nair, *et. al.,* 1998).

The coast of Maharashtra is popularly known as Konkan coast. It is an important sector on the west coast of India because of its biota, physical distinctiveness, and marine resources. The coastal areas are populated and developed in the active region of Konkan. The coastal region is narrow, hilly and highly dissected with transverse ridges of Western Ghats and many places extending as promontories notches, sea caves, embayment, and submerged shoals and off shore islands.

The major problems faced by the littoral zone and the shore front areas of Maharashtra coast are related to coastal siltation, erosion, pollution, sea level rise, destruction of mangrove swamps, salt marshes, land slides and slope failure, pressure of population, industrialization, road transport etc.

Due to persistent pollution some of the coastal areas such as Dahanu-Vadhavan, Colaba-Alibag and Dabhol - Ratnagiri have been exposed to rapid industrialization and resulted in severe environmental degradation. The mangroves and back waters of Dabhol coast are very productive and contribute for fishery production.

The MIDC has established chemical zone at Dombivali, Trans Thane Creek, Badlapur, Kalyan, Bhiwandi, Roha, Taloja, Ambernath, Patalganga, Tarapur, Mahad and Lote-Parshuram. Lote-Parshuram Industrial Area (LIT) is located in the Ratnagiri District of the Konkan region of Maharashtra. In 1978, the Maharashtra Industrial Development Corporation (MIDC) appropriated 575 hectares of land of Lote, Awashi, Songaon, Dhamandevi and some other villages for setting up a Chemical Industry Zone. The development of the industrial belt was part of the government's plan to develop the Konkan region and provide better survival opportunities for people.

Ratnagiri and Raigad districts in Maharashtra show fast industrial development. Due to major water resources in Konkan region, MIDC has developed industrial zone at Ratnagiri District. Total area of Lote MIDC is about 575 hectares including 270 industries with 79 manufacturing, pesticides, chemicals, paints, dyes, pharmaceuticals, detergents etc and discharging gaseous, liquid and solid effluents in air, water and soil polluting local and near by environment. Liquid effluents of various industries are carried through the drainage pipes and discharged in to Dabhol Creek. Pollution prone area includes 42 villages from Chiplun, Guhagar, Khed and Dapoli tehsil. Most adversely affected villages are Lote, Kotawali, Songaon, Ghanekhunt, Dhamandevi, Asagani, Dabhil, Level, Chirani and Ambadas.

According to survey conducted by Parivartan (Local NGO from Chiplun) in village Kotawali, the economy of 48 fishermen's was totally collapsed. The industrial effluents released in creek are responsible for fish mortalities. Mortality in fishes started from 1996, there was tremendous increase in mortality from June 1997 to August 1997. Since then occasional occupational mortalities of fishes are occuring due to industrial effluents released from Lote M.I.D.C. (Plate No. V).

The soil and water samples from pollution prone area showed concentration of heavy metals such as Chromium, Zinc, Cadmium, Mercury, Copper, Nickel, more than permissible level. Sodium cyanide was also detected from the water sample (Pria and Parivartan, 1998).