CHAPTER I
GENERAL INTRODUCTION

1.1. HYDROLOGY

The study of freshwater ecosystem is gaining momentum today as freshwater is one of the most essential resources for biological life and there are many competitive demands for it. Many different kinds of freshwater bodies are present in our country which include ponds, lakes, rivers, reservoirs etc. The ecological state and performance of aquatic ecosystem is intrinsically linked with its catchment, both structurally and functionally. Aquatic ecosystem is a source for the production of cheap and quality proteins. Aquatic ecology attracted biologists in the past with the pioneering works of Forel (1841-1912). Limnology as a distinct field of science has developed during the last 200 years or so. Forel is considered as the founder of modern limnology. Forel’s work led to the formation of a Limnological Commission in Switzerland in 1890 and the impacts of freshwater investigation began to be felt by the establishment of Freshwater Biological Station in Europe and USA. These early freshwater stations yielded a wealth of information, which later added much to the early groundwork of modern ecology.

Flowing water comprises a very distinctive type of ecosystem with their unidirectionality, their integration with the catchment, high dynamic nature and unique biota. It constitutes a small fraction of the stored water in the Biosphere. Rivers play a vital role in fulfilling a variety of needs of human community. It is a
major lotic system, which is acting as the circulatory system of the land. It connects lentic ecosystems on the way of its flow and plays significant role in food production. Rivers have played a decisive role in inspiring imaginations. They are the cradles of civilizations. Five thousand years ago Indian civilization flourished in the valleys of River Indus. Rivers are sacred for every Indian.

There are 14 major rivers, 44 medium and 55 minor river systems in our country (Sharma, 1997). All Indian rivers from the mighty sacred Ganga to a tiny rivulets are under the crushing pressures of ecological degradation and environmental pollution caused by rapid urbanization and population explosion. Despite extensive efforts to conserve and manage water resources, water demands continue to rise, and availability continue to fall. In countries like India where the population is still rapidly growing, impending water crisis will be the major environmental problem in the coming years. Exploding population, measures to maintain food security, urbanization and industrialization pose serious threat to the availability of reliable water. India is rich in water resources, being blessed with a network of great rivers and vast alluvial basins to hold groundwater. Though the rainfall over India is slightly above global average, its uneven distribution leads to occasional floods and droughts, in different parts of the country. This disparity in rainfall is reflected in water resources and this is a permanent issue in water management in India. Under the pressure of rapid population growth, the available resources of water are being developed and depleted at a rate faster than replenishment. Integrated plans for protection, management and efficient utilization of rivers become important in this context.
Kerala is the land of rivers and backwaters. In general, rivers of Kerala are small, their length and size being controlled by the topography of the state. Periyar, Pamba, Bharathapuzha and Chaliyar are considered as the major rivers of Kerala. These rivers jointly are more than one hundred and sixty kilometers long and drain about 35% of the state's total area and carry about 45% of the total surface water (Nair, 1997). Out of the 44 rivers of Kerala three viz., Kabani, Bhavani and the Pambar flow eastwards, all other rivers flow westwards.

The environmental pollution due to industrialization, urbanization and swelling human population is a modern evil affecting the aquatic ecosystems. The catchment land use pattern is linked to the nearby flowing streams and rivers. Soil erosion and agricultural run off are also major threats to rivers. All over the world the rivers are changing to sewage depots. There has been large scale pollution and consequent destruction of fauna and flora of the rivers of Kerala. The principal sources of this pollution are sewage from cities, retting of coconut husk, effluents from factories and inorganic pesticides used extensively in agricultural operations. Most of the rivers in Kerala have become seasonal bodies.

1.2. BIODIVERSITY

In the ongoing discussions about nature conservation and faunistic changes due to alterations of environments, biodiversity studies have assumed considerable importance world wide. The Convention on Biological Diversity (1992) defines biodiversity as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part, this includes diversity within species, between
species and of ecosystems. Biodiversity is essential to the functioning of ecosystems. Each species plays a unique role within an ecosystem and every species is dependent on others for food, shelter, or other resources. The loss of a single species, therefore, can have profound effect on the ecosystem as a whole. Loss of biodiversity can occur at ecosystem level, species level and at the genetic level. Clearly quantifying and understanding the loss of biodiversity is the central theme of ecological research and of conservation biology. The crisis facing species today differs in one fundamental way from any other extinction events. All other cases of mass extinction throughout global history have come about as the result of climatic change, a natural geological change or some seismic event. The present crisis however is being driven by human influences.

The intensity of public concern about the loss of biodiversity on local, regional and global scales gains its force from attitudes that range from the ones based on emotions to those based on solid research findings. The earlier loss of biodiversity was due to human colonisation around the world. The number of endemic species in a particular area is a useful measure of biodiversity. The greater the number of endemic species, the greater the importance of an ecosystem from an ecological perspective. If an endemic species is driven to extinction, there are no additional geographic area wherein it exists. This idea has resulted in the identification of biodiversity hot spots. 34 global biodiversity hot spots have been identified by the Organization Conservation International, most of them in the tropics (Roach, 2005). Inland water and freshwater biodiversity constitute a valuable natural resource in economic, cultural, aesthetic, scientific and educational terms.
However, of all the world’s global ecosystems, fresh water ecosystems are experiencing decline in biodiversity far greater than those in the most affected terrestrial ecosystems. It is estimated that just about 5% of the living species on the earth are so far catalogued and nearly 90% of the aquatic species are yet to be characterized and catalogued. Individual large river systems in the tropics have higher recorded bio-diversity than that in the temperate zones (Allan and Flecker, 1993). Knowledge of the number of species dwelling in the streams and rivers of a region is more complete for vertebrates than for invertebrates. Fresh water habitat occupy <1% of the Earth’s surface, yet are hot spots that support 10% of all known species and 1/3 of vertebrate species (Strayer and Dudgeon, 2010). But these species are now facing great threats. This is especially true for aquatic biodiversity. Non marine aquatic habitats comprise only 0.01% of the worlds’ water and cover only 8% of the Earth’s surface. Yet 6% of all species, and more than 10% of all animal species, occur in freshwater, including 25% of all vertebrates and 40% of all fishes (Balian et. al., 2008,). This imbalance of 1–2 orders of magnitude between surface and diversity can be called the ‘paradox of freshwater biodiversity’. Unfortunately, knowledge on the species composition and distribution of these rich assemblages of aquatic organisms is extremely meagre; if at all such knowledge is limited to a few economically important groups. Incomplete knowledge on the species and interrelations of these organisms among themselves and with their environment has been one of the major reasons that has resulted in their overexploitation leading to their depletion and in some cases near extinction and indirectly of the allied ones. The extinction rate in freshwater ecosystems is estimated at 4% per decade in North America; 32% of all species of Amphibia are
threatened with extinction (Ricardi & Rasmussen, 1999). Freshwaters are richer, but also more threatened (Dudgeon et al., 2006).

Research focused on biodiversity has a rich history that has progressed over the past two centuries from the earliest periods of natural history observations to species inventory and biodiversity monitoring. Concerns regarding the loss of biodiversity have increased considerably in the past two decades, leading to unprecedented levels of research and publications that have focused on species in numerous taxonomic groups across many regions of the world. Zheiai et al., (1999) studied the macroinvertebrate fauna of the Yangtze River, China and found that species richness of macroinvertebrates were significantly correlated with factors such as current velocity, water temperature and transparency. The information presented about the loss of biodiversity in books published since 1988 (such as Dobson, 1998: Hunter, 1999) explained the matter in great detail than had been written about the topic during the previous century.

Even in highly developed and environmentally enlightened countries more than 80% of the acreage of historical wetlands have been destroyed (Gibbons et al., 2003a). The extensive ecological degradation and biodiversity loss in riverine ecosystems as a result of overexploitation of rivers raised widespread concern for conservation and restoration of healthy river ecosystems throughout the world (Allan and Flecker, 1993) .

The booming human population, combined with the resulting high levels of land use change, overexploitation of natural resources and pollution are considered by many as important factors affecting biodiversity, both in a particular region and
on a global scale (Gibbons and McGlothlin, 2003b). Further, natural phenomena such as climatic changes, environmental catastrophies have also caused disturbances and destructions of aquatic populations. More importantly, these habitats and their biota have been subjected to intensive pressure by anthropogenic interferences such as overfishing, tourism, industrialization, reclamation etc., pushing many aquatic populations towards complete destruction or near extinction.

Although most research on biodiversity decline and ecosystem functions has concentrated on primary producers (Hooper et al. 2005), studies of single trophic levels are insufficient to understand the functional consequences of biodiversity decline. Natural ecosystems are composed of communities comprising multiple trophic levels; losses and declines of species from different trophic levels can have very different effects on ecosystem function (Duffy et. al., 2007), and changes at any trophic level can lead to cascading effects through food webs.

According to the World Conservation Union, 20% of the world's 10,000 fresh water fish species are at risk of extinction or are already extinct (Richter et.al., 2006)). The World Bank Report on the fresh water biodiversity in Asia has included Kerala as 'hotspots' of biodiversity (Kottelat and Whitten, 1996). National Bureau of Fish Genetic Resources (NBFGR, 2000) has considered the Chalakkudi River of Kerala as one of the richest rivers in India, in terms of fish diversity and abundance. This report stresses the importance of collecting detailed information on biological diversity of the rivers of Kerala state. Fresh water habitats and species living in fresh water are generally more prone to extinction than terrestrial or marine ones. The United Nations declared 2010 as the International Year of Biodiversity. The
current river management and development policies resulted ground water depletion, declines in water quality and availability, salt water intrusion into the river, and a host of other ecological, social and economic problems. Therefore immediate means for conservation of fresh water resources, thus assume paramount importance. The first step towards achieving these goals is to have a thorough knowledge on the ecological status of the aquatic ecosystem, composition and distribution of the species inhabiting there, and of the factors that influence and regulate the life activities of these organisms.

1.3. SIGNIFICANCE OF THE PRESENT STUDY

All freshwater habitats especially riverine systems are in rapid decay due to human intervention. Depletion of vegetation cover, soil erosion modification of land form through construction activities, removal of sand from the river bed, etc affect the pattern of run off and soil water percolation, finally changing the river flow. Fresh water has become the most precious and valuable resources in the world. Conservation and preservation of the fresh water habitats is the most urgent need of the hour. The first step towards achieving these goals is to have a thorough knowledge on the composition and distribution of the species and of the factors that influence and regulate the life activities of these organisms, hence the present study.

The Thutha River, one of the main tributaries of Nila River flows through the Malappuram and Palakkad districts of Northern Kerala. It is the only tributary which supplies water to Nila River during summer. There is no dam across the Thutha River and it joins Nila at Velikulam village near Irimbiliyam in the Malappuram district. All the other tributaries of Nila turn tear drops during summer and moreover
they have dams built on their course. Faunistically, this area is very important because of the presence of the Silent Valley National park. Literature survey revealed that no significant studies have been undertaken on the various ecological aspects of this important waterbody of the state. There are no scientific records on the ecology and biodiversity of Thutha River at present. This paucity of information has been the motivation to undertake this work. The major objectives of the work is to assess the ecological integrity of the river by studying the following aspects:

1. Hydrography of the river.

2. Sediment characteristics.

3. Qualitative and quantitative assessment of the biotic components by collecting data from different study stations during each month for two years.

4. Assessment of the interrelation between the hydrography and biotic components and between sediment characteristics and benthic fauna.

5. Assessment of the extent of physico-chemical and biological deterioration of the river due to anthropogenic interferences.