INTRODUCTION

The variety of life on Earth, its biological diversity is commonly referred to as biodiversity. The term biodiversity was coined by Walter and Rosen (1985) and is the abbreviated word for Biological Diversity. Life originated on earth almost four billion years ago and nature took more than 1 billion year to develop this wide and complex spectrum of life on earth. Scientists believe that the total number of species on earth is in-between 10-80 million (Wilson 1988) of which 1.4 million species have been enlisted so far. However, we are losing this heritage of millions of year at a very fast rate.

1.4 million Species of various life-forms have been enlisted so far. These include 300,000 species of vascular plants; 40,000 species of vertebrates; 800,000 species of insects; 360,000 species of microorganism. However, these estimates are increasing all the time. A conservative estimate of the total figure would be 14 million. According to some recent estimates, the number of insects alone may be as high as 10 million. This means that only 13% of the total biodiversity on earth has been described.

Invertebrates as a whole includes little over one million species, distributed among sponges nine major phyla. These include 800,000 species of insects, 5,000 species of, 38,000 species of molluscs and 9,000 species of crustaceans. The number of species of vertebrates in the world is about 40,000. These include 2,400 species of amphibians, 6,100 species of fish, 6,300 species of reptiles, 9,035 species of birds and 4,230 species of mammals.

India is very rich in all aspects of biodiversity and is one of the most significant biodiversity centres of the world. Varying physiographic and climatic condition at different parts of India is the reason for this high level of biodiversity. India, with a geographical area of 329 million hectare has almost all kinds of ecological zones found in the world. India is the meeting ground for
three major global biogeographic regions: (1) Indo-Malayan, (2) Eurasian and (3) Afro-tropical. It has two of the 34 recognized biodiversity ‘hotspots’ in the world – The Himalaya and the Western Ghats. Nearly 980 species of birds have been recorded in this hotspot of which 15 are endemic. About 300 mammal species have been recorded in the Himalaya, including a dozen that are endemic. 175 species of reptiles and 105 species of amphibian have been documented, of which, 50 and 40 are endemic respectively. Nearly 30 of 270 species of fishes are endemic to this hotspot.

The faunal diversity of India includes 5,000 species of molluscs, 60,000 species of insects, 1,693 species of fishes, 205 species amphibian, 420 species of reptiles, 1,200 species of birds and 372 species of mammals.

Water covers 70.9% of the Earth's surface, and is vital for all known forms of life. On Earth, 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapour, clouds (formed of solid and liquid water particles suspended in air), and precipitation. Only 2.5% of the Earth's water is resfreshwater, and 98.8% of that water is in ice and groundwater. Less than 0.3% of all freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount of the Earth's freshwater (0.003%) is contained within biological bodies and manufactured products.

India is endowed with vast freshwater, consisting 45,000km. Of rivers, 26,334k.m.of canals, ponds and tanks, 2.36 million hectares and 2.05 million hectares of reservoirs, which present like harbour a rich and diversified fish fauna characterized by many rare and endemic fish species.

Aquatic biodiversity can be defined as the variety of life and the ecosystems, which make up the freshwater, tidal, and marine regions of the world and their interactions. Aquatic biodiversity encompasses freshwater ecosystems, including lakes, ponds, and reservoirs, rivers and streams, groundwater, and wetlands. The banks of streams or riparian areas are also
important areas associated with freshwater systems. It also consists of marine ecosystems, including oceans, estuaries, salt marshes, sea grass beds, coral reefs, kelp beds, them.

Aquatic biodiversity has enormous economic and aesthetic value and is largely responsible for maintaining and supporting overall environmental health. Humans have long depended on aquatic resources for food, medicines, and materials as well as for recreational and commercial purposes such as fishing and tourism. Aquatic organisms also rely upon the great diversity of aquatic and mangrove forests.

Aquatic ecosystems also provide a home to many species including phytoplankton, zooplankton, aquatic plants, insects, fish, birds, mammals and others. They are organized at many levels, from the smallest building blocks of life to complete ecosystems, encompassing communities, populations, species and genetic levels. In summary, aquatic biodiversity includes all unique species and habitats, and the interaction between habitats and resources for food, materials, and breeding grounds.

The freshwaters of India have been viewed from a single perspective: that of economic production. They are to be sources of irrigation or urban-industrial water supply or of hydro power; they are to receive sewage and industrial waste; they may produce edible fish. In this strictly utilitarian framework, there is no space to conserve the rich heritage of freshwater ichthyofauna diversity of the country.

About 21,730 species of fishes have been recorded in the world; of which, about 11.7% are found in Indian waters. Out of the 2546 species so far listed, 73 (3.32%) belong to the cold freshwater regime, 544 (24.73%) to the warm freshwater domain, 143 (6.50%) to the brackish water and 1440 (65.45%) to the marine ecosystem.
Due to irrational fishing practices, environmental aberrations like reduction in water volume, increased sedimentation, water abstraction, and pollution over the years this diversity is on a decline and few species have been lost from the freshwater ecosystem of India and some are belonging under endemic, endangered and threatened category. A recent series of reviews (Dudgeon, 1999, 2000a, b, c, d, 2002a, b) has underscored the alarming condition of the region’s rivers, which has been apparent for over a decade (Dudgeon, 1992). Their waters are grossly polluted, and dams and impoundments influence their natural discharge to such an extent that the lower Ganges and the Indus virtually cease to flow during the dry season (Postel and Richter, 2003). In the present context, freshwater fish biodiversity loss is an alarming threat and its conservation is only the solution of the problem.

Though, India comprises diversified Ichthyofauna in various habitats but freshwater fishes are a poorly studied group. There is no proper documentation since information regarding distribution, population dynamics and threats is incomplete, and most of the information available is from a few well-studied locations only. Therefore, it is important to prepare a zone wise database for listing the fish diversity in our country. Moreover, a data base on fish biodiversity is also essential as a decision making tool for conservation and management of fish germplasm, protection and preservation.

Chhattisgarh, state is situated in the heart of India, is endowed with a rich cultural heritage and attractive natural diversity. It is a land of ponds, reservoirs, rivers, wetlands and a long terrestrial belt and hilly areas. The state is full of rare wildlife, exquisitely carved temples Buddhist sites, palaces, water fall, caves, rock paintings and hill plateaus. Most of these sites are untouched and unexplored, and offer a unique and alternate experience to tourists, compared to traditional destinations which have become overcrowded. The green state of Chhattisgarh has 41.33% of its area under forests, and is one of the richest biodiversity areas in the country.
Kanker district has its unique cultural and ecological identity with great diversity of biological species. The surface of Kanker is built of different types of hills. These hills are ancient. These hill groups are spread in the south eastern part of Kanker district, where six phases of quartile and sand are also found. North east part of Kanker comes under Mahanadi plane. The height of this plane is less than 500 meters. The main river of this area is Mahanadi. Hatkul, Chinar, Doodh, Sendoor, Nakti and Toori are the other rivers of the area. Kotri plane comes under Bhanupratappur area. Kotri and Valler are the main rivers of this area. The height of this plane is less than 400 meters. The complex topography, high rainfall, warm humidity, tropical climate, wide altitudinal variation and biogeographic isolation have produced a variety of ecologic riches with unique plants and animal species.

The largest number of species occurs in the tropics and the diversity of fishes, in general, increases from the poles to arr, *Salvelinus alpines* (Johnson 1983) compared to Lake Malawi which has at least 500 species of Cichidae alone (Craig 1992). The Paleoarctic region is species-poor. Southeast Asia, South America and Africa have the most freshwater fishes although many have not been described. For example the Amazon Basin has about 2,000 species, the Mekong Basin about 1,200 species and the Zaire system about 900 species.

There is a fundamental need for taxonomists to describe unknown species in the study of biodiversity especially in these species-rich areas. However it is just as important to protect genetically distinct stocks within a species. As suggested by Ryman *et al.* (1995) the intraspecific diversity for instance of the Atlantic salmon, *Salmo salar*, is as important to protect as is the cichlid flock in Lake Malawi. Fish diversity in reservoirs, derived from river fishes, is not usually as extensive as in natural lakes. Natural lakes have more stable conditions under which the fishes evolve. This is particularly the case in the evolution of cichlid flocks in the African Great Lakes. Riverine species have to live under harsher and more variable conditions. When a reservoir is formed,
several of the riverine species do not adapt and either die or move out of the area. Introducing exotics sometimes increases species ‘richness’.

1.1 Fish Fauna

Fishes make up most of the abundant class of vertebrates, both in terms of number of species and of individuals. They exhibit enormous diversity of size, shape and biology and in the habitats they occupy. Day (1889) described 1418 species of fish under 342 genera from the British India. Jayaram (1981) listed 742 freshwater species of fishes under 233 genera, 64 families and 16 orders from the Indian region. Talwar (1991) estimated 2546 species of fish belonging to 969 genera, 254 families and 40 orders. The Indian fish population represent 11.72% of species, 23.96% of genera, 57% of families and 80% of the global fishes.

Nelson (1984) estimated 21,723 extant species of fish under 4,044 genera, 445 families and 50 Orders in the world, compared to 21,450 extant tetrapods. Other researchers have arrived at different estimates, most of which range between 17,000 and 30,000 for the numbers of currently recognized fish species.

The eventual number of living fish species may be close to 28,000 in the world. Valid scientific descriptions exist for about 24,600 living species of fishes in 482 families and 57 orders (Nelson 1994). One third of the fish families have, at a minimum, one species with members spending at least part of their life in freshwater. Freshwater fish diversity is therefore large compared to other systems since freshwater lakes and rivers account for only 1% of the earth’s surface and <0.01% of its water. Approximately 23,000 species are bony fishes, 10,100 are entirely freshwater and 2,500 move between the sea and freshwater during their life cycles (Helfman et al. 1997).

Six freshwater zoogeographic regions are normally recognised (Nelson 1994; Helfman et al. 1997): a) Neo arctic (North America except tropical Mexico)
with 14 families; b) Neo tropical (Middle and South America including tropical Mexico) with 32 families; c) Paleo arctic (Europe and Asia north of the Himalayas) with 14 families; d) African (Ethiopian) with 27 families; e) Oriental (Indian subcontinent, Southeast Asia, the Philippines and most of Indonesia) with 28 families; and Australian (Australia, New Guinea and New Zealand) with 19 families (these are associated with freshwater but only two species are primary freshwater fishes).

Fish constitutes half of the total number of vertebrates in the world. They live in almost all conceivable aquatic habitats; c. 21,723 living species of fish have been recorded out of 39,900 species of vertebrates (Javaram, 1999), of these 8,411 are fresh water species and 11,650 are marine. India is one of the mega biodiversity countries in the world and occupies the ninth position in terms of fresh water mega biodiversity (Mittermeier & Mittermeier 1997). In India there are c. 2,500 species of fishes, of which, c. 930 live in fresh water and c. 1570 are marine (Kar, 2003a). This bewildering ichthyodiversity of this region has been attracting many ichthyologists both from India and abroad.

About 22000 species of fishes have been recorded in the world; of which, about 11% are found in Indian waters. Out of the 2200 species so far listed, 73 (3.32%) belong to the cold freshwater regime, 544 (24.73%) to the warm fresh waters domain, 143 (6.50%) to the brackish waters and 1440 (65.45%) to the marine ecosystem. Adequate protection of ecosystems is a necessary requirement for survival of all species and proper care is needed to overcome anthropogenic stresses. In the case of commercial species, rational exploitation is a prerequisite for sustainability of the resources. In India, out of 765 native freshwater fish species documented.

In India, out of 765 native freshwater fish species documented by NBFGR, about 450 may be categorized as small indigenous freshwater fish species. The maximum diversity of the SIF’s has been recorded from the North East region followed by Western Gnat and Central India. Based on the
assessment of NBFGGR, of about 450 SIF’s in India about 23% (104 species) are highly important as food and other local significance and also play a significant role in aquarium trade and in providing local livelihood security. Again, of the 104 species, about 62 species have been categorized as food fish while 42 species as ornamental value.

According to the IUCN (2008) Red list of all forms 16928 species are threatened globally, and of these 1275 species are fishes. In Asia, 6106 organisms are threatened of which 688 are fin fishes. Overall, the conservation status of endemic fish species in the Asia can be considered to be relatively satisfactory De Silva et al; (2007) only 16.3% of the endemics are in under status of vulnerability. India contains 659 species of animals listed as globally threatened by IUCN (2008) which is approximately 3% of the world total number of threatened faunal species (16923 species) The 659 globally threatened Indian species includes 42 species of fishes as per IUCN classification under different categories. Among Asian countries India posses the maximum number of endemic freshwater fin fish species (27.8%) followed by China, Indonesia, and Myanmar.

India is rich with inland freshwater fish, with about 940 species known from its rivers, lakes and estuaries. This constitutes about 38 % of the Indian Ichthyofauna and are of considerable economic and scientific value. Of these about 500 species are primary freshwater fish with around 65% endemic, cloistered in the two hot spots of India, the Western Ghats and the North East. Many of these are unique to certain stretches of the various rivers especially the upper reaches and many more new species are being reported from these forested hills. However, threats to these fauna are aplenty, with urbanization, deforestation, habitat loss, pollution, over-harvesting, and culture of exotics. The only way for a fish enthusiast to save the fish and its habitats is creating awareness among the people. In this context, knowledge of the fish fauna of a region is the first step towards conservation.
Kanker district of Bastar region (C.G.) has not been extensively surveyed for fish diversity. The fish diversity is not only the wealth of the district but it also has serious implications fisheries. Thus there is an urgent need for proper investigation and documentation of this diversity. This chapter documents the fresh water fish diversity of Kanker district including identification and association index of fish species.

1.2 Association Index

Ecological communities are composed of a number of coexisting species. Some communities have a large number of species others may have just a few. Species interactions are considered important in the process of understanding the overall ecology of species. In any given habitat there are a number of biotic and abiotic factors which may influence the distribution, abundance and interactions among species.

A pattern of interspecific association between two species will depend upon whether or not the two species select or avoid the same habitat, have some natural repulsion or attraction, or have no interaction at all. Thus, interspecific association may be positive, negative or nonexistent.

Quantifying the degree of spatial and temporal association of individuals of different species is a variable technique for studying inter-specific relationship and community structure. **Positive association** – co-occurrence more frequently than expected by chance – may indicate, for an example, an interaction favourable to one or both species, such as mutualism, commensalism, or a parasite host relation. In a heterogeneous environment, a positive association also indicate similarities of the species in adaptation and responses to habitat condition.

Measures of inter-specific association therefore provide an objective method for grouping species with similar habitat relation. **Negative association** or co-occurrence less frequently than expected by chance, may reflect
interactions that are detrimental to one or both species, such as interspecific competition, interference, or the avoidance of predators by potential prey. In a heterogeneous environment, negative associations result from preference of species for different habitat condition.

Chapter II

STUDY AREA

Ecologically and biogeographically the Indian sub-continent is one of the most fascinating regions in the world. The sub-continent of the India may be taken to extend from Baluchistan and parts of Eastern Afghanistan in the Northwest through Gilgit, Ladakh, Kashmir, Nepal, Sikkim, Bhutan to the Burma border including the entire Pakistan, India, Bangladesh and Cylon.

Biogeographically the Indian sub-continent may be divided into two broad regions: 1) The cis gangetic region covering most of the peninsula and 2) The trans gangetic region of Himalaya and Assam. The cis-gangetic region itself comprising of the following sub regions 1. The gangetic plain 2. The Sahyaderis 3. The chota Nagpur region and the 4. The rest of peninsula, while the trans gangetic region divided into 1) Himalayan region 2) Assam region western Ghats.

Western Ghat from the river Tapti to river Cape Comorin, along with the Western costal strip is a hilly area with peaks rising to over 8000 feet. The region receives over 100 inches of rain almost everywhere, with some areas such as Agumbe and Mahabaleshwar receiving as much as 200 to 300 inches. The Western Ghats tract has rich fauna, remarkable for the fact that some species occur only in the Ghats, and now where else in the peninsula and for the fact that related groups occur only in the Himalayas and Western Ghats.