INTRODUCTION

Water is a vital resource to life on the planet Earth. Early civilizations sprang fast mainly in the fertile flood plains along the banks of the rivers. Freshwater habitats occupy only 0.8 percent of Earth’s surface, about 12% of all animal species are estimated to inhabit freshwater ecosystems (Abramovitz, 1996) while many others are closely associated. Wetlands are one of the most diverse and productive ecosystems in the world which are intermediate forms of terrestrial and aquatic ecosystems or can also be regarded as a link between the two. However, the unique hydrological conditions distinguish wetlands from other land and water bodies (Butler, 2010). Wetlands are ecologically sensitive systems, filled or soaked with water for at least a part of the year or during certain seasons or during a part of the day. Wetlands can be defined as the land areas of poor surface drainage, such as marshes, swamps, bogs etc. Earlier, wetlands were considered the source of immense human suffering harbouring organisms of various diseases, however, their importance could be realized later when they turned out to be great revenue earners as tourist spots due to supporting diverse range of flora and fauna. A huge variety of species of microbes, plants and animals particularly insects, fishes, amphibians, reptiles, birds, mammals etc. are the part of wetland ecosystems. Wetlands not only provide habitats to wildlife and plants, act as water reservoir, provide place for many recreational activities but also are the basis of various ecological inferences and simulation studies as they show complex interaction of both terrestrial and aquatic species of plants and animals and their participation in the nutrient cycling and energy flow.

The increasing demand and pressures on wetlands without understanding their nature and dynamics have often led to their exploitation and degradation, thereby, threatening the survival and sustenance of wetland communities. The consequences are disastrous in a country like India with varied habitats demonstrating rich biodiversity. The failure to protect these productive and diverse areas have resulted in more than 30 percent of the world's freshwater species becoming extinct, endangered or threatened due to their vulnerability to habitat loss and pollution. However, any work related with bio-conservation, eco-regeneration, eco-restoration and environmental impact assessment cannot be done without the correct identification of test species. The physical alteration, habitat loss and degradation, water withdrawal, overexploitation, pollution and the introduction of non-native species all contribute
directly or indirectly to declines in wetland/ freshwater species. The proper identification/ inventorization is absolutely essential for the conservation of these resources.

Consumers play a subtle but important role in wetlands. They range from the tiniest microscopic protists to the largest mammalian representatives, consume energy yielding biomass, convert part of this energy into new biomass and recycle unused organic matter and nutrients. Nematodes are one such consumers which unarguably are the most abundant and diverse metazoans on Earth (Lambshead, 1993; Platt & Warwick 1983). Known for more than 3000 years, nematodes have been greatly neglected by the zoologists until twentieth century. Nematoda represents one of the largest animal phyla on Earth (Poinar, 1983) constituting about 80-90% of all the metazoans in number. Four out of five multicellular animals on earth are nematodes (Lambshead, 1993; Platt & Warwick, 1983). Due to their ecological and biological abilities, they are present in almost all conceivable habitats wherever life can exist. They are present in cultivated fields, in sand dunes, in the sediments beneath the oceanic floor, in glaciers, in groundwater, in plants, animals and even in humans and can withstand freezing and desiccation in more or less inactive stages and resume their activities when the environment becomes favourable again.

Nematodes, the vermiform, triploblastic, unsegmented, bilaterally symmetrical and pseudocoelomate animals have flexible, elongate and cylindrical to fusiform bodies with tapering ends. In absence of an endoskeleton, nematodes solely rely on the pseudocoelomic fluid that forms the hydrostatic skeleton for the movement or functioning of somatic musculature. They lack circulatory and respiratory systems but possess nervous and secretory-excretory systems. The nematodes are mostly dioecous with members usually exhibiting sexual dimorphism. Being immensely diverse in their distribution, the nematodes also vary in their sizes and shapes. The plant parasitic nematodes may range from 0.3-0.5 mm (Paratylenchus pratensis) to 11 mm (Paralongidorus maximus) in size while animal parasites are much bigger e.g., Ascaris lumbricoides (40 cm) and the whale parasite Placentonema gigantissima (8.5 m) (Gibbons, 2001).

The soil nematodes are usually microscopic and move through pore spaces between the soil particles. Although placed at a very low level of taxonomic hierarchy in the animal kingdom, nematodes are an ecologically successful group of lower
invertebrates showing immense variation in community structure and diversity. They are known to occupy important positions in the soil detritus food chain and food web (Ingham et al., 1985; Freckman, 1988) and are crucial organisms responsible for flow of energy and cycling of nutrients in the soil ecosystem (Abebe et al., 2011). The food of nematodes can be the source of protoplasm either from plants, fungi, algae, bacteria, protozoa or even nematodes. On the basis of their diets and feeding habits, the nematodes may be divided into five main guilds: bacterial feeders or bactrivores, predators, plant feeders or phytoparasites and fungal feeders or fungivores and the omnivores. The latter is considered to have unspecified diet. The bacterivores and fungivores are the key components of soil to enhance soil fertility as they also take part in degradation of organic matter (Ferris & Matute, 2003; Ruess & Ferris, 2004). They increase the crop productivity and ecosystem functioning, thus maintaining the soil ecosystem health.

Free-living nematodes are highly diverse in their structure and adaptability to different environment types. The popular nematode Caenorhabditis elegans has attained prominence as a model to provide insights into many areas of biology due to its simple genetic structure, prolific reproduction, transparent body, relatively smaller cell number and ease in culturing.

All organisms have their own level of tolerance for environmental disturbances or pollutants that varies from species to species. Bioindicators are the organisms or group of organisms, whose reactions are inferred to study the functional status of the whole ecosystem. In general, a bioindicator readily reflects the abiotic or biotic state of an environment and indicates the impact of environmental change. There has been an increasing interest in the identification of robust ecological indicators especially the invertebrates that can be readily incorporated into land monitoring and assessment programs because of their dominant biomass and diversity and their fundamental importance in ecosystem functioning. Due to their high species richness, abundance and short generation time, the nematodes serve as excellent tools to monitor changes in environment and to study interactions between biodiversity and ecosystem. Nematode communities significantly respond to soil physiochemical conditions, such as temperature, moisture content (Pen-Mouratov et al., 2004) and organic matter (Yeates & Coleman, 1982). Some nematode species are virtually the last animals to die in polluted or disturbed habitats (Freckman, 1988; Samoiloff, 1987), mainly due
to various life sustaining strategies. Due to their semipermeable cuticle being in direct contact with dissolved chemicals in the soil water, the nematodes show immense sensitivity to various changes in the soil ecosystem and are considered useful organisms for ecotoxicological research (Porazinska et al., 1999). Their community composition indicates the biotic and functional status of soils and helps to assess soil responses to agricultural practices (Porazinska et al., 1999), forestry (Forge & Simard, 2001) and mining (Hohberg, 2003). Some in situ studies on faunal analyses of nematodes at family level provide abundant information on benthic ecosystems. Nematodes can be better models compared to other meiofaunal organisms as the functional guilds of nematodes can be easily categorized by morphology of feeding apparatus and pharynx reflecting their various modes of feeding (Freckman, 1988; Yeates & Coleman, 1982; Bongers & Bongers, 1998; Neher, 2001; Yeates et al., 2009). The relative abundance and size of nematodes also make sampling and extraction easier and less costly than for other soil fauna.

Nematodes are primarily aquatic animals that adjust naturally to a variety of terrestrial habitats and require adequate moisture for sustenance. In the soil, their aquatic requirements are met by the water films around soil particles. However, those inhabiting the freshwater environment show specific adaptations. Besides having a strong protective cuticle, many freshwater forms are long and slender with enhanced swimming abilities. They usually have setose sensilla and photoreceptive eyespots. Many possess caudal glands that open at the tail tip and discharge a sticky secretion for anchorage to substratum. This specific adaptation enables the nematodes to forage and withstand turbulent and fast flowing waters. Despite their importance in the functioning of aquatic ecosystems (Coull & Chandler, 1992) nematodes are prominent among taxa grossly under represented in conservation/biotic survey research (Clark & May, 2002). The wetland/ freshwater nematodes remain one of the largest omissions from global biodiversity research. A major factor for this neglect has been the difficulty in the extraction of nematodes from these water bodies and their identification due to small number of experts working in the area.

Extensive work has been carried out so far on animal and plant parasitic species of nematodes along with some free-living terrestrial nematodes. The estimates suggest that merely 0.3-5.3% of the world’s nematode fauna has been described (Hugot et al., 2001) and a larger proportion is yet to be explored and identified. Nematodes are
inherently small animals and specimens that are identified at the resolution limits of light microscopy. Artefacts due to inadequate preservation, low resolution microscope and environmental conditions may affect the process of identification (Coomans, 2002). It is worthwhile to mention here that habitat-wise, the major share of new species is expected from the scarcely explored aquatic habitats and from those ecosystems of the world which have remained largely inaccessible to taxonomists, till recently. Indian wetlands and fresh water ecosystems are some of such unexplored habitats. Therefore, the task of inventorisation of species should be accomplished fast as many of them may disappear, without being identified. Wetland habitats, predicted to have millions of species, are grossly under-sampled for nematodes. In various ecological studies, the descriptions of many species are inadequate or poor and usually a large proportion of types is improperly preserved or lost. It is also a fact that discussions on species-wise global distribution are still largely premature although generic identification of freshwater nematodes in most of the cases is in place.

The present work envisages the study of the nematode fauna of a nationally conserved wetland, Keetham Lake. The work was undertaken keeping in view the paucity of knowledge on wetland nematodes. The aim of the present work, therefore, is to study the unexplored nematode fauna found in the wetland Keetham Lake, Agra, to investigate and describe the species, to analyse the nematode community structure in order to infer the quality of environment and substrate condition. The present thesis has been divided into two parts: **Part A** deals with the taxonomic study of the nematodes found in the wetland Keetham Lake. A detailed taxonomic study has been made on the select species of nematodes found, belonging to the orders Enoplida, Triplonchida, Chromadorida, Monhysterida, Plectida and Rhabditida in order to add to the existing taxonomic information. In **Part B**, the community structure of nematodes of Keetham Lake has been analysed. Various ecological indices have been calculated for assessing the diversity and food web interactions that may reflect the climatic and substrate conditions at Keetham Lake.

Seven research papers published during the tenure have also been appended along with one accepted that is in press.