Kanpur Zoological Park is spread in 76.56 hectares of a reserve forest on banks of holy river Ganga with having 1262 animals of 105 species in its pride collection. The Kanpur zoo lake is spread in an area of around 18 hectare. Kanpur zoo lake is a part of a Jungle safari of 36 hectares which is an integral part of the zoo. The jungle safari and zoo lake are additionally enclosed by chain link which isolates them from rest of the zoo area. Jungle safari and lake being fenced by chain link and due to not being allowed for visitors except for specific purposes, boasts a natural picturesque view and is a paradise for numerous species of birds including nomadic birds. The lake is surrounded by thick canopy of neem (*Azadirachta indica*), jamun (*Syzigium cumini*), and Kaitha (*Feronia linonia*). The lake also has several small mud mounds with a number of plants on it mainly *Prosopis juliflora* and since these sand mounds are bordered by zoo lake hence they are perfect breeding stand for the birds.

Uttar Pradesh has eight percent of the total wetland area of the country (Jha 2015) and large network of manmade and natural wetlands covering 12,124 hectares. These wetlands support resident as well as migratory birds in large numbers.

Kanpur zoo administration always keeps close watch on activities of birds so that they can have admittance to their safe nesting locations and since the birds are integral part of aquatic life hence zoo administration also ensures plenty of prey bases for them. The Kanpur zoo is home for around 52 types of birds. The common birds of the zoo lake are black-headed ibis, white-breasted waterhen, black-winged stilt, night heron, pond heron, cattle egret, little egret, great egret, darters, purple heron, grey heron, cormorant, woolly-necked stork, painted stork, open-bill stork, white-breasted kingfisher, Pied kingfisher, moorhen, jacana and visiting ducks like, spoonbill duck, whistling ducks etc. These birds feed on different types of aquatic and semi-aquatic plants such as Vallisneria (*Vallisneria spiralis*),...
Oxalis (Oxalis corniculata), Hydrilla (Hydrilla verticillata), Lotus (Nelumbo nucifera) several types of algae like Spirogyra sp. (Chlorophyceae), Naviculla sp. (Navicullaceae), Fragillaria sp. (Fragillariaceae), Microspora sp. (Microsporaceae), Cymbella sp. (Cymbellaceae) and cyanobacteria.

Despite several detailed systematic accounts of a few groups of algae, the total algal flora of India has never been estimated. A preliminary estimate puts the Indian algal flora (excluding marine forms) at about 1800 species of which about two thirds are the blue green algae as stated by Gopal (2013).

Besides water animals like snail, pila, shrimps, insects (Dragonfly), common Indian toad (Duttaphynnos melanostictus) and fishes for example rohu (Labeo rohita), pencil fish (Nannotomus sp.), blue danio (Danio rerio), Indian catfish, green Indian barb (Puntius phutio), Marsh Crocodile (Crocodylus palustris) are also found. The visiting birds mostly come to zoo lake during different periods of year for breeding.

During the British period the zoo lake was being fed by river Ganga during monsoon. However with the spread of the city the lake was cut through Ganga by a road and housing settlements. As a consequence of which the source of water for the lake changed to heavy rains only. Being widely diverse in nature the zoo lake developed a self-sustaining eco system in due course of time. But, growing number of crocodiles was also striking a threat for the birds as the crocodiles shared their feed as well as also began to hunt the birds. The zoo lake was also being fed by a large sewage water nallah and was one of the major reasons of upsetting biodiversity and death of not only fishes but also for the wild domestic animals. The sewage nallah which was terminating in the zoo was decreasing Biochemical Oxygen Demand (BOD) of the lake and was uninterruptedly feeding lake with polluted, contaminated and unclean water and mud. The foul smell of the lake was also one of the causes to keep away the arriving birds. All of these causes resulted in decreasing number of birds in and around zoo lake.

A report of Central Pollution Control Board (1996) found lack of drainage facility for waste water generated by industries as a measure cause of pungent smell and overall unhygienic scenario along the national highway of Kanpur Dehat, India. The report further stated that the area has a huge stock pile of high chromium bearing sludge generated by local industries.

Likewise the oceans are being polluted by untreated sewage and dumping plastics. The Times of India English daily reported that in the coming ten years around 25 crore tonnes plastic is expected to be in the seas. The report further says every year around 80 lakhs tonnes of plastic ends up in the ocean and around 15 crores tonnes of plastic is estimated currently in the ocean (Anonymous, 2016a).

According to a report of Hindustan a Hindi daily (Anonymous, 2016b) around 70% sewage water flows into the rivers, lakes, wells and waterfalls and only 30% sewage water is treated thus making three fourth of water resources of India...
polluted. In the class one and class two cities of India, 3,825 crore litre sewage water is generated of which only 1,178 crore litre is treated in the sewage treatment plants and rest of the sewage water flows in the 80% water resources making them polluted.

Gopal (2005) stated that real threat to aquatic biodiversity of inland water comes from the anthropogenic activities that cause biophysical changes in and around aquatic ecosystem, and the policies that govern these activities aimed at economic developments.

The sewage nallah which was managed by Kanpur Municipal Corporation, flowing into lake, was diverted during the period of 2013-14 due to long efforts made by zoo authorities. The nallah had deposited a thick sludge on zoo lake bed in due period of time with several pollutants. Therefore to clean and disinfect the lake bed, keeping financial factor into consideration, a detailed programme with timeline was chalked out. The core area of twelve hectare in the lake was selected for treatment. The core area of the lake was dried during winters of 2014-15. Since sunlight, drying and desiccation is considered as a good disinfectant therefore the area was left for one month in the sun light. The dried lake bed was dredged after one month and again was left in the sun light for further sunlight treatment. Lime was sprinkled on scoured and dried lake bed and was tilted with the help of a harrow. Tilted lake bed was again exposed to sunlight for one month and was again given lime treatment. The lake was filled by water supply from nearby Ganga river barrage during summer of 2015 and was subsequently filled by rainwater too. Again water from zoo lake, water tank, R.O. plant, and hand pipe were sent to the lab of Central Ground Water Board, Northern Region, Lucknow for examination and were found to be within the limits of BIS, IS 10500, 2012 and thus major improvement in the quality of water was detected after changing the course of sewage nallah and cleaning of zoo lake.

Preparations were also made to transfer the crocodiles of the lake which were around 60. Permission to translocate the zoo crocodiles was taken from the Central Zoo Authority, New Delhi and Principal Chief Conservator of Forest (Wildlife), Uttar Pradesh. Special capture cage were designed by the Kanpur zoo for the task of capturing crocodiles.

Results and Conclusions
The results of the task were very fruitful and in the subsequent year the number and species of the birds visiting zoo lake not only increased but nesting sites were also greater than before. The probable reason of the success was firstly the cleaning and disinfection of the lake which not only increased BOD but also provided fresh and healthy environment for the aquatic life. Secondly, the remaining area of the lake, which was left untreated was relatively upper part of the lake which only gets submerged during rains, remains somewhat non polluted and non-contaminated. This area was left untreated and thus acted as a natural source of micro as well as macro flora and fauna of the lake after treatment and decontamination. Shifting of lake crocodiles also resulted in thinning of top order predator of the lake ecosystem which ultimately led to increased number of fishes which are major source of feed for the visiting birds of the lake thereby attracting number of bird species. The experience of the Kanpur Zoological Park was unique and effective and may prove a helpful tool if any water body management encounters such problem.

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References


