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A Study on the Influence of Habitat Quality on the Water Bird Species

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Abstract – Wetlands are also called as "biological supermarkets" because of extensive food chain and rich biodiversity that they support. They play major roles in the landscape by providing unique habitats for a wide range of flora and fauna. Wetlands support and maintain a diverse community of birds. Wetland birds are broadly defined as „birds ecologically dependent on wetlands" and include recognized groups popularly known as wildfowl, waterfowl, shorebirds and waders (Jayson, 2002). Man has been aware of the link between birds and wetlands for thousands of years. These habitats are useful for birds for breeding, nesting and rearing of young. Declining number of wetlands associate birds is partly attributed to the loss of wetlands.

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INTRODUCTION

The nature and degree of water-bird use of a wetland is generally taken as an indicator of the quality of a wetland. So, a proper understanding of the ecological process in them is essential to devise conservation measures for water-birds that depend on them and for the management of these resources in a sustainable of physico-chemical and biological features of wetlands that influence their use by water-birds. The density and diversity of water-birds had been reported to be influenced by a variety of factors.

Mittal et al., (2010) had stated that functioning of an ecosystem and its ability to support life forms depends to a greater extent on the physico-chemical characteristics of its water. Hydrology and physico-chemical factors were reported to influence wader densities. Wide variations in the water-bird populations associated with the levels of dissolved oxygen, carbon- dioxide, alkalinity, salinity, calcium and magnesium has been reported.

The metabolism, physiology and behavior of aquatic organisms are directly related to the temperature of the aquatic environment. Extreme temperatures restrict the growth and distribution of plants, animals and microbes.

The measurement of dissolved oxygen is one of the most frequently used and the most important of all chemical methods available for the investigation of the aquatic environment (Wetzel and Likens, 2009). Dissolved oxygen provides valuable information about the biological and biochemical reactions going on in waters; it is a measure of one of the important environmental factors affecting aquatic life and of the capacity of water to receive organic matter without causing nuisances.

According to Schell and Krekes, (2009) that acidic lakes may be inferior waterfowl habitats, atleast in the sense that they have less vegetation for shelter and substrate for invertebrates and fewer vertebrates. Water acidity was found to influence the distribution of waterfowl broods in Southern New Brunsnick, Canada i.e., in pH greater than 5.5 the waterfowls are more (Parker et al., 2002). The variation in pH was the principal factor that determines waterbird diversity in the Pichavaram wetlands (Nagarajan and Thiyagesan, 2006).

Compounds of nitrogen and especially those of phosphorus, are major cellular components of organisms. Moyle, (2006) opined that optimum concentration of phosphorus for sustainable and a moderate production was found to be between 0.1 to 0.2 ppm.

Banerjee et al., (2010) stated that, about 0.2 to 0.5 ppm of phosphate in water column is a good indication of pond productivity. Since the availability of these elements may be less than the biological demand, they can regulate or limit the production of organisms in fresh water ecosystems (Wetzel and Likens, 2009). Other elements such as iron and sulfur are essential cellular constituents but are required in relatively low concentrations in relation to availability in fresh waters. The major cations, calcium, magnesium, sodium and potassium are usually required in very low quantities, but their concentrations in fresh water can influence the osmoregulation of organisms.

Banerjee et al., (2010) mentioned that, pond water containing more than 1.0-pp, nitrate nitrogen is considered to be good for optimum production of fishes. Dykyjova et al., (2008) have stated that, when intense macrophyte growth is taking place the nitrate contents are very low or nil. Nitrites were reported to be very low during periods of high primary productivity (Ramamurthy, 2005). The limiting effects of nitrites and phosphate on the productivity in the ecosystem and the consequent faunal (prey) distribution and abundance, as it is well documented that the above nutrients play a vital role in the productivity of many aquatic ecosystems

OBJECTIVES OF THE STUDY

The present study was aimed to study the influence of habitat quality on the water bird species density, diversity and richness at various lakes. In this study, various hydrologic, mud and biotic factors at the lake viz. water temperature, depth, pH, electrical conductivity, turbidity, dissolved oxygen, salinity, nitrate, nitrite, phosphate and silicate (hydrologic factors), soil temperature, electrical conductivity, soil pH, soil nitrogen, phosphorus, potassium and soil texture (soil factors) and availability of plankton and the benthic invertebrates (prey availability) on the monthly and seasonal fluctuations in the water bird species richness, density and diversity in the lake, were assessed.

REVIEW OF RELATED LITERATURE

A survey of literature in reference to the ecological aspects of the lakes has revealed that very little work has been done and comprehensive ecological studies are almost non-existent. It can however be mentioned that studies of such a nature carry a great importance in not only for wetland management but also for bird conservation especially the migratory avian fauna. Sporadic efforts have, however been made to study the ecological components of the lakes (Jabeen 2007 and Ali et al., 2008).

Wetlands have been famously described as “biological supermarkets” because of the exclusive food webs and rich biodiversity they support as “kidneys of the landscapes” because of the functions they perform in the hydrological and chemical cycles (Mitsch and Gosselink, 2003). Wetlands dependent species are often rare, threatened or found only in a very restricted geographical area. Freshwater lakes and rivers contain just 0.008 per cent of the world’s water but are of great importance for biodiversity as they contain twelve percent of all animal species (Shine and de Klemm, 2009). Lind, (2009) and Verry, (2010) carried out limnological studies for wetlands. Bird population parameters such as species richness, relative density and diversity of birds are frequently used as indicators of habitat quality (Nilsson and Nilsson, 2008; Weller 2008 and Sampath and Krishnamoorthy, 2010). The most abundant and spectacular winter migrants to the Indian sub-continent are the ducks and waders that constitute 85 per cent of migrant winter bird populations (Alfred et al., 2001).The Indian sub-continent supports more than 1200 species of birds, which contribute more than 15% of the world’s bird species (Salim Ali, 2002).

Most studies on water-birds and their habitats on managed wetlands focus on species richness and abundance/density of water-birds, which reflect habitat use by water-birds. Species richness, population abundance and the derived indexes (Wolter et al., 2005) are also generally used as succession criteria in evaluating wetland restoration (Neckles et al., 2002; Konisky et al., 2006). Habitat use, however, might not correctly reflect the habitat requirements of water-birds or the quality of wetland habitats (Van Horne, 2003).

Beecher, (2002) found a correlation between physical characteristics of wetland vegetation to aquatic birds. Haramis et al., (2006) reported that suitable habitats provide foods required by wintering waterfowls and allow birds to maintain a favourable energy balance.

Kantrud, (2006) stated that wetlands near agricultural areas often became highly eutrophic from barnyard and feedlot runoff water. He also reported that dissolved salts and residues from agricultural chemicals moved into wetlands and irrigation practices altered the hydrology and vegetation of the wetlands, which affects the value of wetlands to the waterfowls and other birds.

Chughtai, (2009) studied the limnological study of Rohi nallah and noted a significant decrease in total hardness, total alkalinity, total dissolve solids and conductivity which might have been result of dilution of pond by the rain.

Davis et al., (2006) found that an increase in water hardness significantly increased the iron, manganese and nickel in water. Water quality affects the abundance, species composition, stability, productivity and physiological condition of indigenous populations of aquatic communities. Therefore, the nature and health of the aquatic communities is an expression of the quality of water.

Organisms like plankton are highly sensitive to temperature changes. Green algae grow best between 30 – 35^{o}C. Heated water affects the oxygen supply of a water body. Warmer water holds less oxygen than cooler water. Some organisms are indirectly affected by an increase in temperature because they cannot tolerate the lower oxygen content of water (McKinney and Schoch, 2008).

Hutchinson, (2007) stated that “a deficiency of phosphorus is more likely to limit the productivity of any region of earth’s surface than the deficiency of any other metal”. Nilsson and Nilsson, (2008) stated that phosphorus in the bottom soil to be the best

predictor of waterbird density as it is directly related to lake productivity. Patrick and Reimer, (2006) reported phytoplankton as an important indicator of pollution. Fogg et al., (2003) stated that algal growth was particularly abundant in alkaline water. Lenihen and Fletcher, (2008) reported that uncontrolled discharge of effluents could reduce the variety of aquatic life to the point at which it became septic and completely unacceptable for most purposes.

Fishes and invertebrates exposed to organic contaminants may be induced to produce higher levels of enzymes capable of transferring many contaminants to occasionally more toxic metabolites (Conner and Huggett, 2008). Greeson and Clark, (2004), reported wetland importance ecologically and studied factors such as hunting, trapping and fishing.

Water birds use diverse foods, including seeds (dabbling ducks, cranes), leaves (geese), tubers and rhizomes (geese, swans), invertebrates (shorebirds, waterfowl) and some vertebrates, such as fish and amphibians (wading birds), the amounts, composition and spatiotemporal dynamics of these foods largely affect the use of foraging habitats by water birds and can be important indicators of habitat quality

Abundant food attracts large numbers of water-birds and is important for the formation of water bird colonies in breeding periods (Bancroft et al., 2004). However, increasing food for water birds through wetland management can be difficult. Although the enhancement of nitrogen and phosphorous levels in water bodies increases productivity (Frost et al., 2009), which improves the species richness and abundance of waters .

RESEARCH METHODOLOGY

Population Studies

Total counts of water bird densities were made for the entire lake once in a week. Assistance of local volunteers was also obtained during the census operations. Field binoculars (7 x 50") were used to observe birds from all sides of the lake. The birds were identified with the help of their special features. The water birds were categorically grouped into five categories on the basis of their activities as diving birds, swimming birds, small waders, large waders and aerial foragers.

(I) Diving birds

Medium to large sized water birds having stream-lined body with legs set far back. They are experts in diving and well adapted to dive and catch aquatic prey. e.g. Little Grebes, Cormorants, Coots.

(II) Swimming birds

Birds those are associated with the surface of the water column. e.g. Spot-bill Duck.

(III) Small waders

Small birds of shallow open expanses of water such as Pheasant-tailed jacana.

(IV) Large waders

Large, long legged birds that wade into the shallow water in search of prey e.g. Egrets, Herons

(V) Aerial foragers

Birds that search for prey by flying over the water surface and diving from air to capture individual prey items. e.g. Terns

Determination of water quality factors

The following water quality factors were measured once in a week from three stations in each region of the lake.

1. Physical Factors

1.1 Temperature

Surface water temperature was measured at 7.00 a.m. Temperature was measured with a standard hand held centigrade thermometer from all the 9 stations of 3 regions. Water temperature was measured 0.1 m below the water level.

1.2 Chemical Factors of water samples

Ten chemical variables were measured in the water samples i.e. pH, dissolved oxygen, salinity, silicate, nitrite, nitrate, phosphate, sulphate, calcium and chloride. The water samples for water chemistry measurements were collected from 9 stations of 3 regions in separate water cans (1 litre capacity) and were analyzed separately.

CONCLUSION

The water quality factors studied included surface water temperature, pH, dissolved oxygen, salinity, nitrite, nitrate, phosphate, silicate, calcium, chloride and sulphate. The bottom soil parameters studied included mud electrical conductivity, soil pH, nitrogen, phosphorus and potassium. All the water quality and soil quality variable showed month-wise, season-wise, year-wise variations and significantly influenced one or more water bird population characteristics, as inferred from the multiple regression models developed. Water temperature influences the species richness of total water birds. Dissolved oxygen

influences the species richness and diversity of total birds. Salinity influences the species richness and diversity of total water birds. Phosphate influences the density of total water birds. Sulphate influences the density of total water birds. Calcium of the lake water influences the density of total water birds. Chloride influences the density of total water birds recorded in the present study. The Soil pH influences the density of total water birds. Soil Nitrogen influences the density of total water birds.

It was inferred that the physico-chemical features of the lake water and sediment influenced the productivity, availability and accessibility of the prey item and thereby the water bird population characteristics of the lake.

The biological parameters studied included plankton volume, biomass of annelid worms and biomass of benthic molluscs, all of which varied significantly month-wise, season-wise and year-wise. Multiple regression analysis showed that benthic molluscan biomass of the lake soil influences the density, diversity and species richness of total water birds. Plankton availability influences the Species richness and diversity of total water birds.

Major threats recorded were conflicts with irrigation, water quality, fishing, siltation, weed (Ipomoea) invasion, encroachment, poaching of birds, cattle grazing, cattle washing, fuel wood collection and agricultural pollution. The consequences of these threats on the water birds on this lake have been discussed and management suggestions for the conservation and sustainable use of the lake and its resources have been given.

The precautions include proper maintenance of water quality, desalting, weed removal, prevention of encroachment, cattle grazing and cattle washing, prevention of pesticide pollution and educating the public by awareness campaigns. The lake has high potentials for ecotourism, which should be exploited.

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