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Introduction

Biodiversity of birds is an important topic to learn about wetland ecology. Birds are used as an indicator of environmental changes due to their sensitivity to environmental variables. Study of bird community explains why some species are abundant and others are rare within communities in the area (Andrewartha and Birch, 1954; Krebs, 1972; Juanes, 1986; Cotgreave and Harve, 1991, 1992). Different parts of geographical area may have different types of avifauna related to their ecological and environmental factors such as physical, chemical, climatic and biotic and abiotic factors which directly or indirectly affects the wetlands and waterbirds communities.

Wetlands

Historically, a habitat can be defined as simply the home of living organism (Hanski, 2005). The term ‘wetland’ refers to low land logged with shallow and sometimes temporary or intermittent water. The various reservoirs, shallow ponds and numerous dams and tanks support wetland biodiversity and riches the country’s wetland wealth. Wetlands have always been human pre-occupational places in arid and semi-arid areas. As far as my knowledge is concerned there are no specific attempts made by national level for the conservation of wetlands in the region now occupied by India prior to or during the British Colonial Administration of the Indian sub-continent. Early inventory research work tended to be confined to readily accessible wetland sites. In 1980, IUCN complied a Directory of wetlands which were internationally important in the Western Palearctic. This was followed by The International Council for Bird Preservation’s Preliminary Inventory of Wetlands in East Asia. (Karpowicz, 1985). The Directory of Asian Wetlands prepared by Scott, (1989). Scott and Poole (1989) subsequently compiled “An Overview of Important Wetlands in Asia.” It is estimated that freshwater wetlands alone support 20% of the known range of wetland biodiversity in India (Deepa and Ramachandra, 1999). Wetland in India occupies 58.2 million ha area including areas under wet paddy cultivation (Directory of Indian Wetland, 1993).
Many wetland areas are providing important habitat for many types of waterbirds, these species can be affected by changing in alteration use of wetlands due to land use. Multby (1988) has pointed out that degradation of wetland habitat in the developing world at an alarming rate. Many threatened and endangered bird species are totally dependent on wetland habitats but degradation of wetlands may be harmful for their survival. The most important role of this habitat is for breeding, feeding, migration and wintering population of shorebirds (Ahmed, 1983).

**Habitat Structure**

Ecologists have studied the population of many species of birds and viewed that there is a change in their habitats (Fitzpatrick, 2004). Habitat selection patterns have also been studied in wetland ecology and some suggestions made by ecologists. Mc Caskle, G. (1970) suggested that shorebirds and waterbirds use sea for feeding. Weller, (1999) suggests for wetland birds that the amount of open water in a wetland or wetland complex is important for habitat selection. Murkin et al., (1997) studied habitat selection by birds in prairie wetlands over a period of ten years. Loss of habitat or its degradation through changing of management purpose wetlands has been clearly linked to the population decline (Green et al., 1997). Paracuellos and Telleria, (2004) found that structural features of a wetland are important in addition to size and geographic location. They found that avian richness increased with wetland size and suggests that this correlation due to the tendency of habitat heterogeneity to increase with wetland area. Riffel et al., (2006) also found heterogeneity to be important in wetland diversity. Martin and Possingham, (2005) suggests that habitat structure is a major determinant of bird species diversity in agriculture landscapes. Wilson et al., (2004) also suggests that another main casual factor in recent declines of avian agricultural population is that of increased predation rates due to homogeneous swards in the area.

**Waterbirds**

Waterbirds is major group of birds which are indicators of wetlands. They are important biomass for wetland ecology. Their population may affects the diversity of wetlands in specific area.

**Waterbirds Population dynamics**

Waterbirds population is important criteria to evaluate the wetland ecology and productivity. Day by day the total population including migratory
Some bird species in India may decline rapidly and some bird’s species becomes endangered or critically endangered in since last few years due to alarming rate of degradation of wetland areas in India.

Findlay and Houlahan, (1997) found that wetland bird species richness decreased with density of paved roads but in contrast, Findlay and Bourdages, (2000) found that species richness is not very sensitive to paved road density. Wetland connectedness is the most significant predictor of species richness of birds in wetlands, the connectedness as contiguous polygon or relatively un-impacted land over surrounding the wetland site (White et al., 2000). Engelhardt and Richie, (2001) also hypothesized that with higher vegetation species richness more wildlife could be supported in wetland area. They were founded higher overall biomass in wetland area with a greater diversity of vascular plants.

Evenness is a measure of the abundance pattern within communities; which may vary among communities in ways that biotic or abiotic difference. While species of largest body size have lower abundance within communities (Damuth, 1981, 1987; Brown and Maurer, 1986; Jaunes, 1986; Cotgreave and Harvey, 1992). Environmental features of community, including habitat type and latitude can also be associated with differences in evenness (Nee et al., 1992). Evenness varies with habitat type, with communities occurring in specific complex habitats, such as tropical forest being more even in their abundance distribution than communities in very simple habitats (Peet, 1974; Maugurran, 1988). The variance in body size, the degree of colonially or the species-richness of a taxon might affects its evenness. Moreover if it is true competition is important in determining abundance patterns among species within phylogenetic linkages (Nee et al., 1991), Competition may also help to explain variation in evenness among taxa and communities.

**Birds and Bird’s Behavior**

Birds are known as glorified reptiles with feathers, evolved probably about 200 million years ago and the earliest known fossil bird was *Protoavis*; in spite of, famous *Archaeopteryx* was estimated to be 130 million years old. During the early Tertiary period, 65 million years ago during the Ecocene geologic epoch, there was evidence that a great land mass split off from the continent of Africa and drifted across what is now the Indian Ocean and this island was known as Gondwana. Eventually Gondwana land collided with Asia and during a great upheaval in the middle part of the Eocene epoch, 50 million years ago. The Himalayan regions were partly thrust up above the sea, creating a land bridge between south-east Asia and Gondwana, particularly in the Malaysian region. It was through this land bridge that most of the truly Oriental faunal mammals and birds were thought to have colonized or invaded Gondwana land or the Indian subcontinent. The Oriental faunal zone is the name given by zoogeographers to one of the earth’s six major faunal regions (Sclater, 1858), which are characterized by having certain homogeneity of their bird and mammal fauna.

During the late Pliocene, less than 4.5 to 3 million years ago, smaller upheavals or movements of tectonic plates were thought to have created an up lifting of the Himalayan foothill zone and thus produced the region known as Siwalik. These areas were originally sedimentary deposits laid down 25 million years ago by great rivers such as the richest source of fossil remains, which is fortunate for zoogeographers, as the Siwalik beds in the Punjab Salt range have revealed an amazing variety of fossil remains. Up to 1978, scientists from the University of Yale and Peabody Museum expeditions were conducting excavations in the Salt Range have located at least 7 bird’s species. These dating mostly from 30 million years ago (Miocene deposits) represent families of primitive non-passerines which still have their present day counterparts. This includes a Pelican, two Stork, a Pheasant, and two Rail species. These species were confirmed to be the ancestors of present day birds (Robert, 1991).

Wetland’s Hydrology and morphometric studies of lakes, physical feature and topography (Gopal and Sharma, 1994; Ram, 1994) were described in detail in their reports.
Pospahala et al., (1974) studied that the intensive agriculture can severely effect on duck population in the presence of an adequate wetland base. Frayer et al., (1983) and Tinner, (1984) have estimated in California Iowa, over 90% of the original wetlands have disappeared and it is largely due to the wetland drainage for agricultural expansion. Lane and Munro, (1983) reviewed on rainfall and wetlands in the southwest of Western Australia. They explained the water level affected by rainfall and the attraction of waterbirds species towards the wetlands.

Kantrud, (1986) 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 wetland and irrigation practices altered the hydrology and aquatic vegetation of the wetlands, which affects the value of wetlands to the waterfowls and other birds. Paulus, (1988) is of the view that energy relationships between a bird and its habitat, as reflected in its body condition relative to other individuals mediated through the time activity budget of the bird.

Studies are available about the conservation efforts and management of wetlands and waterbirds. Some of the workers gave a special emphasis to these management issues like Bellrose and Low, 1978; Addy and MacNamara, 1948; Burger, 1973; Oetting, 1982; Britton, 1982; Fredrickson and Reid, 1988b; Larsson, 1982; Stotts, 1971. Adamus et al., (1987) has developed wetlands evaluation techniques, Carey and Gill, 1983, studied habitat improvement of wetlands. Cooke, (1988), evaluated lake and reservoir restoration and management techniques. Ecology and management implication of lakes were reviewed by Cook et al., 1986; Duebbert, 1969; Eckert et al., 1978; Piehl, 1986; Weller, 1978; Virkala and Liehu, 1990. Crowder and Bristow, (1988) studied that eutrophication, water pollution and sediment load act synergistically to cause deterioration of wetland habitat. Moore and Guan, 1999); Lehman et al., 1997, develop GIS database for Lake Ecosystem. Detailed study of bird’s habitat, breeding and protected areas was made by Jarvinen and Koskimies, (1990). Grigorieve, (2000) studied that the farming practices such as drainage and intensive crop production through run-off are major contributors to sediment load and eutrophication. Chaudhary, (1992) in a supplementary report stated that due to drainage, the water level of lake is decreasing rapidly.

Lind, 1979 and Verry, 1985b carried out Limnological studies for wetlands. Kentard and Styner, (1979) estimated agricultural run-off from the
catchments area of lakes. (Chugtai, 1979; Mason, D. 1967) studied the Limnological study of lake and noted a significant decrease in total hardness, total alkalinity, total dissolved solids and conductivity which might have been result of dilution of pond water by the rain.

Patrick and Reimer, (1966) reported Phytoplankton as an important indicator of pollution. Fogg et al., (1973) stated that algal growth was particular abundant in alkaline water. Davis et al., (1976) found that an increased in water hardness significantly increased the iron, manganese and nickel in water.

Migration

One of the most spectacular events concerned with bird life is migration. It has intrigued mankind for many centuries. Man has looked up in wonder as clouds of migrating birds darken the skies (Kotpal, R.L. 1976). In a broad sense, “Migration”, as defined by Cahn, (1935), is “A periodic passing of animals from one place to another.” It means a regular, periodic, to-and fro movements of a population of some birds and animals between their summer and winter homes, or from a breeding and nesting place to a feeding and resting place. The distances travelled by migratory birds depend upon local conditions and the species concerned and the journeys are generally recorded by “Banding” or “Ringing.” Several species of migratory birds shows a striking regularity, year after year, in their timings of arrival and departure. And a point which it is important to remember that this is not something which happens just once but, with minor variations, year after year and as far as we know, century after century. Small wonder that bird’s migration regarded as one of the marvels of the universe forever (Robert Spencer, 1963).

Feeding behavior

Feeding in bird’s life is most important activity and it performed by foraging. One important point about habitat structure and foraging in the way in which perceive cover, proximity to cover can have effects on a prey animal, it can provide a hiding place and protection from an attack of enemies or predators, but it can also obstruct their view of approaching predators (Lazarur and Symonds, 1992).

A guild is defined as a group of species that exploit the same class of environmental resources in similar way (Root, 1967). According to listing given by Bennet seven feeding guilds were represented namely folivores, frugivore (including grainivores), insectivores, herbivous, carnivores, and omnivores. But in case of
waterbirds there are four groups: carnivores, omnivores, insectivores and herbivores were represented. Guild structure has been shown to effect species abundances (Jaunes, 1986; Cotgreave and Harvey, 1992). The availability of food appears to be one of the major factor determining the birds numbers and species diversity of specific urban area (Prajapati et al., 2008).

Weather affects the metabolic rate of the birds. It also exerts either indirect or direct effects on bird’s behavior. For example, it can influence foraging conditions and the ability to carry out other essential behavior such as courtship. Weather also impacts on breeding success. For example, chilling or starvation of the young (Newton, 1998). Beecher, (1942) found a correlation between physical characteristics of wetland vegetation to aquatic birds. Haramis et al., (1986) reported that suitable habitats were provide foods required for wintering waterfowls and allow birds to maintain a favorable energy balance. Kantrud, (1986) stated that wetlands near agricultural area often became highly eutrophic from barnyard and feedlot runoff of rainy water.

Zooplankton plays a central role in aquatic ecosystem relative to phytoplankton and higher tropical levels (Banse, 1995). Organisms like plankton are highly sensitive to temperature changes. Some organisms are indirectly affected by an increase in temperature because they cannot tolerate the lower oxygen level of water (McKinney and Schoch, 1998).

Feeding behavior and the relation of foraging group size towards feeding activity in animals have attracted considerable theoretical and observational attention during the last decade (Ellies et al., 1976; Pyke et al., 1977; Krebs, 1978). Nektonic and benthic invertebrates are preferred as prey by most dabbling ducks, especially in spring and in early summer in response to increased nutritional demands for migration and breeding (Batt et al., 1992). According to the principal food component in agro ecosystem, maximum bird species were found to depend on vegetable matters as their main food, followed by insects (Patel, 2008).

**Breeding Behavior**

Reproductive success in birds is influenced by a variety of factors which differ widely among species (Newton, 1989). Although nest predation is often believed to be the most important factor of these variables (Ricklefts, 1969; McCleery and Perrins, 1991), weather condition may also play a key role (Elkins, 1983).
Increased vegetation density and heterogeneity may reduce nest predation rates both increased nest crypsis (Newton, 1998). Local aggregation such as colonial nesting in birds, might also lead to an over-abundance of some species (Preston, 1962), which will affect evenness. Picman *et al.*, (1993) studied predation on passerine nest in marshes. One of the benefits of nesting in marshes may be reduced nest predation rate. When choosing a nest site, some birds may select habitat patches (Martin and Roper, 1988) that improve their chances of successful fledging of young. For example, large shrub patches may contain more potential nest sites for a visual searching predator to investigate (Martin and Roper, 1988) and more effectively screen nests and the actions of parents may faster than smaller patches (Holway, 1991).

**Vegetation and Bird Community**

Vegetation plays an important role in the life of birds. Phenology of different plant species is influence by the environment (Oosting, 1958). Vegetation has long been thought to be major factor in determining bird community composition (Terborgh *et al.*, 1990; Wiens, 1992). Engelhardt and Richie, (2001) also hypothesized that with higher vegetation species richness, more wildlife could be supported in wetlands. They found higher overall biomass in wetlands with a greater diversity of vascular plants. Birds may use certain plant species preferentially and that this can be important in understanding pattern of avian community structure (Holmes and Robinson, 1981). Bird’s species occurrence on specific habitat in each area was related to vegetation type (Gaston, 1978; Synder, 1950) and abundance was related to availability of food (Lack, 1954). Birds constitute an important component of agro-ecosystem and their pestiferous roles have been copiously studied. (Ali, 1949, 1971; Ripley, 1982; Ward, 1965; Mehrotra and Bhatnagar, 1979; Murton and Wright, 1968; Grist and Lever, 1969; Dyer and Ward, 1977). Different uses of plant species by birds has been generally discounted as an important influence of avian resource utilization or community structure (Holmes *et al.*, 1979).

**Effects of climatic and Physico-chemical factors on Avifauna and Planktons**

There is already compelling evidence that animals and plants have been affected by recent climate changes in breeding performance of birds (egg size, nesting success), flowering seasons of plants, change in population sizes, change in
selections differentials between components of a population (Parmesan and Yohe, 2003, Root et al., 2003). Patrick and Reimer, (1966) reported Phytoplankton as an important indicator of wetland’s water pollution. Fogg et al., (1973) stated that algal growth was particularly abundant in alkaline water.

Agriculture can also have effects on wetlands and on wetland birds or waterbirds. The runoff chemicals and sediments in to wetlands from agricultural fields is one of the largest causes of wetland degradation (Stewart, 1999). Gleason et al., (2003) found that sediment loading in wetlands can affect populations of plants and insects in the wetland area. The increased use of herbicides and pesticides has reduced food availability for birds by removing suitable food supplies found on cultivated and wide uncultivated grassy margins in and around fields. Steen et al., (2006) suggested that hydrological change in wetlands in the Great pond region could have large effect on bird communities. The lowering water levels 10 cm below the traditional level significantly increase the number of species and individuals that used a wetland (Taff et al., 2002).

In a study of the impacts of vegetation on bird communities in western Sikkim, India, Chettri et al., (2005) found that there was a significant correlation between bird species richness and tree diversity.

**Overgrazing**

Overgrazing may cause decreases in primary productivity of wetland (Reinold et al., 1975). Cattle grazing in and outer areas of wetland may decrease productivity, insect population that affects food availability of birds and destructs habitats of ground nester. Generally buffaloes, cows, goats and other animals grazing on the pitch areas of the wetlands and destroyed some habitats of birds and insects.