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Macrophytic community architecture a key determinant of avifaunal diversity and distribution in Kashmir Himalayan wetlands

Suzana Bashir[1] , Azra N Kamili[2], M.A.Shah[3]

ABSTRACT

Macrophyte communities comprise of emergents, rooted floating leaf type, free floating and submerged types in the wetlands of Kashmir valley together with a few tree species generally characterise the vegetation of these wetlands. The geomorphology, environmental conditions and biotic interactions influence the macrophytes in the wetland system which in turn significantly influences the habitability of resident and migratory bird species in these systems. More than 100 species of wetland plants are found growing in the floodplain wetlands of Kashmir Himalaya including Hokersar, Mirgund, Shallabugh, Gilsar, Khushalsar, Anchar, Chatlam and Haigam. Here we report the nesting pattern of bird species in the vegetation of the wetland and relationship pattern of bird occurrence and the types of growth form of the macrophytes. In view of the growing anthropogenic pressures, climate change and plant invasions , the macrophyte diversity and distribution pattern has changed over time with a strong bearing on the avifaunal communities. We call for a need to arrest growing plant invasions through restoration of native plant communities for improving the habitat and diversity of resident and migratory bird communities.

Key Words:Wetland plants, diversity, macrophytic assemblages, resident birds, non-resident birds, nesting preferences

I.INTRODUCTION

Wetlands influence human society by providing many vital ecosystem services which depends on plant diversity and its influences on biomass production and nutrient retention (Yoshimura et al 2000). Wetlands cover less than 9% of the earth's surface yet they contribute greatly to the globe's ecosystem services and harbour rich biodiversity (Zedler and Kercher, 2005). The origin of the living organisms linked with wetlands has been found to be due to high biological productivity of these ecosystems and their ephemeral nature characterised by the presence of resident and migratory species from adjacent terrestrial or aquatic environments (Gopal and Junk,2000). Macrophyte diversity in wetlands influences the service efficacy of the wetlands , such as sustainable production of food, water purification by retention of pollutants and sediments (Nagasaka et al 2002) and it has also been found to play a role in organic matter decomposition and nutrients cycling. According to Sondergaard (2013) submerged macrophyte communities and the microflora adhered to them are

essential in structuring microbial metabolism and biogeochemical cycling at the ecosystem level of organisation. The wetland vegetation also supports multifarious wildlife including birds (Brix 1994). Herbivory on living biomass is likely as important for macrophytes as for terrestrial plants (Lodge 1991). One or few macrophyte species dominate most of the wetlands and these plants provide habitats and chemical conditions suitable for a wide range of vegetal, faunal and microbial survival (Viaroli et al 2016). The abiotic requirements for the macrophytes, such as light and nutrient availability or shelter from the wind are recently reviewed in Bornette and Puijalon (2011The increasing process of wetland degradation (e.g., fragmentation, flood control and rice field expansion) is posing a threat to the conservation of aquatic plant species. When established in a wetland aquatic macrophytes can influence the wetland ecosystem in many ways and intervene in various biotic processes. The number of wetlands is decreasing due to agricultural and urban development and the number of waterbirds is decreasing pushing their long term preservation to a precarious position (Chappius et al 2011). Studds et al.(2012) also showed that water quality of lakes and wetlands is being affected by anthropogenic activities and which resulted in a decrease there in the population of specialist birds.

In a wetland ecosystem, macrophytes have three important roles to play:

- Macrophytes effect the physical and chemical composition of water and sediment;
- It has an important role to play in production and processing of organic matter and nutrient cycling and ;
- macrophytes form the community structure and thus provide structural habitat to the biota.

This study gathers the results obtained from several studies carried over the last 15 years to identify the spatial and temporal dynamics of macrophytes in wetlands of Kashmir valley and investigate the effects on the breeding biology of the birds in one of the wetlands i.e., Hokersar wetland.

II. METHODS

The vegetation survey was carried out in the wetlands. Macrophytes were collected and identified as per guidelines of Tomovic et al, (2001) . Quadrats of 1 sqmt area were sampled at random on monthly basis from all the wetlands. Bird surveys were conducted during the breeding season in Hokersar wetland. The waterbody was divided into subunits and population of birds was estimated once every two weeks by visual census and transect method (Gaston 1975,1994). Boat visits were carried out and the study areas were searched for nests during the breeding season. Nest monitoring was done to measure the reproductive success , for their preffered habitat and behavioural clues.

III. RESULTS

The present investigation revealed the presence of more than 100 species of macrophytes. The assemblage of aquatic macrophytes in wetlands of Kashmir valley is represented by a variety of biological types (submerged,rooted floating, free floating and emergent), out of the identified species 26 were emergent, 31 were

rooted floating 27 were submerged and 18 were free floating . The 29 species are dominant in these wetlands and in this group, cyperaceae, and asteraceae are outstanding families.

Overall 22 bird species including both resident and non-resident,were recorded from the wetland. 12 bird species breeding in the wetland were found in or around the wetland and exploited it for various purposes. During the present study nesting behaviour, nesting preferences and the type and degree of habitat use by birds were investigated.

On the basis of the nesting behaviour the birds could be grouped under the following categories;

Birds nesting in the emergent vegetation were Indian Moorhen (*Gallinula chloropus* L), Indian Whiskered Tern (*Chlidonius hybrid indica* Stephen), Indian Great Reed Warbler (*Acrocephalus stentorius brunnescens* Jerdon), Pheasant Tailed Jacana (*Hydrophasianus chirurgus Scopoli*) and Little Bittern(*Ixobrychus minutus minutus* L). Little Ringed Plover(*Charadrius dubius Scopoli*), Common or fantail Snipe(*Gallinago gallinago* L), Pied Kingfisher(*Ceryle rudis* L) and Little Grebe(*Tachybaptus ruficollis* Pallas) were found nesting in marshes whileas Starling (*Sturnus vulgarisL*),Little Egret (*Egretta garzetta* L) and Mallard *(Anas platyrhynchos* L) nested in the willows.

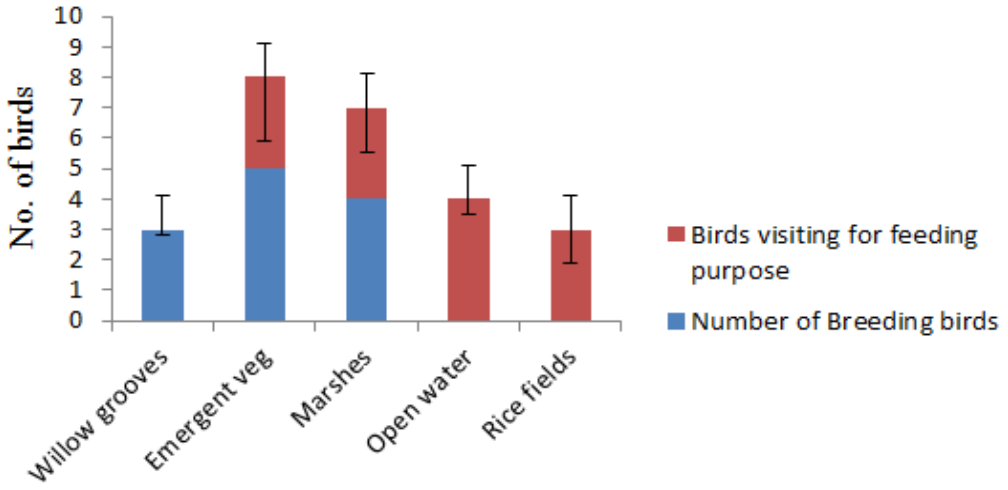
Table, Total number of nests recorded of each species of birds

	Bird	Total number of nests	%age of nests
1.	Pheasant tailed Jacana	2	4%
2.	Snipe	2	4%
3.	Moorhen	22	44%
4.	Kingfisher	2	4%
5.	Reed warbler	6	12%
6.	Little Grebe	4	8%
7.	Plover	1	2%
8.	Little Bittern	2	4%
9.	Whiskered Tern	1	2%
10.	Mallard	1	2%
11.	Common Starling	4	8%
12.	little Egret	3	6%

Several other bird species were observed in the open water zone (submerged vegetation and surface floating vegetation zone). These include Asiatic Cuckoo (*Cuculus canorus*), Central Asian Kingfisher(*Alcedo athis*), Coot (*Fulica atra*) and Common Swallow(*Hrundo rustica*). Birds seen in the adjacent rice fields were Little Egret (*Bubulcus ibis*), Pond Heron (*Ardeola grayii*) and European Hoopoe *(Upupa epops*). Grey Heron (*Ardea*

cinerea), Hodgsons Pied Wagtail (*Motacilla alba*) and Kashmir Grey Tit (*Parus major*) was seen in marshes and reeds. Main purpose of these birds visiting the different habitat conditions is food.

Out of all the nesting birds found in Hokersar wetland 6 species were summer migrants, five were resident birds and one species viz Mallard was a winter migrant. A few of the bird species found nesting in the Hokersar wetland showed habitat specificity. Reed Warbler preffered the Emergent vegetation zone while Faintail Snipe, Little Grebe preffered the marshes , Starling preferred the willow grooves for making their nests. The Ringed Plover and pied Kingfisher were found nesting along the mudbanks. Starling , Little Egret and Mallard preffered the willow zone. The Indian Moorhen , was breeding in the emergent vegetation as well as in willows. Maximum macrophytic density was recorded from emergent vegetation zone and marshes zone, there is a positive correlation between macrophytic density and number of bird species found breeding or feeding in different vegetation zones. The vegetation cover was maximum i.e., 93% in emergent vegetation zone followed by marshes with a cover of 71% and willow grooves with a cover of 53%. A positive correlation was found between vegetation cover and number of bird species breeding in the different vegetation zones. Majority of nests i.e., 58 % were surrounded by vegetation 35-65cm height, 26% of nests were found in vegetation less than 35cm height and 16% of nests were observed in the vegetation more than 65cm in height.



Fig; Number of birds observed in Hokersar wetland in different vegetation zones

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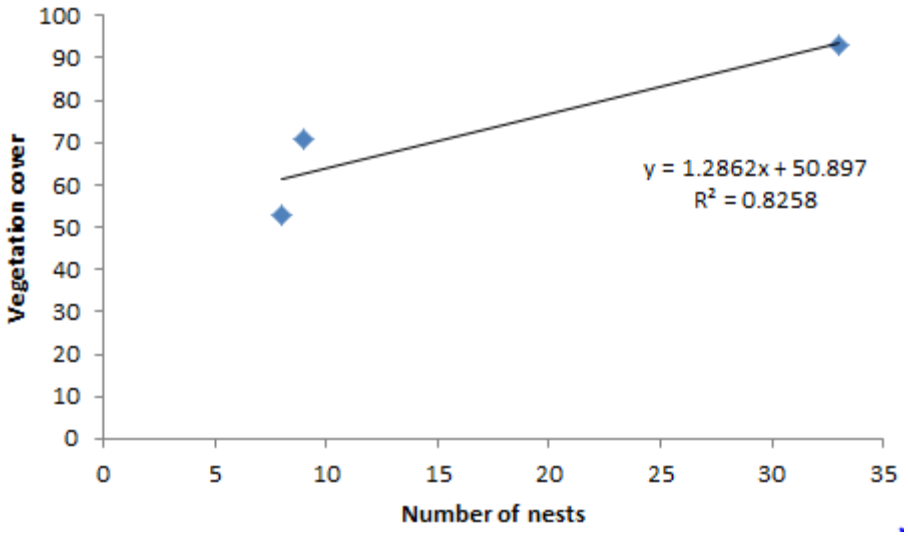

Fig 2: Showing correlation between total number of nests of birds species with vegetation cover in different vegetation zones.

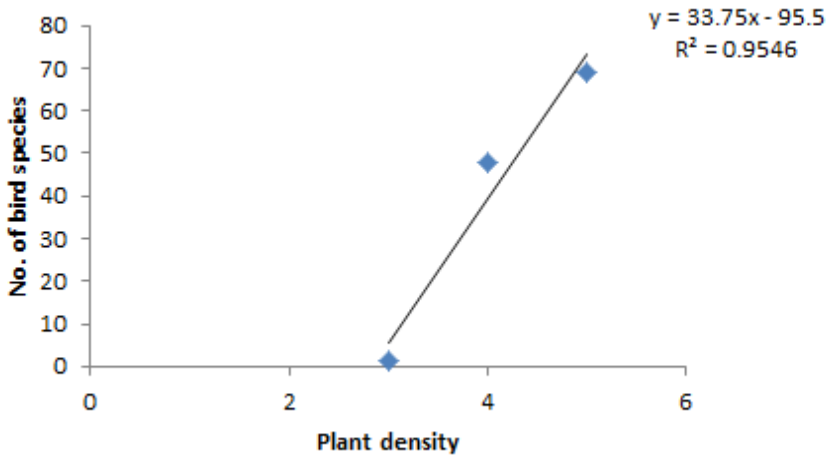

Fig:3 Showing correlation between number of bird species breeding with plant density found in different vegetation zones.

IV.DISCUSSION

There are two types of macrophytic vegetation found in Kashmir wetlands. Aquatic macrophytes are plants that live either completely immersed or floating or have some small portion of the plant emerging from the water. They may be adhered for example *Trapa* spp, *Potamogeton* spp or unadhered to the sediment for example, *Lemna* spp or *Salvinia natans*. Emergent macrophytes are wetland plants which are always rooted in the sediment and whose growth habit results in the plant protruding above the water surface. For example, *Typha angustata, Phragmites australis, Sparganium erectum*

Our results indicate that the macrophytic community architecture is an important determinant of bird communities in the Hokersar wetland. There are several factors that determine the wetland plant community composition like climate, soil texture, position in the landscape and other competitive factors among the plant species. Wetlands are dynamic ecosystems that can combat natural variations in both water level and water quality. As a result within a single year some wetland plants are able to resist both flooding and drought .

As a rule, submerged macrophytes will grow to a depth of two to three times the secchi depth (Canfield et al., 1985; Chambers and Kalff, 1985). In lakes and wetlands with small or large areas , macrophytic growth will be limited where the lake bottom exceeds the above secchi depth. The submerged aquatic macrophytes will be absent where the secchi depth is less than 0.5m. Lakes with a water depth of 10-15m are not expected to have abundant submerged aquatic macrophytes. Emergent and floating –leaved macrophytes occasionally grow in waters having a depth of more than 3m (Canfield and Hoyer, 1992). The area of littoral zone suitable for growth of emergent vegetation decreases with elevated slope of the basin as can be witnessed in our valley lakes, Dal, Manasbal and Wular lake.

Duarte et al (1986) concluded that in small lakes submerged macrophytes are of more importance and with increasing lake size the emergent will become important , but an opposite transition from submergents' dominance to that of emergent vegetation is the part of the natural process of lake succession, witnessed in Kashmir wetlands viz, Hokersar, Gilsar, Anchar, Khushalsar. The aggregation of macrophyte detritus further restrains the growth of submerged macrophytes and enhances the transition to emergent vegetation (Carpenter 1981; Barko and Smart 1983;Wetzel 1979). Established in a lake, aquatic macrophytes influence the lake ecosystem in several ways and bring about biotic interactions (Crowder and Cooper,1982). Emergent macrophtes reproduce by either vegetative means which is much more common and rapid or by the production of seeds. It involves growth of a below ground rhizome which grows parallel to the ground and produces a clone of its parents a short distance away. This mechanism helps emergent plant populations to change their distribution in response to changes in the wetlands hydrological regime. *Sparganium erectum* is a dominant emergent plant species in various wetlands of Kashmir valley as it is able to withstand changes in water levels with recruitment of new individuals either upslope or downslope in response to higher or lower water levels. Common wetland tree species growing in valley wetlands such as *salix sp* and *Populus alba* can tolerate several years of continuous inundation and they reproduce by the production and dispersion of seeds.).

Multifarious macrophytic assembalges in Hokersar is favouring habitation of diverse species of birds there. Varied types of vegetations , low emerging plants and mudflat wetlands supported higher species richness and density of breeders , migrants visitors than the other wetland types (Wang et al 2016).

V. CONCLUSION

In wetlands, small and shallow lakes macrophytes have significant effects on the physico-chemical condition of the water and sediments and have an effect on the lake productivity as well as on biotic interactions.

In the present study the emergent vegetation zone is the most preffered site followed by marshes for breeding and foraging by birds whileas open water area is visited by birds for feeding purpose. Since these birds depend on the food provided by various plants. The vegetation preffered by various birds as food include , *Nymphoides peltata, Trapa sp, Chara sp, Phragmites australis, Sparganium erectum, Ceratophyllum demersum* etc

A comparison of the plant biomass during the present study indicated that feeding activity of the birds had an impact on the plant community in the wetlands. Dwindling population of Phragmites in the wetlands may be attributed to the fact that it is the favourite food plant of the geese. *Sagittaria* and *Alisma* roots (tubers) have become rare in the wetlands , it is probable herbivory in unison with changing ecology of the wetland resulted in the population decrease of these plants. Birds feeding on seeds and fruits of *Phragmites australis, Sparganium ramosum, Trapa natans, Carex sp, Scirpus sp, Juncus sp* ,etc. have affected the reproduction and hence the production of these plants .The changing ecological conditions of the wetlands are quite suitable for the growth and development of the thick population of these plants. Still their population is rather limited. This seems to be directly related to foraging behaviour of the birds. It may therefore be inferred that bird foraging has kept the population of certain plants under check despite of the suitable ecological conditions. *Sparganium erectum* a macrophyte species is creating problems in wetlands of Kashmir valley. Changes in hydrology , nutrient enrichment and disturbances have increased its distribution and abundance in several wetlands of the valley.

Minimizing human interference , weed control, maintaining hydrology of wetlands by controlling inflow and outflow of water is important to protect native wetland vegetation to maintain the habitat complexity and diversity created by assemblages of macrophytes so as to provide a suitable habitat for the native flora and fauna**.**

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