



RESEARCH ARTICLE

BIRD COMMUNITY STRUCTURE AND FACTORS AFFECTING THE AVIFAUNA OF HOKERSAR
WETLAND KASHMIR

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ABSTRACT

The avifaunal diversity of Hokersar wetland was studied for a period of one year from December 2012 to December 2013. The objective of the present study was to evaluate the diversity and distribution of species in and around the wetland. A total of 58 species were recorded belonging to 27 families from 7 different habitats. Family Anatidae shows maximum species diversity. Among the recorded species (41%) were resident, summer migrant (28%), winter migrant (21%), and local migrant (10%). Open water habitat supports most of the winter migrant birds and plantation supports most of the summer migrant species. Most of the species belong to insectivorous category (45%) and most of the waterfowl species were herbivorous (14%). The vegetation structure and diversity of habitats provide food and shelter for thousands of waterfowl in winter. The main threats responsible for the destruction of the wetland are invasive plants, eutrophication, urbanization, hunting, landscape alteration, soil erosion and flooding.

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INTRODUCTION

Wetlands are highly productive (Patoleet *et al.*, 2009) most threatened habitats (Williams 1993) and provide habitat for many threatened species (Findlay and Houlihan, 1997) further loss of which is a serious concern that reduces the regional biodiversity (White law *et al.*, 1989). Wetlands provide shelter to large number of plants, birds, insects, fishes and mammals. Birds play important role in many food chains and web of the ecosystem. Birds are the real bio indicators for studying the environmental problems (Newton, 1995), as ecosystem indicators (Ripley, 1978), as indicators of pollution (Becker, 2003), human disturbance (Talukdar, 1997), and as warning systems for future plans (Gole, 1984). Wetlands are susceptible to developmental activities and act differentially depending on biotic and abiotic factors (Kelly *et al.*, 2010). Different factors govern the bird community structure of wetlands like abiotic changes in the wetlands (Lagos *et al.*, 2008), food availability and size of wetlands (Paracuellos, 2006), change in physical parameters of environment which in turn change the plant and animal communities (Weiher *et al.*, 1996; Gillis *et al.*, 2008), hydrology and change in seasons (Hussain, 1995). The developmental projects has resulted in the change in ecological processes, destruction of habitats (Vijay *et al.*, 2005) and threats for the survival of biodiversity. The land use practices on the adjacent areas and modification

of landscape by road construction changes the hydrology and siltation process of a particular wetland (Burbridge, 1994; Baur and Baur, 1990). The anthropogenic activities change the hydrology (Young *et al.*, 1995) leading to change in nutrient status and changing the aquatic plant composition of many habitats and these plants are indicators of nutrient enrichment like eutrophication (Lehmann and Lachvanne, 1999). The plants act as food and provide shelter for thousands of winter migratory birds. They have a high nutritional value (Gibb's, 1993; Paracuellos, 2006) that attracts a large congregation of birds. The Kashmir valley considered wealthy in all forms of biodiversity situated to the north of Pirpanjal ranges between 30° 1' and 35° 00' north latitude and 73° 48' and 75° 30' east longitude with an area of 5000sq km at mean elevation of 1585m.

The wetlands of this region provide habitat for nesting, roosting and feeding ground for large number of birds. Hokersar wetland is the biggest bird reserve in the Kashmir valley (Rather and Pandit, 2002) and a Ramsar site known for large congregation of birds especially in winter. The only studies conducted so far in Hokersar wetland were based on the mid-winter waterfowl counts conducted by the Department of wildlife Jammu and Kashmir. This is the first study carried for a period of one year to study the avifaunal diversity on different habitats. The threatened species in wetlands need special attention as they are more sensitive to disturbance (Bird Life International 2001, Pandit *et al.*, 2007) for long term management and conservation.

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Study area

Hokersar wetland lies between 33° 59' 48" N and 74° 56' 08" E, North West of Srinagar at an altitude of 1584 m above sea level (Fig 1). Doodhganga canal and Sukhnag stream are the major water sources for the wetland. The wetland has the maximum depth of 2 m in spring and minimum of 0.7 m in autumn (Islam and Rahmani 2004). The highest air temperatures recorded in the summer season is 30 to 35°C and lowest of 0 to -4°C in winter months. The wetland is divided into seven major habitats-Open water, Grassland, Reed bed, Plantation, Urban habitation, Agriculture and Mud flats.

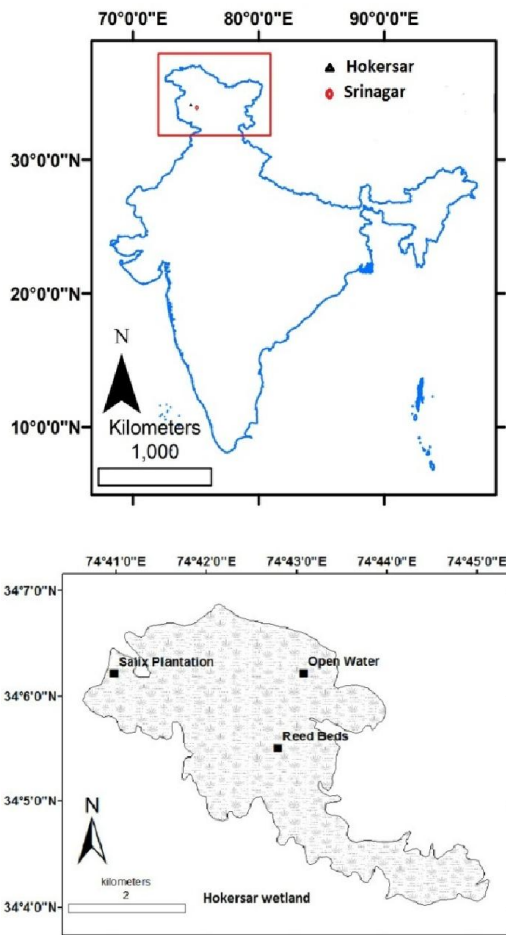


Figure 1. Study area map of the Hokersar wetland Kashmir

Open water

The habitat harbors rich growth of free floating macrophytes like *Salvinianatans*, *Spirodellapolyrhiza* and submerged plants like *Potamogetoncrispus*, *Ceratophyllumdemersum*, and *Batrachiumrionii*. It has an average depth of 1.5m in spring season and 90cm in summer season.

Grass lands

The grasslands are covered with water in winter and spring season but usually dries up with the onset of summer season. The average depth of water is 70 cm in winter. The major vegetation, being *Cynodondactylon*, *Poaspp*, *Medicagosativa*,

Plantago major, *Erigeron canadensis* and *Polygonumhydropiper*.

Reed beds

The habitat covers the vast areas of the wetland known for nesting of Mallards, Purple Moorhen, Common Moorhen and Little Bittern. The average depth of water varies with change in seasons and average depth of 60cm in summer. It contains rich growth of emergent macrophytes like *Sparganiumramosum*, *Phragmitescommunis* and *Typhalatifolia*.

Plantations

The wetland is covered by stretches of willow plantation on the peripheral areas providing good habitat for summer migrant birds. Most of the plantation areas are covered with water in winter and spring season. The habitat is also important for the nesting of Mallard, Little Grebe and Common Moorhen. The average depth of water is 50cm in winter.

Urban habitation

The wetland is bordered by urban habitations on the northern side along the Srinagar-Baramulla highway. The area is thickly populated and major threat is in terms of eutrophication and poaching.

Agriculture

Agricultural lands are seen bordering the wetland from all sides. The land is used for paddy cultivation in summer and for mustard in spring. Most of the lands are covered with water in winter and spring season.

Mudflats

Mudflats are seen along the south eastern border where the Doodhganga canal makes its way in to the wetland. It usually dries in the summer and this habitat is mostly encroached for paddy cultivation. The habitat is suitable for shore birds especially Sand pipers and Plovers.

MATERIALS and METHODS

We selected 7 study units in and around the wetland. The sites were selected so that to include all major habitats of the wetland. The surveys were conducted for a period of one year (eight visits) and included all four seasons-spring, summer, autumn and winter. All birds were recorded in the selected habitats from suitable vantage points. Counting was made with the help of powerful binoculars (10x), spotting scopes (20x). The surveys were conducted in the most active period of the day. In summer the survey was conducted from 6:30 am and in winter from 8:00 am.

Identification of birds

Different field guides (Ali and Ripley, 1987; Grimett *et al.*, 2000) were used for proper identification of species. The common and scientific names followed Manakadan and Pittie, 2002. Local information was also collected from people through informal interviews. Birds were classified as: Resident (R) - Found throughout the year, Summer migrant (SM) - Migrating in spring season from Indian plains and other

countries, Winter migrant (WM)- Birds from central Asia, Europe and Siberia, Local migrant (LM)- found only for a specific period. The relative abundance was calculated in the following four categories as: 1. Very Common (observed in 75-100% of visits) 2. Common (50-74%) 3. Uncommon (25-49%) 4. Less Common (<25). Birds were classified into 7 categories according to their feeding habits as-Insectivorous, Omnivorous, Herbivorous, Raptors, Frugivorous, Granivorous and Piscivorous.

RESULTS

A total of 58 species were studied in Hokersar wetland belonging to 27 families. The maximum number of species were represented by the family Anatidae (8), Corvidae (7), Ardeidae (6), Passeridae (6) and the minimum number of one species each represented by sixteen families. (Table-1)

Table 1. List of birds studied from Hokersar wetland, Kashmir

S.No	Common name	Scientific name	Habitat	Food	Status	Habitats used	(%) sightings	Relative abundance
	Accipitridae							
1	Black Kite	<i>Milvus migrans</i>	Generalist	RP	R	5	100	VC
	Alcedinidae							
2	Central Asian King fisher	<i>Alcedo atthis</i>	Wetland	PS	R	3	87	VC
	Anatidae							
3	Common Teal	<i>Anas crecca</i>	Wetland	HR	WM	3	50	C
4	Garganey	<i>Anas querquedula</i>	Wetland	HR	WM	3	12	LC
5	Gadwall	<i>Anas strepera</i>	Wetland	HR	WM	3	37	UC
6	Greylag Goose	<i>Anser anser</i>	Wetland	HR	WM	3	25	UC
7	Mallard	<i>Anas platyrhynchos</i>	Wetland	HR	R	4	75	VC
8	Northern Showeller	<i>Anas clypeata</i>	Wetland	OM	WM	3	37	UC
9	Northern Pintail	<i>Anas acuta</i>	Wetland	HR	WM	3	37	UC
10	Eurasian Wigeon	<i>Anas penelope</i>	Wetland	HR	WM	1	25	UC
	Ardeidae							
11	Grey Heron	<i>Ardea cinerea</i>	Wetland	IN	LM	4	62	C
12	Indian Pond Heron	<i>Ardeola grayii</i>	Wetland	IN	R	6	100	VC
13	Intermediate Egret	<i>Mesophoyx intermedia</i>	Wetland	IN	R	2	25	UC
14	Little Bittern	<i>Ixobrychus minutus</i>	Wetland	IN	SM	1	50	C
15	Little Egret	<i>Egretta garzetta</i>	Wetland	IN	R	5	87	VC
16	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Wetland	IN	LM	2	12	LC
	Cerylidae							
17	Greater Pied Kingfisher	<i>Megaceryle lugubris</i>	Wetland	PS	R	2	50	C
	Charadriidae							
18	Little Ringed plover	<i>Charadrius dubius</i>	Wetland	IN	R	1	12	LC
	Columbidae							
19	Rock Pigeon	<i>Columbia livia</i>	Generalist	GR	R	3	50	C
20	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	Woodland	GR	SM	3	62	C
	Corvidae							
21	Black Drongo	<i>Dicrurus macrocercus</i>	Woodland	IN	SM	4	62	C
22	House Crow	<i>Corvus splendens</i>	Generalist	OM	R	5	100	VC
23	Eurasian Golden Oriole	<i>Oriolus oriolus</i>	Woodland	FR	SM	2	37	UC
24	Large-billed Crow	<i>Corvus macrorhynchos</i>	Generalist	OM	R	5	87	VC
25	Eurasian Jackdaw	<i>Corvus monedula</i>	Generalist	OM	R	4	62	C
26	Asian Paradise-Flycatcher	<i>Terpsiphone paradisi</i>	Woodland	IN	SM	1	37	UC
27	Yellow-billed Blue Magpie	<i>Urocissa flavirostris</i>	Woodland	OM	LM	1	37	UC
	Cuculidae							
28	Asian Koel	<i>Eudynamis scolopacea</i>	Woodland	FR	SM	2	37	UC
29	Eurasian Cuckoo	<i>Cuculus canorus</i>	Woodland	IN	SM	2	50	C
	Halcyonidae							
30	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Grassland	IN	R	4	62	C
	Hirundinidae							
31	Barn Swallow	<i>Hirundo rustica</i>	Generalist	IN	SM	4	50	C
	Jacaniidae							
32	Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i>	Woodland	HR	SM	2	37	UC
	Lanidae							
33	Rufous-backed Shrike	<i>Lanius schach</i>	Woodland	IN	SM	4	37	UC
	Laridae							
34	Whiskered Tern	<i>Chlidonias hybridus</i>	Wetland	IN	R	1	37	UC
	Muscicapidae							
35	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	Woodland	IN	R	3	37	UC
36	Tickells Thrush	<i>Turdus unicolor</i>	Woodland	OM	SM	1	50	C
	Paridae							
37	Great Tit	<i>Parus major</i>	Woodland	OM	SM	3	87	VC
	Passeridae							
38	Citrine Wagtail	<i>Motacilla citreola</i>	Woodland	IN	WM	4	75	VC
39	House Sparrow	<i>Passer domesticus</i>	Generalist	OM	R	5	100	VC
40	Paddy Field Pipit	<i>Anthus rufulus</i>	Woodland	IN	LM	3	25	UC
41	White Wagtail	<i>Motacilla alba</i>	Generalist	IN	WM	3	62	C
42	Yellow Wagtail	<i>Motacilla flava</i>	Woodland	IN	WM	3	50	C
43	Oriental Sky lark	<i>Alauda gulgula</i>	Grassland	OM	LM	1	12	LC
	Phalacrocoracidae							

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44	Great Cormorand Picidae	<i>Phalacrocoraxcarbo</i>	Wetland	PS	WM	1	12	LC
45	Scaly-bellied Green Wood pecker Podicipedidae	<i>Picussquamatus</i>	Woodland	IN	SM	1	12	LC
46	Little Grebe Psittacidae	<i>Tachybaptusruficollis</i>	Wetland	IN	R	2	100	VC
47	Rose- ringed Parakeet Pycnonotidae	<i>Psittaculakrameri</i>	Woodland	FR	R	3	50	C
48	Himalayan Bulbul Rallidae	<i>Pycnonotusleucogenys</i>	Generalist	OM	R	3	87	VC
49	Common Coot	<i>Fulicaatra</i>	Wetland	OM	WM	4	50	C
50	Common Moorhen	<i>Gallinulachloropus</i>	Wetland	OM	R	5	100	VC
51	Purple Moorhen	<i>Porphyrioporphyrio</i>	Wetland	OM	R	4	75	VC
52	Water Rail Scolopacidae	<i>Rallusaquaticus</i>	Wetland	IN	R	2	50	C
53	Common Sandpiper	<i>Actitishypoleucos</i>	Wetland	IN	R	2	37	UC
54	Commom Snipe Sturnidae	<i>Gallinagogallinago</i>	Wetland	IN	LM	1	37	UC
55	Common Myna	<i>Acridotherestrictis</i>	Generalist	OM	R	6	100	VC
56	Common Starling Sylviidae	<i>Sturnus vulgaris</i>	Wetland	FR	SM	3	37	UC
57	Great Indian Reed Warbler Upupidae	<i>Acrocephalusstentoreus</i>	Grassland	IN	SM	2	50	C
58	Common Hoopoe	<i>Upupaepops</i>	Woodland	IN	SM	2	37	UC

IN-Insectivorous; OM-Omnivorous; HR- Herbivorous; RP- Raptors; FR- Frugivorous, GR-Granivorous; PS-Piscivorous;R-Resident;SM- Summer migrant; WM- Winter migrant;LM-Local migrant; VC-Very common; C- Common; UC- Uncommon and LC- Less common.

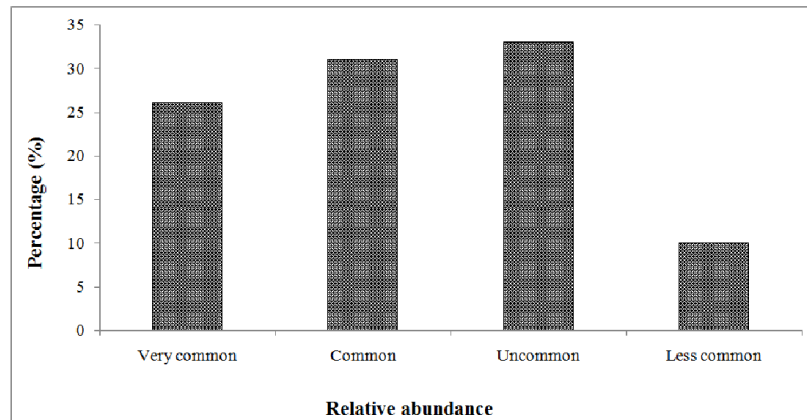


Figure 2. Relative abundance of avifauna in Hokersar wetland

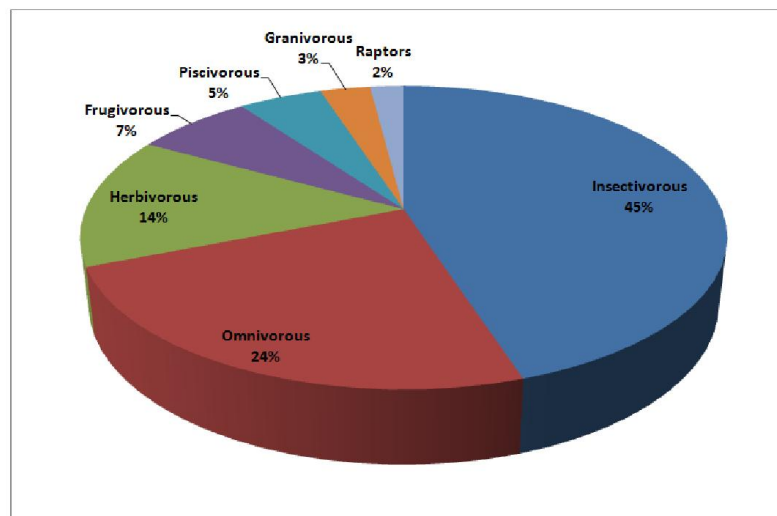


Figure 3. Percentage of feeding categories of avifauna from Hokersar wetland

The invasive plants in the reed beds have degraded the quality of the wetland. The quality of each habitat is determined by species richness. The highest species richness was recorded in the plantation zone (25) and in the grasslands (24). The lowest species richness (14) was recorded in the open water habitat surrounded by urban habitation. The relative abundance was assessed in terms of following four categories- Very common, Common, Uncommon and Less common. About 26% species were Very common, Common (31%), Uncommon (33%) and Less common (10%, Fig 2). Habitat alterations may be fatal when the species are restricted to a particular habitat. During the present study 19% of the species use only one habitat type, 21% use two habitat types and 29% use three habitat types. The highest numbers of six habitats (3%) were inhabited by Common Myna (*Acridotherestrictis*) and Indian Pond Heron (*Ardeolagravii*). The four seasons in the Kashmir valley-summer, winter, autumn and spring change the bird communities with the change in temperature and availability of food resources. The recorded birds were classified into four groups according to their migration patterns – Resident(41%), Summer migrant (28%), Winter migrant (21%) and Local migrant (10%). Hokersar wetland possesses the quality of diversity of habitats and feeding resources for the diverse avifauna in different seasons. The species were classified in to seven groups according to their feeding habits- Raptors (2%), Insectivorous (45%), Omnivorous (24%), Herbivorous (14%), Frugivorous (7%), Granivorous (3%) and Piscivorous (5%, Fig 3) The majority of the species were insectivorous and most of the species are breeding in and around the wetland.

DISCUSSION

During the present study 58 species were recorded from Hokersar wetland. A total of 28 species are water dependent which includes 8 species of waterfowl migrating from Europe and Siberia. According to Hussain (1995) 64 species were recorded from Hokersar wetland in his bird ringing studies. Earlier a total of 12 species of waterfowl were recorded from the wetland which includes Ferruginous Pochard (*Aythya nyroca*), Common Pochard (*Aythya ferina*) and Red - crested Pochard (*Nettarufina*) (Islam and Rahmani, 2004). However the present study does not reveal the presence of Pochards (Diving ducks) due to the shrinking of open water areas and increase in reed beds. The eutrophic conditions and invasion of exotic plant species leads to the decrease in fish population in recent years. The Pallas Fish Eagle (*Haliaeetus leucoryphus*) was not recorded from the last 24 years. The study further reveals that majority of the species are Insectivorous (45%) and all the species of waterfowl are mostly herbivorous depending on wetland resources for their survival. The study reveals the importance of conservation of Hokersar wetland-A Ramsar site and an important IBA (Important Bird Area) in the Kashmir region.

Major threats

The avian diversity of Hokersar wetland is rich by the presence of different habitats favorable for nesting and feeding of both resident and migrant birds but increased human interference has resulted in the destruction of habitats affecting the trophic

structure in food chains, increases pressure on vegetation, nesting and adult birds. The present study reveals following major threats responsible for destruction of the wetland.

Invasive plant species

Hokersar wetland is known for giving refuge to thousands of waterfowl in winter. The birds use the wetland as a feeding zone in winter and depend on aquatic plants for their food. In the recent years the invasion of exotic species has drastically changed the habitat composition of the wetland. The study conducted by Pandit and Kumar, (2006) reveals the presence of 46 plant species from the wetland. The present study shows *Sparganium ramosum*, *Azola* spp., *Salvinia natans*, *Nymphoides peltatum*, *Ceratophyllum demersum*, *Myriophyllum* spp and *Potamogeton crispus* as dominant invasive species from the wetland. Some of the economically important plants of Hokersar wetland such as *Nelumbo nucifera* have been completely replaced and *Trapa natans* restricted to small patches by extensive growth of reed beds.

Urbanization

Urbanization increases exotic bird communities (Marzluff, 2001) and exotic natural predators resulting in competitions. The impact of urbanization has shown its signs from the last three decades at a faster pace in the form of alterations in vegetation structure and decrease in bird species richness. The urbanization impacts can be studied in terms of structure and function of each habitat by changes in physical environment such as hydrological regimes and sediment characteristics. The wetland was once covered by vast stretches of open waters that are now completely covered by reed beds, floating *Azola* spp and duckweeds.

Eutrophication

The nutrient enrichment makes some significant changes in the wetland ecosystem influencing the trophic structure of the wetland by changes in species richness, abundance, species displacement, introduction of invasive and exotic species as the native species cannot take advantage of the existing conditions. The increase in nutrients, turbidity, toxic metals, organic pollutants, changes the water quality that leads to decrease in oxygen concentration, increase in biological oxygen demand and change in pH. The change in water characteristics results in the excessive growth of algal mats, increased biomass, large beds of macrophytes, death of fishes and decrease in waterfowl communities. Microorganisms, algae, invertebrates and vertebrates are directly or indirectly affected by the chemical change altering the physical makeup of the wetland.

Habitat fragmentation

The process of dividing major habitats into smaller fragments or habitat patches by expansion of land use resulted in the decline of biodiversity of natural habitats. The encroachments leading to conversion of mud flats and grasslands into the agricultural lands divides the habitat in to fragments leading to decrease in waterfowl population.

Waterfowl hunting

Hunting is a common practice among the local people around the Zainakote, Hajibagh and Soibugh villages. Some people are dependent on waterfowl for food and their daily needs. The hunting continues from the month of November and ends in the month of April. The birds are killed by gun shots and sometimes trapped by traditional hair snarls. The Mallard (*Anas platyrhynchos*) and Greylag Goose (*Anser anser*) are the favorite birds for the hunters of the locality as they have a great demand in the market for meat and taste.

Deforestation and frequent flooding

The wetlands of Kashmir have lost their identity due to siltation (Kaul and Pandit, 1980) and floods bringing excess quantities of silt during rainy season (Pandit and Qadri, 1990) changing the habitat quality of the wetland. Large scale deforestation in the upstream mountains increased the silt load of the Hokersarwetland in the recent years. From the last few decades Doodhganga canal has deposited thousands of tons of silt in to the wetland. The hydrological flow in to the wetland led to sedimentation, decreasing the water depth and invasion of exotic vegetation.

Conservation plan

The following strategies should be adopted for effective management and conservation of the wetland.

1. The wetland usually dries up in the month of August as the water being diverted towards paddy cultivation on the vast stretches of southeastern border along Hajibagh and border along the Soibugh villages. It affects the breeding of resident and summer migrant birds like Pheasant-tailed Jacana, Little Bittern, Common Moorhen, Little Grebe and Reed Warbler by increasing the predation risk on the nests and adult birds. The diversion of water should be checked by Watergates at different exit points around the wetland.
2. The increase in flow rates in the spring season can be modified by change in slopes and diverting the water streams like Doodhganga away from the wetland.
3. The storm water by the increased runoff water from the surrounding villages needs proper drainage. The border should be demarcated by earthen bunding and plantation of salix and willow trees.
4. The silt flow has to be checked before it enters in to the wetland by the help of reservoirs and settling chambers.
5. Salix and *Populus spp* are often used for timber in the adjacent villages. The reed collection starts from the month of March and ends in November. The hollows of Salix trees are used for nesting by hundreds of mallards. Reed collection and illegal felling of Salix trees should be checked and the nesting areas of should be demarcated.
6. The de-weeding of the wetland needs proper scientific methods and coordination of local communities for habitat restoration and preservation of biodiversity.
7. Regular surveys and periodic monitoring needs to be conducted on both biotic and abiotic components of the wetland and regular check on cattle grazing, fishing and reed collection.
8. Unwanted human activities should be banned in the peak season of waterfowl especially during the nesting of mallards.
9. Strict laws need to be implemented for hunting of birds and conservation with joint coordination of local people, volunteers and NGO's.
10. Awareness programmes through formal and informal means should be conducted about avifauna of the wetland in schools through seminars, group discussions and surrounding villages for effective conservation of the wetland.

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