



Trade Science Inc.

Environmental Science

An Indian Journal

Current Research Papers

ESAIJ, 4(5), 2009 [260-268]

Evaluation of bird population fluctuation in haigam Wetland, Kashmir, India

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Received: 21st January, 2009 ; Accepted: 26th January, 2009

ABSTRACT

An attempt has been made in this research paper to evaluate the current status of Avifauna associated with Hygam wetland. For the purpose of present investigation, the study area was divided (i.e., Transect Method) into three study units of 100m² each, primarily on the basis of characteristics of vegetation and depth of water column. Visual census method was used for the estimation of bird population. Visual counting was made with the help of high power field binocular (20x 50x) from respective vantage points. Observations were made twice in a month. Identification of birds was done with the help of identification keys. The results shows that the Haigam Wetland is particularly important for migratory spp and marsh land breeding spp. Out of 32 species of birds recorded from Haigam wetland 13 spp were found to represent the residents, 9 spp were found to represent the summer migrants while as 10 spp represented the winter migrant community . Densities of little bittern, water rail, common King Fisher are particularly high. Hygam lake is major wintering area for migratory ducks particularly the common teal, Northern Pin Tail, Eurasian Wigeon, Mallard, Gadwall Northern Shoveller, and Common Pochard. This lake is also extremely important breeding area for a variety of birds such as little bittern water rail, Indian moorhen, pheasant tailed jacana and whiskered tern. The wetland is also important for long distance migrants as a stopper site for feeding and resting. Threats to waterbirds and their habitats is observed and discussed. The key issues identified based on Observations and Assessments along with the Remedial measures to be followed to restore the Wetland is also discussed elaborately.

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1. INTRODUCTION

Wetlands are extremely rich in plant and animal species, are one of the most productive of all ecosystems, and carry out critical regulatory functions of hydrological processes within watersheds^[1]. Regulating water quality, water levels, flooding regimes, and nutrient and sedimentation levels are a few of these processes^[5]. Further, wetlands are dynamic, characterized by fluctuating water, nutrient, and vegetation levels. Strategically located at the western extremity of the Himalayan range in India and south of the Pamirs, the wetlands of Kashmir serve as important staging grounds for medium and long distance migratory geese, ducks, shorebirds, cranes and other species that breed in the north-

ern latitudes of Central Asia and Siberia. Many of these wetlands are of international and national importance, due to the large population and diversity of waterbirds and other wetland associated birds that they support. Of these, Wular Lake and Hokersar have already been included under Ramsar Convention considering their importance based on biodiversity and socio economic aspects. More recently Wular Lake and associated marshes viz., Haigam, Hokersar, Mirgund and Shallabugh have been included in the network of Important Bird Areas^[8], based on their international importance for birds and all of which are not formally protected.

Out of more than 9,000 bird species of the world the Indian subcontinent contains 1,300 species or over

TABLE 1: Contribution of resident birds, summer migrants and winter migrants to total 32 spp. Observed during study period (July to Nov. 2007) in Haigam wetland, Kashmir

S. no.	Resident birds	
	Scientific name ¹	Common name ²
01	<i>Passer domesticus griseigularis</i>	Kashmir house sparrow
02	<i>Holpestes leucogenys</i>	White Cheeked bulbul
03	<i>Acridotheres tristis</i>	Common myna
04	<i>Corvus splendens zugmkayeri</i>	House crow
05	<i>Milvus migrans govinda</i>	Common pariah kite
06	<i>Podiceps ruficollis capensis</i>	Dab chick
07	<i>Actitis hypoleucos</i>	Common sand piper
08	<i>Ardea cinerea</i>	Eastern Grey heron
09	<i>Ardeola grayii</i>	Indian pond heron
10	<i>Alcedo atthis pallasi</i>	Central Asian kingfisher
11	<i>Nycticorax nycticorax</i>	Night Heron
12	<i>Gyps himalayensis</i>	Himalayan Griffon Vulture
13	<i>Gailinula chloropus</i>	Indian Moorhen
Summer migrants		
01	<i>Ixobrychus minutus</i>	Little bittern
02	<i>Hirundo rustica</i>	Common swallow
03	<i>Upupa epops</i>	European hoopoe
04	<i>Oriolus oriolus kundoo</i>	Indian Oriole
05	<i>Lainius schach erythronotus</i>	Rufous backed shrike
06	<i>Hydrophasianus chirurgus</i>	Pheasant tailed jacana
07	<i>Metoponia pusilia</i>	Gold franted finch
08	<i>Psittacula himalayana</i>	Slaty headed parakeet
09	<i>Streptopelia decaota decaota</i>	Indian ring dove
Winter migrants		
01	<i>Anas platyrhynchos</i>	Mallard
02	<i>Anas crecca</i>	Common teal
03	<i>Anas acuta</i>	Pin tail
04	<i>Fulica atra</i>	Coot
05	<i>Anas strepera</i>	Gadwall
06	<i>Anas clypeata</i>	Showller
07	<i>Ansar ansar</i>	Grey leg goose
08	<i>Aythya rufina</i>	Pochard
09	<i>Anas penelope</i>	Wigeon
10	<i>Anas querquedula</i>	Garganey

1. Common and Scientific names follow the BirdLife International (2006); 2. Common and Scientific names follow the BirdLife International (2006).

13% of the world's bird species^[6]. The subcontinent rich in avifauna also boasts 48 bird families out of total 75 families in the world. Kashmir valley has always been considered wealthy in floral and faunal diversity-250species of macrophytes, 150-200species of phytoplankton, and 300 taxa of of periphytic algae and

over 50 species of periphytic rotifers^[13]. About 187 species of breeding birds belonging to 46 families under 16 orders have been reported from Kashmir valley. A total of 76 mammalian species belonging to 20 orders have been reported from Kashmir Valey^[3]. The Amphibians and Reptiles are mainly represented by frogs, toads, lizards and snakes. The state of Jammu and Kashmir abounds large number of wetlands which owe their origin to glacial erosions and depositions. The transformed have been filled with the rainwater and melting snow from mountain peaks of Himalayas in north and Pirpanjal range in south. These wetlands are intermingled with the adjoining streams, rivers, or flood channels. Water enriches them to develop characteristics and luxuriant flora which directly or indirectly catches the attention of large number of fauna. Thus emerges the lentic ecosystem. In regard to their nature, biota and other characteristics, the wetlands of Himalayan region are remarkable. The most important chain of wetlands of the Western Himalayas found in the valley of Kashmir are: Hokarsar, Haigam, Mirgund, Wular, Malgam, Malangpora, Narkora, Shallabugh etc. Wetlands are among the most productive life support systems in the world and are of immense socio-economic and ecological importance. Apart from biological characteristics wetlands harbour rich gene pool both at planktonic level as well as vascular plant level. A number of aquatic vascular plants contained in them are used as food, fodder, and other economic purposes. Besides these resources wetlands provide suitable habitat for a large number of birds, amphibians, reptiles and mammals^[11].

Unfortunately all these wetlands are experiencing significant bio-ecological changes that include loss of habitat through continued human impact, denudation of forests, agricultural activities, pollution, erosion of catchment and watershed areas. Further, the impact of fast urbanization, encroachment, siltation and indiscriminate macrophyte removal has seriously affected the use of wetlands by the water fowl. The concern about the habitat destruction and overall deterioration of the wetland stimulated the need to carry out the current status of Avifauna associated with Hygam wetland.

The key habitats for the threatened species are wetlands (29spp), Forest birds (27spp), grass lands (14spp) and scrub land (4spp). The IUCN categorizes

TABLE 2: Site 1- Approximate no. of birds observed in July, August (Summer Season) and September, October (Autumn Season)

S. no.	Scientific name	Common name	Summer season			Autumn season			
			July	Aug	Total	Sept.	Oct.	Nov.	Total
01	<i>Passer domestics griseigulars</i>	Kashmir House Sparrow	15	08	23	01	04	02	07
02	<i>Holpestes leucogenys</i>	White Cheeked Bulbul	12	10	22	00	00	00	00
03	<i>Acridotheres tristis</i>	Common Myna	03	10	13	00	02	02	04
04	<i>Corvus splendns zugmkayeri</i>	House Crow	12	07	19	04	07	09	20
05	<i>Milvus migrans govinda</i>	Common Pariah Kite	10	12	22	06	02	05	13
06	<i>Podiceps ruficollis capensis</i>	Dab Chick	05	03	08	02	00	00	02
07	<i>Actitis hypoleucos</i>	Common sand piper	02	05	07	02	00	00	02
08	<i>Ardea cinerea</i>	Eastern Grey Heron	03	02	05	00	00	00	00
09	<i>Ardeola grayii</i>	Indian pond Heron	10	17	27	00	00	00	00
10	<i>Alcedo atthis pallasi</i>	Central Asian Kingfisher	14	18	32	04	00	00	04
11	<i>Nycticorax nycticorax</i>	Night Heron	02	00	02	00	00	00	00
12	<i>Gyps himalayansis</i>	Himalaya Griffon Vulture	00	00	00	01	00	00	01
13	<i>Gailinula chloropus</i>	Indian Moorhen	12	14	26	09	00	00	09
14	<i>Ixobrychus minutes</i>	Little bittern	02	00	02	00	00	00	00
15	<i>Hirundo rustica</i>	Common swallow	02	05	07	00	00	00	00
16	<i>Upupa epops</i>	European hoopoe	02	04	06	01	00	00	01
17	<i>Oriolus oriolus kundoo</i>	Indian Oriole	04	06	10	01	00	00	01
18	<i>Lainius schach erythonotus</i>	Rufous backed shrike	07	12	19	01	00	00	01
19	<i>Hydrophasianus Chirurgus</i>	Pheasant tailed jacana	00	01	01	00	00	00	00
20	<i>Metoponia pusilia</i>	Gold fronted finch	02	01	03	00	00	00	00
21	<i>Psittacula himalayana</i>	Slaty headed parakeet	05	10	15	02	00	00	02
22	<i>Streptopelia decaota decaota</i>	Indian ring dove	07	03	10	01	00	00	01
	Total		131	148	279	35	15	18	68

communis and a small amount of *Trappa* spp. It is surrounded on one side by paddy fields. It is an open water zone.

2. MATERIALS AND METHODS

Avian fauna was recorded either by direct sightings or by the presence of indirect evidence. Footprints, droppings, and kills (both by predator and road) were carefully analyzed. Bird records were done following imaginary grid method and line transect method as outlined by Gaston^[4].

1. Transect Method: For the purpose of present investigation, the study area was divided into three study units of 100m² each, primarily on the basis of characteristics of vegetation and depth of water column.

Visual census method was used for the estimation of bird population. Visual counting was made with the help of high power field binocular (20x 50x) from respective vantage points. Observations were made twice in a month.

For the winter months where the flock is no more than a few hundred birds, all can be counted from suit-

able vantage points through binoculars. With large number of birds or with mobile flocks counts in twenties are done rather than counting individual birds.

2. Identification: Identification of birds was done with the help of identification keys evolved by Bates and Lowther^[2] and by the help of Department of Wild life of Haigam. Data was collected regarding composition of flock and population of individual spp at three different study sites.

4. Observations

Out of 32 species of birds recorded from Haigam wetland 13 spp were found to represent the residents, 9 spp were found to represent the summer migrants while as 10 spp represented the winter migrant community (TABLE 1). The birds were observed on the monthly basis and the fluctuation in bird population was determined in different seasons like summer, autumn and winter. At site 1 the birds which were dominant during summer season are Central Asian Kingfisher (32) and Kashmir House Sparrow (23). However the birds which were found in low numbers are pheasant tailed jacana (1) and Night Heron (2). The birds which were not found during this season are Himalayan Griffin Vul-

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TABLE 3: Site 2-Approximate no. of birds observed in July, August (Summer Season) and September, October (Autumn Season)

S. no.	Scientific name	Common name	Summer Season			Autumn Season			
			July	Aug	Total	Sept.	Oct.	Nov.	Total
01	<i>Passer domestics griseigulars</i>	Kashmir House Sparrow	40	25	65	00	00	02	02
02	<i>Holpestes leucogenys</i>	White Cheeked Bulbul	09	05	14	01	00	00	01
03	<i>Acridotheres tristis</i>	Common Myna	15	04	19	00	00	00	00
04	<i>Corvus splendens zugmkayeri</i>	House Crow	20	15	35	20	06	04	30
05	<i>Milvus migrans govinda</i>	Common Pariah Kite	15	07	22	12	04	04	20
06	<i>Podiceps ruficollis capensis</i>	Dab Chick	04	02	06	00	00	00	00
07	<i>Actitis hypoleucos</i>	Common sand piper	04	03	07	00	00	00	00
08	<i>Ardea cinerea</i>	Eastern Grey Heron	06	02	08	04	00	00	04
09	<i>Ardeola grayii</i>	Indian pond Heron	20	12	32	00	00	00	00
10	<i>Alcedo atthis pallasii</i>	Central Asian Kingfisher	16	18	34	06	00	00	06
11	<i>Nycticorax nycticorax</i>	Night Heron	04	01	05	00	00	00	00
12	<i>Gyps himalayensis</i>	Himalaya Griffon Vulture	00	01	01	03	00	00	03
13	<i>Gallinula chloropus</i>	Indian Moorhen	15	20	35	09	00	00	09
14	<i>Ixobrychus minutus</i>	Little bittern	07	02	09	00	00	00	00
15	<i>Hirundo rustica</i>	Common swallow	00	00	00	00	00	00	00
16	<i>Upupa epops</i>	European hoopoe	14	09	23	00	00	00	00
17	<i>Oriolus oriolus kundoo</i>	Indian Oriole	08	02	10	00	00	00	00
18	<i>Lanius schach erythronotus</i>	Rufous backed shrike	03	02	05	02	00	00	02
19	<i>Hydrophasianus Chirurgus</i>	Pheasant tailed jacana	02	01	03	00	00	00	00
20	<i>Metoponia pusilia</i>	Gold fronted finch	02	00	02	00	00	00	00
21	<i>Psittacula himalayana</i>	Slaty headed parakeet	06	08	14	02	00	00	02
22	<i>Streptopelia decaota decaota</i>	Indian ring dove	12	07	19	02	00	00	02
	Total		222	146	368	61	10	10	81

ture. The birds which were dominant during autumn season on the same site are House Crow (20) and Common Pariah Kite (13). However the birds which were found in low numbers are Himalayan Griffon Vulture (1) and European Hoopoe (1). The birds which were not found during this season are Eastern Grey Heron, Common Swallow (TABLE 2).

At Site 2 the birds which were dominant during summer season are Kashmir House Sparrow (65) and Indian Moorhen (35). However the birds which were found in low numbers are Himalayan Griffon Vulture (1). The bird which is not found during this season is Common Swallow. While as the birds which were dominant during autumn season are House Crow (30), and Common Pariah Kite (20). However the birds which were found in low numbers are White Cheeked Bulbul (1) and Rufous backed shrike (2). The birds which were not found during this season are Common Swallow and European Hoopoe (TABLE 3).

At Site 3 the dominant birds during summer season are Kashmir House Sparrow (35) and Common Swallow (35). Birds found in low numbers are Slaty Headed Parakeet (2) and European Hoopoe (2). The birds not found during this season are Indian Oriole and Night

Heron (TABLE 6). While as during Autumn season the dominant birds are Kashmir House Sparrow (75) and House Crow (38). Birds found in low numbers are Eastern Grey Heron (1) and Dab Chick (2). The birds which were not found during this season are Common Swallow and European Hoopoe (TABLE 4).

Winter migrants

1. Arrival: From 15th September: Gadwall, Mallard, Common teal, Coot; From 15th October: Brahmany duck, Red Chested pochard, Grey Lag goose; From 15th March: Garganey

2. Return: 5th February to 1st March: Grey Leg goose, Mallard, Brahmany duck; 20th February to April: Wigeon, Gadwall, Pochard, Common teal, Coot.

5. RESULTS AND DISCUSSION

The bird population shows fluctuation with site differences as well as with changing seasons. Results of the annual monitoring programme were analyzed to assess the trends in population changes and change in species composition as well as identification of endangered / critically endangered species along with the historical data. Bird population fluctuation in Haigam wetland

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TABLE 4: Site 3- Approximate no. of birds observed in July, August (Summer Season) and September, October (Autumn Season):

S. no.	Scientific name	Common name	Summer Season			Autumn Season			
			July	Aug	Total	Sept.	Oct.	Nov.	Total
01	Passer domestics griseigulars	Kashmir House Sparrow	10	25	35	25	30	20	75
02	Holpestes leucogenys	White Cheeked Bulbul	12	12	24	10	02	04	16
03	Acridotheres tristis	Common Myna	17	12	29	14	07	07	28
04	Corvus splendns zugmkayeri	House Crow	10	07	17	08	15	15	38
05	Milvus migrans govinda	Common Pariah Kite	05	10	15	09	14	05	28
06	Podiceps ruficollis capensis	Dab Chick	07	04	11	02	00	00	02
07	Actitis hypoleucos	Common sand piper	00	01	01	02	00	00	02
08	Ardea cinerea	Eastern Grey Heron	04	03	07	01	00	00	01
09	Ardeola grayii	Indian pond Heron	00	06	06	00	00	00	00
10	Alcedo atthis pallasi	Central Asian Kingfisher	07	09	16	15	00	00	15
11	Nycticorax nycticorax	Night Heron	00	00	00	00	00	00	00
12	Gyps himalayansis	Himalaya Griffon Vulture	00	00	00	00	00	00	00
13	Gailinula chloropus	Indian Moorhen	15	12	27	06	02	00	08
14	Ixobrychus minutes	Little bittern	00	00	00	00	00	00	00
15	Hirundo rustica	Common swallow	15	20	35	00	00	00	00
16	Upupa epops	European hoopoe	02	00	02	00	00	00	00
17	Oriolus oriolus kundoo	Indian Oriole	00	00	00	00	00	00	00
18	Lainius schach erythonotus	Rufous backed shrike	03	02	05	04	00	00	04
19	Hydrophasianus Chirurgus	Pheasant tailed jacana	00	00	00	00	00	00	00
20	Metoponia pusilia	Gold fronted finch	02	00	02	00	00	00	00
21	Psittacula himalayana	Slaty headed parakeet	00	02	02	00	00	00	00
22	Streptopelia decaota decaota	Indian ring dove	04	05	09	07	00	00	07
Total			113	130	243	103	70	51	224

TABLE 5: Bird population fluctuation in Haigam Wetland during the study period (July to November)

Sites	July	Aug	Sept	Oct	Nov
1	131	148	35	15	18
2	222	146	61	10	10
3	113	130	103	70	51
Total	466	424	199	95	79

TABLE 6: Residents and summer migrants in Haigam Wetland during the study period (July to November)

Sites	Total	Residents	Summer migrants
Site 1	350	271	79
Site 2	449	358	91
Site 3	464	398	66
Total	1263	1027	236

during the study period (July to November) is shown (TABLE 5) and depicted graphically (Figure 2).

During the five months study (July to November) a total of 1263 birds were recorded from the study area. Among them 1027 (81.3%) were residents and 236 (18.7%) were summer migrants (Figure 3). In total 22 bird spp belonging to 14 families under 7 orders were observed at three study sites (TABLE 6).

At Site 1 a total of 350 birds (27.71%) were observed among which 271 (21.45%) were Residents and 79 (6.20%) were Summer Migrants. At Site 2 a total of 449 birds (35.50%) were observed among which

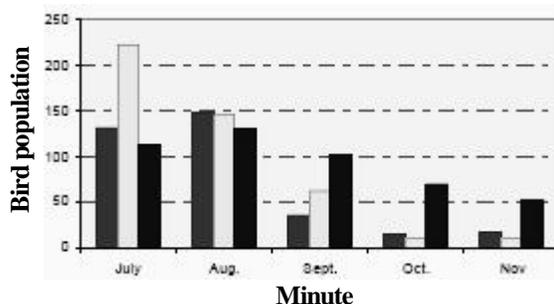


Figure 2: Bird population fluctuation in Haigam wetland, Kashmir during the study period (July to November, 2007)

358 (28.34%) were Residents and 91 (7.21%) were Summer Migrants. While as at Site 3 a total of 464 (36.70%) birds were observed among which 398 (31.51%) were Residents and 66 (5.23%) were Summer Migrants.

Site 1 is an open site with scattered trees and hence less number of birds was recorded at this site. Site 2 is covered by dense emergent vegetation and Salix trees and therefore space for nesting, breeding and resting place of birds. This Site hence shows maximum number of birds in the summer season (residents and summer migrants). Site 3 is towards the residential side of the wetland and hence shows an increase number of

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TABLE 7: Approximate no. of birds observed in Summer and Autumn season in Haigam Wetland, Kashmir

Sites	Summer season (July to Aug.)			Autumn season (Sept. to Nov.)		
	Total	Resident	Summer migrants	Total	Resident	Summer migrants
Site 1	279	206	73	68	62	06
Site 2	368	283	85	81	75	06
Site 3	243	188	55	224	213	11
Total	890	677	213	373	350	23

resident birds in the Autumn season.

In Autumn season 373 birds were observed of which 350 were residents and only 23 were summer migrants (TABLE 7). Autumn season shows decrease in the number of birds (both residents and summer migrants). This is due to the fact that summer migrants go for migration and residential birds move towards residential areas and nearby paddy fields. Fires in the emergent vegetation like *Typha* spp in October and November makes grounds for the winter migrants but hampers the nesting and breeding of summer migrants.

Till November, December Haigam wetland was almost completely dry with water being diverted and used for irrigation and other purposes resulting in the complete non use by any water fowl till then they start coming to the wetland when the wetland was filled with water. However in mid December a total approximate of 18,000 birds were observed in the wetland which is the lowest as compared to other months^[10] and only 5 spp were observed. In the month of January there was influx of winter migrants into the wetland and a total approximate of 1,32,000 birds were observed belonging to 7spp. However the maximum number of birds were observed in the month of February (approximately 3,00,000) belonging to 10 spp^[12].

In the total number of birds mallard, common teal, pin tail and coot altogether making up to 75 to 78% . Areas having dense vegetation of emergent macrophytes are preferred by mallards. Where as pochards, coot, gadwall and geese prefer open waters. *Trapa* spp provide the best food for various bird spp. While as *Typha* spp, phragmite spp and some other emergent macrophytes provide the food and best places for resting and breeding purposes.

In the present research work, it has been observed that the wetland mostly visited by the winter migratory fauna. It is because of the severe cold and non avail-

ability of food for their survival in Siberia and other cold areas in Europe. 37 spp of water fowl are reported to breed in the western Siberia. Out of these 15 spp has been reported from Hokersar wetland and 10 spp were observed in Haigam wetland.

6. Threats to waterbirds and their habitats

The threats to migratory and breeding waterbirds in general include heavy poaching, loss and modification of habitats. Decrease in wetland area leading to loss of food and cover plants have led to decline in waterbird populations.

The specific threats to waterbirds are:

1. Lack of formal conservation status (such as protected areas) for most sites leading to poaching. Thousands of geese and ducks are hunted by the poachers in the unprotected areas leading to their movement to protected areas such as Haigam during day and their reverse movement during night.
2. Collection of eggs and chicks of nesting waterbirds that constitutes a loss to breeding success.
3. Degradation and destruction of the immediate forested catchments causing increased siltation, eutrophication, excessive weed infestation and degradation of water quality.
4. Spread of aquatic vegetation over open water areas leading to habitat loss of birds that prefer open water.
5. Heavy grazing leading to destruction of breeding and feeding grounds of birds.
6. Unregulated and over fishing in some area resulting in loss of fish and invertebrate prey and disturbance to migrants, seasonal migrants and resident waterbirds.
7. Encroachment by agriculture and urbanisation, resulting in the decrease in the size and functions of many wetland areas affecting waterbirds.
8. Discharge of domestic waste from point and non-point sources leading to habitat modifications.

7. The key issues identified based on observations and assessments

1. Absence of comprehensive base line information on waterbirds necessary for trend analysis and planning.
2. Intense poaching in unprotected areas leading in

decline in waterbird populations.

- Habitat modifications due to changes in natural water regimes and human Activities.

A recent risk to waterbirds and mass deaths of different migratory species to a highly pathogenic avian influenza virus (strain H5N1) from domestic poultry or other sources in east, southeast and north-central Asia, has highlighted the need for greater attention to understanding the impact of the virus on waterbirds and of the potential role of waterbirds in its spread. As the state of Jammu and Kashmir shares international borders with Pakistan and China, countries in which the virus has been recorded, there is a high risk of incursion of the virus to the waterbirds of the Valley.

8. Remedial measures to restore the Haigam Wetland

1. Habitat restoration

Regulation of water levels is critical to the maintenance of species diversity and abundance. Haigam, which, was originally connected with the Wular Lake through a channel has been isolated due to siltation of the channel and human encroachment. This channel needs to be restored for effective water exchange between Haigam and the Wular Lake. Following restoration of the channel, manipulation of the water level can be made within the wetland as per the requirement of different species. Areas of open water also need to be created to cater to the requirements of some bird species, particularly diving ducks for feeding and many other species for resting. The food and feeding habits of different species need to be investigated to advice on their precise needs. Thereafter, a detailed survey of the lake is required to ensure that there is a proper proportion of open water area and surrounding vegetational belts.

2. Rehabilitation of threatened/rare species

Maximizing of the carrying capacity of the wetlands and associated marshes for waterbirds that use a range of preferred habitats for feeding, resting/roosting and nesting requires considerable planning and location specific knowledge. Adaptive management should be applied based on available knowledge of the management of the marsh vegetation and water depths. Through experimentation within sample plots, different vegetation management regimes may be tested during which time

continuous monitoring of waterbird diversity, abundance and habitat use as well floral species diversity, abundance and cover, aquatic faunal diversity and abundance should be undertaken. Actions to manage the aquatic vegetation (species, quality and abundance/densities) should be undertaken with a complete understanding of their importance for waterbirds, fishes and other aquatic fauna.

3. Control of poaching

Control of poaching requires an understanding of the modus operandi, impact on species and socio-economic impacts to enable appropriate responses to be undertaken.

Main locations of poaching, seasonality, main species taken and numbers per season are quantified.

For the resident species, an analysis of poaching of eggs, chicks and adults at nests and disturbance through cattle grazing, reed harvesting, lotus/other plant collection should be undertaken.

9. CONCLUSIONS

The bird population shows fluctuation with site differences as well as with changing seasons. Less number of birds was recorded at site 1 because this Site is an open site with scattered trees. Population density of birds shows direct relationship with density of emergent vegetation plus density of trees. Mathematically,

$$px = K\{py+pz\}$$

Where "px" is the Avian fauna Density (in Wetland), "y" denotes the Emergent Vegetation Density (in Wetland), "pz represents" the Tree Density (in Wetland) and "K" is the Proportionality constant (depending mainly upon the Environmental conditions).

As Site 2 is covered by dense emergent vegetation and Salix trees and therefore space for nesting, breeding and resting place of birds, hence this Site shows maximum number of birds in the summer season (residents and summer migrants). Site 3 is towards the residential side of the wetland and hence shows an increase number of resident birds in the autumn season. Hence, July to November months are mainly dominated by Residential birds. Autumn season shows decrease in the number of birds (both residents and summer migrants). This is due to the fact that summer migrants go

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for migration and residential birds move towards residential areas and nearby paddy fields.

In the present research work, it has been observed that the wetland mostly visited by the winter migratory fauna. It is because of the severe cold and non availability of food for their survival in Siberia and other cold areas in Europe. 37 spp of water fowl are reported to breed in the western Siberia. Out of these 15 spp has been reported from Hokersar wetland and 10 spp were observed in Haigam wetland.

Earlier the area was about 1400 hectares with reed beds of about 400 hectares but now total reserve has shrunk to 725 hectares. Most of the study area is covered with a dense growth of reeds and other emergent vegetation. Decrease in wetland area leading to loss of food and cover plants have led to decline in waterbird populations. In order to protect the "Dying Haigam Wetland", The remedial measures suggested in this research work should be immediately and keenly implemented.

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