

**WETLAND BIRDS COMMUNITY OF BEESHAZARI AND
ASSOCIATED LAKES RAMSAR SITE, CHITWAN**

**A Dissertation
Submitted for the Partial Fulfillment of the Requirements for the Master's
Degree of Science
In Zoology (Ecology)**

By

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February 2010

DECLARATION

I hereby declare that the work presented in this thesis has been done by myself and has not been submitted elsewhere for the award of any degree. All sources of information have been specially acknowledged by reference to authors or institution.

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RECOMMENDATION

This is to recommend that the dissertation entitled “**WETLAND BIRDS COMMUNITY OF BEESHAZARI AND ASSOCIATED LAKES RAMSAR SITE, CHITWAN**” for the partial fulfillment of M.Sc.degree in Zoology (Ecology). This original work was conducted under my supervision. To the best of my knowledge, this dissertation work has not been submitted for any other degree.

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On the recommendation of supervisor Mr. Tej Bahadur Thapa, this thesis submitted by Dan Kumar Subedi entitled “**WETLAND BIRDS COMMUNITY OF BEESHAZARI AND ASSOCIATED LAKES RAMSAR SITE, CHITWAN**” is approved for examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for Master’s Degree of Science in Zoology with special paper Ecology.

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ACRONYMS AND ABBREVIATIONS

%-	Percentage
BPP	Biodiversity Profile Project
B.S. -	Bikram Sambat
BCC	Biodiversity Conservation Centre
BCF-	Bharandabhar Corridor Forest
BCN-	Bird Conservation Nepal
BLI-	Birdlife International
DNPWC-	Department of National Parks and Wildlife Conservation
Fig. -	Figure
HMGN-	His Majesty's Government of Nepal
IUCN-	International Union for Conservation of Nature/ The World Conservation Union
KMTNC	King Mahendra Trust for Nature Conservation
RIS	Ramsar Information Sheet
RH-	Relative Humidity
VDC-	Village Development Committee
WWF-	World Wildlife Fund

ABSTRACT

Wetland birds are the indicator of wetland habitat. The study entitled “WETLAND BIRDS COMMUNITY OF BEESHAZARI AND ASSOCIATED LAKES RAMSAR SITE, CHITWAN” was carried out during the period of October 2007 to July 2008 to assess seasonal diversity, habitat association and conservation threats.

The direct count method using vantage points (n=15) was done to assess the species richness. Questionnaire survey was done to collect primary field data related to threats. Diversity data were analysed in terms of Shannon's index of diversity, Sorensen's similarity index and Chi Square test was employed to test the diversity of birds in different seasons.

The secondary information was collected through literature. During the study period 19 species of birds representing 11 families and 3 orders were recorded. The highest number of individuals of birds were recorded in the winter season (345) and followed by autumn season (167). The diversity of birds was found highest in winter (1.806) in Beesh Hazari Taal but in its associated lakes diversity was highest in summer (1.92). The similarity index was 64.28 between Beesh Hazari and its associated lakes. The result showed that the species richness was not affected by seasons. Carnivores represented the highest number of bird species followed by piscivores. Most of the wetland species were found in perennial lakes than in seasonal marshes. Major conservation threats found were human pressure, siltation and sedimentation, fishing and poisoning, tourism and tourist activities and invasive alien species. Restoration of the wetland habitat must be done by irrigation and awareness of the people about the importance of wetland is crucial for conservation.

Key words: *Wetland birds, diversity, habitat, threats*

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- 1 Asian Openbill (*Anastomus oscitans*)
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CHAPTER -1 INTRODUCTION

1.1 Background

The community concept is one of the most important principles in ecological thought and practice (Odum 1996). A community structure is an assemblage of population living in a prescribed area and community structure refers to biological structure of a community (Krebs 1994). Determination of bird population in different habitats is central to understand the community structures and niche relationships as well as for intelligent management of population (Chettri *et al* 2005).

Ramsar Convention on Wetlands defines wetlands as “areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters” (Ramsar Convention Bureau 1987; Article 1.1). Further, the Convention defines that wetlands “may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands” (Article 2.1).

Nepal’s National Wetland Policy (2003) defines wetlands as “natural or artificially created areas, such as swamp, marsh, riverine floodplain, lake, water storage area and agricultural land containing water from underground water resources or atmospheric precipitation that may be permanent or temporary, static or flowing, freshwater or saline”. Koshi Tappu is the First Ramsar site of Nepal (Shah 1997). Other Ramsar sites are Ghodaghodi lake (2563ha), Beeshazar and Associate Lake (3200ha), Jagadishpur Reservoir (225ha) (DNPWC and WWF 2003), Rara Lake (1583ha), Phoksundo Lake (494), Gosaikunda and Associated Lake (1030ha), Gokyo and Associated Lake (7770ha) (DNPWC and WWF 2007) and Mai Pokhari (12ha) (DNPWC and WWF 2008).

Wetlands are essentially important for their ecological, hydrological, socio-economic, cultural, scientific, aesthetic and recreational values. The wetlands provide tremendous socio-economic benefits to mankind through agricultural production, wood and timber production, purification of water, energy and food resources, water storage and check the destructive power of natural hazards such as flood and erosion

(Anon 2005). Wetlands remove bio-degradable organic, inorganic and toxic materials from water flowing across them through intra-system cycling and chemical exchange (Bhandari 1998).

One of the best functions of wetland is to provide habitat for birds. Waterfowl such as grebes have adapted to wetlands to such an extent that their survival as individual species depend on availability of certain type of wetland within their geographical range (Weller 1999). Bellrose (1977) found waterfowl densities and propagation to be related to number of wetlands per square miles. Generally, waterfowl densities and propagation increased as number of wetlands increased.

A bird's breeding habitat must provide all of the resources that the bird needs to live and reproduce. These resources include food, water, nesting sites, roosting place, and cover. Wetland provides many important resources for birds, and many birds use them as breeding habitat. They provide water, which is necessity for birds for drinking and bathing. Open water also provides feeding opportunities for some birds, in particular for diving ducks (Weller 1999). Wetland vegetation can provide locations for escape from predators (Weller 1999). Ducks use open water for their courtship display while Red-winged Blackbird males sing from their territories in vegetation to attract females. Nests are placed in all parts of the wetland, from open water to the dry edges of the wetland (Weller 1999). Because open water in a wetland and vegetation affect the wetland bird community (Weller 1999), the geology and subsequent hydrologic conditions that exert control over the wetlands' ecology (Hammer 1997) could affect bird communities.

1.2 Research Problem Statement

Beesh Hazari Taal and Associated Lakes Ramsar Site located in Barandabhar Corridor Forest is one of the important bird areas in Nepal (Baral and Inskipp 2005). High biodiversity of the area attracts the attention of the people and research related to the biodiversity has been carried out in the area (Baral 1996, Dahal 2002, Adhikari *et al* 2000, Jha 2007, Chettri 2008, Ghimire 2009). Many researchers have focused on avifaunal diversity and vegetation of the area. There is still not much information on particularly wetland birds and their diversity. Threats to wetland birds and their

relation with the habitat are insufficient. Similarly the distribution of different wetland bird species in different wetlands of Beesh Hazari lake system is not adequate for the proper management. So to understand and to explore seasonal diversity, habitat status and threats; the present research was carried out and the result will help in the proper management of wetland birds of Beesh Hazari and Associated Lakes.

1.3 Objectives of the Study

The main objective of the study is to evaluate the wetland birds community of Beeshazari and Associated Lake. The specific objectives are-

- To explore seasonal abundance of wetland birds,
- To determine habitat association, and
- To find out conservation threats to the wetland birds.

1.4 Rationale

The research carried out by many researchers focused on vegetation, avifauna and effect of invasive alien species on wetland birds (Baral 1996, Jha 2007, Chettri 2008) in Beesh Hazari and Associated Lakes but not on the diversity of wetland birds and the habitat status. The result showed an alarming condition of the wetland birds, their habitat status and their threats. The present information would be useful to understand the existing condition of wetland bird species and to identify the management strategy for the conservation of wetland bird species.

1.5 Research Hypothesis

- The diversity of the wetland bird species (species richness) depends upon the seasons.
- The diversity of wetland birds depend on the habitat of the wetlands.

1.6 Limitation

The present study was carried out along the North side of the Khageri canal so marshes south of it were not included in the study. Only ten major wetlands and Beesh Hazari Taal were studied. The study was conducted with in limited time and resources.

CHAPTER-2 LITERATURE REVIEW

Avifauna of Barandabhar Corridor Forest has been studied by many researchers (Baral 1996, Adhikari *et al* 2000, Dahal 2002, Sharma 2004, Ghimire 2009) because of its high potentiality of avifauna. Barandabhar Corridor Forest (BCF) ranges from 1.5- 7 km in width and stretches from Chitwan national park in south to Mahabharat range in the north (Baral and Inskipp 2005). Forest south of East west Highway lies in the Buffer Zone is an important bird area of Nepal (Baral and Inskipp 2005). A total of 282 bird species have been recorded in the Barandabhar forest and Beesh Hazari Taal (Baral 1996, Adhikari *et al* 2000, Dahal 2002). In spite of its small size it provides important forest corridor, providing migratory route for the passage of birds and other wildlife (Dahal 2002). Sharma (2004) studied the diversity of threatened birds and their conservation threats in BCF and recorded 160 species of which 12 were nationally threatened.

Ghimire (2009) studied the seasonal diversity and habitat utilization of birds in the Barandabhar Corridor Forest and 123 bird species of which 117 were found during Spring and 82 during Autumn season. He found only 2.88% of individuals were utilizing wetland habitat. Similarly Chhetri (2008) recorded 18 wetland dependent bird species in Beesh Hazari Taal and found American cutgrass (*Leersia hexandra*) and Water hyacinth (*Eichhornia crassipes*) as main invasive alien plant species. Bird monitoring in BCF by KMTNC during 2001-2005 recorded 307 species belonging to 54 families 15 orders of which 60% were resident, 25% summer visitors, 31% winter visitors and 1% vagrant (KMTNC 2005). Threats to the birds in BCF were habitat destruction, over fishing and hunting, poisoning and trade and degradation of wetlands (KMTNC 2005).

Birds have long been used as indicators of environmental change due to their sensitivity to environmental variables (Fitzpatrick 2004). More recently ecologists have monitored the populations of many species of birds to indicate change in their habitats (Fitzpatrick 2004). In a study of the impact of human disturbance on bird communities in western Sikkim, India, Chettri *et al* (2005) found that there was a significant correlation between bird species and tree diversity. Many bird species uses wetland for breeding and foraging, they have the potential to be useful indicators of changes in wetland environment. Weller (1999) suggested that for wetland birds, the amount of open water in a wetland or wetland complex is important for habitat

selection. Giri (2008) recorded 39 species of wetland birds in Phewa Lake, of which highest number of species (35) in winter season with migratory birds.

Kafle *et al* (2008) studied the status of and threats to water birds of Rupa Lake and recorded 36 species of water birds of which Anatidae (9) represented the highest number of species. And major threats were hunting/trapping, fish farming, habitat destruction by soil erosion, sedimentation and agricultural conversion. Water Hyacinth (*Eichhornia crassipes*) of the lake had reduced the feeding areas for ducks and other water birds. In a study carried out by Chettry (2006) in Koshi Barrage area recorded 98 species of wetland birds of which 41 species were winter visitors, 9 summer visitors, 14 occasional visitors and 39 were residents. Zakaria *et al* (2009) studied species diversity and feeding guilds of Paya Indah Wetland Reserve, Peninsular Malaysia and recorded 100 species and 38 families. Ardeidae was the most dominant family with nine species. The highest bird diversity was observed in marsh swamp while the lowest was in patchy shrub land. Feeding guilds indicated that insectivore was most dominant group (37%). Rimal (2006) carried out a study in Shivapuri National Park about community structure and habitat association of birds and found that that vegetation structure showed remarkable variation in species composition, densities, height of trees in different habitats. Forty-two bird species were habitat specific, 23 species were restricted only in the undisturbed habit. Insectivores represented highest number of bird species and species richness was higher in disturbed habitats but undisturbed habitats supported more habitat specialists.

CHAPTER-3 MATERIALS AND METHODS

3.1 Study Area

3.1.1 Location

This study was conducted in the Beesh Hazari and Associated Lake- Ramsar Site (Figure 1), which is located at the Buffer Zone Area of Chitwan National Park of Central Terai, Nepal in Baradabhar Corridor Forest (BCF). Beesh Hazari Taal is the second largest natural lake in Nepal (area 100 ha) after Ghodaghodi Lake (area 138 ha). Its depth in the center varies from 3 m in dry season to 5 m in rainy season and is subjected to the flow of water in canal (Bhandari 1998). The total forested wetland area of Beesh Hazari and Associated Lake Ramsar site is 3200 hectares (RIS 2003).

Beesh Hazari and Associated Lakes are a part of forested wetland within BCF. Before the construction of the Khageri irrigation canal in 1967 the lake was in a much-degraded condition. This irrigation canal provided great contribution for the conservation of the Beeshazari Taal. Few patches of small stream shaped marshy land locally known as ghols are impounded due to the construction of levee of the irrigation canal. The canal of Khageri Irrigation diagonally crosses the forested wetland. The mud filled dam along the southern slope of this wetland supported for the formation of Beeshazari Lake from water logging. The lake has many ramifications. Most of the branches have already undergone succession and other are on the verge of succession. Numerous wetlands are lying on either side of the canal. Other small lakes, swamps and ghols along the canal are Satrahazari Lake, Kabra Lake, Choubishhazari Lake, Kamana Lake, Laxmi Lake (IUCN 1998).

3.1.2 Geology and Soil

Geology of the area composed of hard rock, principally granite or quartzite and limestone of late Tertiary Siwalik origin which is characterized by the presence of large boulders carried from the north as outwash deposits (IUCN 1998). The soil consists of deep sand, loam and silt loam (KMTNC 1998). Soils are largely alluvium left by meandering river courses. The core of the Siwalik consists mainly of sandstone, conglomerates, quartzites, shales, and micaceous sandstones (IUCN 1998).

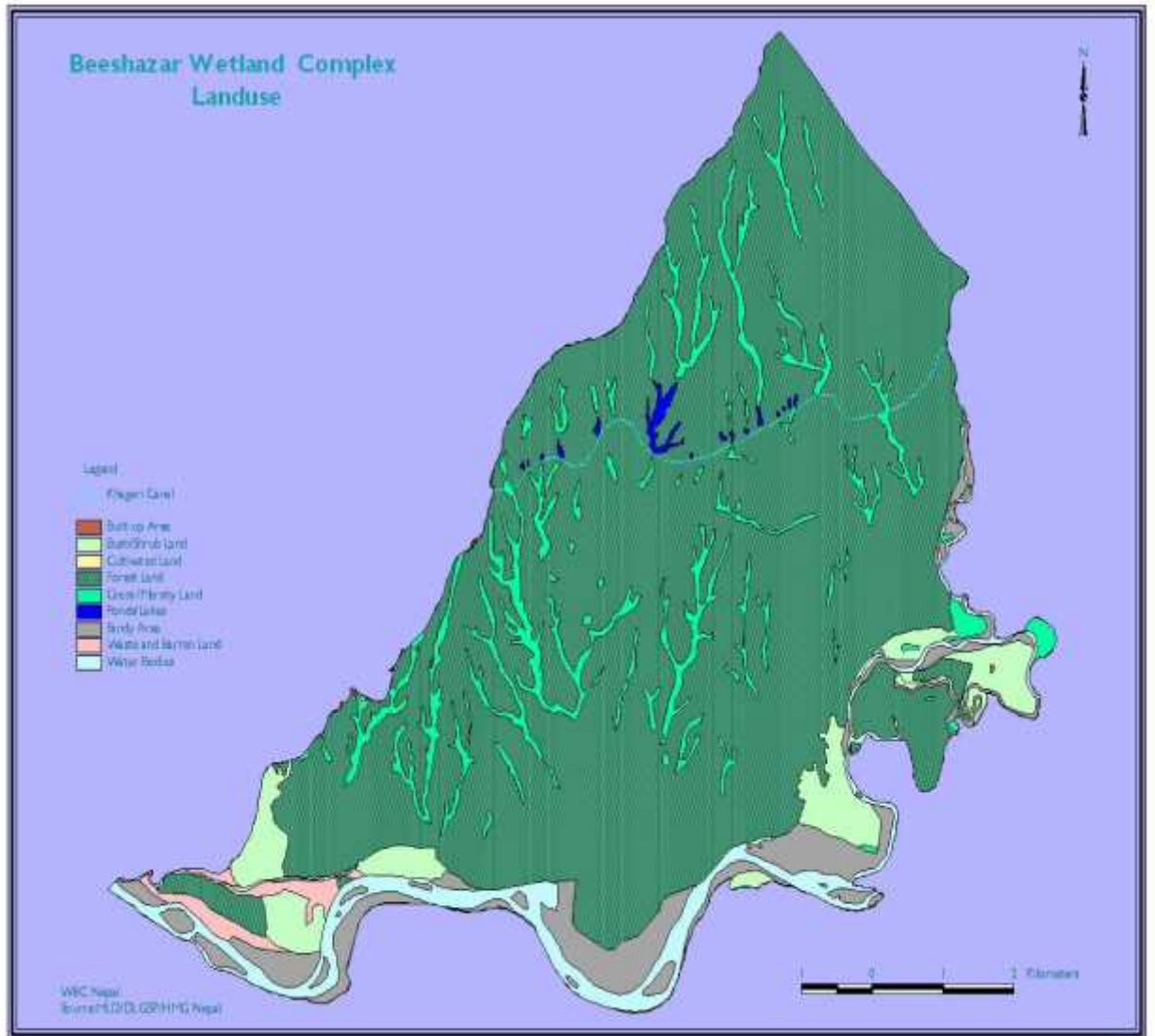


Figure 1: Map showing Beeshazari and Associated Ramsar Site

3.1.3 Climate

The climate of the study area is mainly subtropical with three distinct seasons namely spring, summer and winter. The climatic data shows that days of summer are hot with mean maximum temperature 35.3°C in May followed by June and April. December, January and February represent cold winter months. Mean minimum temperature shows that January is the coldest month with 7.86 °C (Fig 2).

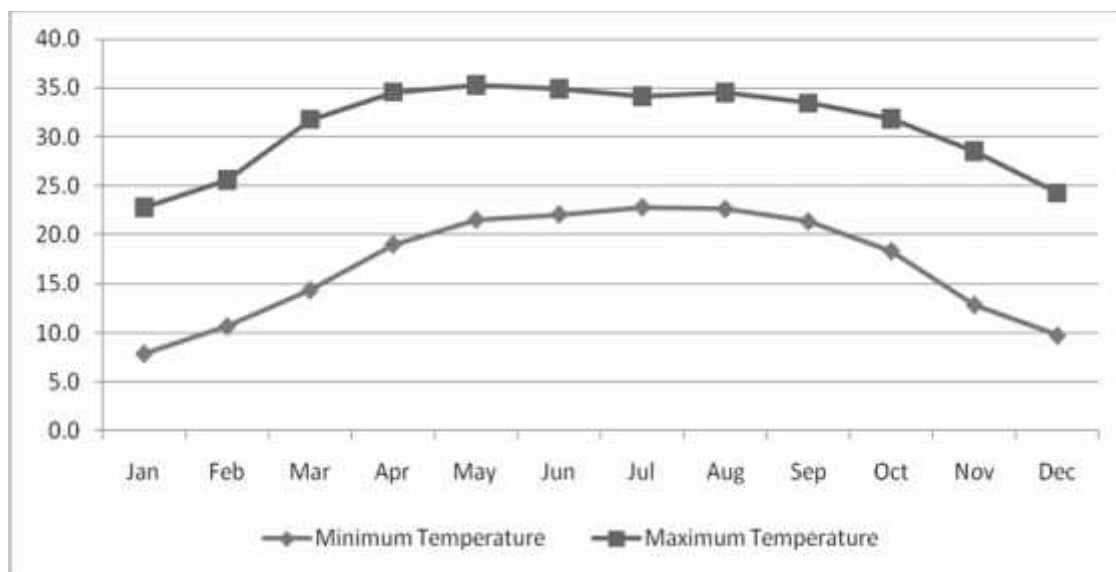


Figure 2: Mean Monthly Maximum and Minimum Temperature recorded at Bharatpur Meteorological Station, Chitwan (2001-2007).

The monsoon is responsible for rain and begins from June to September. Mean annual rainfall shows that September received 551.0 mm, July 472.0 mm and August 456.0 mm where as November and December received very little rainfall 3.65 mm and 6.33 mm respectively (Fig 3).

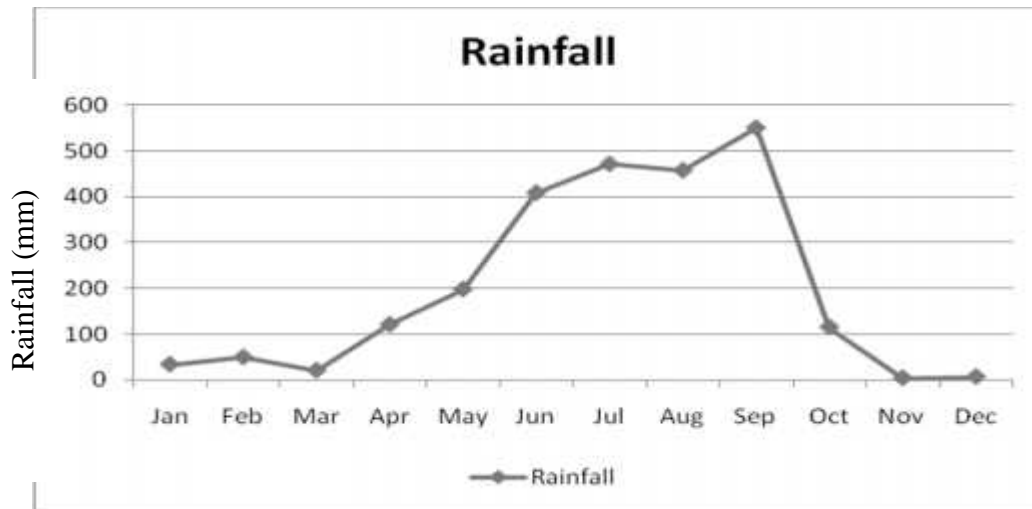


Figure 3: Mean Monthly Rainfall recorded at Bharatpur Meteorological Station, Chitwan (2004-2007).

Mean relative humidity is highest in December (98.1%) followed by January (97.5%) and February (97.3%) and least values are recorded in the months of May (88.8%), April (89.5%) and June (91.8%) (Fig 4).

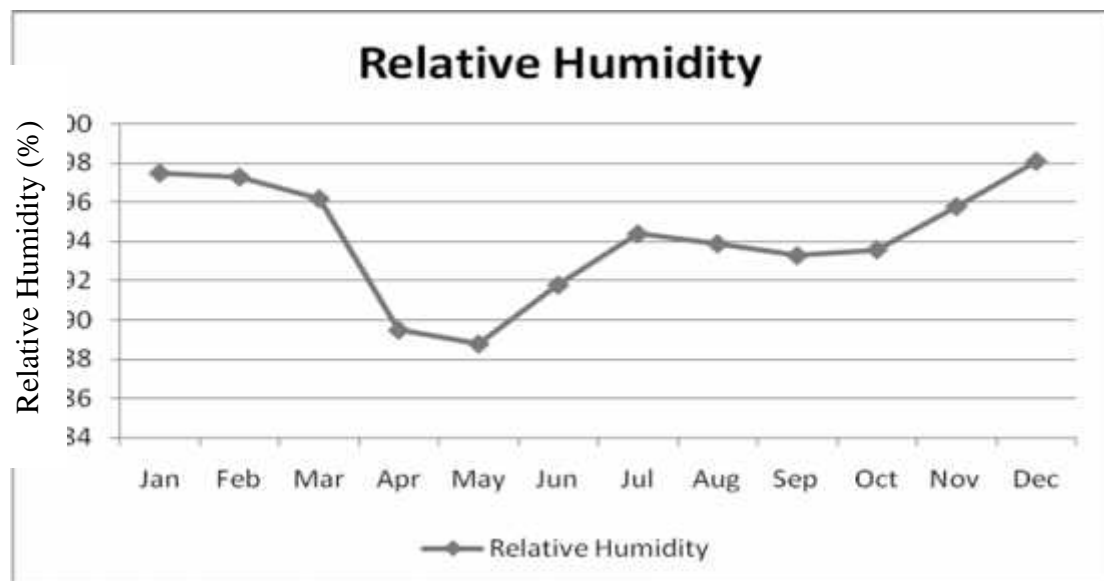


Figure 4: Mean Relative Humidity (RH) recorded at Bharatpur Station, Chitwan (2001-2007).

3.1.4 Vegetation

Beesh Hazari Taal is rich in biodiversity represented by 131 species of plants comprises 32 trees, 64 shrubs and 99 aquatic species (IUCN 1998). The aquatic vegetation include 99 species consisting of 72 genera and 36 families of which 79 species are emergent in nature (IUCN 1998). The aquatic plants life forms inhabiting

different zones of lake comprising 8 free floating plants, 7 submerged plants and 4 rooted floating broad-leaved plants (IUCN 1998).

The terrestrial vegetation is dominated by Sal (*Shorea robusta*). Other prominent association include Asna (*Terminalia alata*), Simal (*Bombax ceiba*), Khayar (*Acacia catechu*), Bot Dhainyaro (*Lagerstroemia parviflora*) and among grasses Kuro (*Chrysopogon aciculatus*), Siru (*Imperata cylindrica*), Kans (*Saccharum spontaneum*). Aquatic vegetation is represented by extensive coverage of floating leafed species mainly water hyacinth (*Eichhornia crassipes*), water chestnut (*Trapa bispinosa*), followed by Evening Primrose (*Ludwigia adscendens*). The free floating species include Water Velvet (*Azolla imbricate*) and Duckweed (*Lemna spp*). The abundant submerged species include Hornwort (*Ceratophyllum demersum*), Hydrilla (*Hydrilla verticillata*) and Water Nymph (*Najas minor*) (Jha 2007).

3.1.5 Fauna

Seventeen species of fish have been recorded, of which *Channa striatus* is a hill fish found in the lake because the water of Khageri Irrigation feeds the lake (BPP 1995). Other important fishes are *Ompok bimaculatus*, *Wallago attu*, *Heteropneustes fossilis*, *Clarias batracus*, *Xenentodon cancila* etc (BPP 1995). The wetlands of the Beeshazari Tal system support 13 species of reptiles including 8 species of snakes, 1 species of Crocodile (Marsh Mugger *Crocodylus palustris*), and 2 species of monitor lizards (Bengal Monitor *Varanus bengalensis* and Yellow Monitor *Varanus flavescens*) and 1 species of Indian soft-shell turtle (Yonzon 2000). Two species of amphibians *Rana cyanophlystis* and *Rana limmocharis* have been recorded from the area (RIS 2003).

A total of 273 species of birds representing 61 families have been recorded from BCF, of which 60 species are wetland dependent (Baral 1996). The forested wetland habitat provides a refuge for a significant number of storks, ibises, fishing eagles and lesser whistling teals. The meadow provides a good opportunity for egrets, herons and serpent eagle to forage upon snakes (RIS 2003).

In Beesh Hazari Lake Forest, a part of Barandabhar Corridor Forest, Royal Bengal Tiger (*Panthera tigris*), Greater One-horned Rhinoceros (*Rhinoceros unicornis*), Sloth Bear (*Melursus ursinus*), Smooth-coated Otter (*Lutra perspicillata*) have been recorded.

3.1.6 Socio Economic Aspects

Beesh Hazari and Associated Lake system is surrounded by three Village Development Committees (VDC) and two municipalities. Their total population is 162,887 with 34,652 households (DPC 2059). The major ethnic group comprises of Brahmin, Chhetri, Newar, Damai, Kami, Tamang, Magar and the indigenous groups like Tharu, Darai and Praja. Except indigenous group, ethnic groups belong to the hill migrant community. Paddy, wheat, mustard and maize are grown as major crops. Other crops grown in the area are buckwheat, millet, gram, lentil, etc.

Table 1: Population of adjoining VDC and Municipalities of the Lake

Place	Household	Total Population	Male	Female	Literacy (%)	
					>6 years	>15 years
Gitanagar	2558	12281	6062	6219	80.55	63.8
Bachhyauli	1882	10508	5333	5175	70.1	50.1
Pathiyani	2287	10929	5292	5637	77.9	59.8
Bharatpur Municipality	20391	90473	46059	44414	80.0	62.2
Ratnanagar Municipality	7534	38696	19493	19203	81.95	60.9
Total	34652	162887	82239	90648		

(Source: District Profile of Chitwan; 2059)

The lake was used for fishing, water storage for irrigation, grazing of cattle, fodder and fuel wood collection. Fishing has been banned in this area since 2003 A.D. However collection of fodder and fuel wood from the lake area have been regulated and monitored by Buffer Zone Community Forest User Groups. Due to the scenic beauty of the lake and its surrounded forest many tourist visit the area for bird watching.

3.2 Research Procedures

3.2.1 Preliminary survey: A preliminary survey was done during September second week 2007. During the survey the vantage points were selected. The study area was surveyed by walking around the different wetlands, the condition of the wetlands were also identified.

3.2.2 Materials: Birds were observed with the help of binocular (SAKURA, 10-20×50). During observation name of birds, number, habitat and activity were noted. “Birds of Nepal” hand book (Grimmett *et al.* 2000, 2003) was used as field guide to identify observed birds.

3.2.3 Bird Survey:

Birds were counted by the direct observation i.e direct counting method (Bibby *et al* 2000). It was considered appropriate because the study area was small and there were no obstructions like tall grasses and other factors. According to Bibby *et al* (2000), a direct counting method is generally used if congregation is no more than 3000 birds. Weller (1999) described that birds in wetlands are best inventoried by direct count method where visibility is unobstructed, such as open water areas, mudflats and short-grass flats.

Vantage Points: Five vantage points were chosen randomly considering that the important sites would not have been missed in Beesh Hazari Taal and other ten vantage points for the Associated Lakes. In each vantage point ten minutes time was spent and recorded all the birds seen or heard within the site boundaries during that time. Birds flying over or through the site were not recorded. The distance between census points were 200meters to avoid the repeating of same individuals. Different vantage points were marked and 10 minutes was spent for recording of the birds. For birds resting in trees, during the census the height of tree, branches and diameters at breast height were recorded.

3.2.4 Habitat Association

The habitat was surveyed and classified into perennial lake, seasonal marsh and swamp. The areas with open water through out the year were designed as perennial

lake and the areas that contain water during the months of monsoon were referred to as seasonal marshes.

3.2.5 Questionnaires

Questionnaire survey was carried out to collect the attitude of local people and some visitors in the Beesh Hazari Taal. The aim was to collect the information about the illegal activities like unauthorized hunting of birds, collecting eggs, poisoning and fishing etc and how much they are aware about the deteriorating condition of the study area (Appendix :3).

3.2.6 Secondary Information

The secondary information and subject related information were collected from different sources like books, journals, booklets, reports, etc. These all were collected from the library of BCN, DNPWC, WWF, IUCN and some were downloaded from the related websites.

3.2.7 Forage Category

The forage category of the wetland bird species were identified from the secondary information. For the diet of the wetland bird species reference was obtained from the book of Ali and Ripley (1987).

3.3 Data Analysis

3.3.1 Shannon's Index of Species diversity

Species diversity of birds was calculated by using Shannon index of general diversity (Shannon and Weiver 1949).

$$\bar{H} = - \sum \left(\frac{ni}{N} \right) \log \left(\frac{ni}{N} \right)$$

or

$$\bar{H} = - \sum pi \log pi$$

3.3.2 Evenness index

$$e = \frac{\bar{H}}{\log S}$$

Where,

\bar{H} = index of diversity. It combines both evenness and richness in a single measure
 n_i = importance value for each species is the number of individuals in each species;
the abundance of each species.

S = Species richness is the number of species and is simply a count of the number of different species in a given area.

N = total of importance value, total number of individuals observed.

e = evenness index.

The diversity is higher if the value of 'e' is in between 0.6-0.9. If the value of 'e' is closer to zero, then there will be no diversity.

3.3.3 Similarity Index(S)

Index of Similarity (S) was used to find the similarity of bird communities in the different wetlands. The index can be given as-

$$S = \frac{2C}{A+B}$$

Where, A=number of species in Beeshazari Tal

B=number of species in other Associated Lakes

C=number of species common in both

3.3.4 Chi-square (χ^2) Test

Chi-square test was used to test whether the species diversity of wetland birds related to season.

$$\chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i}$$

Where, O_i = Observed values

E_i = Expected values

k = Number of categories

CHAPTER- 4: RESULTS

4.1 Species richness

I recorded 19 species of bird representing 11 families and 3 orders (Table 4). The order Cicconiformes represented the highest species richness (14) followed by Coraciiformes (3) and Guriformes (2) is represented by one species.

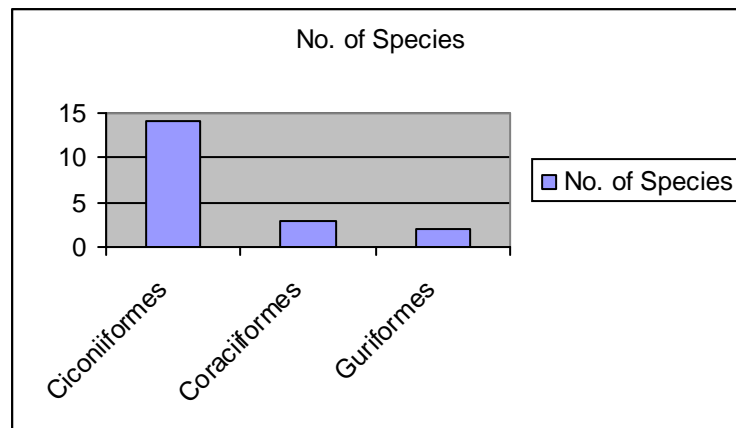


Fig 5: Orders of birds

Seasonally, winter season was the most diverged season in terms of the number of species. In a total of 19 species, 13 species were recorded in winter season, 11 species in autumn, 8 species in spring and 6 species in summer season.

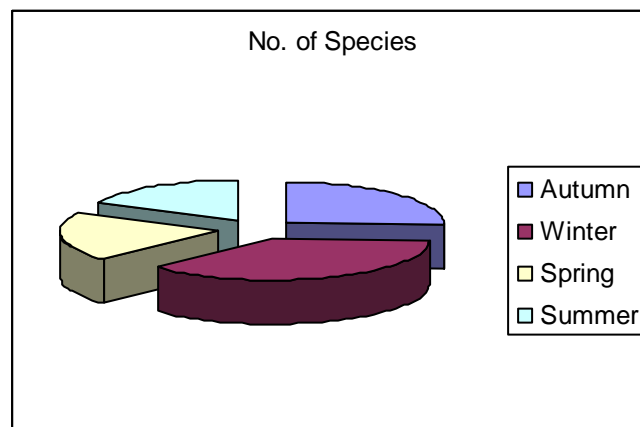


Fig 6: Seasonal distributions of birds

The value of Shannon's index of diversity was found highest in winter season (1.806) and lowest in summer season (1.233) in the Beesh Hazari Tal.

Table 2: Bird diversity in Beesh Hazari Taal

Seasons	Number of species	Shannon-Wiener Index (\bar{H})	Jacob's coefficient (J)
Autumn	11	1.593	0.725
Winter	13	1.806	0.704
Spring	8	1.269	0.652
Summer	6	1.233	0.688

The value of Shannon's index was found highest in the summer season (1.92) and lowest in the winter season (1.40) in other than the Beesh Hazari Taal, i.e. Lakes.

Table 3: Bird diversity in other Associated Lakes

Seasons	Number of species	Shanon-Wiener Index (\bar{H})	Jacob's coefficient (J)
Autumn	8	1.699	0.817
Winter	7	1.40	0.719
Spring	8	1.63	0.783
Summer	9	1.92	0.873

Out of 19 species 4 species were belonged to the family Ardeidae and 3 species to Ciconiidae. Alcedinidae (1), Jacanidae (1), Podicipedidae (1), Anhingidae (1), Phalacrocoracidae (1), Threskiornithidae (1), Rallidae (2) represented by only one species.

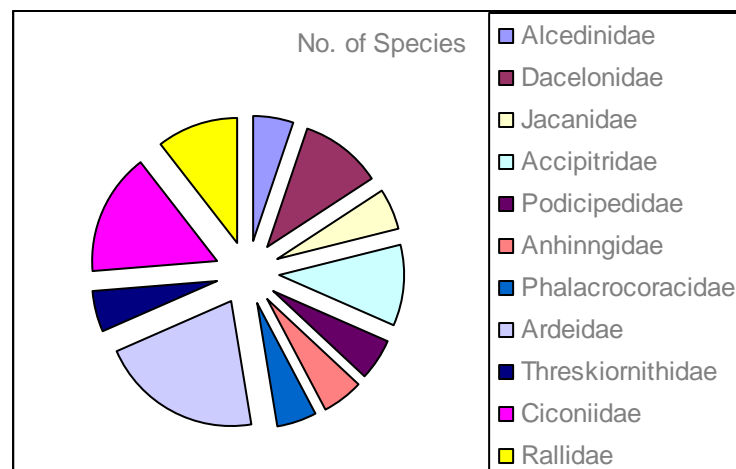


Fig 7: Family wise distributions of birds

Table 4: Total number of bird species recorded at the study area in different seasons.

S.N	Species	Seasons			
		Autumn	Winter	Spring	Summer
1	Bronze winged jacana	37	86	45	28
2	Lesser adjutant strok	19	15	10	10
3	Asian openbill	26	38	17	11
4	Common moorhen	-	77	46	-
5	Black ibis	14	28	3	-
6	Little grebe	-	-	-	67
7	Osprey	-	5	-	-
8	Indian pond heron	38	57	22	6
9	Purple heron	-	3	1	-
10	Woolly necked strok	16	2	-	10
11	Cattle egret	-	-	-	21
12	Oriental darter	3	5	1	1
13	Little cormorant	-	-	16	-
14	Grey headed fish eagle	4	-	-	-
15	Grey heron	3	2	-	-
16	White breasted water hen	-	-	1	-
17	Common kingfisher	5	6	2	2
18	Stroke billed kingfisher	7	2	3	2
19	White throated kingfisher	6	3	1	-

4.2 Population Abundance

The total number of individuals of bird species was found varied in different survey seasons. The highest number of the birds was found in winter (345) and second largest number was in autumn (178 individuals) (Appendix: 3 and 4). Spring and summer had less number of individuals (Figure 8).

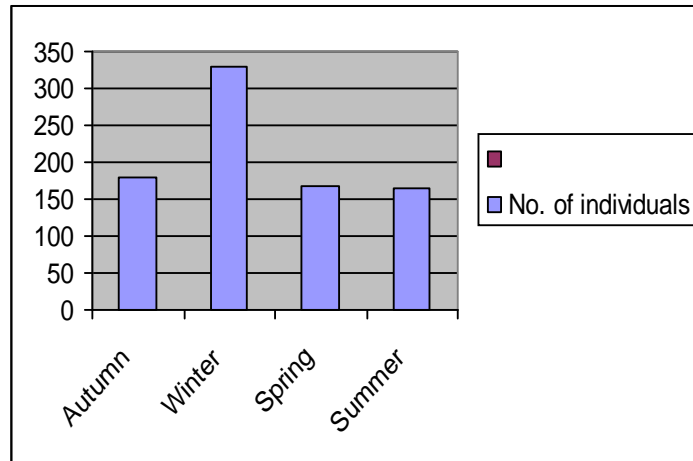


Fig 8: Total numbers of individuals counted in different seasons.

4.3 Community Similarity

The value of Similarity index was high (64.28) between Beesh Hazari Taal and its Associated Lakes.

4.4 Seasonality in Species richness

The calculated value of Chi-square ($\chi^2 = 3.33$) at 5% level of significance and 3 df was lower than the tabulated value ($\chi^2 = 7.18$). The null hypothesis was accepted i.e there is not significant difference in species richness between different seasons.

4.5 Forage Category

Based on the literature Carnivores were recorded as the most common during the study (8) followed by Piscivores (7).

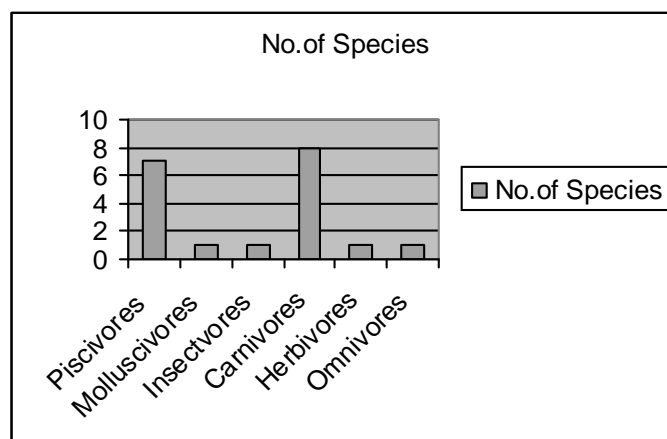


Fig 8: Forage categories of wetland birds

4.6 Habitat Association

4.6.1 Habitat Classification

The wetland habitats of the study area were classified into following three categories. The classifications of the wetland habitat were primarily based on Mitsch and Gosselink (1993).

Category 1: Perennial lake

These were the areas that contain open water through out the year. Beesh Hazari Lake was perennial lake.

Category 2: Seasonal marsh

Permanent or periodically inundated site characterized by nutrient rich water. Ekkashazari, Baishazari, Teishazari, Choubishazari, Pacchishazari, Chhabishazari, Sataishazari, Attaishazari and Gainda Ghole were seasonal marshes. The edges of Beeshazari Lake fall under seasonal marshes.

Category 3: Swamp

The area with more water than marsh and characterized by growth of trees, shrubs and herbaceous plants. Satrahazari Lake was swamp.

4.6.2 Habitat Association with Birds

The wetland bird species recorded in different habitat were represented in the table.

Table 5: List of wetlands birds recorded in different habitat and their status.

S no	Species Recorded	Habitat			Status IUCN
		Prernnial Lake	Seasonal Marsh	Swamp	
1	Asian openbill	+	+	+	
2	Bronze winged jacana	+			
3	Osprey	+			
4	White throated kingfisher	+	+		
5	Grey headed fish eagle	+			Near threatened
6	Strok billed kingfisher	+			
7	Little grebe	+			
8	Common moorhen	+			
9	Little cormorant	+			
10	Black ibis	+			
11	Woolly necked strok	+	+		
12	Purple heron	+	+		
13	White breasted waterhen	+			
14	Oriental darter	+			Near threatened
15	Grey heron	+			
16	Lesser adjutant		+	+	Vulnerable
17	Indian pond heron		+		
18	Common kingfisher		+	+	
19	Cattle egret		+	+	

(Status source BLI 2009)

Wetland bird species like Asian openbill, Lesser adjutant, Cattle egret, Purple heron and White throated kingfisher were not habitat specific where as Oriental darter, little cormorant, Osprey, Black ibis, Common moorhen, Strok billed kingfisher were associated with perennial lake. Many of the wetland bird species were habitat specific. Seasonal marsh and swamp were the main habitats of globally threatened Lesser Adjutant.

4.7 Major Conservation Threats for Wetland birds of Beesh Hazari and Associated Lakes

According to the result of questionnaire survey (75) respondent following threats were found for the conservation purpose.

Human Pressure

The study area lies between various villages. People living nearby them are depending on the forest product and collect fodder, grasses for their cattle. Out of 75 respondent 30% reported human pressure as a conservation threat.

Cattle Grazing

This is also considering one of the major threats of wetlands. Since the area lies in the buffer zone of Chitwan National Park, cattle grazing are prohibited but many ruminants are seen grazing near by the wetland. 15% of the respondent said that the grazing of cattle was a threat.

Siltation and Sedimentation

During the months of monsoon there were the records of siltation and sedimentation. This was the major threats which decrease the size of the wetlands. The Khageri canal irrigates the water into the wetlands. Flooding was also common during the rainy season. 10% of the people's view was the natural process like siltation and sedimentation as a threat.

Fishing and Poisoning

People in the area were also seen fishing around the wetlands, although fishing was prohibited in the Beesh Hazari Taal. Not only had they caught fish with different fishing gears but also poisoning was common.

Tourism and tourist activities

The location of the study area lies in the buffer zone of the Chitwan National Park, where thousands of local and international tourists came for recreation. The site was also famous for picnicking. The solid waste like plastic bags, plastic bottles, metal

cans were thrown in the area. Since these wastes were non bio degradable their effect last longer.

Invasive Aliens water Species

The lake was seen as a thick blanket of water hyacinth and American cutgrass. 13 invasive aliens' species were found to be grown in the lakes and marshes (Jha 2007). These reduces the feeding ground of the diving species. So it was also considered as a conservation threat.

CHAPTER-5: DISCUSSION

I recorded 19 species of wetland birds in the study area of which Cicconiformes order represent the highest species richness. Similarly the family Ardeidae represents the highest species richness followed by Ciconiidae. The index of diversity of the wetland birds was found higher in the winter ($\bar{H}=1.806$) season and lower in the summer ($\bar{H}=1.233$). This was probably more migratory birds were recorded in the winter season than the summer season. The result of Giri (2008) in Phewa Lake also showed similar pattern. Out of 39 species of wetland birds recorded in Phewa Lake 15 were winter migratory. Similarly the result of Chetry (2006) suggested that winter migratory species were recorded more than the summer migratory. In his research in and around the Koshi Barrage out of 98 species of wetland birds 41 were winter migratory and 4 were summer migratory (Chetry 2006).

The index of diversity of wetland birds in the Associated Lake of Beesh Hazari Taal was found highest in summer (1.92) and lowest in the winter although the number of individual is reverse because the number of individuals of summer migratory birds were more than the individuals in other seasons. During the study period more resident wetland birds were sighted and heard than the migratory birds. The result of seasonal diversity showed that the diversity of birds was affected by season but it was not significant. This could be because of less number of migratory birds recorded than resident birds. Winter migratory birds recorded in the study area included Common Moorhen *Gallinula chloropus*, and Osprey *Pandion haliaetus*, and Summer migratory include Little Gerbe *Tachybaptus ruficollis*.

Record of the species of the wetland birds that were recorded in Beesh Hazari Taal was decreasing year by year. Chherti (2008) recorded 18 species of wetland dependent birds. Common sand piper *Actitis hypoleucos* recorded by Chhetri (2008) was not recorded during the study period. The present study shows alarming threats of the wetlands birds of Beesh Hazari and Associated Lakes. The main cause might be of the condition of the lake since the invasive species of plants were growing. Record of resident wetland bird species (15) were more than migratory birds (4) as they might have found the habitat suitable for feeding and breeding.

The value of community similarity was 64.28% between Beesh Hazari Taal and its associated lake. This shows that there exists similar type of habitat condition since most of the wetlands were seasonal marshes. Higher number of wetland birds that were recorded in autumn than spring probably because some parameters like available food and cover were suitable for some of the birds. Bronze-winged Jacana *Metopidicus indicus* were most abundant in the marshy area. The result of Chhetri (2008) showed that it can adapt itself in such habitat. Record of maximum number of Lesser adjutant was in marsh rather than in open water may be the indication of its' habitat preference in marsh than open water. The result of occurrence of more Lesser Adjutant *Leptoptilos javanicus* in marsh was similar with that of Sharma (2006) in Far Western Low Land of Nepal.

Accurate censuring of wetland birds requires a variety of techniques, including nocturnal surveys, nest counts, intensive effects involving or canoeing through marshes, and the use of recorded calls to elicit responses (Weller, 1999: Cited in Dahal, 2006). As only direct count method was used in the study, probably, some species which were in less number as common snipe, were not recorded. Similarly nocturnal wetland species like night heron was also not recorded during the study period.

Habitats studied must have their own significance in the biological sciences. In a study carried out by Subedi (2006) about wetland avifauna in Rupa Lake of Pokhara valley recorded 30 species of wetland birds of which 16 species were resident, 12 species were winter visitors. The lake was good for resident species as result also showed more record of resident wetland bird species.

Baral (1996) recorded 60 wetland birds in the Beesh Hazari Taal of which species of Anatidae family include Common Shelduck (*Tadorna tadorna*), Cotton Pygmy-goose (*Nettapus coromandelians*), Gargaeny (*Anas querquedula*) but no species of anatidae was recorded during this survey. There was the record of globally threatened Lesser Adjutant in marshy type of wetlands and Oriental darter and Grey headed fish eagle in open water were near threatened (BLI 2009). It was found that most of the wetland bird species were habitat specific. Wetland bird species like Oriental darter, Black

ibis, Grey headed fish eagle, Common moorhen, Stork billed kingfisher, Little Grebe, Bronze winged jacana, Osprey were found in open water that is perennial lake. Asian openbill, Lesser Adjutant, Cattle egret were utilizing seasonal marsh and swamp.

Forage category of the recorded wetland bird species had shown that most of the wetland birds were carnivored and piscivores. Common moorhen was among the herbivore and Asian openbill was among the mollusivore.

People hunt wetland birds for food, destroy their eggs, graze domestic animals, and introduce exotic predators in their habitat. Habitat alteration, destruction or loss is the major threat to survival of birds (Baral *et al.*, 1996).

Habitat loss is major threat to 89% of nationally threatened birds of Nepal (Baral *et al.*, 1996). Most birds have little tolerance to environmental change. Most of Nepal's environmental problems have been attributed to poverty and a rapidly growing population, but other factors, including national dept, insecurity of land tenure, and tourism are also important (Dahal, 2006).

According to Baral *et al.* (1996), tourism is a major industry and source of foreign exchange in Nepal, and tourism based industries may cause some damage of wildlife if not planned carefully. New lodges are built almost every year in several trekking areas. This involves clearing patches of dense forests and subsequently leads to forest thinning and degradation. The study area was located in the vicinity of Sauraha which was very good place for tourists and many of them visit Beeshazari lake system which disturbs the bird species. As a consequence bird species, which are sensitive to even small changes in the ecosystem, decline because of their specific habitat requirements (Baral *et al.*, 1996).

The wetlands are fast disappearing ecosystems of Nepal. The wetland habitats in Nepal face various problems due to habitat loss and damage, water pollution, fish poisoning, hunting and trapping, food shortage due to over fishing and disturbances and destruction of nesting and breeding sites Study on wetland birds from 1989 to 1999 has shown to decline some wetland birds such as Lesser Whistling Duck *Dendrocygna javanica*, Oriental Darter *Anhinga melanogaster*, Ruddy Shelduck

Tadona ferruginea, Great Cormorant *Phalacrocorax carbo* and Storks (Baral, 1999). As many as 44 wetland species have been considered threatened at national level (Baral and Inskipp 2004). Threatened wetland species recorded at Beesh Hazari and associated lakes during the study period were Darter *Anhinga melanogaster*, Asian Openbill *Anastomus oscitans*, Grey headed fish eagle *Ichthyophaga ichthyaetus* and Lesser adjutant stork *Leptoptilos javanicus*.

Hunting is contributing to the decline of some species, including the globally threatened Greater Adjutant *Leptoptilos dubius*, Lesser Adjutant *L. javanicus*, Sarus Crane *Grus antigone*, Spot-billed Pelican *Pelicanus philippensis*, and Cheer Pheasant *Catreus wallichii*. Illegal bird trading goes on near Koshi Barrage all the year round (Inskipp, 1989). Hunting of Asian Openbill Stork *Anastomus oscitans* for their flesh was also found during the questionnaire survey. Giri (2008) also recorded the dead Common coot *Fulica atra* in Phewa Lake that was hunted by man. So, hunting of the birds and collection of eggs were also major problems.

In Beesh Hazari and Associated Lakes the open water was heavily infested by invasive alien species (Jha 2007 and Chhetri 2008) that may be responsible for the decline of number and species of wetland birds particularly migratory birds. The species like Common Moorhen *Gallinula chloropus*, Bronze-winged Jacana *Metopidius indicus*, Indian Pond Heron *Ardeola grayii* and Cattle Egret *Bubulcus ibis* are highly adaptable species (Dahal, 2006) and were recorded regardless of the intensity of the invasion. Research carried out by Chhetri (2008) also showed that Bronze-winged Jacana *Metopidius indicus* and Common Moorhen *Gallinula chloropus* were highly adaptable species in Beesh Hazari Taal. Kafle *et al.* (2007) suggested the scientific research and monitoring of biodiversity and wetland ecology in the Ghodaghodi lake area and further recommended that the lake area should be declared as 'Conservation Area' with provision of its buffer zone so that its significance for biodiversity conservation and community development will further be explored since it is experiencing problems like increasing human encroachment along the lake shore, proliferation of invasive alien species, poaching and hunting and fishing in lake, natural eutrophication etc which were similar in Beesh Hazari and associated lake.

CHAPTER-6 CONCLUSION

Beesh Hazari and Associated Lakes Ramsar site was found one of good place for the wetland species of birds. Although the species diversity of wetland bird was found higher in the winter season in Beeshazari Tal, other Associated Lakes were not like that of Beeshazari Tal. The species composition showed that the area was becoming unfavorable for the migratory birds especially of duck family. Autumn season was also good for the resident wetland birds. Since the wetland comprises several ghols that contain more or less similar type of community structure there was the chance of local migration. Perennial lakes and seasonal marshes and swamp were the main habitats. Out of these three types of habitat the perennial lakes supported more number of wetland bird species than the seasonal marshes and swamps. Species like bronze winged jacana *Metopidus indicus* and common moorhen *Gallinula chloropus* had adapted themselves in the area with invasive of Water hyacinth *Eichhorria crassipes* and American cutgrass *Leersia hexandra*. The grey headed fish eagle was also seen during the study suggest that the habitat is suitable for it. Lesser adjutant, Oriental darter and Grey headed fish eagle were the threatened and near threatened wetland species. Of which Lesser adjutant was utilizing seasonal marshes and swamps where as other two were utilizing perennial lake. Fishing and poisoning were the threats found there that may affect the species like grey headed fish eagle and other piscivores. Oriental darter, white throated kingfisher, stork billed kingfisher were among the piscivores. Lesser adjutant and Asian openbill stork spent most of their time in the area where succession was proceeding. The conservation threats of the area were cattle grazing, fodder collection, tourism activities, fishing and hunting, siltation, growth of invasive species. Disappearance of several species of wintering migratory birds that were frequently observed in the area was a serious problem in the light of conservation. Activities like restoration of the wetland was found must in Beesh Hazari and Associated Lakes.

As it is declared as Ramsar site and the activities under taken is not enough for conservation. The area will become important in near future if the level of the pond can be raised by irrigation and the invasive species can be removed wisely. The forested wetland plays important site for various wetland birds as well as forest and grassland birds so the immediate measure should be taken for its conservation.

CHAPTER-7 RECOMMENDATION

On the basis of the present study following recommendation will be helpful for the conservation and management of Beesh Hazari and Associate Lakes.

- The present study has been conducted north of the Khageri canal and was primarily focused on the wetland bird species so a comprehensive bird survey should be conducted in and around the Beesh Hazari and its Associated Lakes to understand the present condition of avifauna.
- Yearly bird survey should be conducted to understand the impact of conservation measures.
- Perennial lake is the main habitat of globally near threatened Oriental darter and Grey headed fish eagle so the open water should be maintained in the lake.
- The habitat of globally threatened Lesser adjutant, perennial marsh and seasonal marsh should be maintained by irrigation.
- Effective awareness programs, trainings and seminars should be carried out for possible minimization of hunting of birds. Such programs should be carried out intensively in the school children to discourage upcoming generation in such illegal activities.
- Picnicking around the lake has generated waste that has impact on wetland bird species so it should be managed properly.
- Pesticides and farm chemicals when reached in the water bodies they affect the aquatic organisms and then to wetland birds so it should be prevented from reaching the wetlands.

CHAPTER-8 REFERENCES

- Adhikari, R, Karmacharya R, Adhikari Y, and Sapkota D. R. 2000. The birds of Barandabhar. Unpublished report. Bird Education Society, Sauraha.

- Ali, S and Ripley S.D 1987. Compact handbook of the birds of India and Pakistan. Second edition, Bombay, Oxford University Press.
- Anon, M. 2005. Introduction to Wetlands. In selected readings on wetlands and coastal habitat management. Wildlife Institute of India, Deharadun, India.
- Baral, H.S. 1996. Avifauna of Bees Hazari Tal, Chitwan. A report submitted to IUCN Nepal.
- Baral, H. S. 1999. Decline of wetland dependent birds in Nepal with reference of Chitwan. Danphe, Vol. 8, No.1, 5pp. Bird Conservation Nepal.
- Baral, H. S. and Inskipp C. 2004. The state of Nepal's birds. Department of National Parks and Wildlife Conservation, Bird Conservation Nepal and IUCN Nepal.
- Baral, H. S and Inskipp C. 2005. International Bird Areas in Nepal: key sites for conservation Bird Conservation Nepal and Bird Life International. Kathmandu and Cambridge.
- Baral, H. S, Inskipp C, Inskipp, T and Regmi U. R. 1996. Threatened Birds of Nepal. Bird Conservation Nepal and Department of National Park and Wildlife Conservation, Kathmandu.
- Bellrose, F.C. 1977. Species distribution, habitats and characteristics of breeding dabbling ducks in North America in Bookhout, T.A, Water fowl and wetlands –An integral review: Proceedings of a symposium held at the 39th Midwest fish and wildlife conference Madision, Wisconsin, La Printing Co. Inc 152p.
- Bhandari, B. 1998. An Inventory of Nepal's Terai Wetlands. Kathmandu. IUCN, Nepal.
- Bibby, C.J, Burgess N.D, Hill D.A, Mustoc S.H. 2000. Bird Census Technique. Second edition, British Trust for Ornithology. Academic Press, London. PP. 65-90.
- Bibby, C.J, Jones M, and Marsden S. 2000. Expedition Field Techniques, Bird Surveys. Published by Birdlife International, Cambridge. PP. 82-89
- Bird Life International 2009. Species Fact Sheet: *Leptoptilos javanicus*. Downloaded from <http://www.birdlife.org> on 29/12/2009
- Bird Life International 2009. Species Fact Sheet: *Anhinga melanogaster* Downloaded from <http://www.birdlife.org> on 29/12/2009

- Bird Life International 2009. Species Fact Sheet: *Ichthyophaga ichthyaetus*
Downloaded from <http://www.birdlife.org> on 29/12/2009
- BPP 1995. Red Data Book of the Fauna of Nepal, Biodiversity Profile Project
Technical Publication No-4. Department of National Parks and wildlife
Conservation, Ministry of forests and Soil Conservation.
- Chhetri, B.K. 2008. Impacts of Invasive Alien Plant Species on The Wetland
Dependent Birds of Beesh Hazari Taal, Chitwan, Nepal. M.Sc. Thesis, Central
Department of Zoology, Kirtipur, Kathmandu.
- Chhetri N., Deb D.C, Sharma E, Jacson R. 2005. The relationship between bird
community and habitat. Mountain Research and Development 25:235-243.
- Chhetry, D.T. 2006. Diversity of wetland birds around the Koshi Barrage
Area. Our Nature 4:91-95
- Dahal, B. R. 2002. Bird Checklist of Barandabhar forest corridor. Unpublished
report submitted to KMTNC, Jawalakhel, Lalitpur.
- Dahal, B.R. 2006. Effects of invasive weeds particularly water hyacinth
Eichhornia crassipes and human disturbances on community structure of
wetland birds in Koshi Tappu Wildlife Reserve, Nepal. M.S. Thesis in
International Studies in Aquatic Tropical Ecology, University of Bremen,
Faculty of Biology and Chemistry.
- DPC Chitwan. 2059. District Profile of Chitwan.
- DNPWC and WWF 2003. FACTSHEET Beeshazar and Associated Lakes
Chitwan.
- DNPWC and WWF 2003. FACTSHEET Ghodaghodi Lake Area Kailali.
- DNPWC and WWF 2003. FACTSHEET Jagadishpur Reservoir Kapilvastu.
- DNPWC and WWF 2007. FACTSHEET Gokyo and Associated Lakes
Solukhumbu.
- DNPWC and WWF 2007. FACTSHEET Gosainkunda and Associated Lakes
Rasuwa.
- DNPWC and WWF 2007. FACTSHEET Phoksundo Lake Dolpa.
- DNPWC and WWF 2007. FACTSHEET Rara Lake Mugu.
- DNPWC and WWF 2008. FACTSHEET Mai Pokhari Ilam.
- Fitzpatrick, J.W 2004. Bird conservation. In Hand book of bird biology. Ed.
Podulka S, Rohrbaush R W and Bonney R. Cornell lab of Orinthology, Ithaca
NY.

- Ghimire, B.C 2009. Seasonal diversity and habitat utilization of birds in the Barandabhar Corridor Forest of Chitwan District, Nepal. M.Sc Dissertation, Central Department of Zoology, Kritipur, Kathmandu.
- Giri, B. 2008. Wetland Avifaunal Diversity, Population Status and Conservation Threats in Phewa Lake Pokhara, Nepal. M.Sc. Dissertation, Central Department of Zoology, Kirtipur, Kathmandu.
- Grimmett, R., Inskipp C, and Inskipp T. (2000). Birds of Nepal. Helms Field Guide. London.
- Grimmett, R, Inskipp C, Inskipp T. and Baral H.S. 2003. Birds of Nepal. Helms field guide (Nepali Version).
- Hammer, D.A 1997. Creating Freshwater Wetlands, 2nd ed. New York: Lewis Publisher.
- HMGN 2003. National Wetland Policy 2003. His Majesty's Government of Nepal, Ministry of Forests and Soil Conservation, Kathmandu, Nepal.
- Inskipp, C 1989. Nepal's Forest Birds: Their status and conservation. International Council for Bird Conservation, Monograph No 4, Cambridge.
- IUCN 1998. A study on Conservation of Beeshazari Tal. Wetland and Heritage Unit IUCN Nepal.
- Jha, S. 2007. Phytodiversity in Beeshazar Lake and Surrounding Landscape system. Our Nature 5:41-51.
- Kafle G, Balla M.K, Baral H.S, and Thapa I. 2007. Ghodaghodi lake area: resources, opportunities and conservation. Danphe 16(3): 1-6
- Kafle G, Cotton M, Chaudhary J.R, Pariyar H, Adhikari H, Bohora S.B, *et al* 2008. Status and Threats to Waterbirds of Rupa Lake, Pokhara, Nepal. Journal of Wetlands Ecology. 1(1/2):9-12.
- KMNTC 1998. Royal Chitwan National Park After Twenry Years: An assessment of threats and opportunities, KMNTC, Kathmandu, Nepal.
- KMTNC 2005. Status of the birds in Barandabhar Corridor Forest. BCC Tiger/Rhino Conservation Project Sauraha.
- Krebs, C.J 1997. Ecology, the experimental analysis of distribution and abundance. Harper Collins.
- Mitsch, W.J and Gosselink J.G 1993. Wetlands 2nd edition Van Nostrand Reinhold 10, New York.

- Odum, E.P 1996. Fundamental of Ecology. Third Edition. Natraj Publisher. Dehra Dun.
- Ramsar Convention Bureu 1987. The Ramsar Convention: Convention on Wetlands of International Importance Especially Waterfowl Habitat. Gland, Switzerland, Pamhlet.
- Ramsar Information Sheet. 2003. IUCN-The World Conservation Union, Nepal and DNPWC. Kathmandu. Nepal.
- Rimal, R.P 2006. Community Structure and Habitat Association of Birds in Shivapuri National Park of the Central Mid-Hill of Nepal. M.Sc Dissertation, Central Department of Zoology, Kirtipur, Kathmandu.
- Shah, J.P 1997. Koshi Tappu Wetlands: Nepal's Ramsar site. IUCN, Bangkok, Thiland.
- Shannon, C and Wiever W 1949. The Mathematical theory of communication. University of Illinois Press, Urbana.
- Sharma, H.K. 2004. Diversity of Threatened Birds and Their Conservation Threats in Barandabhar Corridor Forest, Chitwan. M.Sc. Dissertation, Central Department of Zoology, Tribhuvan University, Kirtipur, Kathmandu.
- Sharma, S 2006. Population status and distribution of Lesser adjutant (*Leptoptilos javanicus*) in Far- Western Lowland Nepal. Tiger Paper 33:4,9-11pp
- Subedi, B.R. 2006. Wetland Bird Diversity of Rupa Lake. M.Sc. Dissertation, Tribhuvan University, Kirtipur, Kathmandu.
- Weller, M.W. 1999. Wetland birds: Habitat Resources and Conservation Implications. Cambridge University Press.
- Yonzon P. 2000. Win Little, Lose More. Habitat Himalaya. Vol.VII. No. I.
- Zakaria M, Rajpar M.N and Sajap A.S. 2009. Species Diversity and Feeding Guilds of Birds of Paya Indah Wetland Reserve, Peninsular Malaysia. International Journal of Zoological Research.

Appendix: 1 Field Data Sheet

"WETLAND BIRDS COMMUNITY OF BEESHAZARI AND ASSOCIATED LAKES RAMSAR SITE, CHITWAN"

Date:

Jungle Time:

On:

Off:

Contact Time:

On:

Off

Temperature:

Weather:

S.N.	Habitat Type	Common Name	No. of Individual	Activities	Status

Appendix: 2 Record of wetland bird species at different vantage point.

Vantage points	Nameof ghols/lakes	Habitat status	Wetland birds
1	Attaishazari	Seasonal marsh	Indian pond heron
			Lesser adjutant
			Asian openbill
			Common kingfisher
2	Sattaishazai	Seasonal marsh	Lesser adjutant
			Indian pond heron
			Little grebe
			Woolly necked strok
			White throated kingfisher
3	Chhabishazari	Seasonal marsh	Little grebe
			Lesser adjutant
			Asian openbill
			Woolly necked strok
4	Pachishazari	Seasonal marsh	Lesser adjutant
			Indian pond heron
			Common kingfisher
			Oriental darter
5	Chaubishazari	Seasonal marsh	Lesser adjutant
			Indian pond heron
			Asian openbill
6	Teishhazari	Seasonal marsh	Stroke billed kingfisher
			Asian openbill
			Lesser adjutant
			White throated kingfisher
7	Basishazari	Seasonal marsh	Lesser adjutant
			White throated kingfisher
			Common kingfisher
8	Ekkashazari	Seasonal marsh	Asian openbill
			Lesser adjutant
			Common kingfisher
9	Satrahazari	Swamp	Lesser adjutant
			Asian openbill
			Common kingfisher
			Cattle egret
10	Gainda Ghole	Seasonal marsh	Lesser adjutant
			Indian pond heron

11	Beesh Hazari A	Perennial lake	Grey headed fish eagle
			Asian openbill
			Oriental darter
			Woolly necked strok
			Indian pond heron
			Bronze winged jacana
			Black ibis
			Little grebe
			Common moorhen
			White throated kingfisher
			Purple heron
			Osprey
12	Beesh Hazari B	Perennial lake	Bronze winged jacana
			Osprey
			White throated kingfisher
			Grey headed fish eagle
			Stroke billed kingfisher
			Little grebe
			Common moorhen
			Little cormorant
			Black ibis
			Oriental darter
13	Beesh Hazari C	Perennial lake	Purple heron
			Black ibis
			Oriental darter
			Common moorhen
			Bronze winged jacana
			Little cormorant
			Asian openbill
			Little grebe
14	Beesh Hazari D	Seasonal marsh	Grey headed fish eagle
			Asian openbill
			Oriental darter
			Woolly necked strok
			Indian pond heron
			Black ibis
			White throated kingfisher
			Stroke billed kingfisher
15	Beesh Hazari E	Seasonal marsh	Lesser adjutant

			Asian openbill
			Stroke billed kingfisher
			Cattle egret
			Bronze winged jacana
			Woolly necked strok
			White throated kingfisher
			Common moorhen
			Grey headed fish eagle

Appendix: 3 Questionnaire

Name : _____ **Sex :** _____ **Age:** _____
Education: _____ **Occupation:** _____ **Site:** _____

1. Are you native?
2. (If not), migrated? When?
3. What changes have you seen here since you have come here?
4. What changes have you been noticing during last 5-10 years?
 - I. Human increment/encroachment to lake.
 - II. Road construction
 - III. Land slide
 - IV. Others
5. Have you ever noticed the birds found here?
6. How many types of birds have you noticed?
7. Have you seen the water birds like ducks and others?
8. In which season do you see more birds?
 - I. Spring
 - II. Summer
 - III. Autumn
 - IV. Winter
9. Can you name some birds which you see regularly and occasionally?
 - I. Regularly:
 - II. Occasionally:
10. Can you name which you have not seen for 5-10 years?
11. Do you know bird migration? And have you ever seen?
12. Have you ever felt harmful effects from water birds and other birds?
13. What types of problem do they create?
14. Have ever seen people hunting birds?
15. Which birds are generally hunted?
16. Which stage is focused?
 - I. Egg
 - II. Chicks
 - III. Adults
17. Which instrument do they use mostly for hunting?
 - I. Catapult
 - II. Gun
 - III. Net
 - IV. Others
18. Do you also involved in hunting birds?
19. What may be the reason of decreasing birds of this area?
 - I. Hunting
 - II. Loss of habitat
 - III. Pollution
 - IV. High disturbance
 - V. Others
20. Have you been noticing pollution increased in the water of Beesh Hazari Lake?
 - I. Increasing turbidity

- II. Stinking of water
 - III. High increment of invasive aquatic plants (Water hyacinth)
21. What do you think the reason for the pollution of water?
- I. Sewages disposal from houses and hotels
 - II. Washing clothes and taking baths in the lake
 - III. Disposal of other materials like bottles, plastics, etc.
22. Since when the water pollution and water hyacinth became as a big problem?
23. Water hyacinth is being removed-
- I. Once a year
 - II. Twice a year
 - III. More
24. Any awareness program held here for water birds (Birds) conservation?
- I. Yes/No
 - II. (if yes) How many times?

Appendix: 4 Numbers of individuals of the birds recorded during the study period at Beeshazari Tal

S N	Birds	Seasons			
		Autumn	Winter	Spring	Summer
1	Bronze-winged jacana <i>Metopidius indicus</i> Lathm	37	86	45	28
2	Lesser adjutant stroke <i>Leptoptilos javanicus</i> Horsfield	1	1	-	-
3	Asian openbill stroke <i>Anastomus oscitans</i> Baddaert	9	17	7	1
4	Common moorhen <i>Gallinula chloropus</i> Linnaeus	-	77	46	-
5	Stroke billed kingfisher <i>Halcyon capensis</i> Linnaeus	5	2	1	-
6	White throated kingfisher <i>Halcyon smyrnensis</i> Linnaeus	4	2	-	-
7	White breasted waterhen <i>Amaurornis phoenicurus</i> Pennant	-	-	1	-
8	Little gerbe <i>Tachybaptus ruficollis</i> Pallas	-	-	-	50
9	Osprey <i>Pandion haliaetus</i> Linnaeus	-	5	-	-
10	Indian pond heron <i>Ardeola grayii</i> Skyes	22	22	9	-
11	Purple heron <i>Ardea cinerea</i> Linnaeus	-	3	1	-
12	Woolly necked stroke <i>Ciconia episcopus</i> Baddaert	11	-	-	6
13	Cattle egret <i>Bubulcus ibis</i> Linnaeus	-	-	-	15
14	Black ibis <i>Pseudibis papillosa</i> Temninck	14	28	3	-
15	Oriental darter <i>Anhinga melanogaster</i> Pennant	2	4	-	1
16	Little cormorant <i>Phalacrocorax niger</i> Vieillot	-	16	-	-
17	Grey-headed fish eagle <i>Ichthyophaga ichthyaetus</i> Horsfield	4	-	-	-
18	Grey heron <i>Ardea cinerea</i> Linnaeus	3	2	-	-

Appendix: 5 Numbers of individuals of the birds recorded during the study period other than Beeshazari tal

SN	Birds	Seasons			
		Autumn	Winter	Spring	Summer
1	Indian pond heron <i>Ardeola grayii</i> Skyles	16	35	13	6
2	Lesser adjutant stork <i>Leptoptilos javanicus</i> Horsfield	18	14	10	10
3	Asian openbill stork <i>Anastomus oscitans</i> Baddaert	17	21	20	15
4	Little gerbe <i>Tachybaptus ruficollis</i> Pallas	-	-	-	17
5	Woolly necked stork <i>Ciconia episcopus</i> Baddaert	5	2	-	4
6	Oriental darter <i>Anhinga melanogaster</i> Linnaeus	1	1	1	-
7	Stork billed kingfisher <i>Halcyon capensis</i> Linnaeus	2		2	2
8	White throated kingfisher <i>Halcyon smyrnensis</i> Linnaeus	2	1	1	2
9	Common kingfisher <i>Alcedo atthis</i> Linnaeus	5	6	2	2
10	Cattle egret <i>Bubulcus ibis</i> Linnaeus	-	-	6	5

Appendix: 6 Record of wetland bird species in Beeshazari and Associated Lakes.

S.No	Name of species	Location	
		Bees Hazari Lake (A)	Associated Lakes (B)
1	Little cormorant	+	–
2	Little grebe	+	+
3	Asian openbill	+	+
4	Oriental darter	+	+
5	Black ibis	+	–
6	White throated kingfisher	+	+
7	Lesser adjutant	+	+
8	Strok billed kingfisher	+	+
9	Woolly necked strok	+	+
10	Grey heron	+	–
11	Purple heron	+	–
12	Cattle egret	+	+
13	Indian pond heron	+	+
14	Bronze winged jacana	+	–
15	Common moorhen	+	–
16	Grey headed fish eagle	+	–
17	Osprey	+	–
18	White breasted water hen	+	–
19	Common kingfisher	–	+

Photo Plate 1



1 Asian Openbill (*Anastomus oscitans*)



2 Purple heron (*Ardea purpurea*)



3 White throated kingfisher (*Halcyon smyrnensis*)



4 Indian Pond Heron (*Ardeola grayii*)



5 Little Grebe (*Tachybaptus ruficollis*)



6 Bronze-winged Jacana (*Metopidius indicus*)