

1. INTRODUCTION

1.1 Background

Diversity of avifauna is one of the important ecological indicators to evaluate the quality of habitats (Sarkar et al. 2009). Study of avifaunal diversity is an essential ecological tool which acts as an important indicator to evaluate different habitats both qualitatively and quantitatively (Bilgrami 1995). Therefore detail study on avifauna and their ecology is important to protect them. Birds are quite sensitive to changes in habitat structure and composition, therefore excellent bio-indicators of quality of the ecosystem (Clergeau et al.1998).

Nepal is very rich in avifauna diversity because the country is situated between two major biogeographic regions, Palaertic in north and indo Malayan in south has caused assemblage of diverse flora and fauna (Sharma 1995). A total of 871 bird species of sixteen orders and 61 families have been recorded in Nepal forming more than nine percent of the world's known bird species, among them 149 species of birds have been identified as nationally threatened in 2010 (BCN and DNPWC 2011, 2012). The foot hill of Nepal supports half of the bird species found throughout the entire area of south Asia (Shrestha 2000). Elevation has control over climatic condition of certain place. So that climate is tropical in lowland and arctic in high peak (Inskipp and Inskipp 1991).

The major habitat of birds includes forests, wetland and grassland. Forest and bushes contribute 77% of Nepalese breeding birds (Grimmet et al. 2000). More than 193 species are dependent on wetlands and among them 187 species are dependent on the wetland of Terai of Nepal (Bhandari 1998). Availability of food, detectability and capture, location of nesting sites, availability of nesting materials, presence of predators and competitors were the major factors known to influence the population of birds (Wiens 1989a). Natural disturbances have contributed to high species diversity in many tropical ecosystems (Restrepo and Gomez 1998). Such natural disturbances are thought to promote species diversity by preventing competitive exclusion and creating habitat heterogeneity thereby allowing specialization and partitioning (levey 1998).

Over half (56%, 83 species) of Nepal's nationally threatened species are only found in the lowland (75–1000 m). Some 19% species occur in the lowlands as well as in the middle hills (75–3050 m), 13% (20 species) only in the middle hills (1000–3050 m), 5%

(8 species) in the middle hills and higher altitudes and just 1% (2 species) only at higher altitudes (BCN and DNPWC 2011). The Siwalik region of Nepal is the most diverse area that supports highest percentage of threatened species that depends on forest of Siwalik (Baral et al. 1996).

About 36 species recorded in Nepal are listed in IUCN Red List of globally threatened birds (BirdLife International 2012). Loss of habitat is the major threat for 86% bird species in Nepal (Baral et al. 1996). Nearly one in five species are considered threatened at the National level and over 100 species are thought to be on the very edge of extinction (BCN and DNPWC 2011). The major cause of extinction of avifauna is due to the degradation and habitat loss, use of excessive pesticide on field, hunting and poisoning (Birdlife International 2003).

1.2 Occurrence and abundance of species

The richness and composition of bird species varies according to land use and physiographic zones. The bird diversity and abundance can reflect ecological trends of biodiversity (Furness and Greenwood 1993). Habitat structure, floristic composition such as canopy cover, tree species diversity and distribution of specific plant taxa have significant role in defining the occurrence of species (Joshi et al. 2012). The pattern of bird distribution and abundance within a landscape are influenced by multiple factors that interact in space and time (Orians and Wittenberger 1991). Occurrence of bird species correlates with vegetation structure (Roth 1976, Finch 1989, 1991). Vegetation structure and several other factors such as temperature and productivity vary along the environmental gradient associated with elevation (Able and Noon 1976). Physical conditions become more adverse for some birds at higher elevations. As elevation increases, the availability of resources for birds diminishes reflecting differences in forest stand structure, site productivity, vegetation species composition, stand disturbance patterns, secondary biotic interactions, and available land area (Able and Noon 1976).

1.3 Objectives

The main objective of the study was to explore the diversity and habitat association of avifauna in Someshwor Range of Madi, Chitwan, Nepal.

The specific objectives were to explore the:

-) species richness of birds in Someshwor range.
-) seasonal variation in bird species richness and
-) relationship between bird diversity and vegetation structure.

1.4 Rationale

Forests of Terai, Churia, Bhabar and Siwalik range supports a large number of bird species (Shrestha 2003). Someshwor range, situated on Madi valley is an important part of buffer zone of Chitwan National Park in terms of biodiversity. Data on avifauna of this area is not adequate to assess conservation needs. Only little information from records of bird watchers, Nature guides, Bird education society etc. are available which are insufficient for implementing proper conservation and management plan. Research concerning on avian fauna in relation to vegetation structure were less studied. So this research is focused to create the baseline data on seasonal diversity, species composition along with vegetation structure, and major threats of birds in Someshwor range for proper conservation and management.

1.5 Limitations

The study was conducted on the Someshwor range in a limited time period of six months i.e. January 2014 to June 2014 for two seasons (winter and summer). Therefore it might not assess the overall bird diversity of Someshwor range. Similarly only tree plant was sampled for vegetation sampling might not assess the overall plant diversity.

2. LITERATURE REVIEW

2.1 Bird species richness

Birds live in virtually every habitat, from the lowest deserts to the highest mountain. The country with tropical and sub-tropical climate supporting the highest species richness of bird due to different fundamental biogeographic factors that affect the pattern of bird diversity (MacArthur and MacArthur 1961). Most of the studies on bird community were focused on the understanding of the structure of a community based on the population (MacArthur and MacArthur 1961, Wiens 1989a). Population studies have been traditionally used to monitor long term changes in avian population and to assess both habitat quality and the responses of birds to both natural and human caused environmental changes (Wiens 1989b). Many studies on birds were conducted in Nepal on focusing on species richness. A total of 871 bird species have been recorded in Nepal (BCN and DNPWC 2012). Chitwan is also equally rich in bird diversity. BES (2013) recorded 625 species of bird. Many researchers such as Sharma (2004), Ghimire (2009), Aryal et al. (2012), Lamichhane et al. (2013) concentrated their researches in the northern part of Chitwan particularly in the Barandabhar Corridor forest. Furthermore, Poudel (2005), Malla (2006), Rimal (2006), Thakuri (2007), Khanal (2008), Basnet (2010), Aryal (2013), Katuwal (2013) and Panthi and Thagunna (2013) studied on relationship between species richness and factors influencing the distribution of birds in different parts of Nepal. They found that land use patterns, climatic condition, elevation gradient and Aspects (North and South) and season were the major factors for the species richness and distribution of bird.

2.2 Seasonal Variation in Species Richness

Seasonal differences of climatic effects on bird range from local level shifting in tree-species use by resident species to the use of drastically different areas by migrant birds (Conner 1981, Morrison et al. 1985). Khanal (2008) documented the higher diversity of birds in agricultural land than forest and grassland in winter season due to the suitable climate and easy availability of food. Ghimire (2009) reported higher richness in spring than in autumn in a study done in Barandabhar corridor forest. Poudel (2005) observed higher number and diversity of birds in winter than in summer in Kirtipur. Malla (2006) recorded higher species richness winter and spring than other seasons in Nagarjun Forest, Kathmandu. Likewise Rimal (2006) found the highest number of species in spring and

lowest in monsoon in Shivapuri National Park. Thakuri (2007) documented higher species richness in summer followed by autumn and spring season in a research in Northern part of Kathmandu Valley. Research conducted in Godavari forest concluded that species richness was the highest in winter and lowest in autumn (Basnet 2006). Katuwal (2013) recorded the high species richness of birds in post- monsoon season and low in the pre-monsoon season in Manaslu Conservation Area. Similarly, Aryal (2013) found higher species richness in spring than in the winter in Kanchenjunga Conservation Area this variation was due to the climatic and biotic factors that varied in different seasons. Giri (2008) studied the seasonal diversity of water bird in Fewa Lake, Pokhara. He recorded 31 species of birds in winter and 17 species of birds in summer season. Similarly, Basnet et al. (2005) studied the bird diversity and their status at Raja Rani Community forest, Morang. He found the high species of birds in winter (71) followed by spring (64) autumn (63) and summer (61).

Harish and Hosetti (2009) recorded maximum species in Early winter (102) which was followed by summer(96), spring(90), late winter(85) respectively in lakkavalli range forest of western Ghat, India. North-south migration, breeding, flowering of plants, availability of food and change in vegetation pattern contributes to high species richness of birds during early winter. Murgui (2007) studied the effects of seasonality on bird species in urban parks of Valencia (Spain) and found that bird richness became higher during breeding period i.e., in spring and summer than in the winter season due to the unfavorable climatic conditions, shortage of food and predation in winter season.

2.3 Bird – habitat relationship

Many studies have been conducted to establish the relationship between habitats and bird species richness. Ghimire (2009) documented the highest bird richness in Sal forest than the mix forest in the BCF of Chitwan. Species richness of birds was higher in agricultural farmland with wetland and lower in forest habitat while studying on Seasonal diversity, Status and Habitat utilization of birds in a Nawalparasi forest (IBA) of in Nepal (Khanal 2008). Thakuri (2007) studied on Seasonal Diversity and Community Composition of Birds in Satikhel and Dallu community forests of Seshnarayan VDC also concluded that the birds were found more in forested areas than in riverine, agricultural land, marshes, urban and human settlements.

Joshi et al. (2012) examined the effect of vegetation structure on the species richness of bird and found that canopy cover and species richness of tree were positively correlated with richness of bird in Nainital district, India. Bird species richness is inversely related to woody plant species diversity and vertical stratification in the natural vegetation of Uttara Kannada, the district with the largest contiguous tract of humid tropical forest in peninsular India. This inverse relationship may be explained by the fact that although the peninsular Indian evergreen forests are rich in woody plant species when compared with the drier vegetation, they harbor an impoverished bird fauna due to their smaller overall extent and greater isolation (Daniels et al. 1992). Turshak et al. (2011) conducted survey to find out the effect of vegetation structure on the species diversity of birds in Kurra fall forest of Nigeria and found that Tree height, number of trees, and percentage of canopy cover showed significant relationship with species diversity. Species diversity increased with an increase in tree height but decrease with increase in number of tree and percentage canopy cover. This was because large sized tree contain large amount of fruits and flowers that attract many species of bird also flower attracts the large numbers of insects provides contagious food supply for many insectivorous bird.

Kim et al. (2007) studied the effects of habitat patch size on the species richness of birds and found that bird diversity is significantly correlated with the number of insect species presence at the patch but not related to the size of studied patch and the distance to adjacent traffic roads because insects acts as the food resources for bird species. He also suggested that small habitat size with multiple vegetation structure can provide bird shelter and play a role as corridors for dispersion. Raman (2001) studied the impact of fragmentation and plantations on bird community of rainforest in the Western Ghats. Wiens and Rotenberry (1981) studied the relationship between the distribution of birds, their abundance and habitat characteristics at a regional scale, using surveys conducted over three consecutive years in the shrub steppe of the northwestern Great Basin of North America.

3. MATERIALS AND METHODS

3.1 Study area

The Someshwor range encompasses areas of the Madi Municipality, Chitwan from east to west in a rectangular shape. It is the southern parts of buffer zone of Chitwan National Park. On the south it is border to Indian State, Bihar and remains link with Balmiki Wildlife Sanctuary, India. The Someshwor range is a complex of deep ravines and steep slopes, with highest peak reaching an altitude of 870 m (Gurung et al. 2006). This range is lying to the south of cultivation lands are comprised of 112 km² forests dissected by deeply eroded streams. The Reu River originates the tributaries that arise in the Someshwor and Churia ranges (DNPWC and PPP 2000). Many small rivers like Magai, Ghagar and Anar River etc. also originate from Someshwor range.

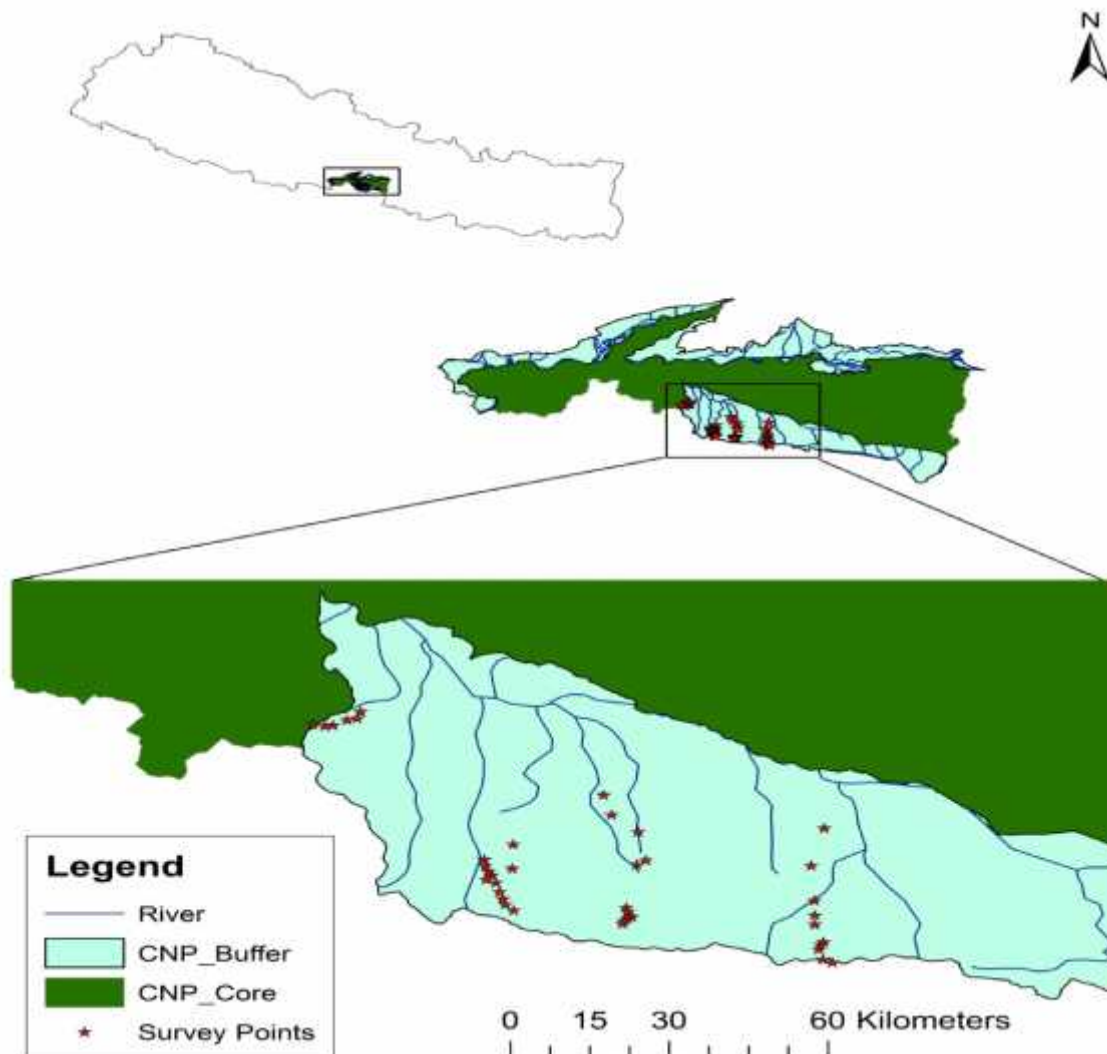


Figure 1 : Map of Someshwor range with sampling points

3.2 Climate

The climate of Chitwan is subtropical with four distinct seasons, Pre-monsoon (March-May), Monsoon (June-August), Post Monsoon (September-November) and winter (December-February) seasons. Winter season is relatively high humidity and very cold. The minimum relative humidity is 89% and highest is 98% (Figure 2). The highest rainfall is about 550 mm per year and about 90% of rainfall occurs within three months of monsoon seasons (June-August) (Figure 3). The monsoon rain causes dramatic floods and changes in the character and course of rivers and is one of the important and dramatic factors in terms of ecosystem dynamics. Winter season is marked as the coldest season and temperature can drop to 8°C. Summer season is marked as pre-monsoon season and temperature may rise up to 37°C (Figure 4).

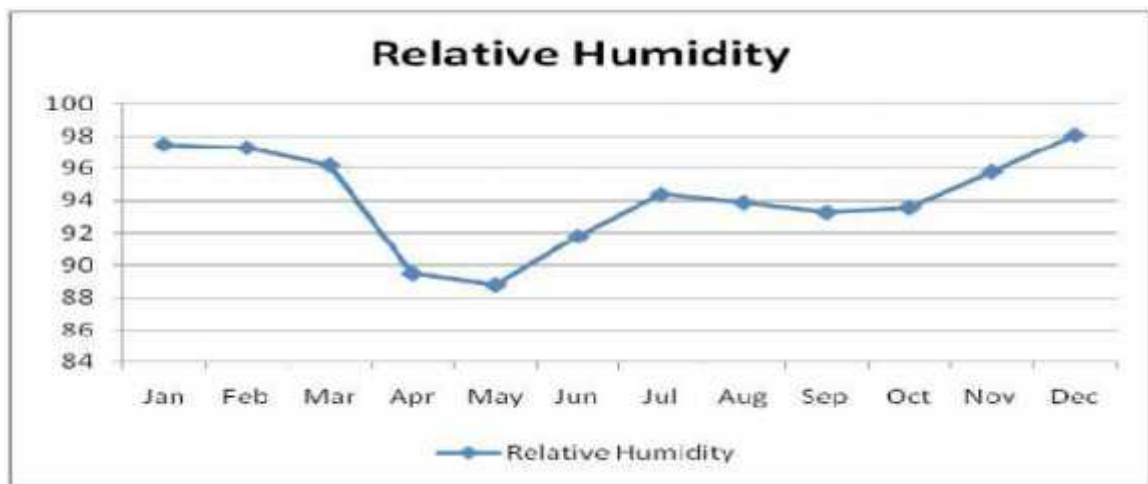


Figure 2: Average relative humidity of Bharatpur recorded from 2000- 2012

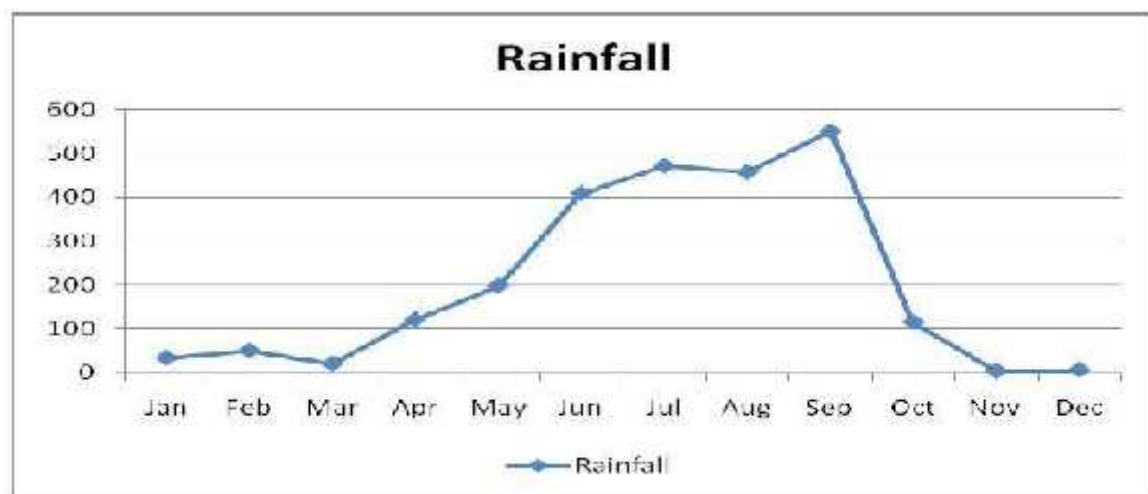


Figure 3: Average rainfall (mm) of Bharatpur recorded from 2000- 2012

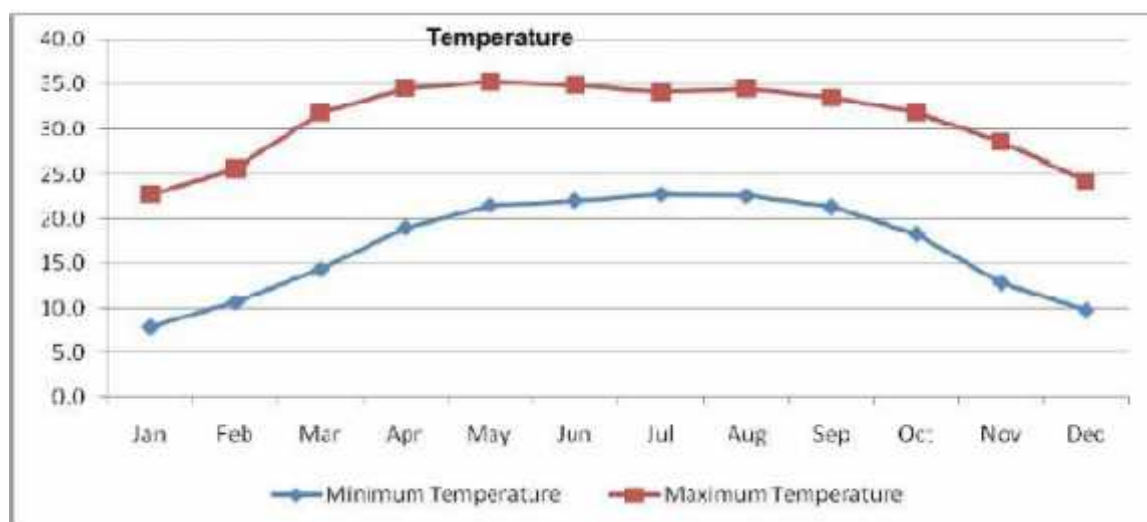


Figure 4: Mean minimum and maximum temperature of Bharatpur recorded from 2000-2012.

3.3 Biodiversity

3.3.1 Flora

The vegetation of the area ranges from tropical to subtropical type. The forest is predominantly Sal (*Shorea robusta*) forest. The remaining vegetation includes Sisso (*Dalbergia sisoo*), Neem (*Azadirachta indica*), Indian Rose wood (*Dalbergia latifolia*), Khair (*Acacia catechu*) and Simal (*Bombax ceiba*), Black plum (*Syzygium cumini*), Wood Apple (*Aegle marmelos*), Yellow Myrobalan (*Terminalia chebula*), China- Berry (*Melia azedarach*), Cluster Fig (*Ficus racemosa*), Common Mistletoe (*Viscum album*), Oriental Cashewnut (*Semicarpus anacardium*), Arnotto (*Mallotus philippensis*), Monkey Jack (*Artocarpus lakoocha*) etc. (Bishokarma et al. 2005).

3.3.2 Fauna

The study area harbors varieties of wild animals. This area offers the habitat of different mammalian species including Royal Bengal Tiger (*Panthera tigris tigris*), Common Leopard (*Panthera pardus*), Samber Deer (*Cervus unicolor*), Barking Deer (*Muntiacus muntjak*), Sloth bear (*Melursus ursinus*), Hanuman langur (*Semnopithecus entellus*), Wild boar (*Sus scrofa*) etc. The avifauna includes Black capped Kingfisher (*Halcyon pileata*), Laughingthrushes such as Rufous necked Laughingthrush (*Garrulax ruficollis*), Lesser necklaced Laughingthrush (*Garrulax monileger*), Asian paradise Flycatcher (*Terpsiphone paradise*), Sand Lark (*Calandrella raytal*) and many other common birds such as House Sparrow (*Passer domesticus*), Plum-headed Parakeet

(*Psittacula cyanocephala*), White breasted Waterhen (*Amaurornis phoenicurus*), Common hoopoe (*Upupa epops*), Jungle owlet (*Glaucidium radiatum*), Common Tailorbird (*Orthotomus sutorius*), Lesser Coucal (*Centropus bengalensis*), Crimson Sunbird (*Aethopyga siparaja*) etc (BES 2013). Critically endangered White rumped vulture (*Gyps bengalensis*) and Slender-billed vulture (*Gyps tenuirostris*) also recorded (Gupta and Pandey 2007). Different types of herpetofauna such as Asiatic rock python (*Python bivittatus*) and protected marsh crocodile (*Crocodylus palustris*) etc. has been confirmed along with different others amphibians and reptiles (Lamsal 2014).

3.3.3 Culture and ethnicity

The study area is inhabited by Brahman and Chhetri along with other ethnic groups such as Tharu, Gurung, Magar, Newar, Kami, Sarki etc. who are the followers of Hinduism and Buddhism. There are total 8960 households and population is 37,683 in Madi (CBS 2014). Forest products are used in various ways such as in the form of fodder, household goods, and thatching materials. Main occupation of villagers is agriculture and animal husbandry. Rice (*Oryza sativa*), Wheat (*Triticum spp*), Corn (*Zea mays*) and Millet (*Eleusine coracana*) are major crops in the area, whereas Mustard (*Brassica campestris*), Potato (*Solanum tuberosum*), and Legumes are grown as minor crops. Livestock is the major component of the agricultural system in the area. The main livestock groups are cattle, buffalo, goat, pig and poultry etc.

3.4 Research Design

Field research design was made using the topographic map of Someshwor range (1:25000) and a field reconnaissance surveys. For the sampling of birds and vegetation the entire Someshwor range was divided into two broad elevational zones.

a) Lower belt (Disturbed Area): The lower belt range in elevation from 210m - 410m. It includes human settlements, agricultural lands as well as forest area which are close to the human settlements. Most of the forest in the area is dominated by sparse Sal tree because of human use and livestock grazing.

b) Upper Belt (Undisturbed Area): These are the upper parts of the forested area, elevation ranges from 410m- 810 m with no or little human disturbances. It mainly includes natural mixed forest in the steep slope and generally far from the human settlements.

A total of twenty plots were established in each belts for bird survey. Hence, altogether 40 sampling plots were selected for the survey of birds in the study area by following the human trail in each 50m elevation interval starting from 210 m altitude. The human trail was used as the reference points for the plots setting. Sampling was done in different buffer zone community forests of newly established Madi Municipality (Figure 1). They were:

- i) Vangata/ Gardi- Chure buffer zone community forest (Ward No. 2)
- ii) Charchare/Someshwor buffer zone community forest (Ward No. 6)
- iii) Laxmibas/ Rewa buffer zone community forest (Ward No. 9)
- iv) Kantipur / Anar- tamta buffer zone community forest (Ward No. 11)

3.5 Birds survey technique

Fixed point count method

Point count method was used for the survey of birds within the 50m circular plot. It is a widely used surveying method of birds in different land use types (Hutto et al. 1986). In point count methods counting of birds are undertaken from a fixed location for a fixed time. This method is more suitable than transects in patchy habitat though much less so in open habitats where birds are likely to flee from the observer (Sutherland 2006). This method is used for highly visible or vocal species, often passerines, in a wide variety of habitats and are particularly suited to dense vegetation. An advantage of point counts over line transects is that it is often easier to approach and gain access to individual points than to establish transect lines, particularly when access and the terrain are problematic (Sutherland 2006). **Call count method** was employed within the plots for the identification of shy birds, which could not be observed directly. The unfamiliar calls of birds recorded with the help of recorder and identified it with the help of bird experts in Kathmandu.

The birds were scanned from 6:30AM to 11:00AM in the morning. In each plot, birds counted for 15 minutes but repeated observation of the same species was not enumerated. All flying bird above transects were not included in the list. Bird censuses were not carried out on rainy, windy and cloudy day to avoid biases due to change in intensity of bird activities. Abundance of the species was estimated from point count during observation. Bushnell binocular with magnification 8x42 and Canon camera with 50X

was used for the effective study. Birds were identified in the field using standard field guides (Grimmet et al. 2003) and GPS (e-trex 10) used to mark the location of the plots. Photograph of unknown species were identified with the help of Bird experts or other reference library in Nepal.

3.6 Vegetation survey

To understand the Bird-vegetation associations between two different belts, vegetation sampling was done in the forest habitats. Vegetation survey was conducted in the same plots where Birds surveys were conducted. But 10 m sized circular plot were used for sampling. DBH of trees were measured by using measuring tape. Trees with DBH < 10cm were not included in the sample. Density and Basal area dominance of tree in each belt was measured in per Ha area. Tree species were identified with the help of literature (Shrestha 1998) and local people. Herbarium of unidentified species were made and identified with the help of plant experts.

3.7 Threats assessment

Group discussion was made with the local resident to gather information about status, diversity and conservation threats of birds. Intensive field visits was made to observe the deforestation and forest fragmentation.

3.8 Data analysis

3.8.1 Bird data analysis

Bird data was analyzed as species richness, Diversity, Evenness and Relative abundance for two different habitat belts and two different seasons.

Marglef Species richness index (d) = $S^{-1} / \log N$

Where, S= Number of species

N = Number of individuals

Species Diversity Index

The diversity of species was calculated by using Shannon-Weiner diversity index

Shannon Weiner diversity index is designated as H', which is calculated as:

$$H' = - \sum (n_i / N) \log (n_i / N)$$

Or, if $P_i = n_i / N$

$$H' = - \sum P_i \log_e P_i$$

Where,

n_i = Importance values for each species is the number of individuals in each species, the abundance of each species.

N = Total Importance value, the total number of individual observed.

$P_i = n_i / N$ = Relative abundance of each species, calculated as the proportion of individuals of a given species to the total number of individuals in the community.

Evenness index

To calculate whether species are distributed evenly across seasons and across landscapes elements, evenness index was determined by the equation

$$E = H' / \log S$$

Where, H' = Shannon-Wiener's diversity index.

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

Relative abundance

Relative abundance refers to the evenness of the distribution of individuals among species in the community. Two communities may be equally rich in species but differ in relative abundance.

$$\text{Relative abundance or \% of Dominance} = n_i / N \times 100$$

On the basis of population status, birds were further categorized into in Very common, Common, Fairly common and Rare.

3.8.2 Vegetation Analysis

Density

To compare tree density between two different belts, the tree density was calculated as:

$$\text{Density (No /m}^2\text{)} = \frac{\text{No. of individuals of a species}}{\text{Size of plot} \times \text{total no. of sample plot}}$$

Basal area dominance

Dominance is calculated on the basis of basal area. It is the cross sectional area of tree at breast height. It is the main characteristics to determine the dominance.

$$\text{Basal Area (cm}^2\text{)} = \frac{C^2}{4}$$

Where, C= circumference of tree at breast height,

$$= 3.14$$

DBH class

All the trees were classified in-to nine DBH class and density of trees in each dbh class were compared between lower belt and upper belt forest. The nine DBH classes were 10-25cm, 25-40cm, 40-55cm, 55-70cm, 70-85cm, 85-100cm, 100-115cm, 115-130cm and >130cm.

Species Diversity Index

The diversity of species was calculated by using Shannon-Weiner diversity index,

Shannon Weiner diversity index is designated as H, which is calculated as:

$$H = - \sum (n_i / N) \log (n_i / N)$$

Or, if $P_i = n_i / N$

$$H = - \sum P_i \log_e P_i$$

Where, n_i =Importance values for each species.

N =Total Importance value.

SPSS -17.0 was used for statistical analysis of the collected data. Chi square test was used to analyze the significance difference in bird species richness between two seasons. One way ANOVA was conducted to find any significant difference in bird species richness between two belts. Carl Pearson's Correlation was used to find out the relationship between tree structural variables and bird species richness.

The following hypotheses were tested:

H_0 : There is no significant difference in species richness between different seasons.

H_0 : There is no significant difference in species richness between two belts

4. RESULTS

4.1 Bird species richness in the Someshwor range

A total of 101 species of bird belonging to 11 orders and 32 families were recorded during summer and winter seasons (Figure.5 and Annex 1). The highest numbers of species (59) were represented in the order Passeriformes along with 15 families. Other major orders in terms of species richness were Ciconiformes (5 families and 8 species), Coraciformes (3 families and 7 species), Piciformes (2 families and 6 species), Cuculiformes (1 family and 5 species), Columbiformes (1 family and 5 species), Psittiformes (1 family and 4 species), Galliformes (1 family and 3 species), Strigiformes (1 family and 2 species) and other orders representing 1 family and 1 species were Upupiformes and Bucerotiformes. Out of 101 species, 85 species were resident, 7 species were winter visitor and 9 species were summer visitor (Annex I). The higher species richness was recorded in the lower belt in comparison to the upper belt i.e. 87 species were recorded from lower belt 61 species were recorded from upper belt and 46 species were common to both belts (Annex III).

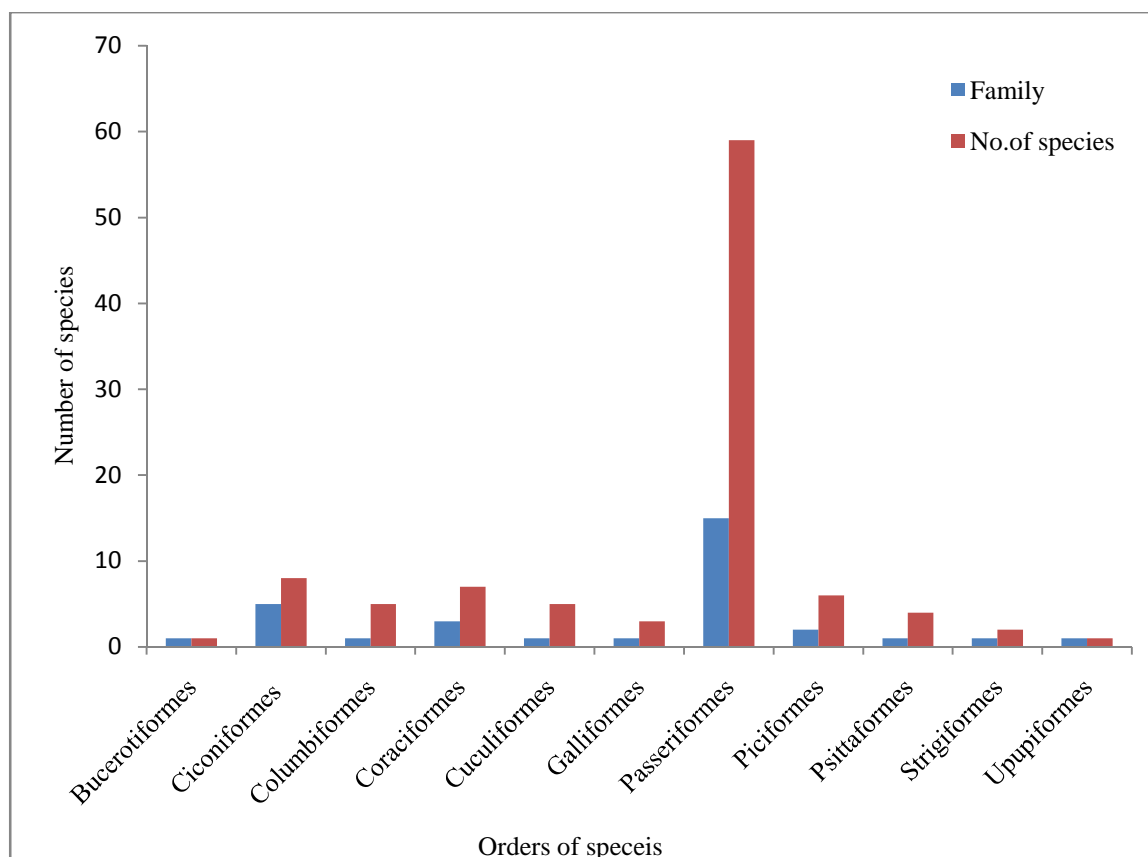


Figure 5: Numbers of bird species with orders and families recorded in Someshwor range, Madi.

4.2 Seasonal diversity of birds in Someshwor range

Species richness and population size of birds was found higher in the winter season than the summer. The result showed that 87 and 79 species were recorded from winter and summer season respectively (Table: 1) and 65 species were common to both season (Annex I). Some of the birds were found to be use habitat in different altitude in different seasons categorized as the local migratory species.

Table 1: Comparison of species richness and diversity of avifauna recorded during winter and summer seasons in the Someshwor range, Madi.

Seasons	Number of species	Number of individuals	Shannon wiener index	Evenness index
Winter	87	1167	1.71	0.88
Summer	79	1059	1.64	0.86

Relatively higher number of species was recorded in lower belt during winter season but during summer season relatively higher species were recorded in upper belt. Similarly the number of individual recorded higher in lower belt during winter seasons but slightly less number of individual was recorded in lower belt during summer season (Table 2).

Table 2: Seasonal variation of the bird species richness and abundance between two elevational belts of the Someshwor range, Madi.

Seasons	Number of species		Number of individuals	
	Lower belt	Upper belt	Lower belt	Upper belt
Winter	77	45	799	368
Summer	70	46	690	369

Chi square test showed that there was significant difference (P-value= 0.674, df = 1, 2 =1.134) in species richness of birds between two seasons. Long-tailed Broadbill (*Psarisomus dalhousiae*), Common Sandpiper (*Calidris ferruginea*), Grey-winged Blackbird (*Turdus albocinctus*), Large-tailed Nightjar (*Caprimulgus macrurus*), Collared Falconet (*Microhierax caerulescens*), Streaked Spiderhunter (*Arachnothera magna*), Black-shouldered Kite (*Elanus caeruleus*), Yellow-footed Green Pigeon (*Treron phoenicoptera*) etc. were seen during winter season only (Annex I). Similarly Green Bee-eater (*Merops orientalis*), Blue-throated Barbet (*Megalaima asiatica*), Indian Pitta (*Pitta brachyura*), Eurasian Cuckoo (*Cuculus canorus*), Asian Paradise Flycatcher (*Terpsiphone*

paradisi), Indian Grey Hornbill (*Ocyceros birostris*), Bright-headed Cisticola (*Cisticola exilis*), Red-breasted Parakeet (*Psittacula alexandri*) etc. were observed during summer only (Annex I).

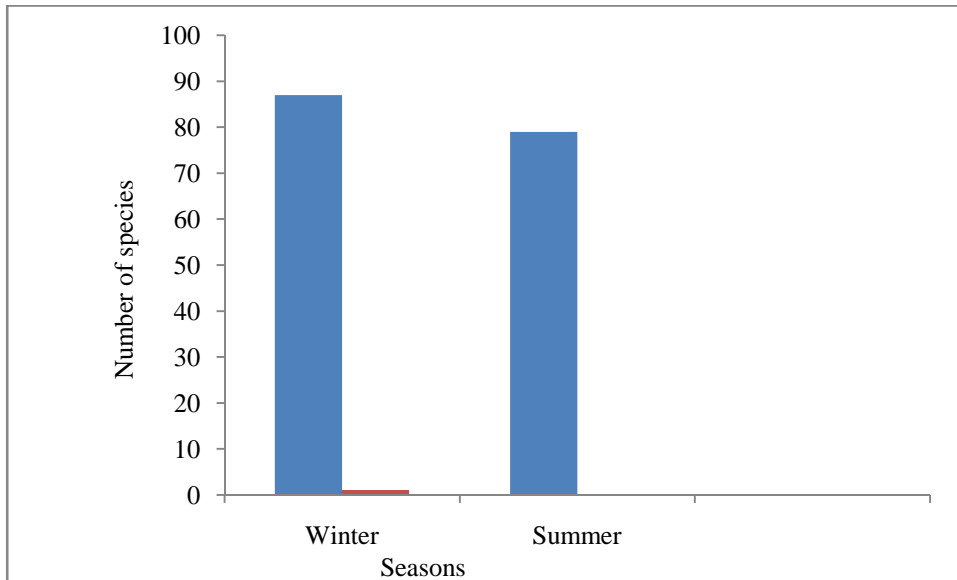


Figure 6 : Seasonal Species richness of birds in Someshwor range, Madi (Table 1).

Each category of abundance had different population and relative abundance category in between two seasons (Annex III). A fairly common bird category was more abundant in both seasons whereas a very common bird category was found low in both seasons.

Table 3: Seasonal variation of relative abundance of bird in the Someshwor range, Madi.

Categories	Relative abundance	Population	Number of species	
			Winter	Summer
Very common	>4.060	43-80	4	2
Common	1.799- 3.598	21-42	12	16
Fairly common	0.566- 1.713	6- 20	46	41
Rare	0.094 - 0.472	1-5	25	20
		Total	87	79

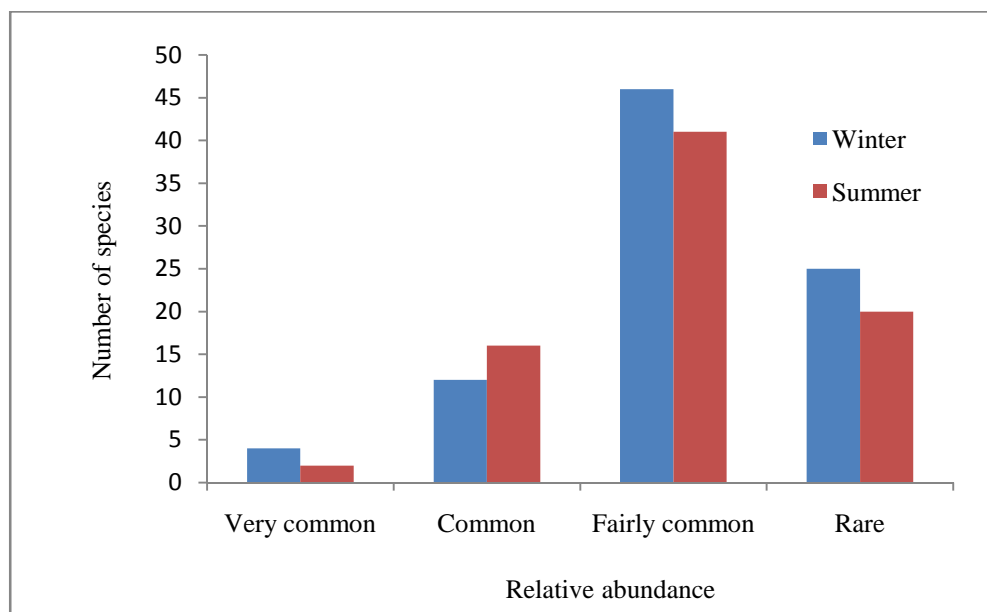


Figure 7: Local abundance categories of bird species between two seasons in Someshwor range, Madi.

4.2 Bird - Habitat relationship in Someshwor range

The landscape of Lower belt was combination of both plain as well as sloppy area with moderate disturbance where as upper belt was total sloppy area with low human disturbance. So that lower belt considered as disturbed area and upper belt considered as undisturbed area. Different habitats types such as agricultural lands/ farmlands, human settlements as well as the advantage of forest edge found on the lower belt.

Table 4: Characteristics of two belts of the Someshwor range, Madi.

Parameters	Lower belt	Upper belt
Elevation (m)	210- 410	410- 810
Landscape	Plain + Hill	Hill
Human disturbances	Moderate	Low
Dominant tree species	Sal tree	Subtropical mixed forest
Fire	Rare	Common (in summer season)

Forty seven species of trees were identified from 40 sampling plots located in two different elevation zones. Out of 47 species, 39 and 27 species of trees were recorded from lower and upper belt respectively (Table 5). In the Lower belt, the forest was mostly predominated by Sal (58%) along with some riverine forest such as Black Plum (*Syzygium cumini*), Rhino Apple Tree (*Trewia nudiflora*), China Berry (*Melia azedarach*)etc.and in the upper belt Sal with Sub-tropical mixed type was dominant. Tree

species found in upper belt were Nepali Butter Tree (*Diplpknema butyracea*), Yellow Teak (*Adinia cordifolia*), Indian Rose Wood (*Dalbergia latifolia*) etc. (Table 5). There was remarkable variation of density of DBH class between two different belts of Someshwor range. The tree with lower DBH class i.e. 10-25; 25-40; 40-55 cm were more abundant in lower belt but percentage composition of tree having greater DBH were found high in upper belt of the range. Tree with 130 cm⁺ DBH class were found more on the upper belt of the range. More uniform type of DBH was found on upper belt of the forest (Figure 8).

The lower belt of Someshwor range had more complex bird community structure in terms of species richness and species diversity. One way ANOVA revealed that there was a significant difference ($F = 5.46$, $df = 1$, $P < 0.05$) in species richness of birds among the two different belt of the forest. The vegetation structures i.e. tree density, tree species diversity were higher at lower elevation zone (lower belt) but average DBH and Basal area of tree were higher at upper elevation zone (upper belt) (Table 4). However the abundance, species richness and species diversity of bird was higher at lower belt. The bird species richness was significantly positively correlated with tree species diversity ($r = 0.69$) and tree density ($r = 0.71$) but Negative correlation was found between bird species richness and tree DBH ($r = -0.54$).

Table 5: Density, DBH and Basal area of individual tree species recorded in between the two belts of Someshwor range, Madi.

S.N.	English Name	Density(No./Ha)		DBH(Cm)		Basal Area(m ² /Ha)	
		Lower belt	Upper belt	Lower belt	Upper belt	Lower belt	Upper belt
1	Emblic Myrobalan	4.77	7.95	36.65	47.67	10.07	28.4
2	Mango	4.77	-	61.67	-	28.52	-
3	Monkey Jack	6.36	-	51.05	-	26.06	-
4	China Berry	7.95	-	35.16	-	15.45	-
5	Axle Wood	11.14	6.36	58.61	74.5	60.11	55.5
6	Bastard Myrobalan	3.18	4.77	57.5	77.66	16.53	45.23
7	Chunetro Ghas	3.18	-	47.5	-	11.28	-
8	Wood Apple	3.18	-	44	-	9.68	-
9	Oriental Cashewnut	7.95	15.9	51.4	62.32	33.02	97.09
10	Botdhairo	4.77	9.55	59.1	68.67	26.14	70.79
11	Nepali Butter Fruit	-	7.95	-	63.2	-	49.61

12	Wodier Wood	6.36	-	40.75	-	16.6	-
13	Fire-Flame bush	9.55	6.36	57.24	58.12	49.14	33.77
14	Cluster Fig	1.59	-	52	-	7.56	-
15	Gayo	7.95	-	38(5)	-	18.05	-
16	Common Mistletoe	1.59	4.77	53	71.05	7.022	37.86
17	Phaledo	-	3.18	-	54.45	-	14.82
18	Yellow Myrobalan	6.36	9.55	72.33	65.25	52.31	63.86
19	Black Plum	14.31	4.77	40.56	58.5	37	25.66
20	Kadam	4.77	-	43.33	-	14	-
21	Kalikath	4.77	-	34	-	8.67	-
22	Yellow Teak	-	12.73	-	75.17	-	113.01
23	Jack Fruit	1.59	-	45	-	5	-
24	Malay Bushbeech	-	9.55	-	71.45	-	76.57
25	Tallow Tree	3.18	-	38	-	7.22	-
26	American Mulberry	4.77	-	25	-	4.68	-
27	Lac Tree	3.18	6.36	38	53.2	7.22	28.3
28	Kutmiro	7.95	4.77	45	75.5	25.31	28.5
29	Kyamun	7.95	4.77	54	68	36.45	34.68
30	Lampate	4.77	11.14	49.8	45	18.6	35.43
31	Latikath	9.54	12.73	40.27	59.11	20.27	52.4
32	Common Nut	11.13	-	31	-	16.81	-
33	Eye's Apron	3.18	-	35	-	6.12	-
34	Bustard Teak	4.77	-	46.72	-	10.91	-
35	Peepal Tree	1.59	-	76	-	14.44	-
36	Lourel Tree	25.46	35	88.74	119.63	315	787.12
37	Sandan	4.77	12.73	76.42	71.4	43.77	101.95
38	Sal Tree	335	203	72.84	126.65	2838.5	4932.3
39	Indian Rose Wood	-	17.5	-	87.6	-	211.02
40	Simal Tree	3.18	-	70.32	-	24.72	-
41	Arnotto	15.9	6.36	55.3	64.25	76.45	41.28
42	Sisso	4.77	-	48.44	-	17.59	-
43	Nepalese Elephant Apple	7.95	4.77	56.45	49	39.83	18
44	Rhino Apple Tree	3.18	-	54	-	14.58	-
45	unidentified A	-	6.36	-	73.66	-	54.25
46	unidentified B	-	1.59	-	69.56	-	10.74
47	unidentified C	-	3.18	-	58.33	-	17

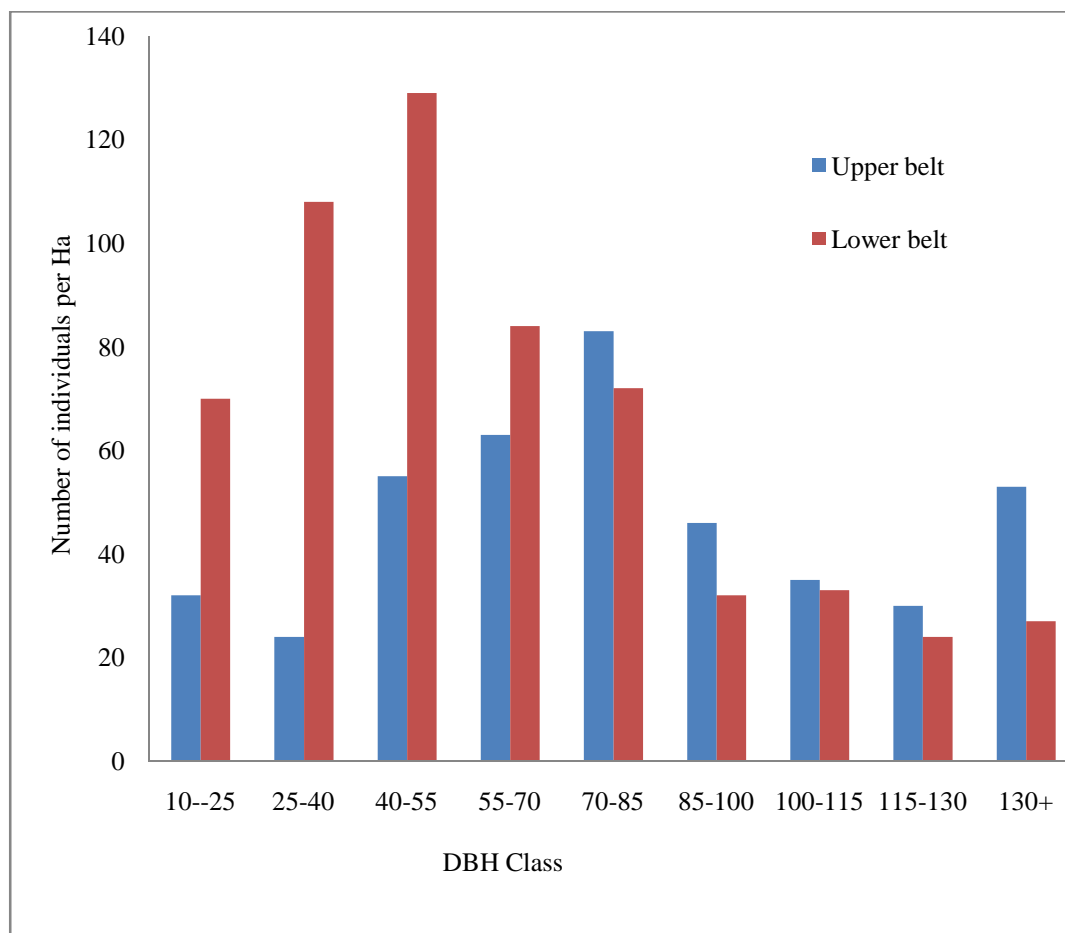


Figure 8: Comparison of DBH class of tree between two belts of Someshwor range, Madi

Table 6: Summary of vegetation characteristics and bird community structure between lower and upper belt of Someshwor range (With structural variables).

Variables	Forest Range	
	Lower belt	Upper belt
1). Bird variables		
Species Richness	87	61
Individual Recorded	1499	714
Shannon Weiner's diversity index	2.002	1.577
Evenness index	0.88	0.85
Marglef species richness	28.04	25.81
2). Tree structural variables		
Density (Number/Ha)	578	420
Diversity	1.28	1.14
Evenness	0.79	0.78
DBH(Mean +_ SD)	64.43	83.63
Total species	39	28
Basal Area(m ² /Ha)	108.62	256.15

4.4 Threats to Avifauna in the Someshwor range

The expansion of agricultural fields in the close vicinity of Someshwor range is causing much severe structural threats to biodiversity especially by creating disturbance to avifauna. The construction of dams, ditches and agriculture development are the main cause of habitat destruction. People were found involved in fishing from Charchare and Kantipur through mining of sand and stones directly affect the species such as Kingfisher, Stork, and others birds by creating difficulties in feeding and breeding activities. School aged children were found to involve in hunting birds by using catapult for pleasure. Rearing of Hill myna, parakeets were found in the cage of 5 houses. Lack of awareness and knowledge about the importance of avifauna for balancing ecosystem were found. Poverty is one of the major causes for a threat of avifauna as these communities were heavily depends upon the forest for their persistence and well being.

4.5 Threatened species in the Someshwor range

According to the IUCN Red List, all the observed species belonged to the category Least Concern and some of the species included in CITES Appendix II and III. However few species such as Red jungle Fowl, Hill myna and Blue-eared Kingfisher are listed as a nationally threatened species category (Annex I).

5. DISCUSSION

5.1 Species Richness of Someshwor range

This study was done to determine the bird species richness with reference to seasonal variation and vegetation structure. A total of 101 species of birds were recorded in the Someshwor range during study period. This investigation revealed that only 16% for the total avian species of Chitwan District (BES 2013) and 12% of the Nepal (DNPWC and BCN 2012) found in Someshwor range. BES (2013) recorded 625 bird species from different parts of Chitwan district and KMTNC (2005) recorded 303 species belonging to 15 order and 34 families only from Barandabhar Corridor Forest (BCF). Such variation may be due to different study area, different habitat condition, time and duration of intensive survey. Low species recorded due to different habitat conditions, duration of extensive field survey and lack of diverse habitat types in Someshwor range.

5.2 Seasonal variation of species in Someshwor range

Different environmental and climatic factors are responsible for the distribution and diversity of birds. That might be the causes for fluctuation of population and species richness of bird according to season. The bird community of any given habitat changes seasonally (Avery et. al. 1989). During this study, there was significant difference (P -value= 0.674, $df = 1$, $t = 1.134$) in species richness of birds between two seasons and it was higher in winter (87) than summer (79). Birds were highly territorial for breeding activity in summer season which had reduced its detection. Thus, fewer species might have observed in this season. Juveniles of some species were seen for example Red vented Bulbul (*Pycnonotus afer*), Red-billed Blue Magpie (*Urocissa erythrorhyncha*), Black-hooded Oriole (*Oriolus xanthornus*), House Sparrow (*Passer domesticus*) during winter season indicate the high abundance. Availability of food, temperature, humidity and flowering of plants varies according to seasons. Thus seasonal variation highly affects the species richness and distribution of birds (Cueto and de Casenave 2000). However, temperature is most important factor for the seasonal change in the distribution of birds (Lennon et al. 2000). Most of the migratory birds visit during winter season because of suitable ecological and climatic condition. Various bioclimatic factors affects on the distribution and abundance of birds (Shoo et. al. 2005). Vegetation is one of the important factors for the species richness of birds. The rate of seasonal change of ground vegetation found high in winter season might be the evidences for the high species

richness than the summer. Similar type of result also reported by Bhat et al.(2009), Jayson and Mathew (2000) and Khanal (2008) while conducted research in Karnataka, western Ghats (India) and Nawalparasi, Nepal as bird diversity and the number of individuals were high during winter season and less in summer season because the climate and vegetation pattern of Chitwan and Nawalparasi are almost same. During winter season easily available food, increased vegetation and flowering of plant attract large number of birds in this area. Harsha and Hosetti (2009) found flowering in the early winter assure food availability could be contributed for high species richness. However, Aryal (2013) found less species during winter season in Ghunsa valley of Kanchenjunga Conservation Area because landscapes above 3,000m were covered by snow in winter. Some of the species were found to use habitat in different altitude in different seasons considered as local migratory species. Many resident species of Nepal bird are seasonal altitudinal migrants. The level to which they descent in winter depends on weather condition (Inskipp and Inskipp 1991).

Out of 101 species recorded, 84% species were resident, 7% species were winter visitor and 9% were summer visitor (Annex I). Some birds such as Red-vented Bulbul (*Pycnonotus cafer*), Himalayan Bulbul (*Pycnonotus leucogenys*), House Crow (*Corvus splendens*), Jungle Myna (*Acridotheres fuscus*), Spotted Dove (*Streptopelia chinensis*), Rufous Treepie (*Dendrocitta formosae*), Rose-ringed Parakeet (*Psittacula krameri*), Plum-headed Parakeet (*Psittacula cyanocephala*), Crested Serpent Eagle (*Spilornis cheela*), Long-tailed Shrike (*Lanius schach*)etc. were common in both season (Annex I). So such species can be considered as residential species.

5.2 Bird- habitat relationship in Someshwor range

Bird species are habitat specific (MacArthur 1964). This study revealed that Bird species richness were significantly positively correlated with Tree species diversity ($r = 0.69$) and tree density ($r = 0.71$) but Negative correlation was found between bird species richness and tree DBH ($r = -0.54$). However, Rimal (2006) concluded that there was negative correlation ($r = -0.44$) between diversity of tree and diversity of birds between the disturbed and undisturbed sites of different forest of Shivapuri National Park. Higher tree diversities in the lower belt of Someshwor range support the high bird diversity. This is understandable that variety of plant species or plant species diversity provide food, good shelter and roosting sites to the bird communities. Some studies indicates positive

correlation between plant species diversity, foliage high density and bird species diversity and have shows the variety of plant species supports more bird species in tropical area as compare to temperate habitats (Orians 1969). James (1971), Karr and Roth (1971) suggested that the Tree diversity and canopy cover were the most important variables that affected Bird species diversity. Wilson (1974) reported a linear correlation between bird species diversity and tree density. This was supported by the finding that high bird species diversity can be attributed to high tree diversity of forest (Hino 2002). Furthermore, regenerative / immature types of forest with small DBH and high tree diversity were found on lower belt indicates the sign of disturbances. Which was supported by the fact that tree diversity increases as the ecosystem develops and decreases when maturity (Gupta and Shukla 1991). This suggested that vegetation structure of the habitat seems to be one of the key features which influence the avian species at local level.

Higher species richness of birds was found in the lower belt then the upper belt. One way ANOVA revealed that there was a significant difference ($F = 5.46$, $df = 1$, $P < 0.05$) in bird species richness among the two different belt of the forest. Factors like availability of food and disturbances, slope, heterogeneity, edge effect were the important factor for occurrence and distribution pattern of birds in different belts. Lower belt lies adjacent to the human settlement where different types of micro habitats such as agricultural land, grassland as well as forest edge were the supporting causes for the high species richness as well as population of birds. Daniels (1989) and Kilgo et al. (1997) suggested that higher species at open canopy (disturbed) condition could be due to the edge effect that structurally complex habitats may provide more Niches and diverse way of using the environmental resources and thus increase species diversity (Bazzaz 1975).

Sharp effect of altitude variation was seen on the species richness and population of bird species. While moving from lower to higher belt species richness of birds were decreased drastically by 50%. Low availability of water resources and food, low productive forest, lack of microhabitats such as cultivated land, settlement etc. could be the reason for low species richness in the upper belt. This result seemed similar with Aryal (2013), Grytnes et al. (2008) and Romdal and Grytnen (2007). Able and Noon (1976) have determined that elevation increases the availability of resources diminish, reflecting differences in forest stand structure, site productivity, vegetation species composition and distribution

pattern. Katuwal (2013) found higher species richness in moderately disturbed forests than natural forest supporting the intermediate disturbance hypothesis. Similar types of result found by Vetaas (1997) and Chettri et al. (2005). Rimal (2006) found higher species richness in undisturbed forests than in disturbed one.

Presence of nationally threatened species indicates the conservation significance of the study area as the number of threatened species may exceed if investigate the whole season in a year. So this area can be considered as one of the important bird area of the Siwalik region. Most of the birds are common to both belt indicate the short migration of birds. Some species were habitat specific found only in the specific habitat. Common Myna (*Acridotheres tristis*), Long-tailed Shrike (*Lanius schach*), Rock Pigeon (*Columba livia*), Shikra (*Accipiter badius*), Black shouldered Kite (*Elanus caeruleus*), Lesser Coucal (*Centropus bengalensis*), etc. were seen only in lower belt (Annex II). So that these species were common near to the human settlement considered as generalist and disturbance tolerant species. Similarly, Kalij Pheasant (*Lophura leucomelanos*), Long-tailed Broadbill (*Psarisomus dalhousiae*), Long-tailed Nightjar (*Caprimulgus macrurus*), Asian paradise Flycatcher (*Terpsiphone paradisi*), Streaked Spiderhunter (*Arachnothera magna*) etc. were seen in upper belt only (Annex II). So these species were restricted to the forest interior considered as disturbance sensitive species. Black-hooded Oriole (*Oriolus xanthornus*), Great Tit (*Parus major*), Chestnut-bellied Nuthatch (*Sitta himalayensis*), Fulvus-breasted Woodpecker (*Dendrocopos macei*), Grey-headed Woodpecker (*Dendrocopos canicapillus*), Eurasian Cuckoo (*Cuculus canornus*) etc. were common on both belts (Annex III). So that habitat has no effect on the distribution of these species and can adopt on both habitats.

6. CONCLUSION AND RECOMMENDATIONS

The species richness and seasonal composition of birds were assessed with references to vegetation structure within two belts during winter and summer seasons at Someshwor range by using fixed point count method and call count method. A total of 101 species belonging to 11 orders and 32 families were recorded within 40 plots from 210m to 810m at the interval of each 50m altitude. Among the recorded birds, 85 species were residential, 7 were winter migrants, and 9 species summer migrants. The highest number of species was represented by order Passeriformes with 59 species (Annex I).

Higher species richness was recorded in winter than summer season. There was significant difference in species richness of birds between seasons indicating seasonal influences on bird species richness. This result indicates that winter season favours for relatively more species. Climatic factors (temperature, humidity), elevation are the important environmental variables that affect the birds community composition in the area.

Species richness is interrelated with the habitats. There was significant difference in species richness of birds among the two belts. There was mark variation in species richness of birds among the belts. The positive correlation between bird species richness and tree species diversity and negative correlation between the DBH and Basal area of tree with bird species diversity suggested the direct influence of vegetation structure on the species richness of birds.

Habitat disturbances, forest fire, overfishing, use of pesticides by the farmers near the forest, poaching, poverty and lack of awareness education were major threats of birds inhabiting in the Madi valley.

Based on my research, Followings are the some recommendations which will be useful for the conservation of avifauna of Someshwor range.

-) To assess the effect of change in habitat structures and complexity of bird community structure and habitat relationship, long term bird monitoring program should be launched in the Someshwor range.
-) Detailed study on the effect of canopy cover of forest to the species richness of bird should be conducted.
-) As the Someshwor range encompasses three nationally threatened species of bird, so that further exploration should be done.
-) Awareness program regarding the conservation of birds should be done through birds watching program and through the establishment of green club.
-) Uncontrolled forest fire, overfishing, hunting and use of pesticides should be controlled for the long term conservation of bird.

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ANNEX- I

Conservation status and migratory patterns of bird species recorded during winter and summer seasons in the Someshwor range, Madi, Chitwan.

S.N	Common Name	Scientific Name	Winter	Summer	C.S	CITES	MP
1	Asian Pied Starling	<i>Sturnus contra</i>	+	+	LC	-	R
2	Jungle Myna	<i>Acridotheres fuscus</i>	+	+	LC	-	R
3	Common Myna	<i>Acridotheres tristis</i>	+	+	LC	-	R
4	Hill Myna	<i>Gracula religiosa</i>	+	+	LC	II	R
5	Bronzed Drongo	<i>Dicrurus aeneus</i>	+	+	LC	-	R
6	Black Drongo	<i>Dicrurus macrocercus</i>	+	+	LC	-	R
7	Spangled Drongo	<i>Dicrurus hottentottus</i>	+	+	LC	-	R
8	Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	+	+	LC	-	R
9	House Crow	<i>Corvus splendens</i>	+	+	LC	-	R
10	Large-billed Crow	<i>Corvus macrorhynchos</i>	+	+	LC	-	R
11	Long-tailed Shrike	<i>Lanius schach</i>	+	+	LC	-	R
12	Black-hooded Oriole	<i>Oriolus xanthornus</i>	+	+	LC	-	R
13	Rufous Treepie	<i>Dendrocitta vagabunda</i>	+	+	LC	-	R
14	Purple Sunbird	<i>Nectarinia asiatica</i>	+	+	LC	-	R
15	Common Tailor bird	<i>Orthotomus sutorius</i>	+	+	LC	-	R
16	Rock Pigeon	<i>Columba livia</i>	+	+	LC	-	R
17	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	+	+	LC	-	R
18	Scarlet Minivet	<i>Periceocotus flammeus</i>	+	+	LC	-	R
19	Small Minivet	<i>Periceocotus cinnamomeus</i>	+	+	LC	-	R
20	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>	+	+	LC	-	R
21	Black-crested Bulbul	<i>Pycnonotus melanicterus</i>	+	+	LC	-	R
22	Black Bulbul	<i>Hypsipetes mcclllandii</i>	+	+	LC	-	R
23	Red-vented Bulbul	<i>Pycnonotus cafer</i>	+	+	LC	-	R
24	Red-billed Blue Magpie	<i>Urocissa erythrorhyncha</i>	+	+	LC	-	R
25	Scaly-breasted Munia	<i>Lonchura punctulata</i>	+	+	LC	-	R
26	Oriental Magpie Robin	<i>Copsychus saularis</i>	+	+	LC	-	R
27	Great Tit	<i>Parus major</i>	+	+	LC	-	R
28	Chestnut-bellied Nuthatch	<i>Sitta castanea</i>	+	+	LC	-	R
29	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	+	+	LC	-	R
30	Black Kite	<i>Milvus migran</i>	+	+	LC	II	W
31	Plum-headed Parakeet	<i>Psittacula cyanocephala</i>	+	+	LC	II	R
32	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	+	+	LC	-	R

33	River Lapwing	<i>Vanellus duvaucelii</i>	+	+	LC	-	R
34	Himalayan Flameback	<i>Dinopium shorii</i>	+	+	LC	-	R
35	Fulvous-breasted Woodpecker	<i>Dendrocopos macei</i>	+	+	LC	-	R
36	Grey-headed Woodpecker	<i>Dendrocopos canicapillus</i>	+	+	LC	-	R
37	Large cuckoo Shrike	<i>Coracina macei</i>	+	+	LC	-	R
38	Pied Bushchat	<i>Saxicola caprata</i>	+	+	LC	-	R
39	Common Stonechat	<i>Saxicola torquata</i>	+	+	LC	-	W
40	Grey-breasted Prinia	<i>Prinia hodgsonii</i>	+	+	LC	-	R
41	Crested Serpent Eagle	<i>Spilornis cheela</i>	+	+	LC	II	R
42	Grey Wagtail	<i>Motacilla cinerea</i>	+	+	LC	-	R
43	White-browed Wagtail	<i>Motacilla maderaspatensis</i>	+	+	LC	-	R
44	White Wagtail	<i>Motacilla alba</i>	+	+	LC	-	W
45	Lesser Coucal	<i>Centropus bengalensis</i>	+	+	LC	-	R
46	House Sparrow	<i>Passer domesticus</i>	+	+	LC	-	R
47	Baya Weaver	<i>Petronia xanthocollis</i>	+	+	LC	-	
48	Oriental White eye	<i>Zosterops palpebrosus</i>	+	+	LC	-	R
49	Jungle Babbler	<i>Turdoides striatus</i>	+	+	LC	-	R
50	Grey-hooded Wabblers	<i>Seicercus xanthoschistos</i>	+	+	LC	-	R
51	Red Junglefowl	<i>Gallus gallus</i>	+	+	LC	-	R
52	Spotted Dove	<i>Streptopelia chinensis</i>	+	+	LC	-	R
53	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	+	+	LC	-	R
54	Large Woodshrike	<i>Tephrodornis gularis</i>	+	+	LC	-	R
55	Blue-eared Kingfisher	<i>Alcedo meninting</i>	+	+	LC	-	R
56	Indian Roller	<i>Coracius benghalensis</i>	+	+	LC	-	R
57	Common Hawk Cuckoo	<i>Hierococcyx varius</i>	+	+	LC	-	R
58	Indian Cuckoo	<i>Cuculus micropterus</i>	+	+	LC	-	S
59	Dollar Bird	<i>Eurystomus orientalis</i>	+	+	LC	-	S
60	Ashy Woodswallow	<i>Artamus fuscus</i>	+	+	LC	-	R
61	Red-collared Dove	<i>Streptopelia tranquebarica</i>	+	+	LC	-	R
62	Common Hoopoe	<i>Upupa epops</i>	+	+	LC	-	R
63	Lesser Yellownape	<i>Picus chlorolophus</i>	+	+	LC	-	R
64	Rose ringed Parakeet	<i>Psittacula krameri</i>	+	+	LC	III	R
65	Black Redstart	<i>Phoenicurus ochruros</i>	+	+	LC	-	R
66	Streaked Spiderhunter	<i>Arachnothera magna</i>	+		LC	-	R
67	Orange-bellied Leafbird	<i>Chloropsis aurifons</i>	+		LC	-	R
68	Indian Pond Heron	<i>Ardeola grayii</i>	+		LC	-	R
69	Spotted Owlet	<i>Athene brama</i>	+		LC	I	W
70	Paddyfield Pipit	<i>Anthus rufulus</i>	+		LC	-	R

71	Slaty-headed Parakeet	<i>Psittacula himalayana</i>	+		LC	II	R
72	Kalij Pheasant	<i>Lophura leucomelanos</i>	+		LC	-	R
73	Common Sandpiper	<i>Actitis hypoleucos</i>	+		LC	-	W
74	Rufous-tailed Shrike	<i>Lenuis isabellinus</i>	+		LC	-	W
75	Grey-winged Blackbird	<i>Turdus albocinctus</i>	+		LC	-	W
76	Verditer Flycatcher	<i>Eumyias thalassina</i>	+		LC	-	S
77	White-capped Water Redstart	<i>Chaimarrornis leucocephalus</i>	+		LC	-	R
78	Long-tailed Broadbill	<i>Psarisomus dalhousiae</i>	+		LC	-	R
79	Black Francolin	<i>Franolinus francolinus</i>	+		LC	-	R
80	Large-tailed Nightgar	<i>Caprimulgus macrurus</i>	+		LC	-	R
81	Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	+		LC	-	R
82	Bar-winged Flycatcher Shrike	<i>Hemipus picatus</i>	+		LC	-	R
83	Yellow-footed Green Pigeon	<i>Treron phoenicoptera</i>	+		LC	-	R
84	Greater Yellownape	<i>Picus flavinuche</i>	+		LC	-	R
85	Collared Falconet	<i>Microhierax caerulescens</i>	+		LC	II	R
86	Black-shouldered Kite	<i>Elanus caeruleus</i>	+		LC	-	R
87	Shikra	<i>Accipiter badius</i>	+		LC	II	R
88	Indian Pitta	<i>Pitta branchyura</i>		+	LC	-	S
89	Chestnut-headed Bee eater	<i>Merops lischenaulti</i>		+	LC	-	S
90	Chestnut-tailed Starling	<i>Sturnus malabaricus</i>		+	LC	-	R
91	Plumbus Water Redstart	<i>Rhycuornis fuliginosus</i>		+	LC	-	R
92	Black-backed Forktail	<i>Enicurus immaculatus</i>		+	LC	-	R
93	Eurasian Cuckoo	<i>Cuculus canorus</i>		+	LC	-	S
94	Blue-throated Barbet	<i>Megalaima asiatica</i>		+	LC	-	R
95	Asian paradise Flycatcher	<i>Terpsiphone paradisi</i>		+	LC	-	S
96	Bright-headed Cisticola	<i>Cisticola exilis</i>		+	LC	-	R
97	Blue tailed bee-eater	<i>Merops philippinus</i>		+	LC	-	S
98	Eurasian Golden Oriole	<i>Oriolus oriolus</i>		+	LC	-	S
99	Red-breasted Parakeet	<i>Psittacula alexandri</i>		+	LC	II	R
100	Green Bee-eater	<i>Merops orientalis</i>		+	LC	-	R
101	Indian Grey Hornbill	<i>Ocyrceros birostris</i>		+	LC	-	R

C.S. = Conservation Status, **LC**= Least Concern, **M.P.** = Migratory pattern, **R**= Resident, **W**= winter visitor, **S**= summer Visitor, **CITES**= Convention on International Trades in Endangered Species of Flora and Fauna.

ANNEX II

Uncommon Bird species on different belts and different seasons in Someshwor range, Madi,
Chitwan

Winter Season		Summer Season		Lower Belt	
S.N.	Name of Species	S.N.	Name of Species	S.N.	Name of Species
1	Streaked Spiderhunter	1	Indian Pitta	1	Common Myna
2	Orange- bellied Leafbird	2	Chestnut-headed Bee eater	2	Red-vented Bulbul
3	Indian pond Heron	3	Chestnut-tailed Starling	3	Long-tailed Shrike
4	Spotted Owlet	4	Plumbus Water Redstart	4	Red-billed Blue Magpie
5	Paddyfield Pipit	5	Black-backed Forktail	5	House Sparrow
6	Slaty-headed Parakeet	6	Eurasian Cuckoo	6	House Crow
7	Kalij Pheasant	7	Blue- throated Barbet	7	Large- billed Crow
8	Common Sandpiper	8	Asian paradise Flycatcher	8	Hill Myna
9	Rufous -tailed Shrike	9	Bright-headed Cisticola	9	Baya Weaver.
10	Grey-winged Blackbird	10	Blue- tailed Bee- eater	10	Common Sandpiper
11	Verditer Flycatcher	11	Eurasian golden Oriole	11	Indian Roller
12	White-capped Water Redstart	12	Red-breasted Parakeet	12	Indian pond Heron
13	Long -tailed Broadbill	13	Green Bee- eater	13	Scaly-breasted Munia
14	Black Francolin	14	Indian Grey Hornbill	14	Oriental Magpie Robin
15	Large-tailed Nightjar		Upper Belt	15	Black shouldered Kite
16	Green-billed Malkoha	S.N.	Name of Species	16	Paddyfield Pipit
17	Bar-winged Flycatcher-shrike	1	Kalij Pheasant	17	Lesser Coucal
18	Yellow-footed Green Pigeon	2	Streak Spiderhunter	18	Purple Sunbird
19	Greater Yellownappe	3	Long- tailed Broadbill	19	Rufous Treepie White-capped Water Redstart
20	Collared Falconet	4	Asian paradise Flycatcher	20	Shikra
21	Black Shouldered Kite	5	Orange- bellied Leafbird	21	Asian Pied Starling
22	Shikra	6	Black-backed Forktail	22	Green-billed Malkoha
		7	Plumbus Water Redstart	23	Rock Pigeon
		8	Black-crested Bulbul	24	River Lapwing
		9	Velvet-fronted Nuthatch	25	Black Francolin
		10	Collared Falconet	26	Verditer Flycatcher
		11	Yellow -footed Green Pigeon	27	Pied Bushchat
		12	Large-tailed Nightjar	28	Common Stonechat
		13	Bright-headed Cisticola	29	White Wagtail
		14	Blue-eared Kingfisher	30	Spotted Owlet
		37	Indian Pitta	31	Eurasian Collared Dove
		38	Indian Grey Hornbill	32	Rufous-tailed Shrike
		39	Green Bee-eater	33	Common Hoopoe
		40	Chestnut-tailed Starling	34	Black Kite
		41	Eurassian Golden Oriole	35	Black Redstart
		42	Red -breasted Parakeet	36	

ANNEX- III

Abundance and number of species recorded in two elevational belts of Someshwor range,
Madi, Chitwan.

S.N	COMMON NAME	Lower belt		Upper belt		Total
		Winter	Summer	Winter	Summer	
1	Asian Pied Starling	29	19	-	-	48
2	Jungle Myna	33	10	-	3	46
3	Common Myna	32	33	-	-	65
4	Hill Myna	13	13	-	-	26
5	Bronzed Drongo	2	4	16	12	34
6	Black Drongo	26	23	9	8	66
7	Spangled Drongo	1	8	5	8	22
8	Greater Racket-tailed Drongo	11	5	2	4	22
9	House Crow	15	21	-	-	36
10	Large-billed Crow	9	13	-	-	22
11	Long-tailed Shrike	7	9	-	-	16
12	Black-hooded Oriole	18	16	9	12	55
13	Rufous Treepie	9	12	-	-	21
14	Purple Sunbird	2	1	-	-	3
15	Common Tailor bird	37	27	25	20	109
16	Rock Pigeon	11	14	-	-	25
17	Green-billed Malkoha	4	-	-	-	4
18	Blue Whistling Thrush	2	3	6	1	12
19	Scarlet Minivet	15	15	14	12	56
20	Small Minivet	4	7	8	-	19
21	Himalayan Bulbul	8	11	19	10	48
22	Black-crested Bulbul	-	-	3	8	11
23	Black Bulbul	12	24	-	2	38
24	Red-vented Bulbul	20	16	-	-	36
25	Red-billed Blue Magpie	3	3	-	-	6
26	Scaly-breasted Munia	20	27	-	-	47
27	Bar-winged Flycatcher Shrike	3	-	2	-	5
28	Indian Pond Heron	3	-	-	-	3
29	Rose ringed Parakeet	21	21	14	13	69
30	Slaty-headed Parakeet	4	-	7	-	11
31	Plum-headed Parakeet	12	15	5	8	40
32	White-throated Kingfisher	7	6	2	3	18

33	River Lapwing	9	7	-	-	16
34	Greater Yellownape	3	-	5	-	8
35	Himalayan Flameback	14	3	2	3	22
36	Fulvus-breasted Woodpecker	8	3	10	5	26
37	Grey-headed Woodpecker	3	4	6	5	18
38	Oriental Magpie Robin	7	13	-	-	20
39	Great Tit	25	16	26	13	80
40	Chestnut-bellied Nuthatch	9	6	19	16	50
41	Velvet-fronted Nuthatch	-	-	8	10	18
42	Grey-winged Blackbird	5	-	4	-	9
43	Kalij Pheasant	-	-	3	-	3
44	Yellow-footed Green Pigeon	-	-	21	-	21
45	White-capped Water Redstart	6	-	-	-	6
46	Grey-brested Prinia	25	16	5	22	68
47	Black Franolin	3	-	-	-	3
48	Large-tailed Nightjar	-	-	2	-	2
49	Lesser Coucal	7	8	-	-	15
50	Verditer Flycatcher	3	-	-	-	3
51	Large Cuckooshrike	8	6	9	9	32
52	Pied Bushchat	5	13	1	-	19
53	Common Stonechat	7	5	-	-	12
54	Collared Falconet	-	-	2	-	2
55	Black-shouldered Kite	4	-	-	-	4
56	Shikra	3	-	-	-	3
57	Crested Serpent Eagle	3	1	1	2	7
58	Grey Wagtail	13	4	-	4	21
59	White-browed Wagtail	8	6	-	4	18
60	White Wagtail	5	8	-	-	13
61	Long-tailed Broadbill	-	-	6	-	6
62	Orange-bellied Leafbird	-	-	4	-	4
63	Streaked Spiderhunter	-	-	2	-	2
64	House Sparrow	17	24	-	-	41
65	Baya Weaver	3	3	-	-	6
66	Spotted Owlet	1	-	-	-	1
67	Oriental White eye	5	20	5	11	41
68	Jungle Babbler	39	24	27	19	109
69	Grey-hooded Warbler	26	3	16	27	72
70	Red Junglefowl	5	3	-	2	10
71	Paddyfield Pipit	9	-	-	-	9

72	Spotted Dove	31	21	17	17	86
73	Eurasian Collared Dove	12	2	-	-	14
74	Common Sandpiper	7	-	-	-	7
75	Rufous-tailed Shrike	2	-	-	-	2
76	Large Woodshrike	3	-	3	6	12
77	Blue-eared Kingfisher	-	-	2	2	4
78	Indian Roller	11	8	-	-	19
79	Common Hawk Cuckoo	4	-	-	7	11
80	Indian Cuckoo	7	4	-	4	15
81	Dollar Bird	4	5	5	4	18
82	Ashy Woodswallow	7	7	4	4	22
83	Red-collared Dove	12	9	3	-	24
84	Common Hoopoe	7	4	-	-	11
85	Lesser Yellownape	7	7	4	7	25
86	Black Kite	3	1	-	-	4
87	Black Redstart	1	2	-	-	3
88	Indian Pitta	-	3	-	-	3
89	Indian Grey Hornbill	-	1	-	-	1
90	Green Bee-eater	-	6	-	-	6
91	Chestnut-headed Bee-eater	-	8	-	6	14
92	Chestnut-tailed Starling	-	15	-	-	15
93	Blue-tailed Bee-eater	-	5	-	6	11
94	Eurasian Golden Oriole	-	5	-	-	5
95	Red-breasted Parakeet	-	2	-	-	2
96	Blue-throated Barbet	-	2	-	11	13
97	Eurasian Cuckoo	-	1	-	4	5
98	Bright-headed Cisticola	-	-	-	3	3
99	Black-backed Forktail	-	-	-	3	3
100	Plumbus Water Redstart	-	-	-	6	6
101	Asian paradise Flycatcher	-	-	-	3	3
	TOTAL	799	690	368	369	2226

ANNEX- IV

Tree species recorded in the Someshwor range during vegetation sampling

S.N.	Common Name	English Name	Scientific Name
1	Amala,	Emblic Myrobalan	<i>Phyllanthus emblica</i>
2	Anp,	Mango	<i>Mangifera indica</i>
3	Badhar,	Monkey Jack	<i>Artocarpus lacucha</i>
4	Bakaino	China Berry	<i>Melia azedarach</i>
5	Banjhi,	Axle Wood	<i>Anogeissus latifolia</i>
6	Barro	Bastard Myrobalan	<i>Terminalia bellirica</i>
7	Cunetro ghas	-	<i>Maghania strobilifera</i>
8	Bel	Wood Apple	<i>Aegle marmelos</i>
9	Bhalayo	Oriental Cashewnut	<i>Semecarpus anacardium</i>
10	Bot dhayaro	-	<i>Lagerstroemia parviflora</i>
11	Chiuri	Nepali Butter Fruit	<i>Aesandra butyracea</i>
12	Dabdabe	Wodier Wood	<i>Lannea coromandelica</i>
13	Dhaiyaro	Fire-flame Bush	<i>Woodfordia fruticosa</i>
14	Dumri	Cluster Fig	<i>Ficus racemosa</i>
15	Gayo,	-	<i>Bredilia retusa</i>
16	Hadchur	Common Mistletoe	<i>Viscum album</i>
17	Phaledo	-	<i>Enythrina stricta</i>
18	Harro	Yellow Myrobalan	<i>Terminalia chebula</i>
19	Jamun	Black Plum	<i>Syzygium cumini</i>
20	Kadam,	Kadam	<i>Anthocephalus chinensis</i>
21	Kalikath,	-	<i>Myrsine semiserrata</i>
22	Karam	Yellow Teak	<i>Adinia cordifolia</i>
23	Katahar,	Jack Fruit	<i>Artocarpus heterophylla</i>
24	Khamari,	Malay Bushbeech	<i>Gmelina arborea</i>
25	Khirro	Tallow Tree	<i>Sapium insigne</i>
26	Kimbu	American Mulberry	<i>Morus rubra</i>
27	Kusum	Lac Tree	<i>Schleichera oleosa</i>
28	Kutmiro,	-	<i>Litsea monopetala</i>
29	Kyamuna	-	<i>Cleistocalyx operculatus</i>
30	Lampate,	-	<i>Dubanga grandiflora</i>
31	Latikath,	-	<i>Cornus oblonga</i>
32	Main kanda	Common Nut/Emetic Nut	<i>Xeromphis spinosa</i>
33	Nimaro	Eye's Apron	<i>Ficus auriculata</i>
34	Palas	Bustard Teak	<i>Butea monosperma</i>
35	Pipal	Peepal Tree	<i>Ficus religiosa</i>
36	Saj	Lourel Tree	<i>Terminalia alata</i>
37	Sadhan	Sandan	<i>Desmodium oojainense</i>
38	Sal	Sal Tree	<i>Shorea robusta</i>
39	Satisal	Indian Rose Wood	<i>Dalbergia latifolia</i>

40	Simal	Simal Tree	<i>Bombex ceiba</i>
41	Sindure	Arnotto	<i>Bixa orelana</i>
42	Sisham	Sisso	<i>Dalbergia sishoo</i>
43	Tatari	Nepalese Elephant Apple	<i>Dillenia pentagyna</i>
44	Vellar	Rhino Apple Tree	<i>Trewia nudiflora</i>
45	Unidentified A		
46	Unidentified B		
47	Unidentified C		

PHOTO PLATES



Spangled Drongo Grey-headed Woodpecker Common Hoopoe



Red-collared Dove



Shikra

Grey-winged Blackbird



Scarlet Minivet Red-breasted



Parakeet

Collared Falconet



Plumbus Water Redstart Spotted

Owlet Chestnut-headed Bee-eater



Indian Pitta Common Hawk Cuckoo Orange-bellied Leafbird



Grey breasted Prinia



Ashy Woodswallow

Crested Serpent Eagle



Himalayan Bulbul



Black Bulbul



Grey-hooded Warbler



Spotted Dove



Rock Pigeon

White throated Kingfisher



Dollar Bird



Scaly breasted Munia



Black Kit



Indian Roller



Long tailed Shrike



Large Cuckooshrike



Blue Whistling Thrush



Blue throated Barbet



Grey Wagtail



Asian Paradise Flycatcher



Jungle Babbler



Verditer Flycatcher



Bronzed Drongo



Green Bee-eater



Hill Myna



Common Stonechat



Plum-headed parakeet



Lesser Coucal



Observing birds using Binocular



Researcher at Nepal-India border



Interaction with local people



Collecting firewood by local people



Children playing catapult



Farmland near forest

