STATUS, DISTRIBUTION AND HABITAT PREFERENCE OF HODGSON'S BUSHCHAT (*SAXICOLA INSIGNIS*) IN GRASSLAND OF SUKLAPHANTA WILDLIFE RESERVE OF FAR-WESTERN DEVELOPMENT REGION OF NEPAL

Bhupendra Prasad Yadav

Department of National Parks and Wildlife Conservation
Nepal

Submitted to
Oriental Bird Club (OBC), United Kingdom
2007

STATUS, DISTRIBUTION & HABITAT PREFERENCE OF HODGSON'S BUSHCHAT (*SAXICOLA INSIGNIS*) IN GRASSLAND OF SUKLAPHANTA WILDLIFE RESERVE OF FAR WESTERN DEVELOPMENT REGION OF NEPAL

Researcher

Bhupendra Prasad Yadav

Department of National Parks and Wildlife Conservation,

Nepal

Email: bpforestry@hotmail.com

bhupendra_iof@yahoo.com

Cover Photo: Hodgson's Bushchat by Vijay Cavalo
Design and Layout: Pradip Saud

Citation: Yadav, B.P.2007.Status, distribution & habitat preference of Hodgson's Bushchat (*Saxicola insignis*) in Grassland of Suklaphanta Wildlife Reserve of Far Western Development Region of Nepal. A report submitted to Oriental bird Club (OBC), UK.

ACKNOWLEDGEMENT

First of all, I would like to give grateful thanks to the Oriental bird Club (Small Grant Program), U.K that provided me the grant to carry out the Hodgson's Bushchat research in Suklaphanta Wildlife Reserve, Nepal. I am deeply indebted to Mr. David Buckingham, Mrs. Carol Inskipp and Dr. Hem Sagar Baral for their valuable help and suggestions and constructive comments at different stages were beneficial to make this report in this form.

I would like to express my heartily thanks to Mrs. Carol Inskipp who helped me at different situation at different time. Her help is memorable and uncountable to me. I would like to give very cordial thanks to Mr. David Buckingham who helped me to construct a strong report by providing me suggestions, encouragement and fruitful analytical comments. I am very much grateful to him. I thanks to Department of National Parks and Wildlife Conservation (DNPWC) and Suklaphanta Wildlife Reserve that provided me the permission and field material support to carry out this study in the SWR.

I would like to share the credit of this research with Mr. Pradip Saud (Research assistant) who assisted me in the field as well as data analysis and report writing. I would like to extend my sincere thanks to research team (field staff)-Mr. Asok Kumar Sah (Ranger), Mr.Saroj Mani Paudel (Ranger), Mr. Santosh Kumar Bhagat (Ranger). This work would not have been possible without the help of the Park staffs (game-scouts) - Arjun Datta Joshi, Ratan Bd. Khadka, Madan Bhatta, Prithvi Bd. Dangi, Hatisare team (elephant rider of Barkaula group), Maharjan Guru (Park driver) and Khadak Bahadur Bista (Park driver) and Bhandari Dai and all of the staff of SWR.

Thanks are extended to Mr. Chiranjibi Prasad Upadhyaya (former Campus Chief, IOF, Pokhara). Special thanks are extended to BCN and BCN staffs Ms.Ishana Thapa, Mr. Dave Ghimire and Ms Susmita Sharma. I would like to extend my thanks to BCN, Pokhara branch team (2005), my friends Mr. Achyut Aryal, Mr.Naveen Kumar Mahato, Mr. Bishnu Hari Wagle, Ms.Sunita Chaudhary, Parash Bikram Singh, Yajna Murti Khanal, Bishnu Shrestha, Bishnu Devkota, Surya Maharjan, Suman Bhattarai,Dipesh K.C.,Nishan Bhattarai, Mahesh Lekhak and also thanks to Mr. Kanchan Thapa (TAL Program Officer and WWF Nepal Program) for his valuable suggestions, his cooperation and nice company during field work at SWR. I am grateful to Mr.Chiranjibi Pokharel, Mr. Suman Malla, Achyut jee including all the staff of the SCP/NTNC.

Finally, my greatest recognition goes to my beloved parents and my family members for rearing me up, for their inspiration and moral support for this study and constant love and support in each and every pace of my life.

ABSTRACT

Status, distribution and habitat preference of Hodgson's Bushchat (*Saxicola insignis*) in Suklaphanta Wildlife Reserve was carried out in Jan, 2005 (after the grass burning) and Jan, 2006 (before the grass burning). The main objective of the research was to find out the status, distribution, habitat preference and existing threats to the Hodgson's Bushchat. The line transect count was adopted as the main method for surveying the grassland bird populations. Different direct and indirect methods were used to complete this study.

A total of 19 Hodgson's Bushchat (19=17M+2F) were recorded in the first time survey (after burning) in Suklaphanta Wildlife Reserve on Jan., 2005. A Total of 8-Male Hodgson's Bushchat were recorded in the second time survey (before burning) on Jan-2006. The population of Hodgson's Bushchat is very low in the case of before burning than that in the case of after burning condition. The population of Hodgson's Bushchat is relatively less in 2005 (after burning of grass) than that in the survey of Baral, 1997 (after burning of grass). The trend of loss of Hodgson's Bushchat shows that it is little bit constant.

In Suklaphanta Wildlife Reserve, its distribution is restricted to Suklaphanta grassland only. In this research we found that the preferred area (Suklaphanta) and avoided area (Barkaula area) of the grassland composition was almost the same but on the basis of RF (%) and RD (%) of grasses it is concluded that the Hodgson's Bushchat preferred mostly Siru (*Imperata cylindrica*), Narenga (*Narenga porphyrocoma) and* Kans *(Saccharum spontaneum)* habitat respectively which supports the most preferred grass species as compared to the other grass species.

Plot condition like, partially burnt/unburnt has influential co-relationship in the Hodgson's Bushchat observation than others. The common average height of perching by Bushchat after burning and before burning was 5 ft. and 4-7 ft. respectively. The analysis of habitat use after the burning and before the burning of Suklaphanta grassland indicates that the grass height makes a little deviation in the habitat use and their observation, which is more prone by the cattle grazing pressure. Even the habitat component do not reveal vary in their composition, the habitat use and avoid by Bushchat is primarily directed by cattle grazing pressures and wildlife grazing pressure. Cattle grazing pressure, forest distance and water distance acted as an absolute correlation in discriminating the variable of the habitat by Hodgson's Bushchat in Suklaphanta wildlife reserve.

Thatch harvesting, habitat loss, grazing, flooding and burning and cutting of grasses are the major issues in the Suklaphanta. Knowledge of identification of this bird and other globally threatened birds and awareness of their global importance and conservation value are lacking among reserve staff and local inhabitants.

Key words:-Status*, distribution, habitat use and Existing threats etc.*

TABLE OF CONTENT

LIST OF FIGURE

LIST OF MAP

LIST OF TABLE

LIST OF ACRONYMS

BCN	Bird Conservation Nepal
BLI	Bird life International
Dept	Department
DNPWC	Department of National Parks and Wildlife Conservation
GIS	Global Information System
Imm. M	Immature Male
IOF	Institute of Forestry
IUCN	International Union for conservation of nature and natural resources
NTNC	National Trust for Nature Conservation
OBC	Oriental Bird Club
PA's	Park Areas
PCP	Participatory conservation Program
RD	Relative Density
RF	Relative Frequency
SCP	Suklaphanta Conservation Program
SWR	Suklaphanta Wildlife Conservation
RSWR	Royal Suklaphanta Wildlife Reserve
TAL	Terai Arc Landscape
VDC	Village Development Committee
WWF	World Wild fund

CHAPTER-ONE: INTRODUCTION

1.1 Background

Hodgson's Bushchat was first described to science in 1846 from a specimen in Brian Hodgson's collection (Gray and Gray 1846). The specimen was listed by Gray and Gray (1846) and by Warreb and Harrison (1971) as collected in Nepal, but is now thought to have originated in India near Segowlee (=Sugauli, Bihar) (Hume 1880a, Inglis 1901, Inskipp and Inskipp 1991). The species was first definitely recorded in Nepal at Koshi Barrage by Robert Fleming, Jr on 11 April 1975 (Fleming et al.1984, Inskipp and Inskipp 1991). It is now well established that it winter in the lowland grasslands both of Nepal and India. The wintering habitat of Hodgson's Bushchat in the Terai are the relatively open and large Phantas (= open plains of grassland). Such a habitat covered much of the Gangetic plain in the past but it is restricted to only a few isolated pockets in protected areas. In India the species occurs in the states which border Nepal, namely Uttar Pradesh, Bihar, and West Bengal (Ali and Ripley 1987) and also in Assam (Sharma et. al.1997).
Despite mention of it in several historic and recent reports, information on the status, ecology and behavior of Saxicola insignis is still lacking. Most of the references have concentrated on describing its morphology, mainly from museum skins.

Taxonomy and Morphology
Scientific Classification
(Based on the "http://en.wikipedia.org/wiki/Hodgson's Bushchat")
Kingdom: Animalia
Phylum: Chordata
Class: Aves
Order: Passeriformes
Family: Muscicapidae
Genus: Saxicola
Species: S. insignis
Binomial Name: Saxicola insignis (Grey, 1846).
English name- Hodgson's Bushchat
Red Data Book: - Vulnerable.

Saxicola insignis (also known as the White-throated Bushchat.): an endemic to the Indian subcontinent has been considered a threatened species by different conservation organization. Birds Life International (BLI) & World Pheasant Association have listed it under the vulnerable category (Collar et. al. 1994, McGowan et.al.1995). BCN has categorized it as an endangered species on national (Baral et. al.1996). A study of Baral in 1998, recommended to Government of Nepal to protect it under the National Parks & Wildlife Conservation Act- 1973.

Adult male birds are easy to identify by the white marks on the wing of the otherwise dark plumage, but female or immature birds in the distance may look like other Saxicola

species & need to be distinguished carefully. Female Hodgson's Bushchats are larger than other Bushchats & their body coloration is lighter. They have dirty white under parts, grey back, black primaries & tall contracting with grey upperparts, a clear dirty white bar is present on the wing. In flight, females show flashes of extensive white like the males. The females in Suklaphanta were noted to be slighter lighter in coloration than show in the illustration in Grimmatt et. al. (1998). The female white tailed Stone chart Saxicola leucura closely resembles the female Hodgson's Bushchat, but it should be easy to separate the two in the field using the features mentioned above. The immature and sub- adults may resemble the common Stonechat (*Saxicola torquata*) but, with practice, one should be able to separate the former from the latter. Hodgson's Bushchat is considerably larger than the other Saxicola species found in Nepal.

The literature indicates that females have been less frequently observed and collected than males (Blyth 1847, Hume1877a).

According to the literature the food consists mostly of live insects from the ground. Occasionally we observed the birds feeding on winged insects. The stomach contents of a bird collected on 10 April 1921, were beetles, larvae and green vegetable matter, whereas one collected on 12 December 1921 contained larvae, Carabids and other beetles (Whistler 1922). Ali and Ripley (1987) described the food as insects (mostly beetles) and their larvae, and also some vegetable matter.

1.2 Current global status

The current population is estimated at between 2,500 & 10,000 (http://www.birdlife.org). An estimate of winter population of Hodgson's Bushchat in Nepal for the year 1997/1998 is 29 and estimated population is 110 and the potential habitat is 22 km^2 (Baral, H.S.1998).

1.3 Range

Hodgson's Bushchat is a relatively little known Central Palearctic and Oriental bird. It breeds very locally in alpine or sub-alpine meadows with scrub in the mountains of Mongolia and adjacent parts of Kazakhstan (Collar et al. 1994), and of Russia (Knystautas1993). It winters in the Gangetic plains of the India a subcontinent (Ali and Ripley 1987).

In the Indian subcontinent, it is found from Haryana (Ambala) east through Uttar Pradesh and Bihar to northern Bengal and Assam (Manas) through the Nepal Terai and Jalpaiguri duars (Hume 1877a, 1877b, 1878a, 1878b, 1880a, 1880b; Vaurie 1959, Ripley 1982).

1.4 Distribution of Hodgson's in the world and in Nepal

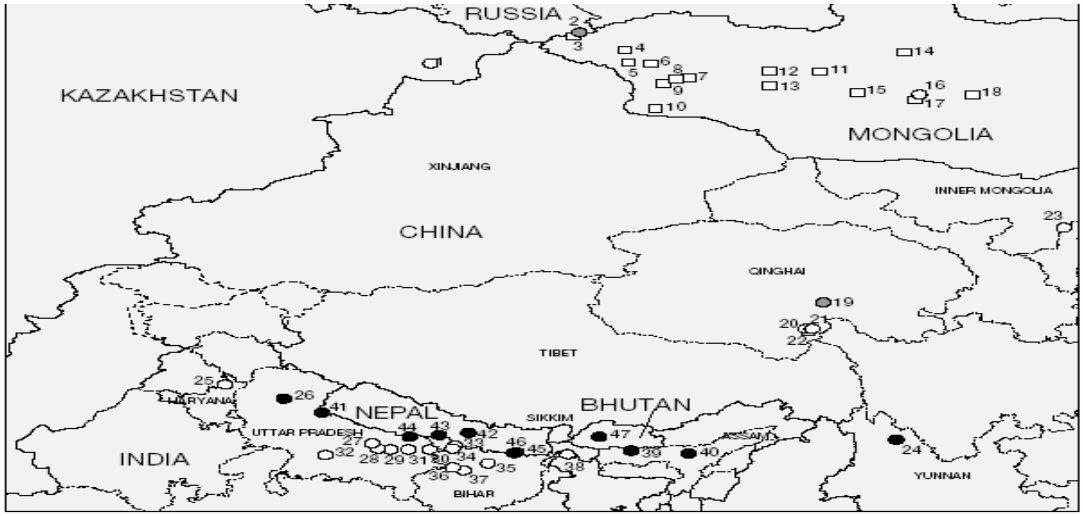
Hodgson's Bushchat is apparently restricted in its global distribution to an area between 26 and 55 N and between 76 and 92 E. The white-throated Bushchat occurs in the breeding season in Kazakhstan, Russia and Mongolia and in the non-breeding season in

Nepal and India, with records of migrating birds from intervening countries. It has been recorded on passage between these regions in Bhutan and Western China.

As easily as 1992 Suklaphanta was considered as a regular wintering place Hodgson's Bushchat (Anon.1992). This site may be of international significance for the wintering population of this species.

There are only five localities from which Hodgson's Bushchats have been recorded in Nepal: Kathmandu Valley, Suklaphanta, Lumbini, Chitwan, and Koshi (Koshi Tappu and Koshi Barrage). Suklaphanta, Chitwan and Koshi Barrage can be considered to be strongholds for this species in Nepal.

Map 1: *Showing distribution of Hodgson's Bushchat in the World.*

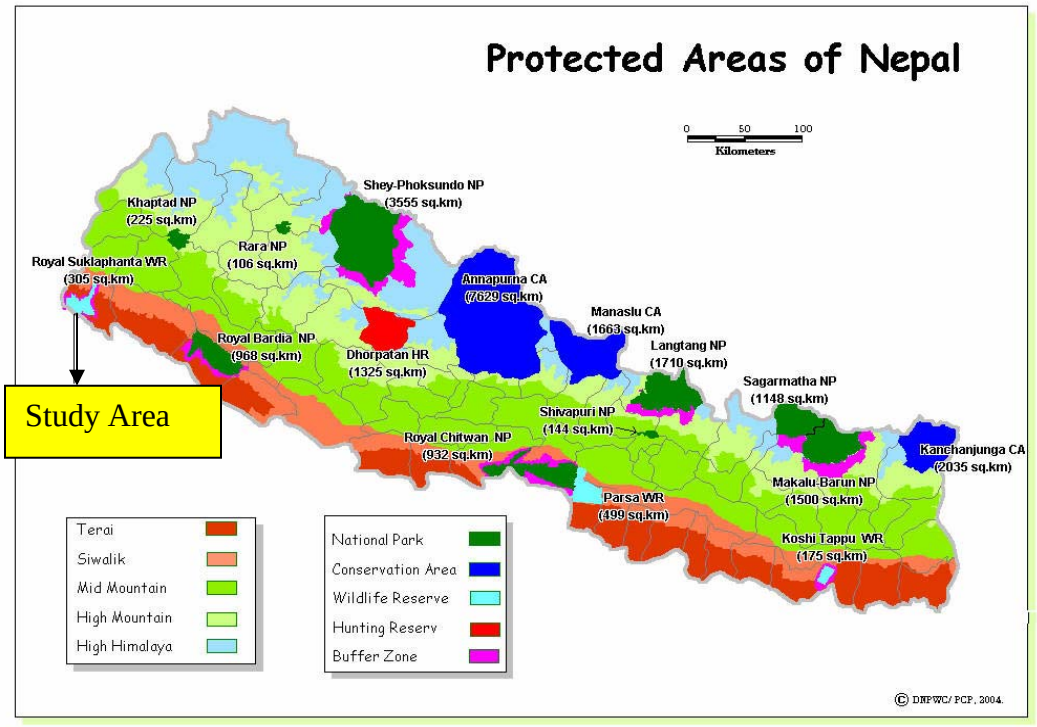


The distribution of White-throated Bushchat *Saxicola insignis*: (1) Zaysan lake; (2) Tashanta; (3) Siljugem mountains; (4) Tsast mountain; (5) Khökh Serkh Uul; (6) Khovd; (7) Bumbag Hayrhan Uul; (8) Ulaan Dabaa; (9) Mönkhkhaïrkhan; (10) Bodonch river; (11) Otgon Tenger Uul; (12) Dzavkhan river; (13) Khasagt Khaïrkhan Uul; (14) Chuluut Gol; (15) Bogdo mountain; (16) Laman-Gegen; (17) Shargaljuut river; (18) Ongiin river; (19) Gyaring Hu; (20) Tongchi Gompa; (21) Camp 80; (22) Chindu county; (23) Helan Shan; (24) Lijiang-Daju; (25) Ambala; (26) Corbett National Park; (27) Gonda; (28) Faizabad; (29) Captainganj; (30) Kasia; (31) Pipraich; (32) Kanpur; (33) Raxaul; (34) Sugauli; (35) Darbhanga district; (36) Chupra; (37) Patna; (38) Jalpaiguri; (39) Manas National Park; (40) Kaziranga National Park; (41) Royal Sukla Phanta Wildlife Reserve; (42) Manohara river; (43) Royal Chitwan National Park; (44) Lumbini Sanctuary; (45) Kosi Tappu Wildlife Reserve; (46) Kosi barrage; (47) Wangdi.

○ Historical (pre-1950) ◎ Fairly recent (1950–1979) ● Recent (1980–present) □ Undated

Source: Adopted from book: Threatened birds of Asia.

Map 2: *Protected area of Nepal*



CHAPTER-TWO: OBJECTIVES

2.1 Project aims & objectives:

The main aim of this project was to assess the population status, distribution & habitat preferences of Saxicola insignis to provide an outline management of prescription to ensure its long-term survival in its natural habitat.
Specific objectives of the study were to:-

- To assess the population status of Saxicola insignis in SWR.
- To assess the habitat preferences of Saxicola insignis in SWR.
- To outline current threats to Saxicola insignis population & their habitat.
- To assess the distribution of Saxicola insignis in SWR.

2.2 Limitation of the study:

1. Political situation of the country: The research was affected by situation of the country lack of security. Free movement was not allowed in the park. Five-six months ago, some staffs were killed by the explosion of the jeep when they were patrolling inside the Suklaphanta Wildlife Reserve. The park security was very sincere due to Maoist problem. Therefore, the situation of the park at the time of research was very critical. The movement of around of the park was full of danger.

CHAPTER-THREE: STUDY AREA

3.1 GENERAL INTRODUCTION

This research was conducted in Suklaphanta Wildlife Reserve (SWR) which is located in Far Western Terai, on the southwestern edge of Nepal. It is situated at latitude 28.49-28.57N & longitude 80.07- 80.15E. It lies in the extreme Southwest of the Terai & is the second smallest of Nepal's protected areas covering 305sq.km (including extension areas), ranging in altitude from 90m to 270m. It was established in 1965 & Gazetted as a wildlife reserve in 1975 July.

3.1.1 Climate

The reserve has tropical climate with more than 90% annual precipitation in monsoon (June-September). The reserve has three seasons, winter, spring and monsoon. The winter season starts in October and lasts until early March during which the weather is dry, the temperature decreased minimum of 7oC in June. The spring begins in March and lasts until June. April-May is the hottest months in which the temperature reaches up to37.49oC. The monsoon usually begins with early July to the end of September. The mean annual rainfall of last ten years was 1844mm and maximum rainfall (2446mm) was recorded in 1998(Bhatta, 1999).

Table 1: *Mean data of temperature and rainfall of the year 1991-2000*

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Mean Maximum Temperature	31.5	31.0	30.3	30.9	30.2	29.8	-	30.0	30.7	29.6
Mean Minimum Temperature	16.1	16.5	16.9	16.7	17.2	17.2	-	-	17.4	17.2
Rainfall-Annual total in mm.	1565	1257	1964	1617	2135	1643	1626	2446	-	2342.6
Maximum in month	136 july	154 aug.	142 sept	112 july	190 aug.	111 sept	118	139 aug	-	158.8 aug

Source: -Year book of dept. of Hydrology and metrology, Babarmahal, Kathmandu.

3.1.2 Geology and Soil

The soil is light colored inceptisols which may show some leaching of the top soil and very little accumulation of clay or oxides. The Soil has variable pH values, which could range from slightly acidic to moderately alkaline. The common soil types found in the reserve are loamy Sand, sandy loam and clay loam (Bhatta and Shrestha1977). The soil of forest around grassland areas is sandy loam but is slightly alkaline (pH is 8.0) (Bhatta and Shrestha 1977). In predominant Sal forest area soil varied from loam to sandy loam being slightly acidic (Bhatta, 1999). The soil of grassland area is clay-loam, slightly alkaline, with pH of 7.81 (Bhatta, 1999).The reserve area is generally flat with old deposits of Gangetic alluvium.

3.1.3 Demography

The Buffer zone includes 52 wards of 11 VDCs and 7 wards of Mahendranagar Municipality. There are 280 settlements and 17,886 households in the Buffer zone. Regarding caste/ethnicity composition of household in the Buffer zone, about 62 percent of households belonged to Brahmin/Chhetri/ Thakuri castes, followed by Kami/ Damai/ Sarki(18%) and Tharu 19.35%), and others (7%) respectively.

3.1.4 Land Use Changes

Table 2: *Percent land use change in SWR and its buffer zone.*

Percent change (1978-1996)

Land use	SWR	SWR-Buffer zone
Forest	-4.19	-21.87
Grassland	-1.29	-2.25
Barren land	0.02	0.17
Agriculture land	0.60	20.68
Water bodies	0.88	1.94
shrub land	3.98	1.34

Source:-DNPWC/PCP.-1996. (Percentage total area:-640.44km2)

3.2 Biological Feature.

3.2.1 Flora (Source –SWR management plan -2003)

Although, Suklaphanta comprises of Terai, Bhabar and Churia, its vegetation can be broadly classified into forests, grassland, wetlands and flood plains. All these aquatic and terrestrial habitats contain more than 665 species of plants belonging to 438 genera within 118 families. This is the highest number of species reported from Terai, Nepal so far for any given protected area.

Out of the 665 species, 109 species were trees, 70 shrubs, 432 herbs, 41 climbers, 4 epiphytes and 9 others tree-16%, herb-65%, Shrub-11%, Climber-6%, others 1% and epiphytes-1%.A total of 8 species falling into different IUCN threat categories are found in SWR. Of these, 2 vulnerable, 1 rare and 1 insufficiently known.

Table 3: *Key plants under various IUCN threat Categories, in Suklaphanta.*

Species	Family	Habit	Threat
Acacia catechu-	Leguminosae-	Tree-	Commercially threatened.
Alstonia scholaris-	Apocynacea	Tree	Rare
Butea monosperma	Leguminosae	Tree	Endangered
Dalbergia latifolia	Leguminosae	Tree	Vulnerable.
Dioscorea deltoidea	Dioscoreaceae	Climber	Commercially threatened
Maharanga bicolor	Boraginaceae	Herb	Insufficiently known
Oroxylum indium	Bignoniaceae	Tree	Vulnerable.
Rauvolfia serpentin	Apocynaceae	Shrub	Endangered.

Forest: i) Sal forest ii) Deciduous riverine forest:-syzygium forest, Mallotus forest, sissoo forest and khair forest etc.

Grassland: Although the composition of vegetation varied in grassland with dominant types occurring as minimum as six types, grassland vertical strata suggested three types:
Tall grassland primarily contained species of Narenga, Saccharum and Themeda with Phragmites in water logged areas.
Short grassland included mainly imperata and Desmos species.
Recently vacated land (extended grassland) had very little ground cover with Cyanodon dactylon.

Aquatic habitat:
The Mahakali River and its tributaries flow in the west of the reserve. Also, several lakes, rivers and oxbow lakes are found. Prominent wetlands are Rani Taal, Sikari taal, Kalikitch and many others. The aquatic vegetation includes floating species like pistaia stratiotes, nelumbo nucifera, Nymphoides indica,nymphoides hydrophullum, chara, red and green algae and blue green algae, persicaria barbata, percicaria capitat, Persicaria glabra, polygonum plebeium, polygonum pulcherum and water side species like Equisetum diffusum, Dryopteris cochleata, and tall grass like phragmites karka.

3.2.2 Fauna

I) Mammals: Suklaphanta Wildlife Reserve supports more than 43 large mammals. Two mammalian features of SWR are so different that they set the reserve as outstanding amongst all Pas of Nepal.

i) SWR harbors the largest herds of Swamp Deer (Cervus Duvauceli) with 1,710-2,250 animals; and

ii) Of all PA's in Nepal, SWR has the highest no of endangered species which include Hispid hare (*Caprolagus hispidus*), and Tiger (*Panthera tigris tigris*), Rhino (*R. unicornis*), Elephant (*E. maximus*), and Swamp deer (*Cervus duvauceli*) In addition, SWR is the centre –place for the TAL because it connnects11 protected areas of Nepal and India within 49,500squire kilometer.

II) Birds:

The reserve is important for grasslands that support the largest population of Bengal florican in Nepal. Several rare grassland bird species such as the swamp francolin, grass owl, large grass warbler and striated marsh occur. A total of 349 species of bird represting 54 families, are reported. Of these, 7species (*Saxicola insignis, S.francolin,B. florican, S. crane,*White rumped vulture, Slendered-billed and Lesser adjutant) are globally threatened. Also, a total of 24 species of breeding birds that are at risk in Nepal occur.

III) Other vertebrates and invertebrates:

Anecdotal repots suggest more than 2 species of reptiles, 20 species of amphibians, 21 fish species and 35 butterfly species also occur.

CHAPTER-FOUR: METHODS

4.1 Data Collection

This study was done in winter seasons-after burning of grass in January, 2005 and before burning of grass in January, 2006.

4.1.1 Bird census

For bird census data sheet of appendix-1 was completed. Bikes, bicycles and elephant and on foot were used for data collection. The jeep was not used due to security problem. Open width transect was selected and mean perpendicular sighting distance of each side of transect was recorded for bird observation.

Bird census was not carried out on rainy, high temperature strongly windy, totally overcast and cloudy days to avoid bias due to the change in intensity of bird activities.
The line transect count was adopted as the main method for surveying the grassland bird populations. The structure of the habitat caused transects to be of different lengths. Where possible, such linear transects were laid out in different grassland types in the study site. As far as possible the number of sections of each habitat type on transect is represented the proportionate distribution of habitats within each region. The length of transects were varies from 400m to 1500m. Each transect was divided into sections of 100m to standardize observations.

4.1.2 Habitat Preference

Habitat data were recorded at each 100m plots at the first time survey after burning condition. While the second time count before the burning condition the habitat data were collected at each 100m section and also the habitat data were collected from that area there was not used by the Hodgson's Bushchat. Almost all the strata of block were homogenous.

All the gathered data were collected from the study area as prescribed data sheet in annex-1. A data sheet for habitat was prepared for each transect. The importance of recording enough habitat variables for easy interpretation of bird distribution in relation to the habitat was recognized from the start. These variables were –prescribed in appendix.

Circular sample plots (10m2, r=1.78m) were used for grass species in each plot (Gyawali, N, 2003). Altogether 70 plots were taken at the first time survey of after burning condition in jan, 2005 in Suklaphanta and the second time survey was carried out before the burning of grass in Jan, 2006 and plots were taken in two places Suklaphanta (55 used area of Hodgson's Bushchat) and Barkaula area (24 plots where Hodgson's Bushchat not

used this area) for the study and data were used for calculating the frequency, relative frequency, density, and relative density by using following formulae:

$$\text{Frequency of "A" species} = \frac{\text{No. of plots where species "A" occurs} * 100}{\text{Total no. of plots}}$$

$$\text{Relative Frequency of "A" species} = \frac{\text{Frequency of one species} * 100}{\text{Sum of all frequency}} = \text{---------}\%$$

$$\text{Population density of "A" species} = \frac{\text{No. of species A in all plots} * 10{,}000 \text{ sq. m.}}{\text{Total no. of plots} * \text{area of plot}}$$

$$\text{Relative density of "A" species} = \frac{\text{No. of individuals of species A in all plots} * 100}{\text{Total no. of individuals of all species}} = \text{-------}\% / \text{ha}$$

4.1.3 Distribution

Distribution pattern was identified on the basis of direct observation, presence and absence of Hodgson's Bushchat and from interviews and other key informants (Park Staffs etc).

GPS points of the Hodgson's Bushchat distribution area was interred in digitizing Topo-Map (1996 year) of study area and prepared the Hodgson's Bushchat distribution map by using GIS software Arc View 3.2 version.

4.1.4 Data collection time

Several surveys and observations demonstrated that more Hodgson's Bushchats were detectable in the afternoon than in the morning. Therefore, considerably higher bird activities occurred in the afternoon compared to the morning because insect activities are at a peak after the ground has heated up. Visibility is slightly better in the afternoon than in the morning and this may have had some effect. Afternoon is the best time because bird activities are high.

4.1.5 Observation Bias

Through pilot study, the team members -2 expert with 4-local staff or familiar staff was divided into two groups, (each group with 2 observers +1 data recorder). Before censing, Practice was done 2 days in the field. In the practice, we had discussed how to distinguish the Hodgson's Bushchat with other Bushchats and how to fill up the data sheet. In the case of female, it was very challengeable task; we had to face many problems to identify the female birds of Hodgson's Bushchat. The group members were discussed in detailed in the pilot study.

As per our pilot study the Hodgson's Bushchat did not fly a greater distance in short time, we found that some birds found same place almost 300m around that was seen previous

day. Care was taken not to count the same individual twice by the same or a different observer. Such effects were eliminated by counting all plots at the same time and by discussion in the field. In the pilot study, we found that the same species at same place in two days program but in study period we found the same result that shows they do not fly greater distance. Therefore, there was small chance to count double.

4.1.6 Information Sample

Formal & informal interviews were organized among local people, park staff, naturalists, wildlife techniques & wildlife biologists who were working in the area. A set of questionnaire was designed to interview key informants to obtain information on population status, distribution & habitat condition of Hodgson's Bushchat. But the questionnaire was not fruitful in the research. Most of the people did not know about the Hodgson's Bushchat.

4.1.6 Secondary data collection

Secondary data relevant to the study was collected from various published & unpublished documents. For this purpose, libraries of BCN, Bird Conservation Society, Department of National Parks & Wildlife Conservation & related websites were searched.

4.1.7 Existing Threats

The existing threats were listed out through field visit and interview of key persons and Park staffs.

4.2. Data Analysis:

The gathered data were analyzed on the basis of objectives. The frequency, relative frequency, density, and relative density were calculated by Microsoft Excel and map was developed by using the GIS software Arc View 3.2 version. Another data were analyzed by using SPSS-10 version and described in the text.

CHAPTER-FIVE: RESULTS AND DISCUSSION

5.1 Population Status of Hodgson in the Study Area

The study shows that:
A total of 19 Hodgson's Bushchat (19=17M+2F) were recorded in the first time survey in Suklaphanta Wildlife Reserve on Jan., 2005.

$$\text{Population Density} = \frac{N}{L \times 2 \times fy}$$

= 19/7kmx2x0.035km
= 5.53 per km2

Where,
N= Total number of Birds seen,
L=Total transect length in km,
fy = Mean perpendicular distance of right and left from transect line in km.

Estimated Population= Potential habitat in km2 X Population density per km2.
= 8 km2 X 5.53=44.31
= 44
The area of potential habitat is based on the observation and assumption.

Table 4: *An estimate of winter population of Hodgson's Bushchat in Suklaphanta for the Year 2005*

Grassland	Observed no.	Potential habitat(km2)	Estimated no
Suklaphanta W/R	19(17M+2F)	8 km2	44

A Total of 8-Male Hodgson's Bushchat were recorded in the second time survey on Jan-2006.

$$\text{Population Density} = \frac{N}{L \times 2 \times fy}$$

= 8/5.3kmx2x0.036km
= 3.97 per km2

Estimated Population= Potential habitat in km2 X Population density per km2.
= 8 km2 X 3.97=31.76
= 32

Table 5: *An estimate of winter population of Hodgson's Bushchat in Suklaphanta for the Year 2006*

Grassland	Observed no.	Potential habitat(km2)	Estimated no
Suklaphanta W/R	8M	8 km2	32

5.1.2 Change in Population

The population of Hodgson's Bushchat were 19 (17 M+2F) in Jan, 2005 after the grass burning and 8 (only male) were found in Jan, 2006 before the grass burning. The effect of burning is playing critical role to determine the population of Hodgson's Bushchat in Suklaphanta grassland. The major concern of the study was to notice what changes might occur after and before the burning of grass in winter season of 2005 and 2006. The population of Hodgson's Bushchat is very low in the case of before burning than that in the case of after burning condition. In the study of Bushchat in after burning condition of grassland, Baral (1997) found only 26 individuals of Bushchat, whereas this study found only 19 individuals of Bushchat. So, it could be concluded that there has not been drastic change in population since 1997. It shows that the certain area of Suklaphanta is still good to stay in winter. The manager of the park should keep the ecology of Hodgson's Bushchat in mind. The ecological behavior supports how to manage it well. But the detailed study of Hodgson's ecology is still unknown.

The recent study emphasizes that the burning of grass on time is the most important managerial work. Hodgson's Bushchat prefers mostly burnt grass with unburnt stem and with open area. There has been a trend to burn grass regularly for Swamp deer but this has also supported in maintaining the population of Hodgson's Bushchat in Suklaphanta. There is no pressure of domestic animals for grazing in proper Suklaphanta.

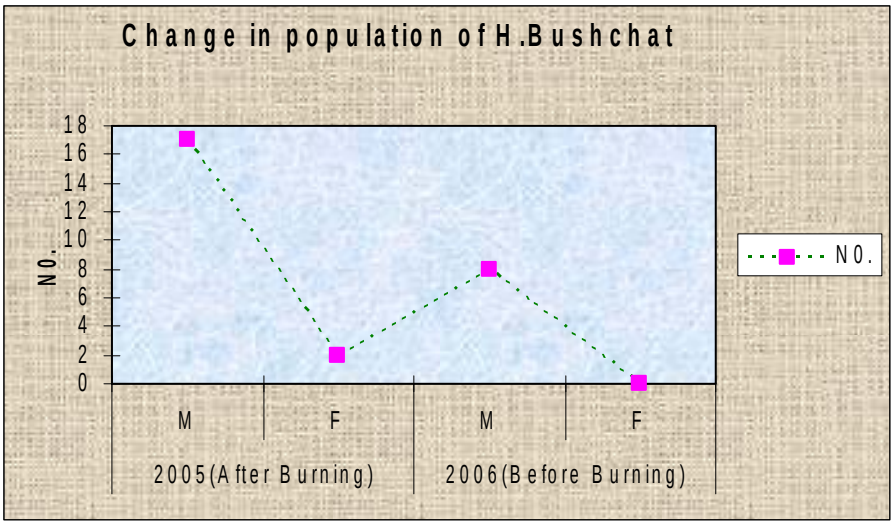


Figure 1: *The change in population of Hodgson's Bushchat at the time of after and before burning.*

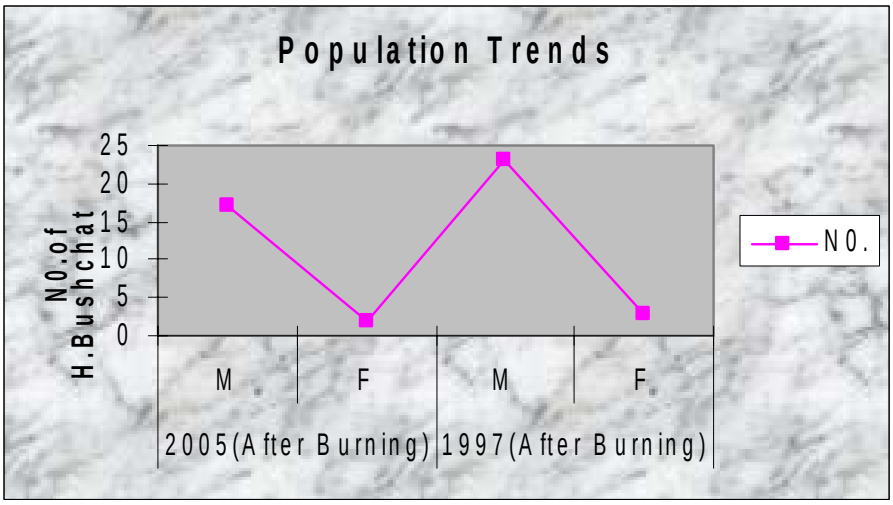


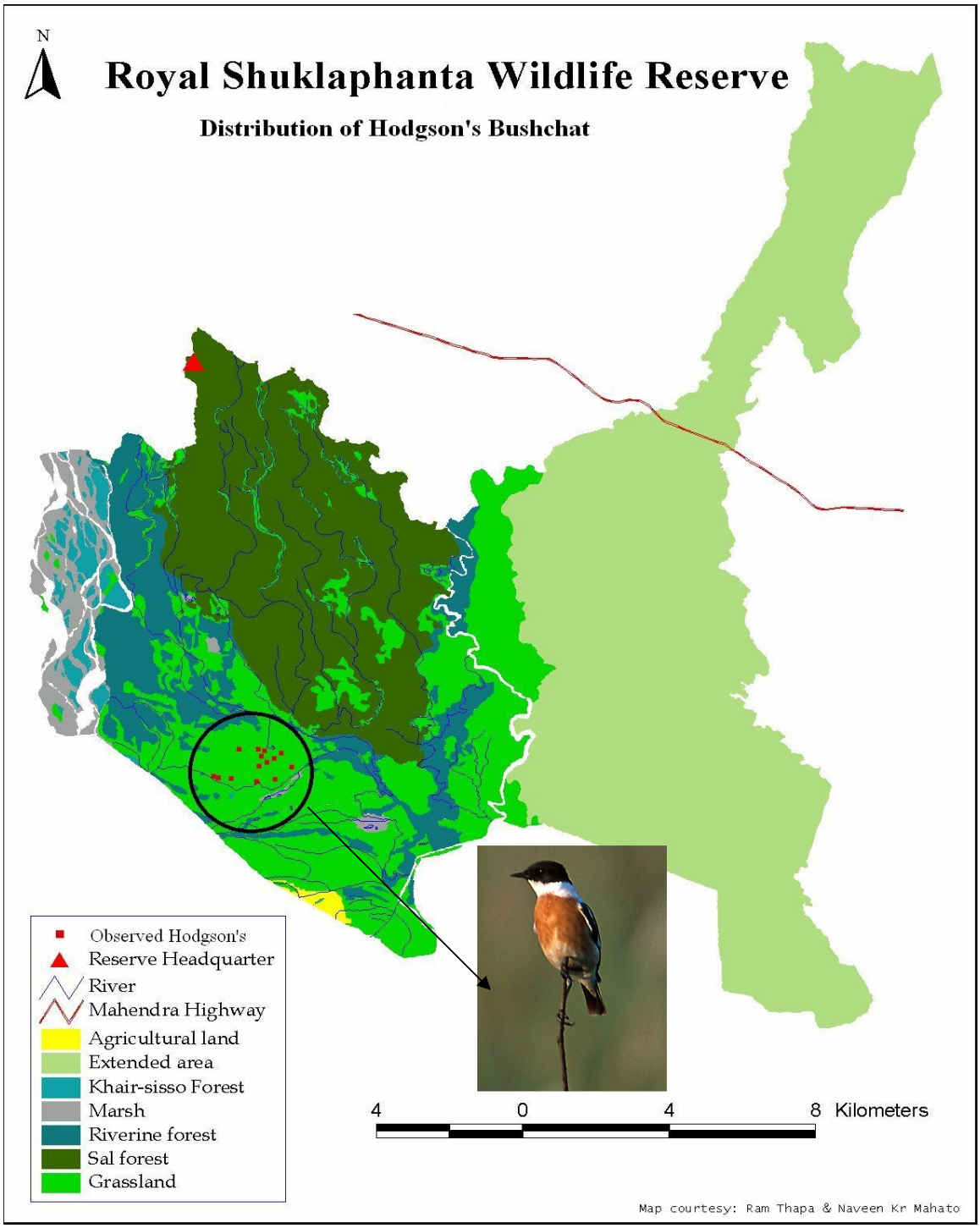
Figure 2: *Population trends of Hodgson's Bushchat*

5.2 Distribution of Hodgson's Bushchat in the Study Area

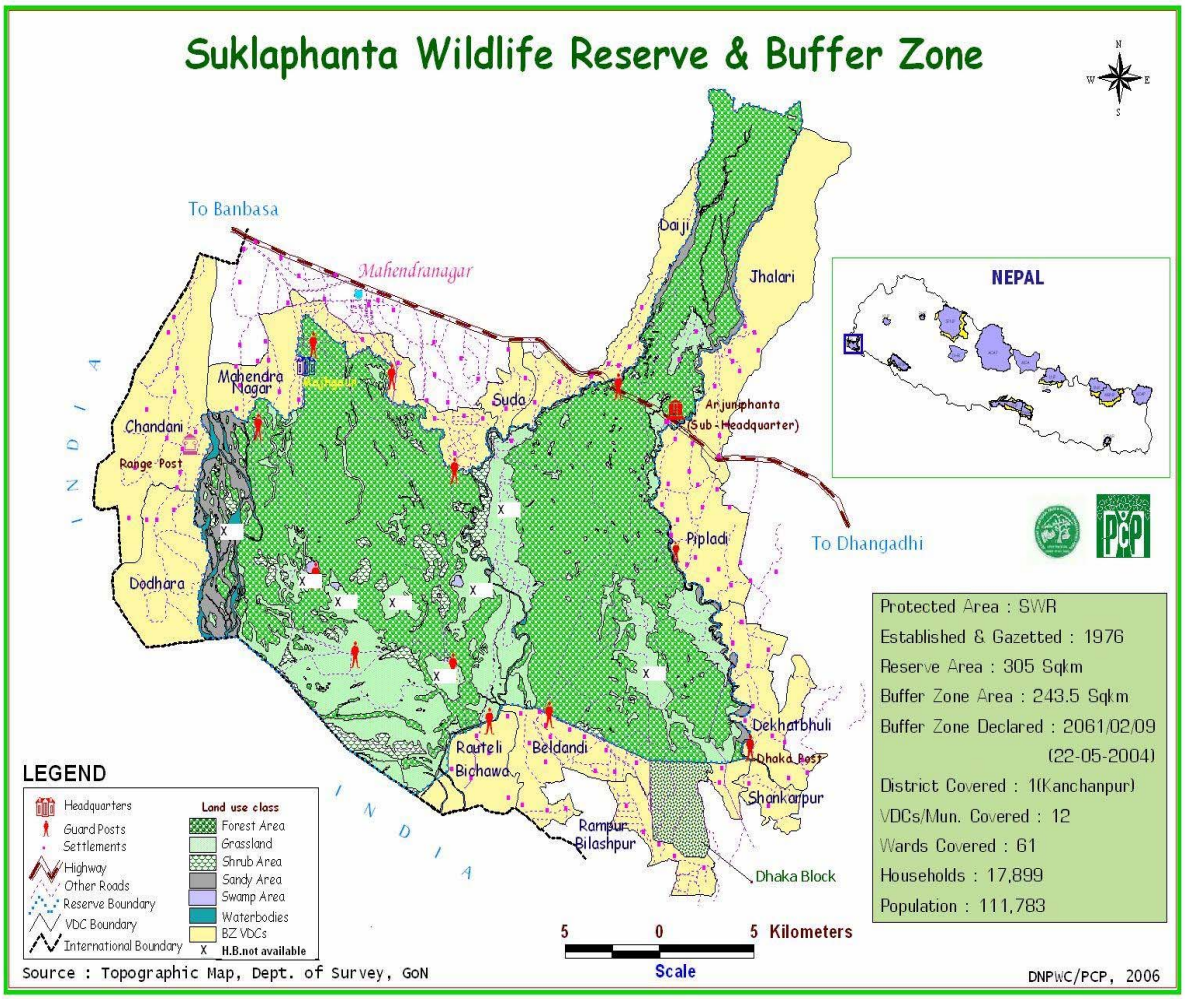
The distribution of Hodgson's Bushchat in the SWR is more in the southwest and a little less in southeast in Suklaphanta grassland that can be seen in the distribution map. The distribution area is based on the assumption and observation and shown by circle in below map

The survey was done in the various Phantas like Suklaphanta, Barkaula Phanta, Singhpur Phanta, Rani Taal grasslands, Haraiya Phanta, Sundari Phanta, Radhapur grassland, Karaiya Phanta, Jhalari Phanta, Arjuni Phanta, Rauteli Bichuwa Phanta, Beldadi area, Pipariya area and Mahakali river area etc. But, only Suklaphanta was found to support Hodgson's Bushchats. Near the Mahakali River, proper Jhala area was surveyed but we did not find Hodgson's Bushchat. We were unable to search all the Mahakali River Range due to security problem. Hodgson's Bushchat is found only in Suklaphanta and its distribution is restricted to certain area of Suklaphanta only.

Map 3: *Distribution of Hodgson's Bushchat in SWR*



Map 4: *Map showing the absent area of Hodgson's Bushchat in SWR*



5.3 Habitat Preferred by Hodgson's Bushchat in the Study Area

5.3.1 Grass Composition of Study Area:

Suklaphanta: (Preferred Area)

Altogether, there were 11 grass species found in Hodgson's Bushchat habitat in Suklaphanta area. Siru-imperata cylindrica- (RF-25%) grass was high in Hodgson's Bushchat preferred habitat followed by Narenga-Narenga porphyrocoma (RF-24%), Kans- Saccharum spontaneum-(R.F-21%), Shiv bagan-(RF-12%), Munj-(R.F-8%), Paniu-(RF-4%), Dhadi-Phragmites kharka-2% and others-(RF-5%). The Suklaphanta site where Relative density of Siru (RD=42.25%) grass was high and followed by Narenga-(RD-23.15%), Kans (RD- 18.38 %), Paniu-(RD-7.36), Shivbagan-(RD-5.48%), Munj-(RD-1.86%) and others.

Barkaula Area: (Avoided Area)

Altogether 12 grass species were found in the Barkaula area. The relative frequency and relative density are shown in the pie chat and also the data sheet in the Annex. The relative frequency and relative density of Narenga (RF-25%&RD-48.01) grass was high and followed by Paniu(RF-12.5%&RD-14.4%), Siru (RF-10.22%&RD-9.14%), Kans (RF-10.22%&RD-4.42%),Barni(RF-11.36&RD4.06), Shivbagan (RF-7.95%&RD-7.36%) respectively.

The preferred area (Suklaphanta) and avoided area (Barkaula area) of the grassland composition was almost the same but it is concluded that the Hodgson's Bushchat preferred mostly Siru (*Imperata cylindrica*), Narenga (*Narenga porphyrocoma*) and Kans (*Saccharum spontaneum*) habitat respectively which supports the most preferred species as compared to the other grass species.

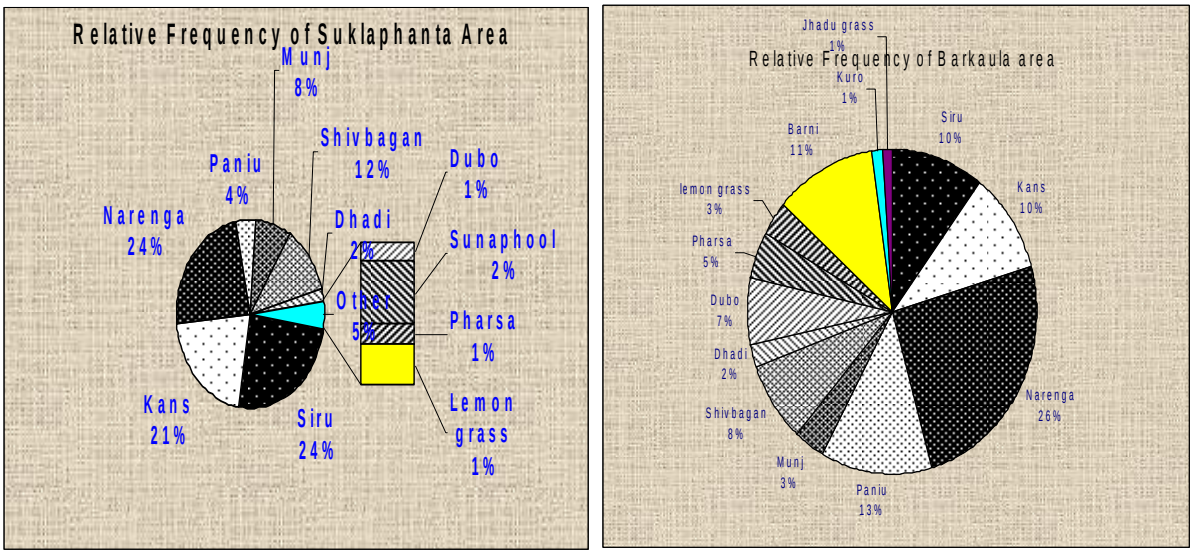


Figure 3: *Grass composition of Suklaphanta area and Barkaula area*

5.4 Habitat use condition and analysis after burning 2005

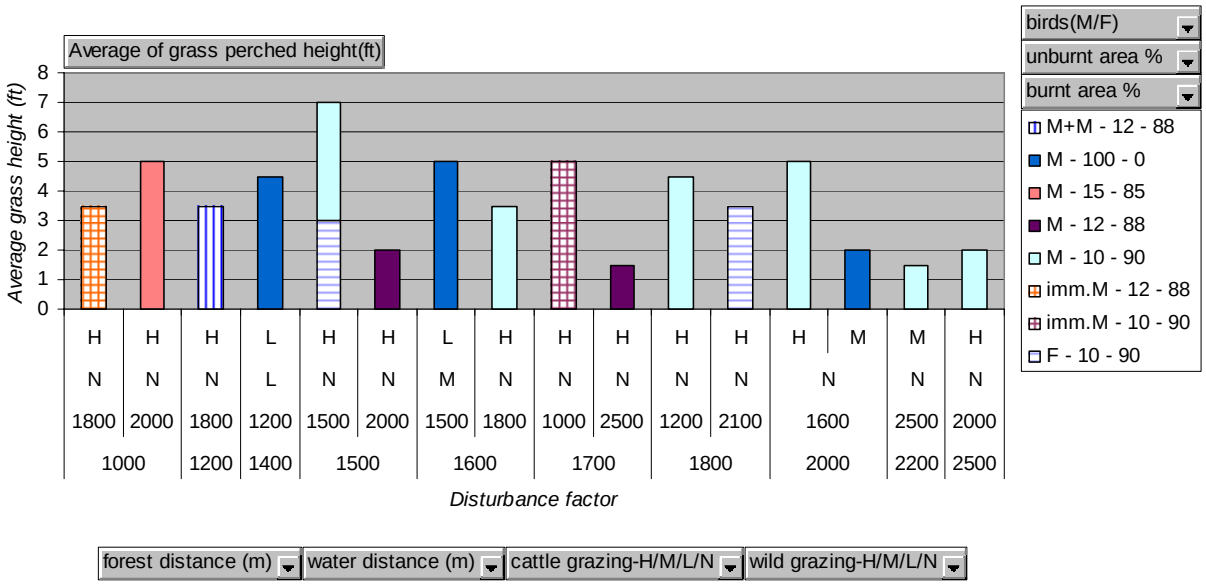


Figure 4: *Bar diagram showing birds found in the habitat with disturbance factors*

Afterburning of grass in Suklaphanta Wildlife Reserve, 70 plots were surveyed. Out of 70 sample plots the Hodgson's Bushchat was found only in 18 plots in 19 numbers. During this period, minimum average grass height of perching by Hodgson's was found to be 1.5 ft and maximum average height of perching was found to be 5 ft.

Correlation

In order to examine the habitat conditions and factors relationship with the Hodgson's Bushchat population, correlation was set up. Habitat conditions like; total burnt, unburnt and partial burnt may have intrinsic relationship in maintaining population of birds.

Table 6: *Descriptive statistics of the plot condition, after burning*

Descriptive Statistics

	Mean	Std. Deviation	N
birds observed	.27	.48	70
total unburnt	14.29	35.25	70
total burnt	32.86	47.31	70
partial burnt	44.79	43.01	68

As the bird were observed in different plot conditions i.e. burnt, unburnt and partially burnt, it becomes necessary to determine whether there is any relationship between the bird observation and plot condition Pearson correlation analysis was set up.
In the Pearson correlation analysis of birds observed, total unburnt plot, total burnt plot and partial burnt plot, the relationship between bird observed population and the partial burning of the plot has significant correlation. So, it could be concluded that birds observed population has very strong relationship with the partially burnt area. The partially burnt area may play vantage point to search the insects as food.

Table 7: *Correlation between bird observation and plot condition*

Correlations

		birds observed	total unburnt	total burnt	partial burnt
birds observed	Pearson Correlation	1.000	.025	-.399**	.447**
	Sig. (2-tailed)	.	.840	.001	.000
	Sum of Squares and Cross-products	15.843	28.571	-624.286	613.706
	Covariance	.230	.414	-9.048	9.160
	N	70	70	70	68
total unburnt	Pearson Correlation	.025	1.000	-.199	-.410**
	Sig. (2-tailed)	.840	.	.099	.001
	Sum of Squares and Cross-products	28.571	85714.286	-22857.143	-40314.706
	Covariance	.414	1242.236	-331.263	-601.712
	N	70	70	70	68
total burnt	Pearson Correlation	-.399**	-.199	1.000	-.726**
	Sig. (2-tailed)	.001	.099	.	.000
	Sum of Squares and Cross-products	-624.286	-22857.143	154428.571	-98547.059
	Covariance	-9.048	-331.263	2238.095	-1470.852
	N	70	70	70	68
partial burnt	Pearson Correlation	.447**	-.410**	-.726**	1.000
	Sig. (2-tailed)	.000	.001	.000	.
	Sum of Squares and Cross-products	613.706	-40314.706	-98547.059	123915.118
	Covariance	9.160	-601.712	-1470.852	1849.479
	N	68	68	68	68

**. Correlation is significant at the 0.01 level (2-tailed).

5.5 Habitat use condition and analysis before burning 2006

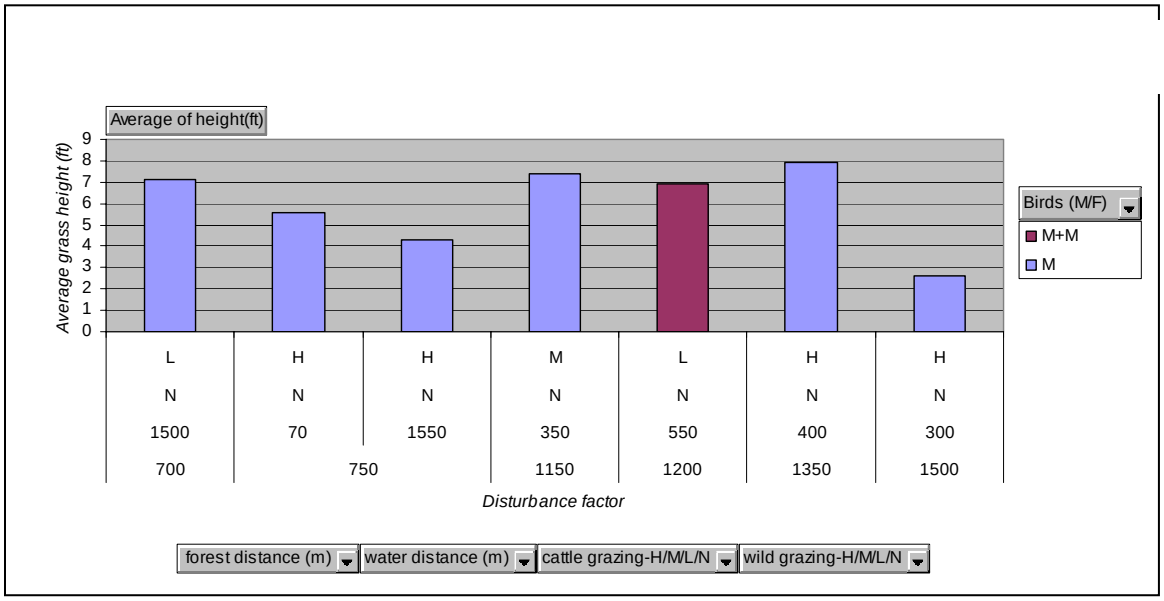


Figure 5: *Bar diagram showing birds found in the habitat with disturbance factors*

In the survey taken before the burning of grassland of Suklaphanta wildlife reserve, out of 53 sample plots, Hodgson's Bushchat was observed in only 7 plots, and total in 8 numbers.

The above diagram shows, that in the habitat used by Hodgson's Bushchat the minimum height of the grass in which it perched is about 2.5 ft and the maximum height is about to 8 ft. The grasses of 4-7ft height could be concluded as the common grass height in which it perches.

Table 8: *Descriptive statistics of bird observation with reference to habitat condition*

	Mean	Std. Deviation	N
Observed birds	.15	.41	53
average grass height (ft)	5.1858	1.3155	53
forest distance (m)	1121.70	282.08	53
water distance (m)	666.13	454.89	53
Cattle grazing	3.92	.27	53
Wildlife grazing	1.57	.69	53

Correlation between bird observation and habitat condition

The result showed that relationship between the bird observation and or habitat use is strongly influenced by the grass height, cattle grazing and wildlife grazing pressure irrespective of the forest and water distance. It may be concluded that cattle and wildlife might timely serve as factor which might create disturbance in their habitat use. Influence of grass height in the habitat preference of Bushchat might be facilitating in searching food and acting as a vantage point. But, forest and water source are not meant to be necessarily proximity of its habitat as grass and bushes might play service providing role, and they could travel any distance for water.

Table 9: *Correlation between bird observation and habitat condition*

Correlations

		Observed birds	average grass height (ft)	forest distance (m)	water distance (m)	Cattle grazing	Wildlife grazing
Observed birds	Pearson Correlation	1.000	.270	-.062	-.006	.106	.167
	Sig. (2-tailed)	.	.050	.660	.966	.450	.233
	Sum of Squares and Cross-products	8.792	7.603	-373.585	-59.057	.604	2.472
	Covariance	.169	.146	-7.184	-1.136	1.161E-02	4.753E-02
	N	53	53	53	53	53	53
average grass height (ft)	Pearson Correlation	.270	1.000	-.170	.058	-.106	.088
	Sig. (2-tailed)	.050	.	.223	.679	.452	.529
	Sum of Squares and Cross-products	7.603	89.981	-3286.226	1808.749	-1.927	4.195
	Covariance	.146	1.730	-63.197	34.784	-3.705E-02	8.066E-02
	N	53	53	53	53	53	53
forest distance (m)	Pearson Correlation	-.062	-.170	1.000	-.603**	-.080	-.025
	Sig. (2-tailed)	.660	.223	.	.000	.569	.861
	Sum of Squares and Cross-products	-373.585	-3286.226	4137547.170	-4022551.887	-313.208	-250.943
	Covariance	-7.184	-63.197	79568.215	-77356.767	-6.023	-4.826
	N	53	53	53	53	53	53
water distance (m)	Pearson Correlation	-.006	.058	-.603**	1.000	-.275*	.035
	Sig. (2-tailed)	.966	.679	.000	.	.046	.805
	Sum of Squares and Cross-products	-59.057	1808.749	-4022551.887	10759932.075	-1735.472	571.038
	Covariance	-1.136	34.784	-77356.767	206921.771	-33.374	10.981
	N	53	53	53	53	53	53
Cattle grazing	Pearson Correlation	.106	-.106	-.080	-.275*	1.000	.235
	Sig. (2-tailed)	.450	.452	.569	.046	.	.090
	Sum of Squares and Cross-products	.604	-1.927	-313.208	-1735.472	3.698	2.264
	Covariance	1.161E-02	-3.705E-02	-6.023	-33.374	7.112E-02	4.354E-02
	N	53	53	53	53	53	53
Wildlife grazing	Pearson Correlation	.167	.088	-.025	.035	.235	1.000
	Sig. (2-tailed)	.233	.529	.861	.805	.090	.
	Sum of Squares and Cross-products	2.472	4.195	-250.943	571.038	2.264	25.019
	Covariance	4.753E-02	8.066E-02	-4.826	10.981	4.354E-02	.481
	N	53	53	53	53	53	53

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5.6 Habitat analysis after and before burning of grassland

Out of total 125 sample plots after and before burning of Suklaphanta grassland, in only 27 sample plots Hodgson's Bushchat was found. But in comparison between these after and before burning of grassland, Bushchat was observed in higher frequency in after burning plot. Therefore, it was necessary to carry out analysis of habitat of this bird, after and before burning of grassland, to make examination whether there is any variation in birds' observation and habitat condition use. For this, total bird observation of both time were related with the habitat condition.

Paired samples test:

In the paired samples test of bird observation with other factors, like average grass height, cattle grazing and wildlife grazing, forest distance (m) and water distance (m) both has about equal average mean. Cattle grazing pressure mean 3.88 and wildlife grazing pressure 1.44 means reveals that, these birds might be more disturbed by wild animal grazing rather than by cattle grazing pressure. Whereas, the average heights of grass mean 4.23 has very little deviation in the birds habitat use.

The mean values of the variables are displayed in the Paired Samples Statistics table.

Table 10: *Paired sample statistics of birds and habitat condition*

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	BIRDS	1.08	25	.28	5.54E-02
	AVGGRSHT	4.2352	25	1.8292	.3658
Pair 2	BIRDS	1.08	25	.28	5.54E-02
	FRSTDIST	1456.00	25	459.69	91.94
Pair 3	BIRDS	1.08	25	.28	5.54E-02
	WATDIST	1452.80	25	675.36	135.07
Pair 4	BIRDS	1.08	25	.28	5.54E-02
	CTLGRAZE	3.88	25	.44	8.79E-02
Pair 5	BIRDS	1.08	25	.28	5.54E-02
	WLDGRAZE	1.44	25	.77	.15

A low significance value for the t test (typically less than 0.05) indicates that there is a significant difference between the two variables (observed birds and habitat condition). Thus, the T test from the table shown below shows that, birds and wildlife grazing has a significance difference in the habitat use of the grass land.

Table 11: *Paired differences in between bird observation and habitat condition*

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	BIRDS - AVGGRS	-3.1552	1.8049	.3610	-3.9002	-2.4102	-8.741	24	.000
Pair 2	BIRDS - FRSTDIS	-1454.92	459.74	91.95	-1644.69	-1265.15	-15.823	24	.000
Pair 3	BIRDS - WATDIS	-1451.72	675.40	135.08	-1730.51	-1172.93	-10.747	24	.000
Pair 4	BIRDS - CTLGRA	-2.80	.50	.10	-3.01	-2.59	-28.000	24	.000
Pair 5	BIRDS - WLDGR/	-.36	.76	.15	-.67	-4.74E-02	-2.377	24	.026

5.7 Habitat Use and Avoid

Suklaphanta Wildlife Reserve has similar grass composition in most of the grassland areas. The two grasslands, Suklaphanta and Barkaula, are close to each other and have similar grass composition. Before the lay out of the plots, a pilot survey was carried out for the rough estimation of the Hodgson's Bushchat and its habitat. But the species was only seen in Suklaphanta grassland not in Barkaula. Literatures were also reviewed for these two grasslands. Finally it was decided to take 24 sample plots in Barkaula grassland to compare with the habitat components of the Suklaphanta. Then also, no Hodgson's Bushchat was observed. So, it compels to carry out critical investigation on its use of Suklaphanta grassland and avoiding of other areas.

Table 12: *Descriptive statistic for the bird observation 0 (Barkaula grassland) and 1 (Suklaphanta grassland)*

Bird observed		Mean	St. Deviation
0	Water distance (m)	271.2500	150.5082
	Forest distance (m)	260.4167	112.2683
	Wildlife grazing pressure	1.6667	.6370
	Cattle grazing pressure	1.6250	.7697
	Average grass height (ft)	5.5017	1.2627
1	Water distance (m)	1452.8000	675.3611
	Forest distance (m)	1456.0000	459.6919
	Wildlife grazing pressure	1.4400	.7681
	Cattle grazing pressure	3.8800	.4397
	Average grass height (ft)	4.2432	1.8300
Total	Water distance (m)	874.0816	771.3939
	Forest distance (m)	870.4082	690.1780
	Wildlife grazing pressure	1.5510	.7089
	Cattle grazing pressure	2.7755	1.2953
	Average grass height (ft)	4.8596	1.6860

Table 13 contains Wilks' lambda, the F statistic, its degrees of freedom and significance level. Wilks' lambda is the ratio of the within-groups sum of squares to the total sum of squares. The Wilks' lambda value of cattle grazing pressure and forest distance are .227 and .234 respectively. It indicates that, these acts as a strong group difference in the observation of Hodgson Bushshact. But the Wilks' lambda value of wildlife grazing pressure and average grass height (ft) which are .974 and .858 respectively which indicates no group difference in the observation and habitat use of Hodgson's Bushchat. So, due to this reason Hodgson Bushchat was only found in the Suklaphanta grassland.

Table 13: *Combined Test of Equality of group means of Barkaula and Suklaphanta grassland*

Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
Water distance (m)	.401	70.062	1	47	.000
Forest distance (m)	.234	153.436	1	47	.000
Wildlife grazing pressure	.974	1.259	1	47	.268
Cattle grazing pressure	.227	160.224	1	47	.000
Average grass height (ft)	.858	7.787	1	47	.008

The 'F' statistics indicate that average grass height (ft), water distance (m), forest distance and cattle grazing pressure has significant group difference in the observation and habitat utilization of Hodgson's Bushchat. Which may be very realistic in the case of Barkaula grassland, as it posses high cattle grazing pressure and close forest distance and availability of water.

Pooled within Group:

The pooled within-groups matrices table displays a covariance matrix. In the below table it is found that cattle grazing pressure and wildlife grazing pressure has minimum covariance i.e. .389 and .500 in the determination of habitat use and avoid by Hodgson's Bushchat.

Table 14: *Pooled within-group Matrices of Barkaula grassland and Suklaphanta grassland*

Pooled within-Group Matrices					
	Water distance (m)	Forest distance (m)	Wildlife grazing pressure	Cattle grazing pressure	Average grass height (ft)
Covariance Water distance (m)	243993.968	5319.309	-42.783	-4.476	-444.236
Forest distance (m)	53149.309	114074.379	-27.291	-19.963	-222.264
Wildlife grazing pressure	-42.783	-27.291	.500	-7830.02	.128
Cattle grazing pressure	-4.476	-19.963	-7.830	.389	6.480
Average grass height (ft)	-444.236	-222.264	.128	-6.480	2.490

a. The covariance matrix has 47 degrees of freedom

Co-variance Matrices:

Furthermore, to screen equal variances and covariance across groups, covariance matrices were carried out. The high covariance 110232.500 is found between water distance and forest distance in bird observation. Similarly, covariance between water distance and wildlife grazing pressure is 0.870 in none observation, which in comparing to bird observation group is high. Similarly, cattle grazing pressure and water distance has high covariance in bird observation i.e. 6.600. But water distance with respect to average grass height has no any significant covariance. This indicated that there is no equal covariance between these factors and group.

Table 15: *Covariance Matrices of Barkaula grassland and Suklaphanta grassland*

Covariance Matrices[a]

Birds observed		Water distance (m)	Forest distance (m)	Wildlife grazing pressure	Cattle grazing pressure	Average grass height (ft)
0	Water distance (m)	22652.717	-6415.761	.870	-16.033	-84.302
	Forest distance (m)	-6415.761	12604.167	-18.116	-30.707	50.221
	Wildlife grazing pressure	.870	-18.116	.406	4.348E-02	-.232
	Cattle grazing pressure	-16.033	-30.707	4.348E-02	.592	-5.543E-02
	Average grass height (ft)	-84.302	50.221	-.232	-5.543E-02	1.594
1	Water distance (m)	456112.667	110232.500	-84.617	6.600	-789.172
	Forest distance (m)	110232.500	211316.667	-36.083	-9.667	-483.395
	Wildlife grazing pressure	-84.617	-36.083	.590	-.195	.473
	Cattle grazing pressure	6.600	-9.667	-.195	.193	-7.377E-02
	Average grass height (ft)	-789.172	-483.395	.473	-7.377E-02	3.349
Total	Water distance (m)	595048.618	412409.758	-110.213	675.310	-814.302
	Forest distance (m)	412409.758	476345.663	-95.855	668.219	-601.460
	Wildlife grazing pressure	-110.213	-95.855	.503	-.207	.198
	Cattle grazing pressure	675.310	668.219	-.207	1.678	-.787
	Average grass height (ft)	-814.302	-601.460	.198	-.787	2.842

a. The total covariance matrix has 48 degrees of freedom.

Box's Test Equality of covariance matrices:

In this analysis multi-group model, log determinant values provide an indication of which groups' covariance matrices differ most. For the non observed plot of Barkaula grassland log determinant is less in comparison to Suklaphanta grassland i.e. bird observed.

Box's M statistic was used to test the null hypothesis of equal population covariance matrices i.e. even the habitat component are same in the adjacent areas, it might not be used by Hodgson's Bushchat. The test result indicates the F value is .00, which is less than .10 to say it significance and accepted hypothesis of equal covariance matrices. So, it could be concluded that Hodgson's Bushchat might not use the habitat even components are same. It may be due to the assumption of multivariate normality of factors used in the analysis.

Table 16: *Log determinants and test results of Box's Test Equality of covariance matrices*

Log Determinants

Birds observed	Rank	Log Determinant
0	5	17.687
1	5	22.836
Pooled within-groups	5	22.644

Test Results

Box's M		109.417
F	Approx.	6.454
	df1	15
	df2	8859.768
	Sig.	.000

Canoncial discriminant Function:

Eigenvalues, percentage of variance, cumulative percentage, and canonical correlations for each canonical variable (or canonical discriminant function) is displayed in below table. It showed there is strong canonical correlation between the bird observation and habitat components.

Table 17: *Eigenvalues of discriminant function*

Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	9.250[a]	100.0	100.0	.950

a. First 1 canonical discriminant functions were used in the analysis.

Whereas, in the Wilks' lambda value is .098 which indicates that the bird observation and or habitat used is significantly differs even if the habitat composition/factor are similar.

Table 18: *Wilks' lalmda value*

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.098	103.562	5	.000

Standardized Discriminant function:

As the different variables were measured in different units, the magnitude of an unstandardized coefficient provides little indication of the relative contribution of the variable to the overall discrimination. So, the coefficients were standardized to allow examine the relative standing of the measurements, which is given below.

Table 19: *Standardized Canoncial discriminant function coefficients and structure matrix*

Standardized Canoncial Discriminant Function Coefficients	*Structure Matrix*
Function/ 1	**Function/1**
Water distance (m)	.465	.401
Forest distance (m)	.729	.594
Wildlife grazing pressure	.165	-.054
Cattle grazing pressure	.743	.607
Average grass height (ft)	.466	-.134

This structure matrix of different variable showed, that cattle grazing pressure, forest distance and water distance as an absolute correlation in discriminating the variable of the habitat by Hodgson's Bushchat.

This below table displays the prior probabilities for birds habitat use either in Barkaula grassland or in Suklaphanta grassland. A prior probability estimates the likelihood of that bird may have equal probability of using both habitat types.

Table 20: *Prior probabilities of Barkuala grassland and Suklaphanta grassland*

Prior Probabilities for Groups

Birds observed	Prior	Cases Used in Analysis	
		Unweighted	Weighted
0	.500	24	24.000
1	.500	25	25.000
Total	1.00	49	49.000

Classification Function Coefficients: Fisher's linear discriminant function was used to estimate the classification function of Barkaula grassland (0) and Suklaphanta grassland (1).

Table 21: *Classification function coefficient*

	Birds observed	
	0	1
Water distance (m)	7.994-03	1.361-02
Forest distance (m)	9.311-03	2.218-02
Wildlife grazing pressure	4.398	5.791
Cattle grazing pressure	6.373	13.474
Average grass height (ft)	4.406	6.164
(Constant)	-23.953	-70.110

5.8 Existing threats

5.8.1 Habitat loss

The main reason to loss habitat is vegetation succession and invasion in SWR. Vegetation succession is playing a critical role in habitat loss. Some patches of Suklaphanta grassland are invaded by trees and shrubs. It is becoming a major issue for Suklaphanta. The photo plate of invasion that was taken from Suklaphanta is attached at the annex.

5.8.2 Thatch harvesting

During the winter season of every year, the park manager gives permission to local people to collect thatch from the reserve area that creates huge pressure on the Suklaphanta because there is a lot of thatch grass. As a result, there is such high concentration of people that it creates great disturbances for the grass birds, small mammals and reptiles. The huge pressure of the people may enforce to move in new area from that area. Over population at the certain place may create trampling effect which may change species composition also.

5.8.3 Burning and cutting of grasses

Controlled burning is in practice but it has not been done carefully; these intensive annual cutting and burning of grassland are likely to alter their species composition, which is an effect still poorly understood. This may cause change in succession stage.

The recent management trend shows that firing of other Phantas like Arjuni, Barkaula and Haris Phanta but due to various limitations it has not been done continuously.

5.8.4 Grazing

There is no pressure of domestic animals for grazing in proper Suklaphanta. But the periphery or other areas have maximum pressure of domestic animals for grazing. As a result the wild animals don't move towards other parts and have to concentrate in Suklaphanta.

5.8.5 Flooding

In the Suklaphanta, the Mahakali River has created major effect on the habitat of Hodgson's Bushchat. The grass height was very different in the Suklaphanta area in 2006 due to over flooding than in 2005 study. One small branch of Mahakali River is going to enter towards the Suklaphanta, if it is not controlled at the time it may loss the Suklaphanta and the habitat of Hodgson's Bushchat also.

CHAPTER-SIX: CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The line transect count was adopted as the main method for surveying the grassland bird populations. A total of 19 Hodgson's Bushchat (19=17M+2F) were recorded in Suklaphanta Wildlife Reserve on Jan, 2005, (after the grass burning). The Population density of Hodgson's Bushchat was 5.53/km2, potential habitat-8km2 and estimated number-44.While the second time survey was conducted on Suklaphanta Wildlife Reserve before the grass burning on Jan, 2006. The Population density of Hodgson's Bushchat was 3.97/km2, potential habitat-8km2 and estimated number-32.

The population of Hodgson's Bushchat is very less in the case of before burning of grass in winter comparatively than that of the after burning of grass in winter. It is concluded that the grass burning at the time in winter play great role in maintaining good habitat for the Hodgson's Bushchat.

The population of Hodgson's Bushchat is relatively less in 2005 (after burning of grass) than that in the survey of Baral, 1997 (after burning of grass). The trend of loss of Hodgson's Bushchat shows that it is little bit constant. There has not been drastic change in population since 1997. It shows that the certain area of Suklaphanta is still good for Bushchat's stay in winter.

The distribution of Hodgson's Bushchat in the SWR is more in the southwest and a little has in southeast in Suklaphanta. In Suklaphanta Wildlife Reserve, its distribution is restricted to Suklaphanta grassland only.

In this research we found that the preferred area (Suklaphanta) and avoided area (Barkaula area) of the grassland composition was almost the same but on the basis of RF (%) and RD (%) of grasses it is concluded that the Hodgson's Bushchat preferred mostly Siru (*Imperata cylindrica*), Narenga (*Narenga porphyrocoma*) and Kans (*Saccharum spontaneum*) habitat respectively which supports the most preferred grass species as compared to the other grass species.

Plot condition like, partially burnt/unburnt has influential co-relationship in the Hodgson's Bushchat observation than others. The common average height of perching by Bushchat after burning and before burning was 5 ft. and 4-7 ft. respectively. The analysis of habitat use after the burning and before the burning of Suklaphanta grassland indicates that the grass height makes a little deviation in the habitat use and their observation, which is more prone by the cattle grazing pressure. Even the habitat component do not reveal vary in their composition, the habitat use and avoid by Bushchat is primarily directed by cattle grazing pressures and wildlife grazing pressure. Cattle

grazing pressure, forest distance and water distance acted as an absolute correlation in discriminating the variable of the habitat by Hodgson's Bushchat in Suklaphanta wildlife reserve.

Thatch harvesting, habitat loss, grazing, flooding and burning and cutting of grasses are the major issues in the Suklaphanta. Knowledge of identification of this bird and other globally threatened birds and awareness of their global importance and conservation value are lacking among reserve staff and local inhabitants.

6.2 Recommendation

- High grazing pressure decreases the vegetation composition. So, illegal entrance of domestic animals should be controlled.
- Protect regeneration from fire and grazing to recover grasses.
- Increase patrolling to control grazing.
- Organize interaction program with local communities to discuss grazing problem and to generate their support.
- Much attention should be given during grass burning because improper annual burning occurred at some places.
- Establishment of seasonal fire fighting units is necessary for the reserve.
- Improve management of grasslands in the buffer zone. This will also help decrease pressure from the reserve grassland and Forest.
- Awareness program on importance of wetland and birds is needed for students as well as other villagers.
- Baseline survey should be done at fixed intervals through Department of National Parks and Wildlife Conservation and SWR.
- Establishment of monitoring plots in the Phantas is required.
- As *imperata cylindrica* dominated grassland and succeeded to tall grassland or forest because of disturbance through grazing, cutting and burning, research and active management will be necessary if assemblage is to be maintained.
- Short grasslands are succeeding into shrub-land, woodland.
- The existing ecological information on the faunal diversity of the reserve is limited. Therefore, it may be inferred that existing management activities are difficult to discern their effectiveness in the absence of ecological information. The reserve staff needs to be trained in research, monitoring, evaluation and documentation.
- It is believed that monitoring is a tool to measure management quality and quantities of on going activities.
- The manager of Suklaphanta should map out the globally threatened species on the Suklaphanta map and should carefully consider them before conducting any kind of activities in that area.
- Some parts of Suklaphanta should be restricted for thatch collection.

- It New grassland should be created in the extended area of park especially Lalpani area of Rauteli Bichuwa-VDC. It should be good a habitat for many kinds of birds and mammals.
- The ecological study of Hodgson's Bushchat is recommended for future study.
- The analysis of the ratio of changing in vegetation succession and grass land composition in Suklaphanta is recommended for future study in detailed.

REFERENCES

Ali, S. and Ripley, S. D. (1987) Compact handbook of the birds of India and Pakistan. Second edition. Bombay: Oxford University Press.

Anon, 1992- NBWC Newsletter. Vol. 1, No. 3.

Bhatta, D.D and Shrestha, T.K.1977. The environment of Suklaphanta.T.U, Kathmandu, Nepal.

Bhatta, N.1999. Impact of burning and grazing on vegetation composition and above ground biomass production in Mangalsera Grassland of RSWR, Nepal, M.Sc. Thesis,T.U.

Baral, H. S.(1997) Birds recorded during grassland bird survey, Sukila Phanta, December 1996-January 1997.Unpublished.

Baral, H. S., Inskipp, C., Inskipp, T.P., Regmi, U.R. (1996): Threatened Birds of Nepal. Kathmandu: Bird Conservation Nepal & Department of National Parks and Wildlife Conservation.

Baral, H.S. (1998) - A study of globally Threatended Hodgson's Brshchat in lowland Nepal.

Birdlife International 2006. Species factsheet: Saxicola insignis. Downloaded from http://www.birdlife.org on 26/2/2007

Birdlife International 2006. Birdlife species factsheet: Saxicola insignis. Retrieved from http://en.wikipedia.org/wiki/Hodgson's on 28/2/2007.

Blyth, E. (1847). Notices and descriptions of various new or little known species of birds. J. Asiatic Soc. Bengal 16: 117-157, 428-476.

Collar, N. J., Crosby, M.J. and Stattersfield, A. J. (1994) Birds to watch: the world list of threatened birds. Cambridge: BirdLife International.

Fleming, R. L. Sr., Fleming, R.L. Jr. and Bangdel, L.S. (1984) Birds of Nepal. Third edition, Kathmandu: Nature Himalayas.

Gray, J.E. and Gray, G. R. (1846) Catalogue of the specimens and drawings of Mammalia and birds of Nepal and Thibet, Presented by B. H. Hodgson, Esq. to the British Museum. London.

Grimmett, R., Inskipp, C. and Inskipp, T. (1998) Birds of the Indian subcontinent. London: Christopher Helm.

Gyawali, N. 2003. Status and Habitat Use of Barasingha *Cervus duvauceli duvauceli* population in royal Suklaphanta Wildlife Reserve, Far Western Lowland, Nepal. B.Sc.Forestry Thesis.T.U, Nepal.

Hume, A. O. (1877a) Notes. Stray Feathers 5:117-140.

Hume, A. O. (1877b) Notes. Stray Feathers 5:495-502.

Hume, A. O. (1878a) Notes. Stray Feathers 7:451-465.

Hume, A. O. (1878b) Notes. Stray Feathers 7:516-523.

Hume, A. O. (1880a) Additional notes on some of our Indian stonechats. Stray Feathers 9: 133-137.

Hume, A. O. (1880b) Notes. Stray Feathers 9:505-507.

Inglis, C. M. (1901). The birds of the Madhubani subdivision of the Darbhanga district, Tirhut, with notes on species noticed elsewhere in the district. J. Bombay Nat. Hist. Soc. 14:132-139.

Inskipp, C. and Inskipp, T. P. (1991) A guide to the birds of Nepal. Second edition. London: Christopher Helm.

Knystautas, 1993, Birds of Russia. London: Harper Collins.

Mc Gowan, P.J.K.; Dowell, S.D.; Carroll, J.P. and Aebischer, N.J. (1995): Status Survey and Conservation Action Plan 1995-1999: Partridges, Quails, Francolins, Snowcocks and Guineafowl. IUCN and WPA, Switzerland & UK.

Ripley, S.D. (1982) A synopsis of the birds of India and Pakistan. Bombay: Bombay Natural History Society.

Sharma, P., Barua, M. and Menon, V. (1997) Orange-billed Jungle Myna and Hodgson's Bushchat in Kaziranga National Park. J. Bombay Nat. Hist. Soc. 94: 156-157.

SWR, 2003**.** Royal Suklaphanta Wildlife Reserve Management Plan. DNPWC, Nepal.

Vaurie, C. (1959). The birds of the Palearctic fauna. Passeriformes.

Whistler, H. (1922) Unpublished manuscript in British Museum.

ANNEXES

Annex-1: Data Sheet for Bird Census and Habitat preferences

Name of data collector:-
Study area:-
Site:-
Transect no.:-
Plot no.
Date:-
Start time:-
End time:-
Soil moisture:-dry/moist/wet
Grass composition:-
Cattle grazing/Wild grazing:-heavy/moderate/low/no
Uncut (%):-
Unburned (%):-

Block/plot	GPS point	Left or Right from transects (Perp.dist.)	Birds(sex)	N0.	Habitat/name of grass	Grass Height	Near forest	Near water	Remarks

Annex 2: Frequency, Relative Frequency, Density and Relative Density of Barkaula and Suklaphanta grassland

Barkaula Area					
Name of Grass	N0.	Frequency	R.F (%)	Density	R.D (%)
Siru	360	37.5	10.22	15000	9.14
Kans	174	37.5	10.22	7250	4.42
Narenga	1890	91.66	25	78750	48.01
Paniu	567	45.83	12.5	23625	14.4
Munj	14	12.5	3.4	583.33	0.35
Shivbagan	290	29.16	7.95	12083.33	7.36
Dhadi	29	8.33	2.27	1208.33	0.73
Dubo	358	25	6.81	14916.66	9.09
Pharsa	50	16.66	4.54	2083.33	1.27
lemon grass	19	12.5	3.4	791.66	0.48
Barni	160	41.66	11.36	6666.66	4.06
Kuro	10	4.16	1.13	416.66	0.25
Jhadu grass	15	4.16	1.13	625	0.38
	3936	366.62	99.93		99.94

Suklaphanta Area					
Name of Grass	N0.	frequency	R.F (%)	Density	R.D (%)
Siru	3212	67.92	25	60603.77	42.25
Kans	1398	56.6	20.83	26377.35	18.38
Narenga	1760	64.15	23.61	33207.54	23.15
Paniu	560	11.32	4.16	10566.03	7.36
Munj	142	20.75	7.63	2679.24	1.86
Shivbagan	417	32.07	11.8	7867.92	5.48
Dhadi	50	5.66	2.08	943.39	0.65
Dubo	26	1.88	0.69	490.56	0.34
Sunaphool	23	5.66	2.08	433.96	0.3
Pharsa	6	1.88	0.69	113.2	0.07
Lemon grass	8	3.77	1.38	150.94	0.1
Total	7602	271.66	99.95		99.94

Annex 3: A Checklist of birds of Suklaphanta Wildlife Reserve

	Common Name	Scientific Name
1	Black Francolin	*Francolinus francolinus*
2	Grey Francolin	*Francolinus pondicerianus*
3	Swamp Francolin	*Francolinus gularis*
4	Red Junglefowl	*Gallus gallus*
5	Kalij Pheasant	*Lophura leucomelanos*
6	Indian Peafowl	*Pavo cristatus*
7	Small Buttonquail	*Turnix sylvatica*
8	Barred Buttonquail	*Turnix suscitator*
9	Bar-headed Goose	*Anser indicus*
10	Ruddy Shelduck	*Tadorna ferruginea*
11	Comb Duck	*Sarkidiornis melanotos*
12	Lesser Whistling-duck	*Dendrocygna javanica*
13	Spot-billed Duck	*Anas poecilorhyncha*
14	Garganey	*Anas querquedula*
15	Ferruginous Pochard	*Aythya nyroca*
16	Gadwall	*Anas strepera*
17	Falcated Duck	*Anas falcata*
18	Eurasian Wigeon	*Anas penelope*
19	Mallard	*Anas platyrhynchos*
20	Cotton Pygmy-goose	*Nettapus coromandelianus*
21	Common Teal	*Anas crecca*
22	Northern Pintail	*Anas acuta*
23	Northern Shoveler	*Anas clypeata*
24	Red-crested Pochard	*Rhodonessa rufina*
25	Common Pochard	*Aythya ferina*
26	Common Merganser	*Mergus merganser*
27	Rufous Woodpecker	*Celeus brachyurus*
28	Great Slaty Woodpecker	*Mulleripicus pulverulentus*
29	Brown-capped Pygmy Woodpecker	*Dendrocopos nanus*
30	Grey-capped Pygmy Woodpecker	*Dendrocopos canicapillus*
31	Yellow-crowned Woodpecker	*Dendrocopos mahrattensis*
32	Lesser Yellownape	*Picus chlorolophus*
33	Bay Woodpecker	*Blythipicus pyrrhotis*
34	Streak-throated Woodpecker	*Picus xanthopygaeus*
35	Grey-headed Woodpecker	*Picus canus*
36	Himalayan Flameback	*Dinopium shorii*
37	Black-rumped Flameback	*Dinopium benghalense*
38	Greater Flameback	*Chrysocolaptes lucidus*
39	White-naped Woodpecker	*Chrysocolaptes festivus*
40	Brown-headed Barbet	*Megalaima zeylanica*

41	Lineated Barbet	*Megalaima lineata*
42	Coppersmith Barbet	*Megalaima haemacephala*
43	Indian Grey Hornbill	*Ocyceros birostris*
44	Oriental Pied Hornbill	*Anthracoceros albirostris*
45	Common Hoopoe	*Upupa epops*
46	Indian Roller	*Coracias benghalensis*
47	Blue-bearded Bee-eater	*Nyctyornis athertoni*
48	Green Bee-eater	*Merops orientalis*
49	Blue-tailed Bee-eater	*Merops philippinus*
50	Chestnut-headed Bee-eater	*Merops leschenaulti*
51	Common Kingfisher	*Alcedo atthis*
52	Stork-billed Kingfisher	*Halcyon capensis*
53	White-throated Kingfisher	*Halcyon smyrnensis*
54	Pied Kingfisher	*Ceryle rudis*
55	Common Hawk Cuckoo	*Hierococcyx varius*
56	Indian Cuckoo	*Cuculus micropterus*
57	Eurasian Cuckoo	*Cuculus canorus*
58	Dollarbird	*Eurystomus orientalis*
59	Pied Cuckoo	*Clamator jacobinus*
60	Asian Koel	*Eudynamys scolopacea*
61	Green-billed Malkoha	*Phaenicophaeus tristis*
62	Sirkeer Malkoha	*Phaenicophaeus leschenaultii*
63	Greater Coucal	*Centropus sinensis*
64	Lesser Coucal	*Centropus bengalensis*
65	Alexandrine Parakeet	*Psittacula eupatria*
66	Rose-ringed Parakeet	*Psittacula krameri*
67	Plum-headed Parakeet	*Psittacula cyanocephala*
68	Red-breasted Parakeet	*Psittacula alexandri*
69	White-rumped Needletail	*Zoonavena sylvatica*
70	Silver-backed Needletail	*Hirundapus cochinchinensis*
71	Asian Palm Swift	*Cypsiurus balasiensis*
72	Alpine Swift	*Tachymarptis melba*
73	House Swift	*Apus affinis*
74	Crested Treeswift	*Hemiprocne coronata*
75	Grass Owl	*Tyto capensis*
76	Oriental Scops Owl	*Otus sunia*
77	Collared Scops Owl	*Otus bakkamoena*
78	Brown Fish Owl	*Ketupa zeylonensis*
79	Brown Hawk Owl	*Ninox scutulata*
80	Eurasian Eagle Owl	*Bubo bubo*
81	Asian Barred Owlet	*Glaucidium cuculoides*
82	Jungle Owlet	*Glaucidium radiatum*
83	Spotted Owlet	*Athene brama*
84	Large-tailed Nightjar	*Caprimulgus macrurus*
85	Savanna Nightjar	*Caprimulgus affinis*

86	Indian Nightjar	*Caprimulgus asiaticus*
87	Rock Pigeon	*Columba livia*
88	Oriental Turtle Dove	*Streptopelia orientalis*
89	Laughing Dove	*Streptopelia senegalensis*
90	Spotted Dove	*Streptopelia chinensis*
91	Red Collared Dove	*Streptopelia tranquebarica*
92	Eurasian Collared Dove	*Streptopelia decaocto*
93	Emerald Dove	*Chalcophaps indica*
94	Orange-breasted Green Pigeon	*Treron bicincta*
95	Yellow-footed Green Pigeon	*Treron phoenicoptera*
96	Bengal Florican	*Houbaropsis bengalensis*
97	Demoiselle Crane	*Grus virgo*
98	Sarus Crane	*Grus antigone*
99	Brown Crake	*Amaurornis akool*
100	White-breasted Waterhen	*Amaurornis phoenicurus*
101	Ruddy-breasted Crake	*Porzana fusca*
102	Purple Swamphen	*Porphyrio porphyrio*
103	Common Moorhen	*Gallinula chloropus*
104	Common Coot	*Fulica atra*
105	Pintail Snipe	*Gallinago stenura*
106	Common Snipe	*Gallinago gallinago*
107	Marsh Sandpiper	*Tringa stagnatilis*
108	Ruff	*Philomachus pugnax*
109	Greater Painted-snipe	*Rostratula benghalensis*
110	Spotted Redshank	*Tringa erythropus*
111	Common Redshank	*Tringa tetanus*
112	Common Greenshank	*Tringa nebularia*
113	Green Sandpiper	*Tringa ochropus*
114	Wood Sandpiper	*Tringa glareola*
115	Common Sandpiper	*Actitis hypoleucos*
116	Temminck's Stint	*Calidris temminckii*
117	Long-toed Stint	*Calidris subminuta*
118	Eurasian Thick-knee	*Burhinus oedicnemus*
119	Great Thick-knee	*Esacus recurvirostris*
120	Pheasant-tailed Jacana	*Hydrophasianus chirurgus*
121	Bronze-winged Jacana	*Metopidius indicus*
122	Black-winged Stilt	*Himantopus himantopus*
123	Yellow-wattled Lapwing	*Vanellus malarbaricus*
124	Little Ringed Plover	*Charadrius dubius*
125	Lesser Sand Plover	*Charadrius mongolus*
126	Small Pratincole	*Glareola lacteal*
127	River Lapwing	*Vanellus duvaucelii*
128	Northern Lapwing	*Vanellus vanellus*
129	Red-wattled Lapwing	*Vanellus indicus*
130	River Tern	*Sterna aurantia*

131	Black-bellied Tern	*Sterna acuticauda*
132	Pallas's Gull	*Larus ichthyaetus*
133	Little Tern	*Sterna albifrons*
134	Osprey	*Pandion haliaetus*
135	Black-shouldered Kite	*Elanus caeruleus*
136	Black Kite	*Milvus migrans*
137	Grey-headed Fish Eagle	*Ichthyophaga ichthyaetus*
138	Egyptian Vulture	*Neophron percnopterus*
139	White-rumped Vulture	*Gyps bengalensis*
140	Long-billed Vulture	*Gyps indicus*
141	Slender-billed Vulture	*Gyps tenuirostris*
142	Eurasian Griffon	*Gyps fulvus*
143	Cinereous Vulture	*Aegypius monachus*
144	Red-headed Vulture	*Sarcogyps calvus*
145	Brahminy Kite	*Haliastur Indus*
146	Pallas's Fish Eagle	*Haliaeetus leucoryphus*
147	Lesser Fish Eagle	*Ichthyophaga humilis*
148	Pied Harrier	*Circus melanoleucos*
149	Tawny Eagle	*Aquila rapax*
150	Crested Serpent Eagle	*Spilornis cheela*
151	Eurasian Marsh Harrier	*Circus aeruginosus*
152	Hen Harrier	*Circus cyaneus*
153	Shikra	*Accipiter badius*
154	Eurasian Sparrowhawk	*Accipiter nisus*
155	Oriental Honey-buzzard	*Pernis ptilorhyncus*
156	White-eyed Buzzard	*Butastur teesa*
157	Long-legged Buzzard	*Buteo rufinus*
158	Booted Eagle	*Hieraaetus pennatus*
159	Changeable Hawk Eagle	*Spizaetus cirrhatus*
160	Mountain Hawk Eagle	*Spizaetus nipalensis*
161	Common Kestrel	*Falco tinnunculus*
162	Red-necked Falcon	*Falco chicquera*
163	Peregrine Falcon	*Falco peregrinus*
164	Little Grebe	*Tachybaptus ruficollis*
165	Great Crested Grebe	*Podiceps cristatus*
166	Darter	*Anhinga melanogaster*
167	Little Cormorant	*Phalacrocorax niger*
168	Great Cormorant	*Phalacrocorax carbo*
169	Little Egret	*Egretta garzetta*
170	Great Egret	*Casmerodius albus*
171	Intermediate Egret	*Mesophoyx intermedia*
172	Cattle Egret	*Bubulcus ibis*
173	Grey Heron	*Ardea cinerea*
174	Purple Heron	*Ardea purpurea*
175	Indian Pond Heron	*Ardeola grayii*

176	Black-crowned Night Heron	*Nycticorax nycticorax*
177	Little Heron	*Butorides striatus*
178	Black Bittern	*Dupetor flavicollis*
179	Yellow Bittern	*Ixobrychus sinensis*
180	Cinnamon Bittern	*Ixobrychus cinnamomeus*
181	Black-headed Ibis	*Threskiornis melanocephalus*
182	Black Ibis	*Pseudibis papillosa*
183	Asian Openbill	*Anastomus oscitans*
184	Woolly-necked Stork	*Ciconia episcopus*
185	Black Stork	*Ciconia nigra*
186	Lesser Adjutant	*Leptoptilos javanicus*
187	Painted Stork	*Mycteria leucocephala*
188	Black-necked Stork	*Ephippiorhynchus asiaticus*
189	Indian Pitta	*Pitta brachyura*
190	Golden-fronted Leafbird	*Chloropsis aurifrons*
191	Brown Shrike	*Lanius cristatus*
192	Bay-backed Shrike	*Lanius vittatus*
193	Long-tailed Shrike	*Lanius schach*
194	Grey-backed Shrike	*Lanius tephronotus*
195	Red-billed Blue Magpie	*Urocissa erythrorhyncha*
196	Rufous Treepie	*Dendrocitta vagabunda*
197	House Crow	*Corvus splendens*
198	Large-billed Crow	*Corvus macrorhynchos*
199	Eurasian Golden Oriole	*Oriolus oriolus*
200	Black-hooded Oriole	*Oriolus xanthornus*
201	Large Cuckooshrike	*Coracina macei*
202	Black-winged Cuckooshrike	*Coracina melaschistos*
203	Black-headed Cuckooshrike	*Coracina melanoptera*
204	Long-tailed Minivet	*Pericrocotus ethologus*
205	Rosy Minivet	*Pericrocotus roseus*
206	Small Minivet	*Pericrocotus cinnamomeus*
207	Scarlet Minivet	*Pericrocotus flammeus*
208	Bar-winged Flycatcher-shrike	*Hemipus picatus*
209	White-throated Fantail	*Rhipidura albicollis*
210	White-browed Fantail	*Rhipidura aureola*
211	Black Drongo	*Dicrurus macrocercus*
212	Ashy Drongo	*Dicrurus leucophaeus*
213	White-bellied Drongo	*Dicrurus caerulescens*
214	Crow-billed Drongo	*Dicrurus annectans*
215	Spangled Drongo	*Dicrurus hottentottus*
216	Greater Racket-tailed Drongo	*Dicrurus paradiseus*
217	Black-naped Monarch	*Hypothymis azurea*
218	Asian Paradise-flycatcher	*Terpsiphone paradisi*
219	Common Iora	*Aegithina tiphia*
220	Large Woodshrike	*Tephrodornis gularis*

221	Common Woodshrike	*Tephrodornis pondicerianus*
222	Blue-capped Rock Thrush	*Monticola cinclorhynchus*
223	Blue Rock Thrush	*Monticola solitarius*
224	Blue Whistling Thrush	*Myophonus caeruleus*
225	Orange-headed Thrush	*Zoothera citrina*
226	Tickell's Thrush	*Turdus unicolor*
227	Dark-throated Thrush	*Turdus ruficollis*
228	Asian Brown Flycatcher	*Muscicapa dauurica*
229	Rusty-tailed Flycatcher	*Muscicapa ruficauda*
230	Rufous-gorgeted Flycatcher	*Ficedula strophiata*
231	Red-throated Flycatcher	*Ficedula parva*
232	Slaty-blue Flycatcher	*Ficedula tricolor*
233	Verditer Flycatcher	*Eumyias thalassina*
234	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*
235	Blue-throated Flycatcher	*Cyornis rubeculoides*
236	Tickell's Blue Flycatcher	*Cyornis tickelliae*
237	Little Pied Flycatcher	*Ficedula westermanni*
238	Siberian Rubythroat	*Luscinia calliope*
239	Bluethroat	*Luscinia svecica*
240	Oriental Magpie Robin	*Copsychus saularis*
241	White-rumped Shama	*Copsychus malabaricus*
242	Indian Robin	*Saxicoloides fulicata*
243	Black Redstart	*Phoenicurus ochruros*
244	White-capped Water Redstart	*Chaimarrornis leucocephalus*
245	Black-backed Forktail	*Enicurus immaculatus*
246	Common Stonechat	*Saxicola torquata*
247	White-tailed Stonechat	*Saxicola leucura*
248	Pied Bushchat	*Saxicola caprata*
249	Jerdon's Bushchat	*Saxicola jerdoni*
250	Grey Bushchat	*Saxicola ferrea*
251	Hodgson's Bushchat	*Saxicola insignis*
252	Chestnut-tailed Starling	*Sturnus malabaricus*
253	Brahminy Starling	*Sturnus pagodarum*
254	Common Starling	*Sturnus vulgaris*
255	Asian Pied Starling	*Sturnus contra*
256	Common Myna	*Acridotheres tristis*
257	Bank Myna	*Acridotheres ginginianus*
258	Jungle Myna	*Acridotheres fuscus*
259	Chestnut-bellied Nuthatch	*Sitta castanea*
260	Great Tit	*Parus major*
261	Sand Martin	*Riparia riparia*
262	Plain Martin	*Riparia paludicola*
263	Barn Swallow	*Hirundo rustica*
264	Red-rumped Swallow	*Hirundo daurica*
265	Northern House Martin	*Delichon urbica*

266	Asian House Martin	*Delichon dasypus*
267	Nepal House Martin	*Delichon nipalensis*
268	Black-crested Bulbul	*Pycnonotus melanicterus*
269	Red-whiskered Bulbul	*Pycnonotus jocosus*
270	Himalayan Bulbul	*Pycnonotus leucogenys*
271	Red-vented Bulbul	*Pycnonotus cafer*
272	Grey-breasted Prinia	*Prinia hodgsonii*
273	Jungle Prinia	*Prinia sylvatica*
274	Yellow-bellied Prinia	*Prinia flaviventris*
275	Graceful Prinia	*Prinia gracilis*
276	Plain Prinia	*Prinia inornata*
277	Ashy Prinia	*Prinia socialis*
278	Zitting Cisticola	*Cisticola juncidis*
279	Bright-headed Cisticola	*Cisticola exilis*
280	Oriental White-eye	*Zosterops palpebrosus*
281	Common Tailorbird	*Orthotomus sutorius*
282	Pale-footed Bush Warbler	*Cettia pallidipes*
283	Chestnut-crowned Bush Warbler	*Cettia major*
284	Aberrant Bush Warbler	*Cettia flavolivacea*
285	Chinese Bush Warbler	*Bradypterus tacsanowskius*
286	Spotted Bush Warbler	*Bradypterus thoracicus*
287	Brown Bush Warbler	*Bradypterus luteoventris*
288	Lanceolated Warbler	*Locustella lanceolata*
289	Orphean Warbler	*Sylvia hortensis*
290	Paddyfield Warbler	*Acrocephalus agricola*
291	Blyth's Reed Warbler	*Acrocephalus dumetorum*
292	Clamorous Reed Warbler	*Acrocephalus stentoreus*
293	Thick-billed Warbler	*Acrocephalus aedon*
294	Moustached Warbler	*Acrocephalus melanopogon*
295	Striated Grassbird	*Megalurus palustris*
296	Rufous-rumped Grassbird	*Graminicola bengalensis*
297	Booted Warbler	*Hippolais caligata*
298	Common Chiffchaff	*Phylloscopus collybita*
299	Yellow-browed Warbler	*Phylloscopus inornatus*
300	Dusky Warbler	*Phylloscopus fuscatus*
301	Smoky Warbler	*Phylloscopus fuligiventer*
302	Tickell's Leaf Warbler	*Phylloscopus affinis*
303	Western Crowned Warbler	*Phylloscopus occipitalis*
304	Blyth's Leaf Warbler	*Phylloscopus reguloides*
305	Greenish Warbler	*Phylloscopus trochiloides*
306	Large-billed Leaf Warbler	*Phylloscopus magnirostris*
307	Golden-spectacled Warbler	*Seicercus burkii*
308	Grey-hooded Warbler	*Seicercus xanthoschistos*
309	Whistler's Warbler	*Seicercus whistleri*
310	Puff-throated Babbler	*Pellorneum ruficeps*

311	Tawny-bellied Babbler	*Dumetia hyperythra*
312	Striped Tit Babbler	*Macronous gularis*
313	Chestnut-capped Babbler	*Timalia pileata*
314	Yellow-eyed Babbler	*Chrysomma sinense*
315	Striated Babbler	*Turdoides earlei*
316	Jungle Babbler	*Turdoides striatus*
317	White-bellied Yuhina	*Yuhina zantholeuca*
318	Rufous-winged Bushlark	*Mirafra assamica*
319	Ashy-crowned Sparrow Lark	*Eremopterix grisea*
320	Rufous-tailed Lark	*Ammomanes phoenicurus*
321	Sand Lark	*Calandrella raytal*
322	Crested Lark	*Galerida cristata*
323	Oriental Skylark	*Alauda gulgula*
324	Thick-billed Flowerpecker	*Dicaeum agile*
325	Pale-billed Flowerpecker	*Dicaeum erythrorynchos*
326	Purple Sunbird	*Nectarinia asiatica*
327	Streaked Spiderhunter	*Arachnothera magna*
328	Crimson Sunbird	*Aethopyga siparaja*
329	House Sparrow	*Passer domesticus*
330	Chestnut-shouldered Petronia	*Petronia xanthocollis*
331	White Wagtail	*Motacilla alba*
332	White-browed Wagtail	*Motacilla maderaspatensis*
333	Citrine Wagtail	*Motacilla citreola*
334	Yellow Wagtail	*Motacilla flava*
335	Grey Wagtail	*Motacilla cinerea*
336	Richard's Pipit	*Anthus richardi*
337	Paddyfield Pipit	*Anthus rufulus*
338	Olive-backed Pipit	*Anthus hodgsoni*
339	Rosy Pipit	*Anthus roseatus*
340	Red Avadavat	*Amandava amandava*
341	Scaly-breasted Munia	*Lonchura punctulata*
342	Finn's Weaver	*Ploceus megarhynchus*
343	Black-breasted Weaver	*Ploceus benghalensis*
344	Streaked Weaver	*Ploceus manyar*
345	Baya Weaver	*Ploceus philippinus*
346	Yellow-breasted Greenfinch	*Carduelis spinoides*
347	Yellow-breasted Bunting	*Emberiza aureola*
348	Common Rosefinch	*Carpodacus erythrinus*
349	Crested Bunting	*Melophus lathami*

(Source: SWR, Draft Mgmt plan 2004, DNPWC and field study record)

Annex 4: Some photo plates

Photo-1.Habitat preferred by Hodgson's Bushchat in SWR.

Photo-2- Researcher watching bird

Photo-3- Invasion of grassland

Photo-4- Grassing pressure

Photo-5- Burning of grassland

Photo-6- Team member

Photo-7- Researcher identifying grass

Photo-8- Cervus duvauceli herd in SWR