CHAPTER-ONE

INTRODUCTION

1.1. BACKGROUND

Nepal covers an area of about 14 million ha. And lies in between latitudes 26^0 20' and 30^0 10' N and longitudes 80^0 15' and 88^0 15' E. Entire country lies in the sub-tropical zone but a wide variety of climatic conditions exist due to latitudinal variation and topography. Climate is mostly sub-tropical.

All Geomorphic and Climatic variations are reflected in the diversification of floristic composition, faunal representation and cultural heritage of the people. This tiny country harbours wide range of avian, aquatic and terrestrial fauna and flora of the world representing 4% of all animals, 8% of all birds and 2% of all flowering plants. About 40% of Nepal is forested. 35 distinct forest types fosters more than 6,500 plants species among these 245 species that are endemic to Nepal and more than 700 species are used in for medicinal purposes. This diverse condition provides excellent habitat for 175 species of mammals, 850 species of birds, 600 species of butterflies, 180 dragonflies and 170 species of fishes in the various reserves and National Parks of the country (Biodiversity conservation in Nepal program, NEP/92/G31).

The country's first National Park has over seven types of forests, six types of grasslands, three main river systems, a number of ox-bow lakes and wetlands, which support 50 species of mammals, 526 species of birds, 49 species of reptiles and amphibians and 120 species of fishes. The floral diversity of the park consists of more than 600 plant species, which include 3 Gymnosperm, 13 Pteridophytes, 415 Dicotyledons, 137 monocot and 16 species of orchids. The park harbours the rare tree fern (*Cyathea spinosa*), Cycas (*Cycas pectinata*), and screw pine (*Pandarus furcatus*) (Royal Chitwan National Park and buffer zone management plan 2001-2005).

Deer are considered to be one of the beautiful wildlife gifts of nature. Wildlife means all non-domesticated animals that live in wild, including mammals, birds and fishes, which may be hunted and captured as controlled by law. The definition of wildlife was first time included in the third edition of Webster's dictionary commonly used in America as "living things that are neither human nor domesticated, especially mammals, birds and fishes hunted by man". But the twelfth edition of oxford dictionary defined wildlife as "the flora and fauna of a particular region". Thus, for English people, wildlife includes all plant and animal, while in America wildlife is considered as only animals, which are hunted, mainly animals with backbone. WWF and National Audubon Society (NAS) defined wildlife to include all biota. In simple terms, wildlife may be defined as all forms of life that are wild i.e. all animals and plants that are neither domesticated nor cultivated. Wildlife is fully renewable natural resources and it is the major part of our living ecosystem.

After the successful eradication of malaria about one hundred thousand people migrated from the hills and settled in the fertile areas of the Chitwan valley. The wildlife and wildlife habitats were decreased due to the new settlements, expansion of agricultural land and heavy poaching (Milton and Binney, 1980). About 1,04,000 ha of forest in Siwalik and Terai were cleared during 1950 to 1985 under the resettlement program. The rate of species extinction is sharply increased due to self-centered and indiscriminate activities of modern man. The main causes of extermination of wild species by man include over hunting and killing for amusement, wildlife trade for meat, fur, feather, trophies etc., and competition with domestic and exotic animals, diseases and insecticides. Therefore, a great number of species population drastically reduced, many species reached at the verse of extinction and many species become endangered and rare. Exploitation of irreplaceable resources and forest cover often involve fragmentation of species habitat and inevitably this leads reduction in the population of species resulting in the loss of genetic diversity.

Deforestation is a major problem and causes declining of 1.3% of the total forest per annum in Nepal (Pesonen and Rautiainen, 1995). As the country has been dominated

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

by rural sectors based primarily on subsidence agriculture, which demand more land to assist the growing population, this has brought massive deforestation of Natural forest leading to environmental hazards. Of course, it is a global problem, but the problem is more serious in developing countries like Nepal due to lack of improper planning.

National parks are the protected area, established by the commission of national park and protected areas of the International Union for the Conservation of Nature and Natural resources (IUCN). According to the current definition adopted by the IUCN, NationalParks are legally designated areas wherein Natural or cultural phenomena of National significance are protected from exploitation for private gains so that they can be enjoyed by the people (Hales, 1989). National Parks have becomes representative of certain vulnerable ecosystems of the world, parks today protect vast areas of diverse natural landscapes which are significantly rich in bio-diversity.

In order to protect the increasing rate of deforestation and unique flora and fauna of this ecological belt, Chitwan National Park was established in 1973, covering 932 sq. km of area as the first National Park of the kingdom by the enforcement of National Park and wildlife Conservation Act, 1973. All human interferences on Park were restricted after establishment. The main objective to establish the National Park was to conserve wildlife habitat as well ecological balance by meeting the needs of local people and promoting tourism in a sustainable manner.

Previously the Chitwan valley was densely covered with vast natural forest and savannas. Malaria was prevalent and only an indigenous ethnic group immune to this disease-the Tharus-inhabited the jungles in relatively low numbers. Though the effects of a USAID program, malaria was finally eradicated in the early 1960's. This opened up the area for settlement. Large tracts of fertile valley were cleared and opened for agricultural production. His Majesty Government of Nepal (HMG) initiated a resettlement scheme whereby poor hill people were given land for cultivation.

Since 1846 to 1950 Rana rulers had protected this rich wildlife habitat as a Royal Hunting Reserve. The Rana regime came to end in 1950. Formally Chitwan valley was well known all over the world as one of the most famous places in Asia for wildlife. In 1962, His Majesty's Government of Nepal set aside the part of Chitwan valley, south of Rapti River as a wildlife sanctuary. Hunting was banned and armed guards; "Rhino Patrol" was established to protect the sanctuary from agricultural encroachment and Poaching. In 1973, the Sanctuary became Chitwan National Park with assistance of HMG of Nepal and other international agencies. Encroachment, Poaching and other problem brought under control very rapidly. In 1984, considering the rich wealth of flora and fauna, Chitwan National Park was included in UNESCO world heritage list. In 1996, an area of 750 sq km surrounding the park was declared a buffer zone, which consists of forest and private lands. The Park and the local people jointly initiate community development activities and manage Natural Resources in the buffer zone. Presently, Chitwan National Park is one of the most visited National Parks in Nepal and it is the biggest tourist attraction in Terai Region of Nepal due to its diverse flora and fauna, cultural attraction, folklore, religion and cross-cultural coexistence.

Wildlife needs a place to live that place is called habitat. But wildlife habitat is not just trees, shrubs, grasses or crops. It is a complex mixture of plant communities, water, weather, animals and other environmental features that provide the cover and food that wildlife need. The four basic component of the wildlife habitat are food, water, cover and space. When all components blend together, wildlife not only survives, they thrive. Removal of any one of the four and wildlife must travel to find the missing component which wildlife at risk, including vulnerability to predators, parasites, accidents and starvation. Most kinds of wildlife need cover to protect themselves from predators and, sever weather especially during cold winter and summer. A common use of cover is to escape from predators. All creatures need room to roam, and many establish territories to defend from others of their kinds, especially during the breeding season. This type of habitat requirement is called living space or simply space.

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

1.2 MORPHOLOGY

Among all the deer species, Chital (*Axis axis*) is perhaps the most beautiful of the entire world's known deer species. Their most distinctive feature is their bright rufous-brown coat, strongly spotted in white that persist throughout the life of the animals, the colour being brightest during the monsoon, and fading during the hot (dry period) and graceful antlers. Old bucks are more brownish in colour and darker. The lower series of spots on the flanks are arranged in longitudinal rows and suggest broken linear markings. The scent gland in the Chital is poorly developed and has small and compact ears, which these two characters chital can differentiate from other deer. The hinds, with their long slender neck and legs are exceptionally elegant. The Chital is a medium-sized deer standing about 35 to 38 inches high at the shoulders. A dark stripe runs down the back from the nape to the tip of the tail. The abdomen, sump, throat and the tip of the legs, tail and ears are white. Adult bucks have a dark brown, swollen neck during the rut, yearling bucks lack the prominently enlarged neck although its colour is sometimes a darker shade than that of does. One adult buck weighted 145 to 190 pounds. The first set of antlers in yearlings consists of simple spikes, usually less than 5 inches long. The graceful antlers have three tines, a long brow tine set nearly at right angles to the beam and two branch tines at the top. The outer tine, the continuation of the beam, is always longer. Male deer sheds its antlers and regrows then every year. Prater (1971) describes 2 subspecies, *Axis axis axis* on the Indian sub-continent and *Axis axis ceylonensis* found in Sri Lanka. Axis deer has also been successfully introduced to other areas like Hawaii and Texas where populations now exceed several thousand individuals (Graf and Nicholas, 1966).

1.3 ECOLOGY AND BEHAVIOUR

Chital always associates with beautiful scenery, with grassy forest glades and shaded streams. Axis deer prefers grasslands and open forest seldom penetrating into heavy jungles. Normally they rest during the hotter part of the day and move about in the early morning and late afternoon. They may become nocturnal in summer or when molested by people. The Chital, like all ungulates, spend a major portion of their life in foraging, resting and wandering within their range, but the extent of these activities is

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greatly influenced by the season. During the cool season, particularly in December and January, the chital become active at or just before sun up at about 0700 hours, when they appear at the forest's edge and begin to graze. The morning peak of feeding is between 0700 and 0830 hours. During the morning hours, between 0300 and sunup, the animals rest in the forest. As the days grows hotter the Chital spend most of the day light hours in the shade. In March some remain open until 0830 hours, but by may they go into the forest by 0700 hours, often foraging a little before lying down. Direct sunlight is avoided. The majorities of Chital do not appear in the open until about 1700 hours and then only to trudge in a listless manner to a water hole, drink and return to the forest. During the monsoon, with its great abundance of forage, the Chital spend fewer hours in grazing than at any other time of the year. The morning peak of feeding is over by 0800 hours, but instead of retreating into the forest. The species is predominantly grazers, though it occasionally browses and is found of various fallen flowers and fruits of forest trees.

The animals are gregarious usually being found in herds of 5 to 10 individuals and sometimes forming aggregations of 50 to 60 individuals. When newly shoots are emerged after cutting or burning in dry season more than 60 spotted deer are seen in one herd. Some groups contain all ages and sexes while others have only adult males or only adult females and young. Herd movements are usually led by an adult female but in social interaction male is dominant. During the mating season individual males roam about in search of oestrous females. They defend such females while courting but did not prevent other males from entering the herd, no territorial behaviour is evident.

In Axis deer, reproduction continues throughout the year, but mating peaks from March to June and most births occur in the cool season from January to May. The gestation period is 8 to 8.5 month; usually a single fawn is born, which becomes independent after 12 months. The young remain hidden in dense cover with the mother feeding nearby, until it has sufficient strength to roam with the herd. Females often attain sexual maturity at 14 to 17 months of age. Chital are prolific breeders; an interval of six months may see the production of a new family.

One of the most striking features is that Chital is always associated with entellus monkeys. In Sal forest, they commonly follow troops of langurs foraging in the treetops and clean up the young leaves, fruit, flower and shoots dropped by the wasteful monkey. Their alarm call-an abrupt, piping whistle-generally gives warning of the presence of a danger and often langur take up the alarm as well.

1.4 DISTRIBUTION

The Chital is only indigenous to Nepal, India, Bangladesh and Sri Lanka. In India, chital are found in the forests at the base of the Himalayas and practically throughout the Peninsula and Ceylon, wherever there is jungle combined with good grazing and plentiful supply of water. It is unknown in the arid plains of the Punjab, Sind etc. it is found in Assam.

In Nepal, it distributed throughout the Terai with major concentrations in Parks, reserves and forest of the eastern and southern part. They are also found in the Nagarjun and Gokarna forest of Kathmandu.

CHAPTER-TWO

STUDY AREA

2.1 LOCATION

The Chitwan National Park, (84° 20' east and 27^0 30' north) lies in the Chitwan, Nawal Parasi, Parsa and Makwanpur districts in the subtropical lowlands of the Terai in the Narayani zone, roughly sixty miles southwest of Kathamndu (fig.1). In the previous document, Area of Chitwan National Park is 932 sq. km but Present calculated area is 1182 sq. km (Resource Profile). This Park consists of Churia (Siwalik) hills, ox-bow lakes, and flood plains of Rapti, Rue and Narayani rivers. The Park is located between the Rapti River, which demarcates the Northern boundary from an intensively cultivated area, and the Nepal-India border, Rue khola and Someswar hills in the south and southwest. The Narayani River has delineated the boundary in the west. It shares its eastern border with Parsa wildlife reserve.

The main study areas are Icharni Island, Kasara and Druba. Icharni Island contains an area about 5.5 sq km. It lies southeast of Sauraha post. Rapti River has delineated the south and southwest while the Kumroj, Icharni khola and Dhumre khola has delineated the east, north and northwest border. Druba lies about 5 km south of Kasara headquarter. In the Kasara area, the Lami tal and Tamor tal are visited during the study.

2.2 CLIMATE

The climate is subtropical typically Monsoonal. There are three distinct seasons. The monsoon rainy season extends from mid-June to mid-October, the cool dry season from mid-October to mid-February and the hot dry season from mid-February to mid-June.

Ninety percent of the rainfall occurs from May through September. Rainfall pattern is unimodel. On average, there are eight consecutive dry months with less than 100 mm of rainfall and four consecutive wet months with more than 200 mm rain (Table

1). Relative humidity during the monsoon period is very high. The south-easterly winds bring heavy rainfall causing heavy flooding of rivers and streams. According to Laurie (1979), mean annual rainfall for the period 1973 to 1975 was 2411.6 mm, 92% of which fell between May and September.

In winter, the nights are damp and cold with heavy fog during early morning. Dry cool northerly winds then blow from the great Himalayas and the Tibetan plateau, reducing day temperatures until mid-February. As is usual in river valleys with very high relative humidity, heavy fog and dew occur as a common feature during nights and in the mornings at this season. Frosts occur occasionally in late December or early January.

It starts warming by mid-February. Dry hot south-westerly winds from the plains of India makes this season, extending through mid-June, the driest and hottest part of the year. Temperature normally reaches a maximum in May about 38^0 C and becomes slightly lower, but with smaller daily amplitudes, during the monsoon and falls progressively until January to about 7^0 C (Table 2).

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.
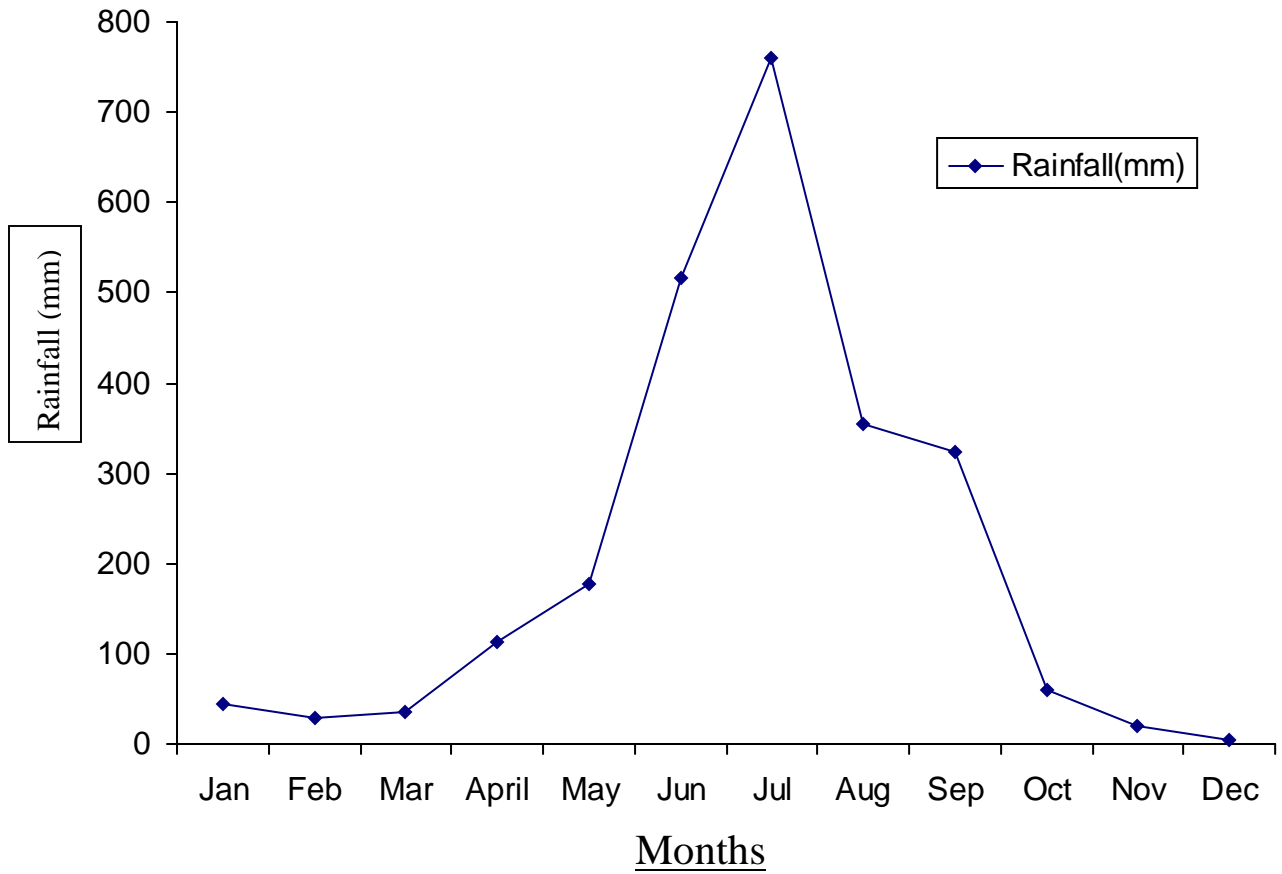
Fig.No.2. Monthly variation of Rainfall of the study area (2002-2004)

Table 1: Rainfall (mm) for RAMPUR

Year	Jan	Feb	Mar	Apr	May	Jun	JUL	AUG	SEP	OCT	NOV	DEC
2002	31.9	28.3	45.6	57.7	319.9	600.9	853.3	303.3	263.7	22.7	44.6	0.0
2003	35.1	59.4	62.0	101.0	99.9	473.2	930.0	548.9	292.2	81.1	0.0	10.7
2004	62.7	0.0	0.0	180.2	111.4	472.5	495.5	214.3	417.7	75.7	12.0	0.0

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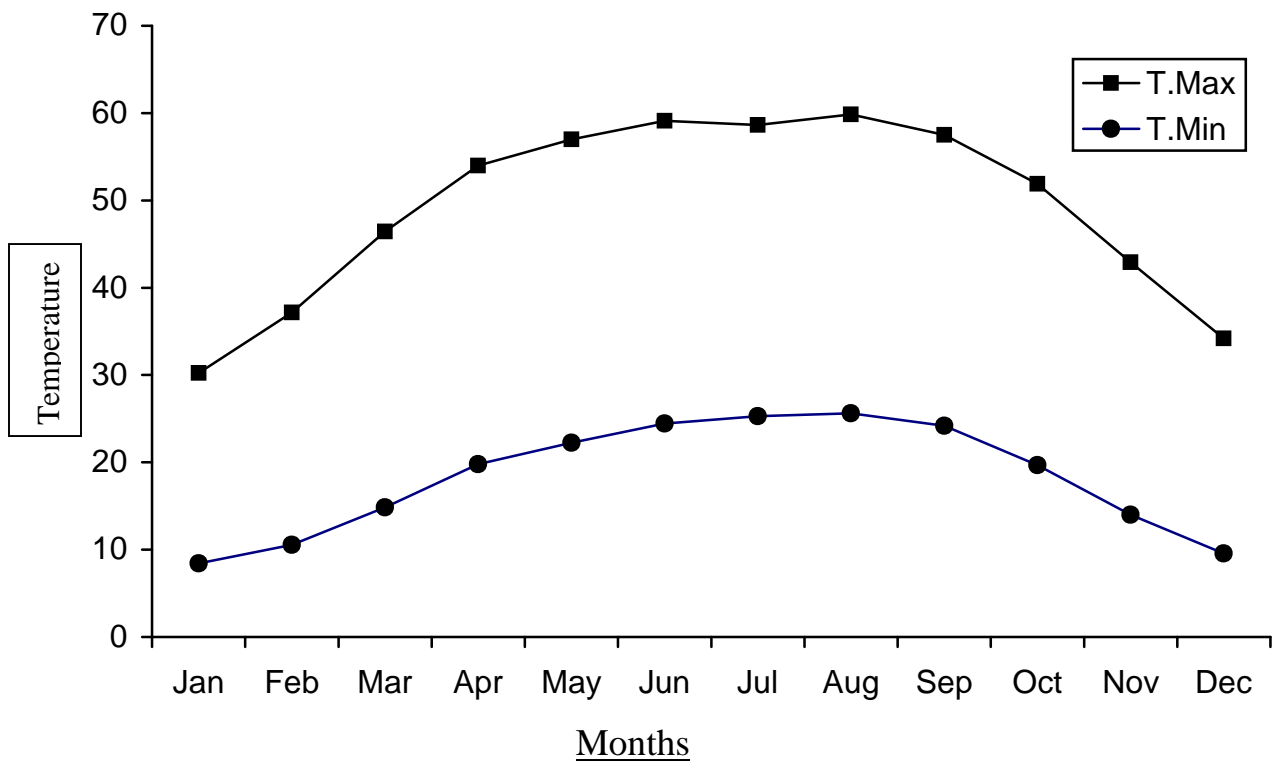
Fig.No.3 Monthly Variation of Temperature of Study Area (2002-2004)

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Table 2: Temperature (^{o}C) for Rampur

Year	Temp. 8:45-17:45	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	Max(^{o}C)	23.6	27.4	32.0	34.3	33.9	35.2	33.4	34.3	33.4	32.4	29.6	24.5
	Min(^{o}C)	8.4	10.9	14.5	19.6	22.9	24.7	25.1	25.3	23.4	19.3	13.9	9.8
2003	Max(^{o}C)	20.5	26.0	29.6	34.8	35.5	34.2	33.7	33.9	33.2	32.8	29.0	24.7
	Min(^{o}C)	7.9	10.5	14.2	19.6	21.2	24.3	25.4	25.6	24.8	20.9	15.1	9.2
2004	Max(^{o}C)	21.3	26.4	33.2	33.4	34.9	34.6	33.0	34.5	33.3	31.5	28.1	24.7
	Min(^{o}C)	9.0	10.3	15.8	20.2	22.6	24.4	25.3	25.9	24.4	18.8	13.0	9.7

▶ Source: Department of Hydrology and Meteorology, Babar-Mahal, Kathamndu.

2.3 TOPOGRAPHY

The flood plains in the park include the low-lying Riverine areas south of the Rapti River, east of the Narayani River and north of the Reu River. The south flood plain extends from the eastern park boundary to the Narayani in the west and is about 50 km long and 2 to 5 km wide. Park altitude varies from 150 m above mean sea level at the flood plain to about 800 m at the Churia ridge close to the eastern boundary. It is about 500 m at the Someswar ridge in the south-western boundary bordering India. The Churia ridge between the Rapti and Reu rivers gradually loses altitude as it extends westward and falls to the flood plain level at Sukibhar.

2.4 GEOLOGY AND SOIL

Geologically the area consists of the late tertiary Siwalik formation. The core of the Siwalik consists mainly of sandstone, conglomerates, shales and micaceous sandstones (Laurie, 1979).

The soil of Chitwan valley is an alluvial plain and terraces developed by the three main rivers – the Narayani in the north, Rapti in the south and Lotjar in the northeast. Geologically, they consist of moderately coarse to medium textured deposits underlined by the fine sand compacted gravel. The texture of the soil varies from the fine sandy loam to silty clay in irrigated low lands. Sandy loams or eroded gravelly loams are often very dark in colour in the hills (Mishra, 1982). Parent rock material is exposed on the steep portions of the Churia and Someswar range. The soil is among the most fertile for agriculture in the Nepalese Terai.

2.5 FAUNA

Chitwan National Park contains endangered mammals such as the Great one-horned rhinoceros (*Rhinoceros unicornis*), Tiger (*Panthera tigris*) Asian wild elephant (*Elaphas maximus*), Sloth bear (*Melurus ursinus*), Gaur (*Bos gaurus*) and Gangetic dolphin (*Plantanista gangetica*) and a number of species of bird such as the Giant hornbill (*Buceros bicornis*), Bengal florican (*Houbaropsis bengalensis*) and the Lesser florican. Almost about 50 species of mammals, over 526 species of birds, about 49 species of amphibians and reptiles and 120 species of fishes and many different invertebrates make the Park unique on the Indian subcontinent (Royal Chitwan National Park and Buffer Zone Management Plan, 2001-05).

Chital (*Axis axis*), Hog deer (*Axis porcinus*), Sambar (*Cervus unicolor*), Barking deer (*Muntiacus muntjak*) and Wild boar (*Sus scrofa*) are fairly abundant (Table 3) among the large mammalian fauna presently found in the Park. These five large ungulates comprise the principal prey of the tiger.

Table 3: Large mammals found in the Chitwan National Park, Nepal.

Scientific Name	Common Name
Order Primata	
Macaca mulatta	Rhesus monkey
Presbytis entellus	Common langur
Order Carnivora	
Canis aureus	Asiatic jackal
Vulpes bengalensis	Indian fox
Cuon alpinus	Indian wild dog
Melurus ursinus	Sloth bear
Lutra perspicillata	Smooth-coated Indian otter
Prinodon pardicolor	Spotted linsang
Herpestes edwardsii	Common grey mongoose
Herpestes urva	Crab-eating mongoose
Felis chaus	Jungle cat
Felis bengalensis	Leopard cat
Felis viverrina	Fishing cat
Panthera pardus	Leopard
Panthera tigris tigris	Bengal tiger
Order Proboscidea	
Elephas maximus	Asian elephant
Order Perissodactyla	
Rhinoceros unicornis	Great one-horned rhinoceros
Order Artiodactyla	
Sus scrofa	Wild boar
Muntiacus muntjak	Barking deer
Axis axis	Chital, spotted deer
Axis porcinus	Hog deer
Cervus unicolor	Sambar
Tetracerus quadricornis	Four-horned antelope,
Bos gaurus	Gaur

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| *Capricornis sumatraensis* | Serow |
| *Nemorhaedus goral* | Goral |

Order Lagomorpha

| *Lepus nigricollis* | Indian hare |

Order Rodentia

| *Hystrix indica* | Indian porcupine |

Order Cetacea

| *Plantanista gangetica* | Gangetic dolphin |

Two species of crocodiles- Gharial (*Gavialis gangeticus*) and Marsh magar (*Crocodilus palustris*) are also important members of the fauna (Mishra, 1982). Due to lack of suitable habitat, virtually no wildlife resides outside the park boundary except those Rhinos, Chitals and Wild boars that enter the agriculture fields during night to feed there. The Rose-ringed parakeet (*Psittacula krameri*) and Red munia (*Estrida amandava*) are also frequently observed during the maize and rice growing seasons.

2.6 VEGETATION

On the basis of observations on vegetative physiognomy and species composition the forest habitat has been classified into three main broad categories: Sal forest, Riverine forest and grassland (Laurie, 1979) and (Mishra, 1982).

2.6.1 SAL FOREST

Sal forest with monotypic stands of Sal (*Shorea robusta*) occupies about 70% of the park area. This species occupies the elevated and better-drained soils. Sal forest remains stable and is considered a climax or fire-climax. Sal (Shorea robusta) is the dominant species attaining a maximum height of 30m. The homogenous Sal forest is occasionally associated with a few other tree species (*Terminalia spp., Bauhinia spp., Dalbergia latifolia, Adina cardifolia, Dillenia pentagyna, Anogeissus latifolia, Mallotus philippensis, Emblica officinalis, Butea monosperma, Careya arborea, Bridelia retusa* etc.) and grass species, mainly *Themeda arundinacea, Saccharum spontaneum, Imperata cylindrica, Cymbopogon martini* and other grasses in varying densities. *Bauhinia vahlii*

and *Milletia auriculata* are common climbers found on sal trees. In the hills, scattered Phoenix, Palms are conspicuous among very sparse undergrowth, and chir Pine (*Pinus roxburghii*) occurs in the tongue extending into the sal forest in the foothills. Bamboos (*Dendrocalamus strictus*) are common on the north facing slopes of the hills.

4.6.2 RIVERINE FOREST

Riverine forest occupies an area of about 7% along the watercourses and islands in both Rapti and Narayani rivers. This type of forest is considered to be at the intermediate stage of the ecological succession. The Riverine forest further can be divided into 6 different types (Rijal 1999).

Khair-sissoo forest- A tropical deciduous type mainly found on the banks of the major rivers either mixed or pure stand of Khair (*Acacia catechu*) or Sissoo (*Dalbergia sissoo*).

Simal-Vellar forest- A deciduas type dominated by Simal (*Bombox ceiba*) and velar (*Trewia nudiflora*).

Tropical evergreen forest- occur in moist places dominated by *Albizia lucida, Magnifera indica, Ficus benjamina, Ficus roxburghii, Ficus glomerata, Ficus locor* and *Cinnamomun tamala*.

Eugenia woodland- occurs in damp places dominated by *Syzygium cumini* and *Syzygium operculata.*

Litsea-Bombax forest- A deciduous type dominated by *Litsea monopetala* and *Bombox ceiba.*

Machilus forest- A dense and broad crown forming type dominated by *Machilus duthiei*.

These trees are generally associated with understory shubs (*Murraya paniculata, M. koenigii, Callicarpa macrophilla, Clerodendron viscosum, Coffia bengalensis, Colebrookia oppositifollia*) and Herbs (*Ageratum conysoides, Euptorium odoratum* and *Oxalis corniculata*) and various types of climbers (*Acacia conicinna, Bridelia stipularia, Stipharia joponica* and *Tinospora sinensis*) are also common in the riverine forest type. Grasses are sparse except in clearings and at the forest edges where tall species such as *Vativeria zizianoides, Saccharum munja* and kans (*saccharum spontaneum*), and shorter

species, such as Dubo (*Cynodon dactylon*), *Seteria pallidefusca, Paspalidium flavidum,* and *Digiterium setigera* occur (Laurie, 1979). Pure stands of *Bombox ceiba* and sometimes in association with *Butea monosperma* and *Erythrina suberosa* are found in scattered patches in grassland giving it a savanna appearance.

2.6.3 GRASSLAND

About 18 percent of the park area is in grassland extending from the low alluvial floodplains to the elevated sal forest areas, are the most preferred habitats by most of the wildlife in the park. The Height attained by grasses is variable at different sites, being poorer on the heaver soils. Kans(*Saccharum spontaneum*), Baruwa (*Saccharum bengalensis*), Phank (*Norenga porphyracoma*), Ooreli (*Themeda arundinesia*), *Phragmitis karka*, and *Typha elephantina* are the most common perennial tall grasses. Siru (*Imperata cylindrica*), a universal weed, forms large grassland patches within the forests. This species is mainly used for roofing houses in adjacent villages. Local Tharu communities use the needlelike part of this species to make brooms. Short grasses such as Dubo, *Seteria pallidefusca, Paspalidim flavidum* and Kuro (*Chrysopogon aciculatus)* grow in the open fields. *Hydrilla verticillata*, *Ceratophyllum demerusm* and *Utricularia aurea* are common aquatic plants in the pools.

These three main habitat types are restricted now only to the park. All forests nearer to rural settlements are seriously degraded and depleted (Edson et al., 1989). Most of the Chitwan valley has been cleared for cultivation.

2.7 OBJECTIVES

This study attempts to deal with the following objectives-
1. Study of habitat in terms of vegetation, topography, water source (holes) and other things.
2. Habitat utilization of Chital in the study area.

3. Study of population status of Spotted deer.

2.8 RATIONALES OF SELECTION OF THE STUDY AREA

The main reasons for the selection of Chitwan National park as the study area were-

1. Study area is close to the residence of the dissertant so it would be easy to visit the site.
2. Due the knowledge about the forest and climate of that area, it would be helpful during the study.

2.9 LIMITATIONS OF THE STUDY

There are some limitations of the study, which are as follows.

1. The field data were collected from May to July, which was short period for the study.
2. The study was conducted by self-expenditure due to the lack of fund, which is difficult for the student.
3. At some places the fire line was considered as line transect due to the dense vegetation in forest and grassland.
4. The populations of Chital have been estimated on the basis of visual count. While counting the heads of Chital, there might have been some heads left uncounted. So, result may not be 100% accurate. But attempts have been done to remove the fault and it is anticipated that, the result will approach the accuracy.

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

CHAPTER-THREE
LITERATURE REVIEW

Mishra (1982), based on the use of habitat the deer species of Chitwan can be divided into three main groups. The hog deer is a species of grassland. In contrast the sambar and barking deer have a distinct preference for forest habitat. On the other hand the Chital (*Axis axis*) fits between these extremes using both the forest and grassland habitat and chital were often seen feeding on leaves, flowers and fruits that drops on the ground. Shrestha (1977), stated that the Chital (*Axis axis*) inhabits where there is good grazing and plentiful supply of water.

Moe (1994), have studied the distribution and movement pattern of deer in response to food quality and manipulation of grassy habitat. According to this study, Axis deer preferred burned areas compared to uncut/unburned and cut/unburned areas. Both the annual (135_-^+33 and 204^+_-38 ha$^+_-$SD for females and males respectively) and the seasonal home ranges were quite small compared with those reported in another study in Nepal. Males used larger areas than females in monsoon and in hot dry season. Mean seasonal home range size was smallest (68 ha and 110 ha for females and males respectively) in the cool dry season. The deer used riverine forest preferentially during the cool and hot dry seasons, whereas sal forest was the preferred habitat during the monsoon and in the cool part of the dry season. Females preferentially utilized grasslands at night during the hot-dry season. Males were more associated with riverine and sal forest than were females, while females used grasslands areas more than males did.

Dinerstein (1982), stated that in the Royal Bardia National Park, Nepal chital, the most common species in Bardia responded to seasonal changes in leaves and shoot development by shifting the grass and browse proportion in their diet and by relative time spent in each habitat types.

Dinerstein (1979 b), studies on habitat utilization by ungulates of Royal Karnali Bardia wildlife Reserves is covered by a rather homogeneous belt of moist sub-tropical deciduous forest, one section of reserve supported a wide variety of habitat types. In this area flood plain savannah and several Riverine forest associations integrated with stands of the dominant *Shorea robusta* forest. Free-living mammals responded to this ecological heterogenecity, permitting an analysis of habitat preferences by the species of Chital (*Axis axis*), Barking deer (*Muntiacus muntjak*), Common langur (*Presbytis entellus*) and Rhesus monkey (*Macaca mulata*). Differences in feeding and antipredator strategies offered a degree of ecological separation between most of the ungulates, change of plant distribution and phenology affected ungulates food habits, energy, movement and seasonal distribution. Chital waiting under foraging monkey troops at least 21 different trees species.

Berwick (1974), in dry tropical forest of Gir (North West India) classified the chital as primarily a browser particularly during the dry season.

Graf and Nichols (1966), Ables (1974), stated that seasonal monsoon rechanges the annual of grasslands, fir maintains a diversification in habitat structure and they observed that Chital are an animal of glades, meadow and grassland habitat.

Schaller (1967), observed in the moist semi evergreen tropical forest of Kanha (Central India), the Chital mostly utilized open meadows grazing on short grasses and chital waiting under foraging monkey troops at four different tree species and indicated that south Asian deer fed on tree leaves, flowers and fruits when accessible.

Johnsingh and Sankar (1991), on Mundanthuria Plateau, from January to July 1984, Chital (*Axis axis*) fed on 162 plant species. Contribution of various plant types (trees, shrubs, creeper/climber, herbs and grasses) to the diet of chital varied with the season. Domestic cattle (*Bos indicus*) used 90 type's food plants and the dietary overlap between the chital and cattle were 65 percent.

Raman, Menon and Sukumar (1996), the Chital population (density of 212.3/km^2 during 1991-92) in Guindy National Park, Madras, India has been increased between 1975 and 1992. Artificial feeding may be responsible for low fawn and adult mortality and thus for maintaining very high chital density. In dry and summer or pre –monsoon season, Woodland was preferred by chital and in the monsoon or wet season, the situation was reversed after the rains with chital density increasing in the shrub land and grassland. During the dry season, chital frequently ate fallen fruits (e.g. *Ficus bengalensis, Albizia lebbek, Limonia acidissima*) in the woodland. Much browsing occurred, mainly on *Radia dumetorum, Radia malabarica* and *Carissa spinarum*. Leaves of *Maytenus emarginata, Cassia roxburghii* and *Syzygium cumini*, fruits of *Phoenix laureirrii*, and the inflorescence of *Phoenix farinifera* were eaten. During summer, chital often fed on the pods of *Tamarindus indica* dropped by foraging Bonnet macaques. During the early wet season, chital were most frequently seen grazing. They ate many common grass species – *Heteropogon contortus, Cynodon dactylon, Cymbopogon flexuosus, Eragrostis Spp., Vertivera Zizanoioides,* and *Aristida setacea.*

Patel (1992), studied that Dholes (*Cuon alpinus*) hunt significantly more male than female chital. Johnsingh's (1983) study revealed that the dhole kills disproportionately more males than females of one of its prey, the Sambar (*Cervus unicolor*) but not of its prey, the Chital (*Axis axis*).

Khan, Chelon and Johnsingh (1995), stated that mean group size of Chital was 6.03$^+$5.9. The adult males to females ratio was 41: 100 females. The result agreed broadly with findings from other wildlife areas in the Indian sub-continent.

Tamang (1982), studied the relative importance of various ungulates in the tiger prey. The preference ratios were determined by species and sex. In order of the total biomass consumed, the Sambar (*Cervus unicolor*), Hog deer (*Axis porcinus*), Chital (*Axis axis*), Wild boar (*Sus scrofa*) and Barking deer (*Muntiacus muntjak*) were the principal prey. Species in the order that they evidently were preferred as prey by tiger was Sambar, Hog deer, Wild boar, Barking deer and Chital. A comparison of kill percentages

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

and availability by sex indicated males of Sambar, Chital and Wild boars were sought out as victims of tiger predation in preference to females. Numerical and biomass densities of ungulates in all vegetation types were estimated. Herd composition counts were carried out on all ungulates to determine herd size, sex and age ratios, and other prey population characteristics.

Shrestha (2004), studied the vegetation of Chitwan district. A total of 450 species of plants has been reported in Chitwan, of which three species has not been reported in any previous literatures. *Cassia alata*, *Bombusa ventricosa* and *Bombusa clavata* are the new species found in chitwan, which is new to Nepal. Altogether, 171 species of herbs, 140 types of trees, 71 species of shrubs and 54 climbers were found in this study including Ornamental or garden plants.

Balasubramanian and Bole (1993), described that spotted deer dispersed 12 species of plant seeds. Seeds of *Catunaregum spinosa (=Radia dumetorum)*, *Dichrostachys chimera, Cassia auriculata* and *Prosopis chilensis* were commonly noticed in their pellet. In Bandipur Tiger Reserve, Johnsinh (1981) observed that large-scale consumption of fruits of *Emblica officinalis* and *Xeromphis Spinosa (=Catunaregam spinosa)* by Spotted deer during the dry season.

Pokhrel (2005), studied distribution and abundance of wild ungulate in Royal Shuklaphanta wildlife Reserve. According to him, spotted deer was more abundantly distributed (2.28±2.23) among all ungulate species where as blue bull was least abundant.

Dinerstein (1979 a), mapped and described the vegetation types in the south west of the Royal Bardia National Park, which included Khauraha and Baghaura phantas. He recorded 154 Plant species including 56 trees, 20 shrubs, 45 graminoids and 33 forbs species. Pokharel (1993), studied on the grassland vegetation of Royal Bardia National Park and recorded 122 species of plants from the five phantasm of Bardia. Lamhkuhl (1989), studies on the grassland vegetation of Chitwan National Park. He found 488 species of plant from the Riverine and savannah forest.

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

CHAPTER-FOUR

METHODOLOGY

The following methods were used for the study.

Primary data collection- methods used for primary data collection were as follows:

SITE SELECTION

The Chitwan National Park was selected for the study. The study was carried out in the 3 main different areas of the park. Icharni Island, Kasara and Druba areas were extensively studied.

POPULATION DENSITY

A Line transect method as described by Eberhardt (1968) was used in the estimation of Chital density. 7 transect line were established and traversed in all vegetation types. 50m perpendicular distance was considered in either side of the transect line and the animal included in the area were counted by guide and dissertant. The line transect method in its simplest form involves an observer traversing in a straight line for some distance across the population's habitat over non-overlapping lines. The observer keeps track of the number of animals sighted, recording either perpendicular distance from the transect line or actual sighting distance and sighting angles or both.

The four most important assumptions underlie the transect sampling process are:

a) Animals directly on the transect line (0 distance) will never be missed.

b) When sighted, each animal is seen at the position it occupied when startled by the observers approach.

c) No animal is counted more than once on a given transect line.

d) The sighting of one animal is independent of the sightings of another.

VEGETATION:

The quadrate was used for the sampling of vegetation in different sites of the studied area. The quadrate was laid 10m far from the main transect line on both side alternate left and right of the line. The first quadrate was taken randomly and successive quadrate was placed 50m apart from the previous one. The size of the quadrate was determined by the minimum size quadrate method and species area curve method.

The appropriate 10m x 10m the requisite size of the quadrate was determined for tree and within each quadrate 5m x 5m sub-quadrates was laid for shrubs and saplings. The plant species having greater than 10cm cbh and 1.3m height were counted and recorded within the quadrate as trees, where as less than 10cm cbh and above knee height with woody stem considered as sapling and shrubs and the remaining are herbs and grasses. Total 233 plots of which 105 in the Riverine forest, 70 in the Sal forest and 58 plots in the grassland are studied.

Specimens of plants were collected and identified by Mr. Bal Bahadur Lama of Sauraha, a senior guide, who had also worked in King Mahendra Trust for Nature Conservation. Some plants specimens were identified in the field with the help of common names provided by the local peoples. The standard books such as Stainton and Polunin (1987), Rajbhandari (2001) and Shrestha (1998), were used for the identification of plant specimens.

HABITAT PREFERENCE:

The habitat analysis was examined by the faecal pellets observations through the line-plot transect method (Wegge, 1976). Observations were collected along the seven transect lines of different lengths. The fire lines were used as the transect line for the study. 5m x 5m square plots were spaced at 50m intervals along the transect lines alternate left and right 10m far from the perpendicular distance of transect line.

Habitat preference was calculated by the formula given below

$$HP = (PPE/TPP)x100$$

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Where, HP = Habitat Preference

PPE = Pellet Present (%)in each Habitat Type

TPP = Total Pellet Present (%) of the all Habitat Types

A chi –square test for goodness of fit (Ellitot, 1971; cited in Yadav et .al, 1987) was used to test whether the use different habitats were significantly significant.

Distribution data of Spotted deer, Barking deer, Hog deer and Sambar were collected by the occurrences of their pellets. Difference in shape, size, color and form of aggregation of pellets were used as criteria in identifying animal species. The diameter and size of spotted deer pellets are smaller than Sambar. The tip of pellet of spotted deer is projected on one side. Sambar pellets are cylindrical in contrast to the pellet of spotted deer. Barking deer pellets are easily separated from the two as being comma-shaped and diameter less than other deer pellets. The pellet of hog deer is somewhat like the spotted deer but the tip is smaller than the spotted deer and hog deer mostly find in grassy habitat.

4.5 VEGETATION ANALYSIS

To estimate the plant density, frequency, basal area, cover and dominancy, transect lining method was applied and for this purpose the minimum index area was determined.

Minimum index area is the minimum size quadrate that includes all necessary types of species in a particular habitat. As small quadrate cannot be representative of that area, importance of minimal index area comes beyond minimal index or negligible increased remain constant or negligible.

The species area relationship was determined by counting the number of species present inside the plot whose area was gradually increased keeping the central point fixed until the number of species remained constant. A curve was drawn between the number of species and size of the plot. Species area relationship showed that the number of species was increasing with the increase in area of the quadrate. There was more than

10% increase of plot size up to 10m x 10m, after which the number of species remained constant in the forest communities. Hence, in the forest communities the requisite size of the plot was identified as 100 m x m, where as 2m x 2m plots size in the grassland. Estimation of canopy cover was done by visual estimation.

4.6 DATA ANALYSIS

Data and information collected from the vegetation sampling in different communities were used to calculate the vegetation parameters viz. Density, Frequency, Basal area, dominancy etc. were calculated.

4.6.1. DENSITY AND RELATIVE DENSITY:

Density is the number of individuals of a species per unit area. It represents the numerical strength of the species in the community. Density gives an idea of degree of competition. The density of each species was calculated as formula presented by Zobel et al.

Density (Pl/ha) =   (Total number of individual of a species/ total no. of plot studied x area of plot) x 10,000

Relative density is the density of one species as a percent of total plant density.

Relative Density (%) = (Density of a species/ total density of all species) x 100

4.6.2. FREQUENCY AND RELATIVE FREQUENCY:

Frequency is the percentage of total quadrate, which contains at least one rooted individual of a given species in a community. Relative frequency is the frequency of one species as a percentage of total plant frequency.

Frequency (%) = (Total no. of quadrates in which a species occur/Total no. of plots sampled) x 100

Relative Frequency (%) = Frequency of a species/ Total frequency of all species) x 100

4.6.3. BASAL AREA (DOMINANCE) AND RELATIVE DOMINANCE:

Dominance (basal area) was estimated on the basis of penetrated by the stems and is readily seen when the leaves and stems are clipped at the ground surface. Basal area is the area covered per unit area by plant stem measured by diameter at breast height.

$$Basal\ area\ (BA) = \pi r^2$$

$$C = 2\pi r$$

$$BA = c^2 / 4\pi$$

Where,

C=circumference at breast height

r= radius at breast height

π=3.14

Relative basal area is the proportion of basal area of species to the sum of the basal area of all species.

$$Relative\ basal\ area\ (\%) = (BA\ of\ a\ species/Total\ BA\ of\ all\ species)\ x\ 100$$

4.6.4. IMPORTANCE VALUE INDEX:

Importance value index refers to the relative to the sum of the relative density, relative frequency and relative covers. This index provides a quantitative basis for the classification of community. The IVI value of any species in a community ranges between 0-300.

$$IVI = RD + RF + RBA$$

CHAPTER-FIVE

RESULT

5.1 VEGETATION ANALYSIS OF MAIN STUDY AREA

Study of vegetation is an important part of the habitat study. The analytical vegetation study was done in the main study area selected in the northern part of the RCNP. For this comprehensive work total 230 plots were laid in three different types of vegetation communities.

All the field data collected from three vegetation communities i.e. Sal forest, Riverine Forest and Grassland have been summarized in the Tabular form (Tables 4 to11)

5.1.1 SAL FOREST

This forest has dominant plant species like *Shorea robusta, Syzygium cerasoides*, *Litsea monopetala* and shrubs like *Clarodendron viscosum, Grewia sclerophyla* and *Corchorus aestrans*.

The density of different plant species of Sal forest in survey area ranged between 3.33 to 190 ha^{-1}. The highest density value was found for *Shorea robusta* (190 ha^{-1}), *Litsea monopetala* (163.33 ha^{-1}), *Syzygium cerasoides* (73.33 ha^{-1}) and *Dillenia pentagyna* (70 ha^{-1}) and the lowest value were shown by *Sterculia villosa* (3.33 ha^{-1}), *Meliusa vilitina (*3.33 ha^{-1}) and *Bombox ceiba* (3.33 ha^{-1}).

The basal area of tree ranged from 0.001-to 89.498-m2 ha^{-1}. The highest basal area was found in *Shorea robusta* (89.498 m^2 ha^{-1}), which was followed by *Syzygium cerasoides* (4.44 m^2 ha^{-1}) and *Litsea monopetala* (2.966 m^2 ha^{-1}) and lowest basal area was found in *Bauhinia malabarica* (0.001 m^2 ha^{-1}), *Grewia subnaequalis* (0.001 m^2 ha^{-1}) and *Meliusa vilitina* (0.001 m^2 ha^{-1}).

Frequency varied from 3.33 to 95%. *Shorea robusta* (95%), *Litsea monopetala* (55%) and *Dillenia pentagyna* (40%) showed higher frequencies. The important value

index (IVI) of different tree plant species ranged from 1.421 (*Meliusa vilitina*) to 143.708 (*Shorea robusta*).

The undergrowth of Sal forest was found to contains the shrubs like *Clarodendron viscosum, Grewia sclerophyla, Corchorus aestrans, Skimmia arborescens* with higher density and frequency and the saplings like *Litsea monopetala, Legerstroemia parviflora and Syzygium cerasoides* with higher density.

Along with the shrubs and saplings the herbs like *Saussurea heteromalla, Narenga porphyrocoma, Dryopteris cochleata, and Imperata cylindrica* and climbers like *Tetrastigma serrulatum, Lygopodium japanicum* were found with higher density and frequency.

5.1.2 RIVERINE FOREST

The Riverine forest of northern part was dominated by species like *Murraya koenigii, Trewia nudiflora, Glochidion velutinum, Errata elliptica and Bombox ceiba* at different sites. The forest canopy was dense and continuous but at some place canopy was open.

In Riverine Forest of Icharni, the density of trees was varied from 13.33 ha^{-1} to 320 ha^{-1}. The highest density was recorded in *Murraya koenigii* (320 ha^{-1}) followed by *Glochidion velutinum* (280 ha^{-1}), *Errata elliptica* (210 ha^{-1}), *Litsea monopetala* (196.67 ha^{-1}) and *Trewia nudiflora* (123.33 ha^{-1}). Similarly, basal area were varied from 0.001m^2/ quadrate (100 m^2) to 6.115 m^2 /quadrate. The highest basal area was found in *Errata elliptica* (6.115 m^2/ quadrate) followed by *Trewia nudiflora* (4.429 m^2/ quadrate) and *Murraya koenigii* (1.157 m^2/ quadrate). The frequency was highest for *Murraya koenigii* (90%) followed by *Errata elliptica* (81%), *Trewia nudiflora* (60%) and *Glochidion velutinum* (46.67%).

In Riverine Forest of Druba, density was highest in *Trewia nudiflora* (185 ha^{-1}) followed by *Litsea monopetala* (167.51 ha^{-1}), *Bombox ceiba* (87.5 ha^{-1}), *Errata elliptica* (62.5 ha^{-1}) and lowest for *Alstonia scholaris* (12.5 ha^{-1}). The most frequent trees were *Trewia nudiflora* (93%), *Litsea monopetala* (85%) and *Bombox ceiba* (62.5%). The most dominant tree was *Trewia nudiflora* with basal area 5.732 m2/ quadrate.

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Important value index (IVI) in the Icharni Riverine forest was highest *for Errata elliptica* (82.62) followed by *Murraya koenigii* (58.802), *Trewia nudiflora* (57.86), *Glochidion velutinum* (40.972) and lowest for *Kydia calycina* (2.624). the important value index (IVI) in the Druba Riverine forest was highest in *Trewia nudiflora* (148.754) followed by *Litsea monopetala* (57.376), *Bombox ceiba* (47.729) and lowest for *Alstonia scholaris* (6.185).

The understory layer was dominated by shrubs like *Coffia bengalensis*, *Clarodendron viscosum, Callicapra macrofila, and Colebrookia opposotifolia* with greater density and lowest for *Maesa chisia* and *Myrsine semiserrata*. The frequency was highest for *Coffia bengalensis* followed by *Clarodendron viscosum* and *Colebrookia opposotifolia* and lowest in *Maesa chisia, Myrsine semiserrata*, *Phyllanthus parviflora* and *Lantana camarah*.

The herbs and climbers associated with shrubs and saplings were *Digitaria ciliaris, Alpinia allughas, Piper langum, Dryopteris cochleata, Machania magarantha* with higher density and frequency.

5.1.3 GRASSLAND

The main grassland community was found to occur close to river. The Icharni and Druba are the main grassland study area. The dominated species in grassland were *Sachharum spontaneum, Imperata cylindrica, Digitaria ciliaris, Sachharum bengalensis, Phragmites karka, Equisetum debile* etc.

The density was varied from 535.70 to 296428.57 ha^{-1}. The highest density was of Sachharum *spontaneum* followed by *Imperata cylindrica, Digitaria ciliaris, Sachharum bengalensis, and Phragmites karka* and lowest for *Argemona maxicana* and *Centella asiatica*. The most frequent species were *Sachharum spontaneum, Cucumi agretis, Equisetum debile* and *Hemorthria compressa*.

5.2 HABITAT UTILIZATION:

The Line-plot method revealed the presence of faecal pellets of spotted deer in six different habitat types available in the intensive study area (Table 12). Total number of plots laid in each habitat types, and plots without faecal pellets are presented in the Table below:

Table 4: Number of plots in each habitat types, Plots with pellets and Habitat Preference (HP) value.

S.N.	Habitat Types	Total no of Plots	Plots with pellet	HP
1	Riverine Forest-Icharni	55	17	13.43
2	Riverine Forest-Druba	50	31	26.95
3	Sal Forest	70	20	12.42
4	Grassland	40	3	3.26
5	Flood plain grassland	18	11	26.56
6	River beds	15	6	17.38

The highest proportion of plots with faecal pellets were recorded in the Riverine Forest (62 %)where as the lowest proportion was recorded in the grasslands.

Of the five different habitat types used by spotted deer, Riverine Forest and Flood Plain Grassland were most preferred with HP value 26.95 % and 26.56 % respectively, and the lowest (3.26 %) HP value was calculated for Tall Grassland.

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.
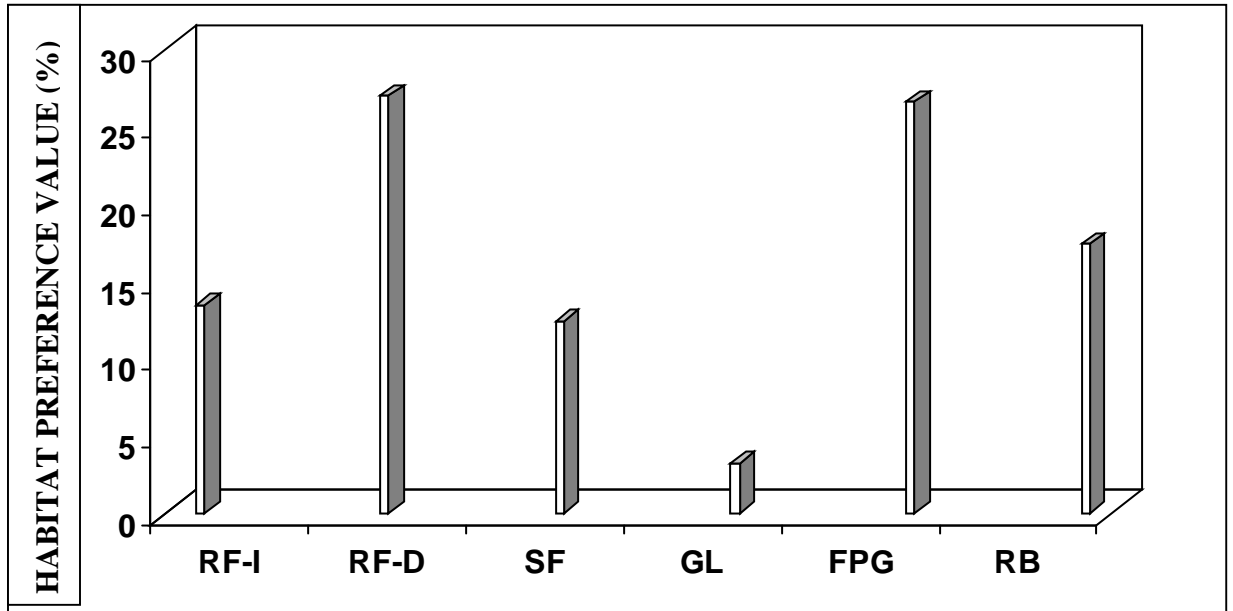
Fig no.4- Habitat Preference Value of Chital.

RF-I= Riverine forest of Icharni   RF-D= Riverine forest of Druba

SF= Sal forest   GL= Grassland

FPG=Flood plain grassland   RB= River beds

5.3 GROUP SIZE OF CHITAL

Among the group size of the Chital in the Chitwan National park, Males with Females and females with Yearlings were most frequently observed. In the present study, only 135 numbers of chital has been observed. The male to female sex ratio was 1:1.8. The largest group size observed during the present study is a group of 62 animals comprising male 22, female 31 with 9 yearlings. The smallest size observed is a 1 male and another group of 2 animals comprising 1 adult female with 1 yearling.

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Table 5: Group size of Chital in the study area

Observation no.	Group size	Male	Female	Yearlings
1.	9	0	7	2
2.	6	2	4	0
3.	5	0	4	1
4.	30	11	16	3
5.	10	4	6	0
6.	62	22	31	9
7.	1	1	0	0
8.	2	0	1	1
9.	10	2	5	3
Total	135	42	74	19

5.4 POPULATION STATUS

A Total of 135 individuals were observed in the survey area during the study period. The density of the spotted deer was 23 individual per square kilometre in the field survey. The field survey was mainly carried out in the Northern side of the Chitwan National Park. The density was 10 individual per square kilometre in the Icharni Riverine forest, 13 individual per square kilometre in the Sal forest of Kasara and About 50 individual per square kilometre in the Riverine forest of Druba. The density was lowest in the Icharni area, because the Forest is dense and dominated by *Murraya koenigii* (Asare) and *Glochidion velutinum* (Kalikath) with higher densities. The Population was declined also due to the flood of 2050 B.S. and 2058 B.S. many animals were swept in those floods. In the Riverine forest of Druba the density is very high. The area is dominated by *Trewia nudiflora* (Vellor), the fruit of which is preferred by the spotted deer and the area was also less dense than the Icharni forest, therefore safe from the predator, which can be easily sighted. The field data were collected from 20 May to 5 July, which is the fruiting season of *Trewia nudiflora.*

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

CHAPTER-SIX

DISCUSSION

6.1 VEGETATION STUDY

Many researchers studied the vegetation of CPN. The vegetation classified by different researchers was found more or less similar. The present findings were revealed from the analysis of three types of vegetation communities found in the Northern Section of the CPN.

All types of forest communities of Northern part of CPN were in the process of becoming denser owing to the enhancement of protection and management measurement initiated by the of National Park. In comparison to Sal forest communities the vegetation of Riverine forest of Icharni was found more diverse in floristic composition. The grassland of Icharni containing saplings of *Bombax ceiba, Trewia nudiflora* etc. seems to be in the process of Successional occupation of the tree and shrubs species resulting into the shrinkage of grassland area.

Among the tree species the density of *Murraya koenigii, Glochidion velutinum* and *Trewia nudiflora* showed higher values in the Riverine forest of the main study area. The Riverine forest of Icharni was denser than the Riverine forest of Druba because the density of *Murraya koenigii, Glochidion velutinum* and *Errata elliptica* were higher in the Icharni forest while the density of *Trewia nudiflora*, *Litsea monopetala* and *Bombax ceiba* were higher in the Druba forest. The data showed that the Icharni Riverine forest is denser than the Druba.

Shrubs like *Coffia bengalensis, Clarodendron viscosum, Callicapra macrofila and Colebrookia opposotifolia* having higher density dominated the understory layer. The density of *Coffia bengalensis* was high in the Icharni forest and shrubs were denser than the Druba forest.

The Sal forest has dominated trees like *Shorea robusta, Syzygium cerasoides, Litsea monopetala*. The highest density in Sal forest was found of *Shorea robusta*. The

shrubs of highest densities were *Clarodendron viscosum, Grewia sclerophyla* and *Corchorus aestrans.* In some places the *under story* was mainly dominated by *Narenga porphyrocoma.*

The *Litsea monopetala* among the tree and *Clarodendron viscosum* among the shrubs were found in both Riverine forest and Sal forest with high density. Among the climber the *Machania magarantha* was most frequent in the Riverine forest. The area, which was covered by *Machania magarantha*, was devoid of shrubs and saplings or herbs because it totally cut off the sunlight for the underlying vegetations.

The density of *Sachharum spontaneum* was highest in the grassland. *Cucumi agretis* was more frequent in the climber species. The most frequent species *Sachharum spontaneum*. The grassland of Icharni was contained the saplings of *Bombax Ceiba* and *Trewia nudiflora* which later would be the wooded grassland resulting in shrinkage of grassland which shows the Successional stage of that area.

The densities of grasses were low in floodplain grassland in the study area and also less species were present. Dominant species was *Sachharum spontaneum.*
More frequent species were more important than less frequent or rare one. Shorea robusta possessed more frequency in Sal forest. Similarly, *Murraya koenigii* was more frequent in Riverine forest of Icharni while *Trewia nudiflora* in the Riverine forest of Druba. In the grassland, *Sachharum spontaneum* was more frequent in both grassland and floodplain grassland.

6.2 POPULATION STATUS

A total of 135 individuals were observed in the survey area during the study period. The density of the spotted deer was 23 individual per square kilometre in the field survey. The density was lowest in the Riverine forest of Icharni but highest in the Riverine forest of Druba. The density is low in the Icharni Riverine forest because the forest was dense. Density of trees like *Murraya koenigii* and *Glochidion velutinum* were high. While the Druba forest was less dense and density of *Trewia nudiflora* was high the fruit of which was preferred by the spotted deer. The Spotted deer was most common species in the Chitwan National Park. The numerical density of Spotted deer was 16.4 individual per square kilometre in the grassland and Riverine forest and 18.6 individuals per square kilometre in the Sal forest of Royal Chitwan National Park (Tamang, 1982). The spotted deer was more abundantly distributed among all ungulate species in Royal Shuklaphanta Wildlife Reserve (Pokhrel, 2005). In general, Spotted deer and Wild boar were more abundant than Sambar and Barking deer in the most of the habitat types studied (Thapa, 2003). The chital population density was 212.3 individual per square kilometer during 1991-92 in Guindy National Park, Madras (Raman, Menon & Sukumar, 1996).

The group size of chital varied from individual to 62 individuals in the study area. The largest group size was found in the Riverine forest of Druba. The male to female sex ratio was 1:1.8 during the study period. The male population was less than the female population because there may be more preference of predator towards the males of spotted deer. Mean group size was highest for the chital (6.03 ± 5.9) among the Sambar, Nilgai and Chital and the adult males to females ratio was 41:100 (Khan, Chellan & Johnsingh, 1995). Dholes (*Cuon alpines*) do hunt significantly more male than female chital (Patel,1992).

Small groups of 2 to 12 individual common, but herds of more than 100 animals can be found. The herd size varies seasonally, increasing during the monsoon (Naess & Andersen, 1993).

6.3 HABITAT PREFERENCE:

The result shows that the most preferred habitat of Chital was Riverine forest. But the habitat preference value was less in the Riverine forest of Icharni because the forest was dense and density of *Murraya koenigii* and *Glochidion velutinum* was high. The most preferred habitat during the study period was Riverine forest of Druba. *Trewia nudiflora*, the fruit of which was preferred by the Axis deer, dominated the forest and also the forest was less dense which was suitable and safe from the predator, which can be easily sighted. In the Sal forest, pellet was absent where the under story contained the *Narenga porphyrocoma* with higher density and the shrubs were dense. In both forest i.e. Riverine and Sal forest, the Chital mostly preferred the area where the under story was open. The habitat preference value was lowest for the grassland habitat and high for floodplain areas. The vegetation in the floodplain area were sparse and height was about was knee height while in the grassland the vegetation was dense and the height of vegetation was more than human height which is avoided by chital. The chital avoided the mature grasses to graze but the short and newly off shoot grasses were preferred. In moist semi evergreen tropical forest of Khan (Central India), chital mostly utilized open meadows grazing on short grass (Schaller, 1967). In Chitwan National Park, chital used both the forest and grassland habitat and mostly prefer the Riverine forest (Mishra, 1982). Axis deer utilize the grasslands opportunistically when high quality forage is available there (Mishra, 1982). Axis deer congregate on the grasslands foraging on the emerging green shoots after cutting or burning (Mishra, 1982). The Chital is an animal that has been reported to favour habitats patches are broken are broken by glades, meadows, grasslands and other features both in its indigenous as exotic environment (Shaller, 1967, Eisenberg and Lockhart 1972 and Dinerstein, 1980). At small scale, Spotted deer was more selective than Sambar by avoiding dense parts with higher tree and sapling density (Thapa, 2003).

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

CHAPTER-SEVEN
CONCLUSION AND RECOMMENDATION

Spotted deer (*Axis axis*) is one of the most important ecological member fauna of the Chitwan National Park. The average density of spotted deer was estimated at 23 individual per square kilometer at present study. The spotted deer was most common species of Chitwan National Park. The male to female sex ratio was 1:1.8. The maximum size of group observed was 62 in the Dhruba Riverine forest and 30 in the Sal forest with average group size of 15 individual.

The line plot method employed to study the habitat utilization revealed the highest preference of Riverine forest and Floodplain grassland. The Riverine forest, which was dominated by *Trewia nudiflora* and *Bombox ceiba* with less dense under story of Shrubs and saplings, was most preferred. Spotted deer preferred the flood plain grassland where density of grasses was low and height less than chest height. The lowest preference value was estimated for grassland where the vegetation height was more than human height. (From the edge of forest pellets were found about one kilometre inside the forest after which it was difficult to observe.)

Plant species like *Shorea robusta, Syzygium cerasoides, Litsea monopetala* and *Dillenia pentagyna* were dominant species of Sal forest in the study area. *Murraya koenigii, Glochidion velutinum* and *Errata elliptica* were found densely and frequently in the Icharni forest while *Trewia nudiflora, Litsea monopetala* and *Bombox ceiba* were dense and frequent in the Dhruba forest. The *Litsea monopetala* was found in both the Riverine forest and Sal forest with high density. The dominated species in grassland were *Sachharum spontaneum, Imperata cylindrica, Digitaria ciliaris, Sachharum bengalensis* and *Phragmites karka*.

Based on the present study following recommendation can be drawn in order to conserve and protect the Chital population and plant diversity of the Chitwan National Park.

▶ Spotted deer usually raid Mustard crop in winter season therefore to reduce agricultural conflicts a barbed wire or electric fence should be erected and maintained regularly to minimize crop damage.

▶ Early burning of dense grassland enhances the growth of new shoots of grass species that become available to deer when most of the grass species reach to their matured stages.

▶ Spotted deer also used to spend their time in the nearby forests of Chitwan National Park crossing the Rapti River. Therefore, such forest and grassland should be restricted for grazing of domesticated animals because it spread diseases.

▶ Spotted deer preferred the forest with less density of trees and shrubs therefore such area should be managed and increased for chital management.

▶ Preferable plant species of spotted deer should be proliferate in the suitable habitat.

▶ The *Machania magarantha*, a climber usually spread over the vegetation very fast and totally cut off the sunlight for the underlying vegetation therefore reducing the diversity of species. Therefore the management of *Machania magarantha* should be done.

▶ Creating awareness among people about the necessity of forest for the survival of human being and wildlife.

► Agro forestry system should be encouraged to apply among villagers providing plant seedlings and technical support should encourage plantation of the firewood, fodder and other indigenous plant species in the marginal land and private land.

► Alternative source of fuel such as kerosene or cooking gas is to be supplied or Biogas plant should be established in hotel and local people houses.

► Those who are poor and hungry will often destroy their immediate environment in order to survive. So that, alternate income generation program should be launched for economic development of local villagers.

► Conservation education programs should be launched to the local villagers about the importance of the park and wildlife resource.

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APPENDIX-I

Sal Forest- Trees

Species	Density	Relative density	Frequency	Relative Frequency	Basal Area	Relative Basal Area	Important Value Index
Adina cardifolia	13.33	1.95	13.33	3.70	0.109	0.669	6.319
Bauhinia malabarica	6.67	0.98	6.67	1.85	0.001	0.006	2.836
Bombos ceiba	3.33	0.49	3.33	0.92	0.006	0.037	1.447
Careya arborea	13.33	1.95	13.33	3.70	0.01	0.061	5.711
Casearia elliptica	20	2.92	15	4.17	0.028	0.172	7.262
Dillenia penta gyna	70	10.24	40	11.11	0.030	0.184	21.534
Grewia subnaequalis	6.67	0.97	6.67	1.85	0.001	0.006	2.826
Kydia calycina	10	1.46	10	2.78	0.004	0.024	4.264
Legerstroemia parviflora	26.67	3.90	16.67	4.63	0.061	0.374	8.904
Lannea coromandelica	6.67	0.98	6.67	1.85	0.027	0.165	2.995
Litsea monopetala	163.33	23.90	55	15.28	0.483	2.966	42.146
Meliusa vilitina	3.33	0.49	3.33	0.93	0.001	0.006	1.421
Phyllanthus	13.33	1.95	10	2.78	0.023	0.141	4.871

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emblica						
Sapium insigne	43.33	6.34	20	5.56	0.090	0.552	12.452
Shorea robusta	190	27.82	95	26.39	14.572	89.498	143.708
Sterculia villosa	3.33	o.49	3.33	0.93	0.002	0.012	1.432
Syzygium cerasoides	73.33	10.73	25	6.94	0.723	4.440	22.11
Terminalia belerica	10	1.46	10	2.78	0.083	0.509	4.749
Terminalia chebula	6.67	0.98	6.67	1.85	0.028	0.172	3.002

Riverine Forest of Icharni- Trees

Species	Density	Relative density	Frequency	Relative Frequency	Basal Area	Relative Basal Area	Important Value Index
Albizia alucida	13.33	1.09	10	2.69	0.646	4.602	8.382
Bombox ceiba	33.33	2.75	13.33	3.58	0.382	2.722	09.052
Bridelia retusa	16.67	1.37	13.33	3.58	0.001	0.007	04.957
Errata elliptica	210	17.31	81	21.77	6.115	43.56	82.64
Kydia calycina	10	0.82	6.67	1.79	0.002	0.014	02.624
Litsea monopetala	196.67	16.20	43.33	11.65	0.593	4.224	32.074
Mallotus philippensis	10	0.82	6.67	1.79	0.001	0.007	02.617
Murraya koenigii	320	26.37	90	24.19	1.157	8.242	58.802
Glochidion velutinum	280	23.08	47.67	12.82	0.712	5.072	40.972
Trewia nudiflora	143.33	10.17	60	16.14	4.429	31.55	57.860

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Riverine Forest of Druba-Trees

Species	Density	Relative density	Frequency	Relative Frequency	Basal Area	Relative Basal Area	Important Value Index
Alstonia scholaris	12.5	2.21	12.5	3.96	0.001	0.015	6.185
Bombox ceiba	87.5	15.48	62.5	19.81	0.824	12.439	47.729
Errata elliptica	62.5	11.06	25	7.92	0.009	0.136	19.116
Kydia calycina	25	4.43	25	7.92	0.005	0.075	12.425
Litsea monopetala	167.51	29.65	85	26.94	0.052	0.786	57.376
Glochidion velutinum	25	4.43	12.5	3.96	0.001	0.015	08.405
Trewia nudiflora	185	32.74	93	29.48	5.723	86.534	148.754

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Riverine forest- Shrubs and Saplings

Species	Density	Relative Density	Frequency	Relative Frequency
Achyranthes bidentata	164.7	0.57	17.64	1.99
Antidesma accidum	870.58	3.03	52.94	6.00
Boehmeria Platyphyla	776.47	2.69	35.29	4.00
Callicapra macrofila	2235.29	7.78	64.70	7.34
Clarodendron viscosum	2705.88	9.41	94.11	10.68
Coffia bengalensis	13764.7	47.85	100	11.34
Colebrookia opposotifolia	1764.7	6.13	82.35	9.34
Eupotorium endonoforum	1717.64	5.98	29.41	3.33
Maesa chisia	47.05	0.16	11.76	1.33
Mimosa rubicoulis	70.59	0.25	17.64	1.99
Myrsine semiserrata	47.05	0.16	11.76	1.33
Phyllanthus parvifolius	188.23	0.65	11.76	1.33
Zizyphus rugosa	70.59	0.25	11.76	1.33

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Murraya koenigii	729.41	2.53	94.11	10.68
Glochidion velutinum	376.47	1.31	41.17	4.68
Errata elliptica	164.7	0.57	29.41	3.33
Pogostemon bengalensis	1611.76	5.61	82.35	9.34
Litsea monopetala	141.17	0.49	17.64	1.99
Bombox ceiba	47.05	0.16	11.76	1.33
Trewia nudiflora	800	2.78	35.29	4.00
Lantana camarah	47.05	0.16	11.76	1.33
Albizia alucida	423.53	1.47	17.64	1.99

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Riverine forest-Herbs

Species	Density	Relative Density	Frequency	Relative Frequency
Ageratum nousetonanum	352.94	0.94	11.76	1.99
Artemissia vulgaris	141.18	0.38	11.76	1.99
Alpinia allughas	4941.17	13.21	29.41	5.00
Cida cardifolia	47.05	0.13	5.88	0.99
Cynthillium cinereum	23.53	0.06	5.88	0.99
Desmodium confertum	164.7	0.44	5.88	0.99
Digitaria ciliaris	10941.17	29.26	23.52	3.99
Dioscorea bulbifera	23.53	0.06	5.88	0.99
Dryopteris cochleata	2776.47	7.43	47.05	8.00
Equisetum debile	94.11	0.25	5.88	0.99
Hemarthria compressa	752.94	2.01	5.88	0.99
Ichinocarpus frutesences	823.52	2.20	64.70	11.00
Lepisorus bicolar	5270.59	1.41	64.70	11.00
Oxalis cornicullata	94.11	0.25	11.76	1.99
Persicaria barbata	141.17	0.38	5.88	0.99

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Pteris vitata	1411.76	3.77	47.05	8.00
Scoparia dulcis	47.05	0.13	5.88	0.99
Solanum surathense	70.58	0.18	11.76	1.99
Cyperus cyperoides	941.17	2.51	5.88	0.99
Trachelospermum leicidum	564.70	1.51	35.29	6.00
Tetrastigma serrulatum	658.82	1.76	47.05	8.00
Piper langum	3058.82	8.18	47.05	8.00
Alternanthera sessilis	282.35	0.75	11.76	1.99
Phragmites karka	188.23	0.50	5.88	0.99
Rungia parviflora	1176.47	3.14	5.88	0.99
Machania magarantha	2400	6.42	58.82	10.00

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Sal forest -Saplings and Shrubs

Species	Density	Relative Density	Frequency	Relative Frequency
Achyranthus bidentata	70.58	0.58	11.76	2.10
Bombox ceiba	70.58	0.58	11.76	2.10
Bauhinia malabarica	23.53	0.19	5.88	1.05
Casearia elliptica	70.58	0.58	11.76	2.10
Clarodendron viscosum	3741.17	31.05	58.28	10.53
Corchorus aestrans	1105.88	9.18	41.18	7.37
Dillenia pentagyna	235.29	1.96	47.06	8.42
Errata elliptica	70.58	0.58	5.88	1.06
Eupotorium endonoforum	305.88	2.54	29.41	5.26
Grewia sclerophyla	2211.76	18.36	70.59	12.63
Indigofera gassioides	470.59	3.91	5.88	1.05
Legerstroemia parviflora	564.70	4.69	17.64	3.16
Litsea monopetala	1176.47	9.77	47.06	8.42
Pogostemon	211.76	1.76	17.64	3.16

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

bengalensis			
Phyllanthus emblica	329.41	2.73	17.64	3.16
Sapium insigne	211.76	1.76	29.41	5.26
Shorea robusta	117.64	o.98	23.53	4.21
Skimmia arborescens	705.88	5.87	41.18	7.37
Syzygium cerasoides	211.76	1.76	41.18	7.37
Trewia nudiflora	117.64	0.98	17.64	3.16
Xeromphis spinosa	23.53	0.19	5.88	1.06

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Sal Forest-Herbs

Species	Density	Relative Density	Frequency	Relative Frequency
Ageratum nousetonanum	3882.35	9.12	35.29	6.46
Alpinia allughas	70.59	0.17	11.76	2.15
Argemona maxicana	847.06	1.99	17.65	3.23
Arissaema flavum	23.53	0.06	5.88	1.06
Asperagus racemosus	423.53	0.99	23.52	4.29
Curcuma angustifolia	282.35	0.66	29.41	5.39
Cyperus compressus	1058.82	2.49	17.65	3.23
Cyperus rotunds	588.23	1.38	11.76	2.15
Desmostachya bipinnata	2705	6.36	29.41	5.39
Digitaria ciliaris	705.88	1.66	5.88	1.07
Dioscorea bulbifera	235.29	0.55	17.65	3.23
Dioscorea deltoidea	211.76	0.50	17.65	3.23
Dix lachryana	1294.12	3.04	11.76	2.15

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

Dryopteris cochleata	4705.88	11.06	11.76	2.15
Imperata cylindrical	4705.88	11.06	23.52	4.29
Leea robusta	2541.18	5.96	47.05	8.60
Lygopodium japanicum	164.71	0.39	17.65	3.23
Narenga porphyrocoma	7200	16.91	76.47	13.98
Plumbago zeylanicum	94.12	0.22	5.88	1.07
Saussurea heteromalla	8517.65	20.01	47.05	8.60
Sida rhombifolia	282.35	0.66	17.65	3.23
Sachharum spontaneum	47.06	0.11	5.88	1.07
Piper langum	494.12	1.16	11.76	2.15
Tagetes glandulifera	188.24	0.44	5.88	1.07
Tetrastigma serrulatum	752.94	1.77	23.52	4.29
Vernenia cinerea	470.59	1.11	5.88	1.07
Vigna mungo	70.59	0.17	11.76	2.15

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Grassland

Species	Density	Relative Density	Frequency	Relative Frequency
Ageratum nousetonanum	1607.14	0.17	14.28	2.70
Argemona maxicana	535.71	0.06	7.14	1.35
Artemissia vulgaris	4821.42	0.51	21.42	4.05
Boehmeria platyphylla	26785.71	2.88	7.14	1.35
Bombox ceiba	1071.42	0.12	28.57	5.41
Calotropis gigantia	178.57	0.02	7.14	1.35
Centella asiatica	535.71	0.06	14.29	2.7
Cida cardifolia	4821.42	0.52	14.29	2.70
Cucumi agretis	3571.42	0.38	35.71	6.76
Cynodon dactylon	44642.86	4.80	21.42	4.05
Cyperus rotunds	892.86	0.09	7.14	1.35
Desmodium confertum	9642.85	1.04	21.42	4.05
Digitaria ciliaris	89464.28	9.62	14.29	2.70
Dryopteris cochleata	2857.14	0.31	21.42	4.05
Elephant opus	178.57	0.02	7.14	1.35

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.

scaber			
Equisetum debile	24464.28	2.63	28.57	5.41
Hemarthria compressa	20000	2.15	28.57	5.41
Imperata cylindrical	297500	30.91	21.43	4.05
Oreo chide frutenscens	10714.28	1.15	7.14	1.35
Phyllanthus amrus	178.57	0.02	7.14	1.35
Phragmites karka	29821.42	3.20	28.57	5.41
Sachharum bengalensis	54642.85	5.87	21.42	24.05
Sachharum spontaneum	296428.57	31.88	92.86	17.57
Stephonia glandulifera	178.57	0.02	7.14	1.35
Tetrastigma serrulatum	714.28	0.07	7.14	1.35
Trigonella sps.	6964.29	0.75	7.14	1.35
Vernenia cinerea	2678.57	0.28	7.14	1.35
Badam pate(Local Name)	3928.57	0.02	21.42	4.05

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APPENDIX-II

Flora of Chitwan National Park

S.N	Scientific Name	Habit	Family	Common Name
1.	*Achyranthes bidentata*	S	Amaranthaceae	Datiwan
2.	*Adina cardifolia*	T	Rubiaceae	Karam
3.	*Ageratum conyzoides*	H	Compositeae	Seto gandhe
4.	*A. nousetonanum*	H	”	Nilo gandhe
5.	*Albizia alucida*	T	Legumuminosae	Padke siris
6.	*Alstonia scholaris*	T	Apocynaceae	Cchatiwan
7.	*Alternanthera sessilis*	H	Amarantaceae	Bhiringe jhar
8.	*Antidesma accidum*	S	Euphorbiaceae	Kalo belauni
9.	*Apltedo mudica*	H	Compositae	Sali banso
10.	*Artemissia vulgaris*	H	”	Titepati
11.	*Asperagus racemosus*	H	Liliaceae	Ban kurilo
12.	*Argemona maxicana*	H	Compositae	Thakal
13.	*Alpinia allughas*	H	Zingiberaceae	Bader
14.	*Bauhinia malabarica*	T	Leguminosae	Ameli
15.	*Bidens bipinnata*	G	Asteraceae	Karaute ghans
16.	*Boehmeria platyphylla*	S	Urticaceae	Kamle
17.	*Bombox ceiba*	T	Bombaiaceae	Simal
18.	*Bridelia retusa*	T	Euphorbiaceae	Gayo
19.	*Callicarpa macrofila*	S	Verbenaceae	Dahi kamla
20.	*Calotropis gigantia*	S	Lycoperdaceae	Ank
21.	*Careya arborea*	T	Lecythidaceae	Kumbhi
22.	*Casearia elliptica*	T	Flacourtiaceae	Chila(N), Deri(D)
23.	*Cassia sophera*	S	Leguminoceae	Tapre
24.	*Centella asiatica*	H	Umbelliferae	Ghod Tapre
25.	*Cida cardifolia*	H	Malvaceae	Balu jhar
26.	*Clarodendron viscosum*	S	verbenaceae	Bhanti
27.	*Coffia bengalensis*	S	Rubiaceae	Jangali coffee
28.	*Colebrookia opposotifolia*	S	Labiatae	Dhursil
29.	*Corchorus aestrans*	S	Tilaceae	Simthi
30.	*Cucumi agretis*	C	Cucurbitaceae	Gurmi
31.	*Curcuma angustifolia*	H	Zinziberaceae	Jangali Besar
32.	*Cyanthillium cinereum*	H	Compositae	Marda jhar
33.	*Cynodon dactylon*	G	Graminae	Dubo
34.	*Cyperus rotunds*	G	Cyperaceae	Mothe
35.	*Cyperus compressus*	H	Cyperaceae	Jhusuna
36.	*Desmodium Confertum*	H	Leguminosae	Bhatmaspate
37.	*Desmodium ganageticum*	H	Leguminosae	Karouchee Jhar
38.	*Desmostachya bipinnata*	G	Grminae	Kush
39.	*Digitaria ciliaris*	H	Compositae	Banso ghans
40.	*Dillenia pentagyna*	T	Dilleniaceae	Tantari

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41.	*Dioscorea bulbifera*	C	Dioscoreaceae	Ban Tarul
42.	*Dioscorea deltoidea*	C	Dioscoreaceae	Githa(D), Vyakur(n)
43.	*Dryopteris cochleata*	H	Polypodiaceae	Neuro
44.	*Elaphantopus scaber*	C	Polypodiaceae	Mulapate lahara
45.	*Equisetum debile*	H	Equisetaceae	Aakha taruwa
46.	*Errata elliptica*	T		Datrung
47.	*Eupotorium endonoforum*	S	Compositae	Banmara
48.	*Euphorbia hirta*	H	Euphorbiaceae	Dudhe jhar
49.	*Grewia sclerophylla*	S	Tiliaceae	Phorso(D), Bhokata(Th)
50.	*Grewia subinaequalis*	T	Tiliaceae	Pharsha(Th), Kathphursa(D)
51.	*Hemarthria compressa*	G	Graminae	Ghode dubo
52.	*Ichinocarpus frutesences*	C	Apocynaceae	Seto lahara
53.	*Imperata cylindrica*	G	Graminoceae	Siru
54.	*Indigofera gassioides*	S	Leguminoceae	Bilul
55.	*Kydia calycina*	T	Malvaceae	Bohari
56.	*Lannea coromandelica*	T	Anacardiaceae	Gingad(N), Singhane(D)
57.	*Lantana camarah*	S	Verbenaceae	Boksi kada
58.	*Leea robusta*	H	Leeaceae	Galeni(N), Goda(D)
59.	*Legerstroemia parviflora*	T	Lythraceae	Bot dhairo(N), Siddho(D)
60.	*Lepisorus bicolar*	H	Polypodiaceae	Dhule uinu
61.	*Litsea monopetala*	T	Lauraceae	Kutmero
62.	*Lygopodium Japanicum*	C	Schizaeaceae	Lahare Neuro
63.	*Machania magarantha*	C		
64.	*Maesa chisia*	S	Myrsinaceae	Belauni
65.	*Mallotus philippensis*	T	Euphorbiaceae	Sindure
66.	*Meliusa vilitina*	T		Karyatha
67.	*Mimosa rubicoulis*	S	Leguminodae	Areli kada
68.	*Murraya koenigii*	T	Rutaceae	Asare
69.	*Myrsine semiserrata*	S	Myrsinaceae	Phalame
70.	*Glochidion velutinum*	T	Euphorbiaceae	Kalikath
71.	*Narenga porphyrocoma*	G	Graminae	Khadai
72.	*Oreochide frutenscens*	H	Urticaceae	Chiple ghans
73.	*Osyris wightiana*	S	Santalaceae	Nundhiki
74.	*Oxalis cornicullata*	H	Oxilidaceae	Chari amilo
75.	*Persicaria barbata*	H		Machhamarnepire
76.	*Phillanthus amrus*	H	Euphorbiaceae	Amala jhar
77.	*Phragmites karka*	G	Graminae	Narkat
78.	*Phyllanthus emblica*	T	Euphorbiaceae	Amala
79.	*Phyllanthus parvifolius*	S	Euphorbiaceae	Jhadu
80.	*Piper langum*	C	Piperaceae	Pipla, Pan
81.	*Pogostemon bengalensis*	S	Labiatae	Rudilo

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82.	*Plumbago zeylanicum*	H	Plumbaginaceae	Chitu, Leadwort
83.	*Pteris vitata*	H	Polypodiaceae	Bis uinu
84.	*Rungia parviflora*	H	Acanthaceae	Ukuse jhar
85.	*Sachharum bengalensis*	G	Graminaceae	Baruwa
86.	*Sachharum spontaneum*	G	Graminaceae	Kans
87.	*Sapium insigne*	T	Euphorbiaceae	Khirro
88.	*Saussurea heteromalla*	G	Graminae	Banspate jhar
89.	*Scoparia dulcis*	S	Scrophulariaceae	Chini jhar
90.	*Shorea robusta*	T	Dipterocarpaceae	Sal
91.	*Sida rhombifolia*	H	Malvaceae	Baleri
92.	*Skimmia arborescens*	S	Rutaceae	Rauna phool
93.	*Stephonia glandulifera*	C	Menisperaceae	Batulipate
94.	*Smilax aspera*	C	Smilacaceae	Kukur Daino
95.	*Solanum surathense*	H	Solanaceae	Kantakari
96.	*Sterculia villosa*	T	Sterculiaceae	Odal
97.	*Syperus cyperoides*	H	Graminae	Kode jhar
98.	*Syzygium cerasoides*	T	Myrtaceae	Kyamuna
99.	*Tectoria macrodonta*	H	Polypodiaceae	Kali Neuro
100.	*Terminalia belerica*	T	Combretaceae	Barro
101.	*Terminalia chebula*	T	Combretaceae	Harro
102.	*Tetrastigma serrulatum*	C	Vitaceae	Charchare lahara
103.	*Trachelospermum leicidum*	C	Apocynaceae	Dudhe lahara, Star Jasmine
104.	*Trewia nudiflora*	T	Euphorbiaceae	Bhellor
105.	*Trigonella sps.*	H	Leguminosae	Methi Jhar
106.	*Tugetes glandulifera*	H		Sayapatri
107.	*Urticularia bifida*	H	Urticaceae	Sim ghans
108.	*Vernania cinerea*	H	Compositae	Phurke Banso
109.	*Vigna mungo*	C	Cucurbitaceae	Banmass
110.	*Xeromphis spinosa*	S	Rubiaceae	Maina kada
111.	*Zizyphus rugosa*	S	Rhamnaceae	Jangli Besar

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APPENDIX-III
PLATES

Plate 1: Kasara Darbar – Kasara   Plate 2: Dissertant Measuring
Circumference of Tree

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Plate 3: Grassland of Dhruba   Plate 4: Sal Forest of Kasara

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Plate 5: Riverine Forest Along the Side of Rapti River   Plate 6: Sal Forest at Bikram Baba

Study of habitat and population status of spotted deer (Axis axis) in Chitwan National Park.