1. INTRODUCTION

1.1 Background

Anthropogenic disturbances have become a major force of deforestation and environmental degradation in the Himalayan region (Bajracharya 1983a, Basnet 1992a, 2006, Ives 2004). The disturbances like firewood and fodder collection, chopping and lopping of trees affect the vegetation structure and recreational quality (Khadka et al. 1994) and cause continuous loss of biomass (Chettri 2000). Human disturbances such as firewood, fodder extraction, and livestock grazing have increased due to rapid population growth and tourism (Sharma et al. 2000, Chettri et al. 2002) resulting in destruction and fragmentation of wildlife habits and natural beauty of the area (Chettri 2000).

In the Himalayan region, human activities including developmental process, survival strategies religious and cultural practices have lead to serious ecological repercussion (Dewan 1988). Livestock rearing is an important means of livelihood among the Himalayan people which bring changes in the forest resource condition and qualities (Rayamajhi et al. 2000). The forest environment of Himalayan region is fragile due to variety of human influences like livestock rearing and collection of forest products (Jackson et al.1993, BPP 1995). Such activities influence the survival of region's wildlife (Brower 1991, Fox et al. 1994). Forest in the Himalaya are under pressure through both internal and external forces with adverse impacts on the firewood, fodder collection, and other daily needs of local people and also on forest based government revenues (Eckholm 1982, Ramakrishnan et al.1992). Firewood is the major source of fuel for mountain people (Fox 1984, Basnet 1992a, b, Sundriyal and Sharma 1996). Firewood for heating and cooking, fodder for livestock and timber for construction are major products extracted from the forests that cause degradation of natural vegetation (Bajracharya 1983a, b). Commercial harvesting and heavy grazing of livestock in the forest reduces species diversity, density and survivorship of plants and other wild species (Basnet 2006).

The destruction of forest ecosystem is especially tragic when results in disappearance of the species having a small geographical range and are adapted to narrow range of habitat (Upreti 1991). Human pressure on forest resources and infrastructure development have been increasing since last few decades, resulting threats to the fragile ecosystems of the region (Rai and Sundriyal 1997). The use of forest resources to meet the needs of local people causes thinning of woodlands (Griffin and Muick 1990) and affects the vegetation structure and composition (Block and Brennan 1993). Destruction of tropical forests and other large-scale human disturbances have increased concern about effect on vegetation structure as well as on other forest communities (Schulte and Niemi 1998).

The distribution of bird communities is affected by habitat fragmentation or other means of disturbances and reflects inter-specific dynamics and population trends associated with the habitat (O'Connell et al. 2000). Himalayan region provides habitat for large mammals that have adapted to the harsh climatic and environmental condition over evolutionary time scales (Schaller 1998). Recently their numbers have declined and their distribution has become increasingly fragmented due to poaching, over-hunting, direct and indirect effects of increased human activities, and use of habitats (Nowell and Jackson 1996). These may be due to the livestock grazing, disturbances to breeding or foraging wildlife, and marginalization of critical wintering habitat (Fox 1997).

Government of Sikkim has enforced a law to forbid the use of forest resources like firewood, fodder, collection of medicinal plants, and poaching of wild species but the practices are still prevalent, because local people require even more access to resources from near by forests through illegal means. Information regarding human impact on wildlife and wildlife habitat in Maenam Wildlife Sanctuary is not available. This study was therefore carried out to examine the human impact on wildlife and wildlife habitat. Moreover this study provides relevant information regarding impacts on wildlife by human in Maenam Wildlife Sanctuary so that it helps other researchers, students and policy makers to make innovative conservation plans and programs.

1.2 Objectives

The main objective of this research was to explore major human impact on wildlife and wildlife habitats in Maenam Wildlife Sanctuary in Sikkim Himalaya. Specific objectives were to:

a) explore vegetation structure of disturbed and undisturbed sites,
b) inventory of birds and mammals in disturbed and undisturbed sites,
c) evaluate species diversity and abundance of birds and mammals of disturbed and undisturbed sites, and
d) assess human disturbances in Maenam Wildlife Sanctuary.

1.3 Justification

Maenam Wildlife Sanctuary (MWS) being rich in biodiversity provides diversified location, specific opportunities of biodiversity linked micro-enterprise development apart from meeting local subsistence needs for timber, fodder, firewood, and other forest products. Conservation of birds and mammals of MWS will ultimately conserve the watershed, because the sanctuary has tremendous watershed value being only source of perennial water in the ridges. Namchi (south district headquarter, 30km away from this sanctuary) is totally dependent on the piped water from Bermelly stream originating within this sanctuary. This sanctuary also provides perennial water source to the adjoining town that is Ravangla (WWF-India 2000). The biological resources of MWS is facing heavy pressure of increase human population and their activities like firewood extraction, fodder collection, timber harvesting, livestock grazing, poaching, killing animals, and collection of medicinal plants. The work was also done by Dhakal (2004) in forest resources, but no work has been done on human impact on birds and mammals and their habitats. Therefore, present study was conducted in MWS where human activities or disturbances are increasing steadily.

2. STUDY AREA

2.1 Area and Location

Maenam-la (Sikkimese Tibetan Language) means treasury of medicines being a rich trove of endemic medicinal plants. It is located in northern corner of south Sikkim within 27°05'-27°17'N and 88°25' - 88°40'E and has an area of 35.3km² (Verma 2005). The Sanctuary has altitudinal gradient ranges from 2300m-3263m. The Maenam ridge bisects the Sanctuary longitudinally in north-south direction. This ridges gain in height as it proceeds from north to south till it reaches a maximum of 3263m. The streams originating from the eastern flank of this ridges drain into the Tista River while those originating from the western flank into the Rangit River. There are 54 village settlements with 3267 households and 31000 people living around the Sanctuary. Out of fifty-four villages, I selected only four (Revangla, Yangang, Mangzing and Lingmoo) as study area (Figure 2.1).

2.2 Climate

Two major features that are temperature and precipitation decide the climate of the region. These features in turn are naturally influenced by three physical attributes location (altitude and latitude), altitude, and exposure to powerful winds. The study area has mean monthly maximum temperature that ranges from 14.3-23.3°c and mean monthly minimum temperature from 5.4-15.8°c. Total rainfall varies significantly with maximum during monsoon season and minimum in winter season. Relative humidity varies between 80-95% during the summer season and decreases to about 45% in spring.

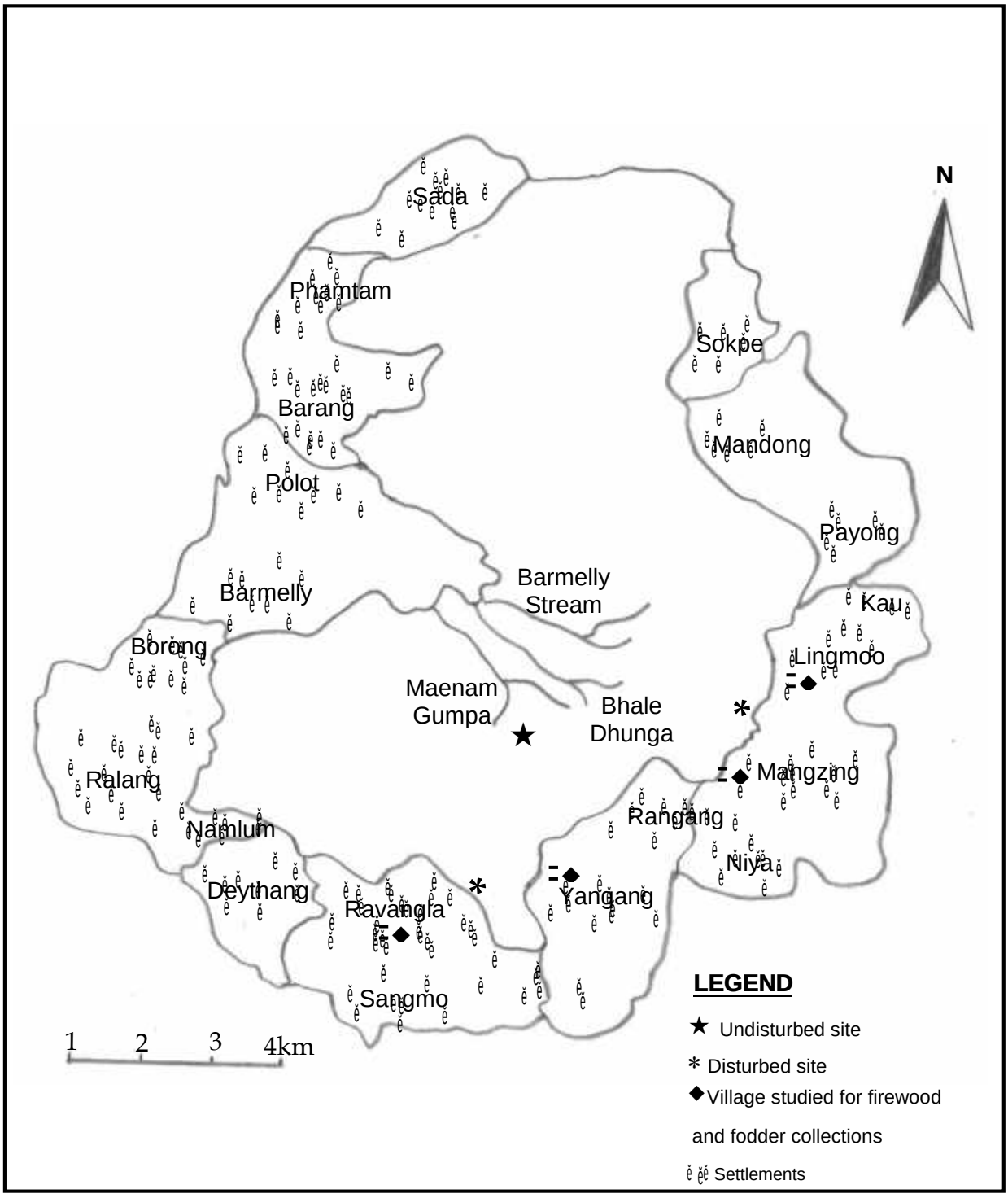

Figure 2.1Map representing the study sites of Maenam Wildlife Sanctuary

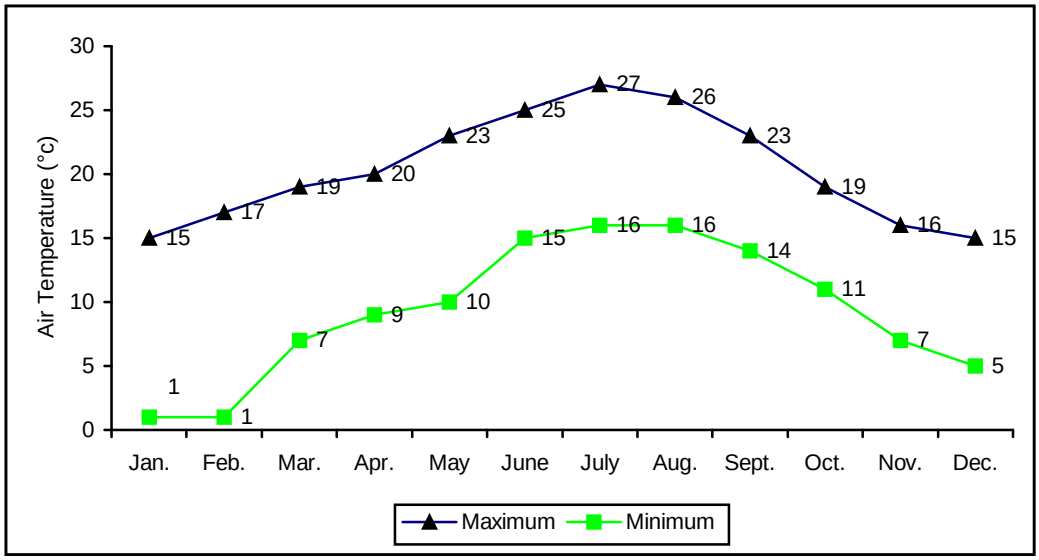

Figure 2.2 Monthly variation of maximum and minimum temperature (°c) at Maenam Wildlife Sanctuary

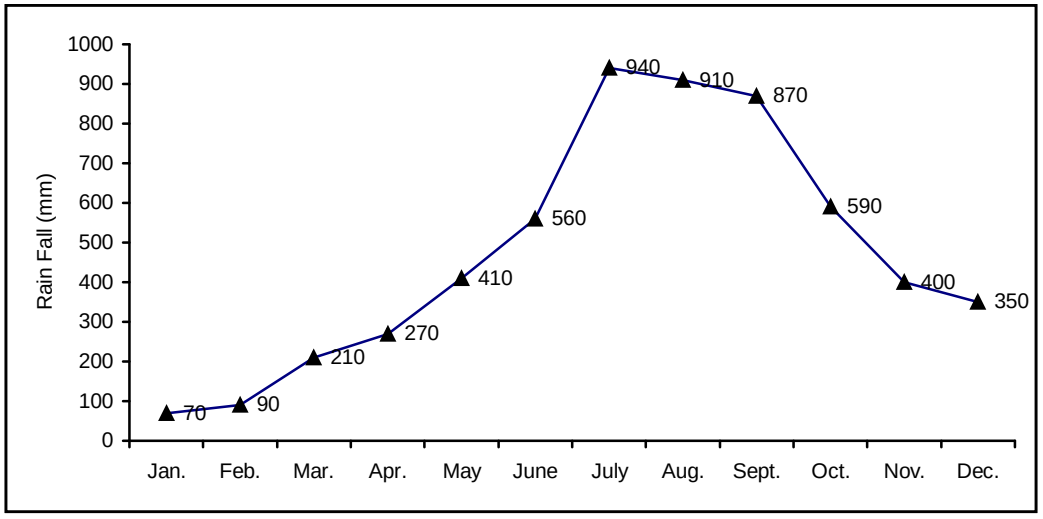

Figure 2.3 Monthly variation of rainfall at Maenam Wildlife Sanctuary

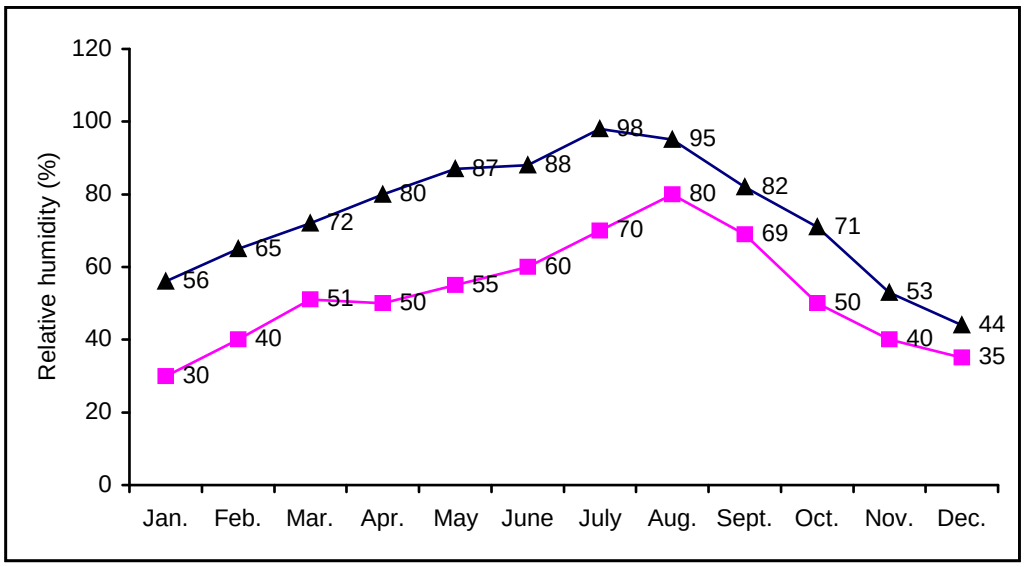

Figure 2.4 Monthly variation of relative humidity at Maenam Wildlife Sanctuary

2. 3 Biological components

2.3.1 Natural Vegetation

Maenam Wildlife Sanctuary is unique for the diversity of plants. Forest is dominated by *Quercus lamellosa, Quercus lineata* and bamboo, providing the main habitat for Red panda. The common species of bamboo are Gopey (*Cephalostachyum capitatum*) and Pareng (*Arundinaria hookeriana*). Important plants of sanctuary are *Machilus edulis, Michelia lanuginosa, Michelia excelsa, Elaeocarpus sikkimensis, Rhododendron falconeri, Castanopsis tribuloides* and *Magnolia campbelii, Quercus pachyphylla.*

2.3.2 Wildlife

Bird species like *Ictinaetus malayensis, Falco tinnunculus, Tragopan satyra, Lophura leucomelana, Streptopelia chinensis, Cuculus micropterus, Dumetia hyperythra, Phylloscopus affinis* and *Passer montanus* are found in the Sanctuary.

Some of the important mammals found in the Sanctuary are Barking deer (*Muntiacus muntjak*), Clouded leopard (*Neofelis nebulosa),* Goral (*Nemorhaedus goral),* Himalayan black bear (*Selenarctos thibetanus),* Wild pig (*Sus scrofa),* Porcupine (*Hystrix indica*), etc.

2.4 Socio-Economic Conditions

2.4.1 Human Population

There are about 31000 people in 3267 households living around the Sanctuary. Among the total population, 54.2% is male and 46.8% female with mixed ethnic group (Population Census 2001). Among the ethnic groups, Chhetri has the highest percentage (53.3%) followed by Bhutia (27.5%), Brahmin (9.1%), Gurung (6%), and Tamang (4.1%).

2.4.2 Agriculture

Agriculture is the major source of earning. The major crops grown in the study site are millet, maize, cardamom, potato, sweet potato, yam, pea, etc. The cardamom occupies the largest area (about 70%) which is also one of the main

cash crops of Sikkim. Remaining 30% land is occupied by paddy, pea, maize, millet, potato, sweet potato, yam, etc.

Livestock rearing is an integral part in the hilly regions. It is an important component of Nepalese farming system that provides food, manure and cash income from farm. Mostly they prefer goat which is easy to rear followed by cow, buffalo, and sheep. The cropping seasons for main crops in the study area is given below.

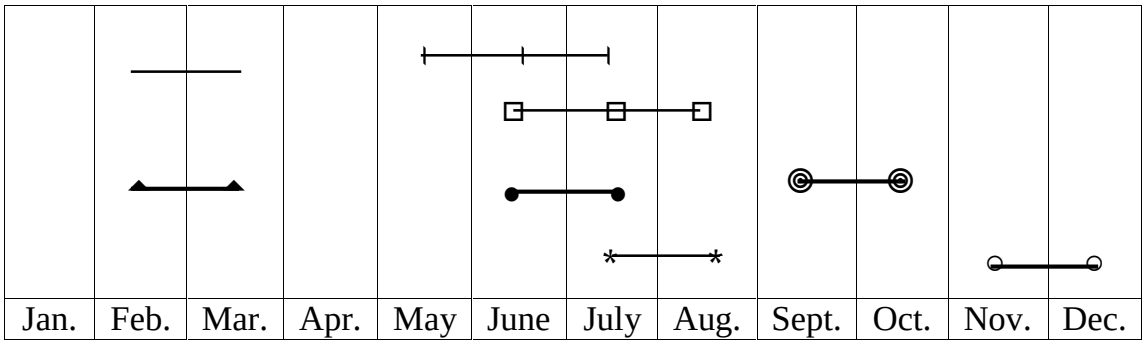

Figure 2.5 Season of different crops in study area

▲ → Maize — → Yam
• → Paddy □ → Sweet potato
* → Millet ○ → Potato
ı → Cardamom ◎ → Pea

2.4.3 Economic Condition

Agriculture is the main source of the people living around the Sanctuary. More than 75 percent of people depend on agriculture and livestock rearing. Most of the people are land holders but not sufficient. Few people are engaged in government services, business, and labors.

2.4.4 Tourism

Maenam Wildlife Sanctuary is 12 km away form Ravangla Bazaar and it takes not more than four hours to reach the peak. It is also one of the important tourist spot of Sikkim. There is a footpath to reach the peak. The peak is also called Bhaley Dhunga, it is the religious site or holy place, where people used to visit for worship. Mostly it is visited by locals and sometimes by foreigners for scenery.

3. REVIEW OF LITERATURE

Vegetation, Birds and Mammals

The effect of human on biodiversity and landscapes has been widely recognized and many species are threatened with extinction (Wilson 1998, Liu et al. 1999). The most important direct cause of biodiversity loss is habitat distraction from clearing and burning of forest, fodder, firewood collection, converting natural ecosystem for agriculture, and human settlements (Rao 1983). Poorly conceived and inconsistent government policies are another cause of biodiversity loss (WRI/ IUCN/ UNEP 1992). Human settlements and livestock grazing in the Himalayan region are root cause of biodiversity loss (Stone and Hamilton 1991).

Many factors are responsible for degradation of forest (Basnet 1992a,b). Studies in middle mountain region have shown that degradation is mainly due to human activities to meet their need of firewood, fodder, and agricultural expansion (Bajracharya 1983a,b, Mahat et al. 1986). The destruction of forest resources and environment degradation is mainly due to the demand for energy resources by local people (Bajracharya 1983a, Basnet 1992a,b). The encroachment of the local people for various purposes like agriculture, firewood, fodder collection, timber harvesting, and their shifting in the forest for settlements are also the cause of forest degradation (Bajracharya 1983a, Basnet 1992a).

The increase in population pressure together with penetration of market and tourism led to many undesirable trends, the loss of plant diversity, habitat degradation, loss of wildlife, and environmental functions of natural ecosystem (Ramakrishnan 1992, Rao and Saxena 1994). The cultivation of maize and potato was associated with increase reclamation of dry agricultural lands, particularly from forest and so contributed to be the advanced state of deforestation and degradation (Regmi 1978).

Wildlife and wildlife habitats in Himalayan region are mostly affected by human settlements, their activities, and livestock grazing. Animal husbandry is an integral part of subsistence agriculture in mountains (Basnet 2006). Approximately 10% of the world's population lives in mountain areas with livestock contributing substantially to their economy (Pun and Mares 2000). In mountain pasture, livestock is widely regarded as competing with wild herbivores by depleting forest resources (Rikhari et al. 1992, Schaller 1977). It also generates number of impacts on wildlife such as degradation of habitat, poaching of wildlife, competition for forage, and influences the survival of the region's wildlife (Brower 1991, Fox et al. 1994). Wildlife habitat in Himalayan region has been affected by several human activities like livestock grazing, firewood, and fodder collection. An increased number of livestock and overuse of pastures lead to degradation of habitat for herbivore (Rawat 2000). The destruction of forest reduces canopy structure, which brings change in the age and size distribution of stands (Aigner et al. 1998). Such changes affect occupancy and resource use pattern of birds and mammals (Block and Brennan 1993). Due to increase human population and to meet their needs, large scale habitat changes are occurring globally (Khan et al. 1993). The site which is rich in diversity of birds and mammals is facing threat due to increased tourist movement. Extraction of forest resources for meeting the needs of local people and tourism purposes has resulted in habitat degradation of wildlife (Rai and Sundriyal 1997, Kharel 1997, Thapa and Gurung 1998, Chettri et al. 2001).

Species Diversity

Information on biodiversity such as wildlife status (abundance, distribution and home range), population and community interaction and their contribution to ecosystem development is essential for conservation and management of wildlife and protected area (Basnet 1998).

Indian subcontinent is rich in birds and mammalian species whose taxonomy, distribution, and their general habitat characteristics are well documented in India (Ali and Ripley 1983). Eastern Himalaya supports a wild diversity of

birds and mammals due to complex physiographic and bioclimatic zonation and also it lies in between palaearctic and oriental zoo-geographical realms (Ives and Messereli 1989, Inskipp 1989). Chettri et al. (2001) reported a rich diversity of birds in Kanchendzonga region of Sikkim Himalaya. Fleming and Bangdel (2000) has made an extensive report on diversity of birds of Nepal and has found the eastern region "hot spot" of avifauna species. The distribution and diversity of birds and mammals depends on number of interrelated factors such as temperature, rainfall, and vegetation structure. Disturbance plays an important role in the dynamics, structure, and function of ecosystems. Thus to understand the human impact, we need to study about birds and mammalian interactions over a variety of habitats and ecological conditions. Determination of birds and mammalian population in different habitats are central point to understand the community structure and niche relationship as well as for intelligent management of population. Moreover seasonal monitoring is equally important to trace the dynamic movement of birds in such habitats (Green and Catterall 1998).

Human Disturbances

Firewood is the major source of energy for mountain people (Fox 1984, Basnet 1992a,b, Sundriyal and Sharma 1996) because it is easily and freely accessible (Blaikie 1985). Extensive use of firewood and fodder by local people and tourist exerts pressure on the forest causing degradation and loss of biomass (Chettri 2000). Such activities pose threats to the biological resource (Rai and Sundriyal 1997, Rai and Sharma 1998). Generally poor people prefer to collect firewood rather than buying and they have a tendency to exploit the forest near to settlements rather than to think about sustainable use. The continuous illegal collection of firewood, fodder, grazing of livestock, and other activities inside the forest causes depletion of resources that cause adverse effect on biodiversity (Rai and Sundriyal 1997).

4. MATERIALS AND METHODS

4.1 Field Survey and Observation

I collected data by direct and indirect methods. Direct method included field survey and observation while indirect method included questionnaire survey, interview, and participatory rural appraisal (PRA). The preliminary field survey was conducted in the month of September 2004 to explore habitats before initiating actual data collection. The actual field survey was initiated from September 2004 and lasted until September 2005. This covered information on vegetation, birds, mammals, and human disturbances of the Sanctuary.

4.2 Questionnaire Survey

I gathered quantitative information from random questionnaire survey from local people, forest guards, block officers, and rangers. Altogether twenty five villagers and five workers were selected for questionnaire survey. The survey was designed to gather the maximum information on firewood consumption, timber, and fodder extraction by local people.

4.3 Vegetation Sampling

Based on preliminary field survey and mode of forest utilization by settlements, I divided Maenam Wildlife Sanctuary into disturbed (human used) and undisturbed sites. Within disturbed and undisturbed sites, I took four random samples of vegetation by making 20m × 20m plot and compared the vegetation by calculating the density and relative density. The tree species having the diameter more than 12 cm was recorded and the diameter of each tree species was measured at breast height.

Density is the number of individual per unit area. It represents the numerical strength of the species in the community. It can be calculated as:

$$\text{Density} = \frac{\text{No. of individual of a species}}{\text{Size of plots} \times \text{total no. of plots sampled}} \times 10000$$

Relative Density of the species is the density of a particular species with respect to total density of all species.

$$\text{Relative density \%} = \frac{\text{No. of individual of a species}}{\text{Total no. of individual of all species}} \times 100$$

4.4 Faunal Survey

I divided the study area into disturbed and undisturbed sites and followed the line transect method described by (Burnham et al.1980). Each site was surveyed by diurnal walking through fixed transect line of two kilometers length. I used two transect lines in both sites. Besides, random search was carried out to record the observed birds and mammalian species. The abundance or status of birds and mammals were made on the basis of indirect signs, field and questionnaire survey.

4.5 Firewood extraction

I used questionnaire survey for the estimation of firewood. During the survey, I visited each of ten sample households and monitored the amount of firewood burnt during a particular day. I bundled firewood each of 40kg, weighting with a spring balance and requested the family member to burn the bundled wood only. Next day, I returned to the same households with the spring balance and calculated the actual consumption during the day by deducting from the given bundle. The seasonal use of firewood was estimated by weighting the wood at each of the sampled households in all four seasons. Observations were also made in each sampled households to quantify firewood used for various purposes such as heating of water and drying cardamom.

4.6 Fodder Extraction

I took ten sample households in each site and used questionnaire method to gather information on fodder extraction from the forest and farm. The number of livestock in each sample household. The per capita household requirements of fodder for the entire livestock were estimated. The season wise fodder collection from forest and farm was estimated by weighting method.

4.7 Data Analysis

I used student t-test to find the significant difference between vegetation, birds and mammals in disturbed and undisturbed sites by setting following hypothesis.

For vegetation

Ho: There is no significant difference in vegetation structure between disturbed and undisturbed sites.

H_1: Vegetation structures in disturbed and undisturbed sites differ significantly.

For birds

Ho: There is no significant difference in birds between disturbed and undisturbed sites.

H_1: Bird species in disturbed and undisturbed sites differ significantly.

For mammals

Ho: There is no significant difference in mammals between disturbed and undisturbed sites.

H_1: Mammals in disturbed and undisturbed sites differ significantly.

5. RESULTS

5.1 Vegetation Composition

There were thirty-eight tree species in disturbed and undisturbed sites. Out of them, thirty-one species were in undisturbed site and twenty-six species were in disturbed site (Table 5.1). There was higher mean number of trees per quadrat in undisturbed site (46 per quadrat) than in disturbed site (20 per quadrat). The mean difference of trees was statistically significant ($t = 1.94$, $df = 6$, $p = 0.05$) between disturbed and undisturbed sites (Table 5.2).

Tree density was higher in undisturbed site (1149.1 per hectare) than in disturbed site (486.6 per hectare). In undisturbed site, the highest density (62.5 per hectare) and relative density (5.4%) was observed for *Rhododendron barbatum* followed by *Rhododendron falconeri* having density 56.2 per hectare and relative density 4.8%, while *Castanopsis indica* had the lowest density (18.7 per hectare) and relative density (1.6%). Similarly in disturbed site, *Castanopsis hystrix* had the highest tree density (43.7 per hectare) and relative density (8.9%) followed by *Juniperous ramose* with density 37.5 per hectare and relative density 7.6%, while *Betula utilis, Machilus edulis,* and *Symplocos laurina* had the lowest density (6.2 per hectare) and relative density (1.2%), (Table 5.1).

Table 5.1 Density and Relative Density of Tree Species in Disturbed and Undisturbed Sites (Note: P (√) =Present, A (–) =Absent)

S.N.	Scientific Name	Local Name	Disturbed			Undisturbed		
			P/A	Density no/ha	R.D. %	P/A	Density no/ha	R.D. %
1	*Quercus glauca*	Phalant	√	18.7	3.8	√	31.2	2.7
2	*Quercus lamellosa*	Bajrant	-	0	0	√	25.0	2.1
3	*Castanopsis tribuloides*	Musure katus	√	18.7	3.8	√	31.2	2.7
4	*Acer cambellii*	Kapasay	√	12.5	2.5	√	37.5	3.2
5	*Alnus nepalensis*	Uttis	√	25.0	5.1	-	0	0
6	*Betula utilis*	Bhuja pat	√	6.2	1.2	√	37.5	3.2
7	*Litsea crata*	Saur	√	18.7	3.8	-	0	0
8	*Machilus odoratissima*	Lali kawlo	√	12.5	2.5	-	0	0
9	*Machilus edulis*	Kewlo	√	6.2	1.2	√	18.7	1.6
10	*Ficus neriifolia*	Dudhilo	√	31.2	6.4	√	25.0	2.1
11	*Ficus clavata*	Lute khenew	√	18.7	3.8	-	0	0
12	*Ficus bengalensis*	Bar	-	0	0	√	31.2	2.7
13	*Pratia nummularca*	Malagiri	√	18.7	3.8	√	43.7	3.8
14	*Symplocos theifolia*	Kharane	-	0	0	√	37.5	3.2
15	*Symplocos laurina*	Kholme	√	6.2	1.2	√	31.2	2.7
16	*Viburnum rutra*	Asare	√	12.5	2.5	√	50.0	4.3
17	*Lyonia ovalifolia*	Angeri	√	12.5	2.5	√	37.5	3.2
18	*Nyssa javanica*	Lekh chilaune	√	18.7	3.8	-	0	0
19	*Acer oblongum*	Patley	√	31.2	6.4	√	50.0	4.3
20	*Eugelherdtia sp.*	Mahawa	√	6.2	1.2	√	25.0	2.1
21	*Juglans regia*	Okhar	√	12.5	2.5	√	43.7	3.8
22	*Michelia champaca*	Rani chanp	-	0	0	√	37.5	3.2
23	*Michelia cunia*	Titay chanp	-	0	0	√	31.2	2.7
24	*Gynocardia odorata*	Banghi	-	0	0	√	37.5	3.2

25	*Acrocarphus taxinifolins*	Madane	√	18.7	3.8	√	50.0	4.3
26	*Magnolia campbelli*	Ghoge chanp	-	0	0	√	43.5	3.8
27	*Rhododendron barbatum*	Chimal	-	0	0	√	62.5	5.4
28	*Abies spectabilis*	Gobre salla	-	0	0	√	43.7	3.8
29	*Rhododendron falconeri*	Korlingo	-	0	0	√	56.2	4.8
30	*Saurauia napaulensis*	Gogen	√	18.7	3.8	-	0	0
31	*Populus indica*	Pipli	√	25.0	5.1	√	37.5	3.2
32	*Elaeocarpus sikkimensis*	Bhadrasay	√	6.2	1.2	√	31.2	2.7
33	*Juniperous ramosa*	Dhuppi	√	37.5	7.6	-	0	0
34	*Semecarpus anacardium*	Bhalayo	√	31.2	6.4	√	37.5	3.2
35	*Erythrina stricta*	Phalado	√	18.7	3.8	√	43.7	3.8
36	*Eurya acuminata*	Jhingani	-	0	0	√	25.0	2.1
37	*Castanopsis indica*	Dhalne katus	-	0	0	√	18.7	1.6
38	*Castanopsis hystrix*	Patle katus	√	43.7	8.9	√	37.5	3.2
	Total			486.6			1149.1	

Table 5.2 Comparison of Vegetation Structure of Disturbed and Undisturbed Sites

Sites	Total no. of trees	Mean value	Density	T-test calculated	Remarks t=1.94, df=6, p=0.05
Disturbed	78	20	486.6	3.3	Ho: Rejected
Undisturbed	184	46	1149.1		

5.2 Birds

5.2.1 Species Richness and Abundance

There were thirty-seven bird species belonging to nineteen families in both disturbed and undisturbed sites. Out of them, thirty-one bird species belonging to sixteen families were in disturbed site, while eleven species of bird belonging to nine families were in undisturbed site. Five bird species belonging to five families were common in both sites. Student's t-test also showed a significant difference (t=2.92, df=2, p=0.05) between number of birds in

disturbed and undisturbed sites in different seasons (Table 5.5). Out of thirty-one bird species recorded in disturbed site, I observed eighteen bird species belonging to eleven families as common, two bird species belonging to two families as uncommon, eleven bird species belonging to seven families as frequent (Table 5.3). Similarly in undisturbed site, there were one bird species belonging to one family as common, three species belonging to three families as uncommon, four species belonging to four families as frequent, and three species belonging to three families as occasional (Table 5.4).

Out of thirty-seven species of bird, twenty-six bird species were observed only in disturbed site and six species only in undisturbed site, while five bird species were observed both in disturbed and undisturbed sites. The disturbed site showed the highest numbers of bird species (Annex II).

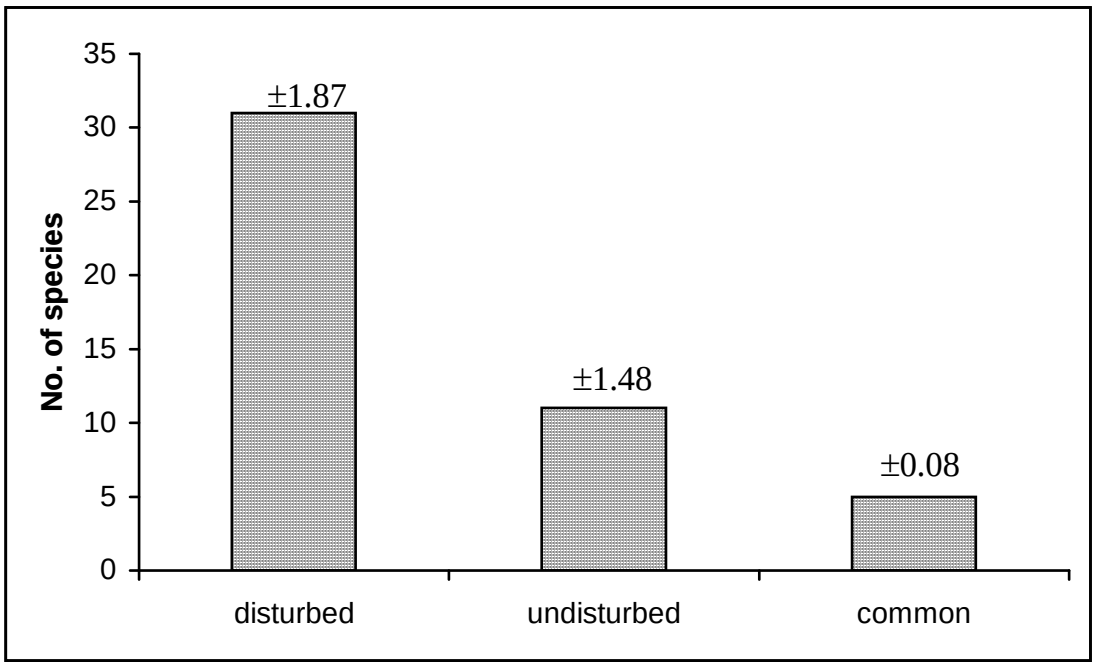

Figure 5.1 Species richness of birds at different sites of the study area (Note: Figures on the top of bars indicate standard deviation)

Table 5.3 Total Number of Bird Recorded in Disturbed Site and their Abundance in Maenam Wildlife Sanctuary

S.N.	Family/Scientific Name	Local Name	Autumn		Winter		Spring		Summer		Total No.	Abundance
			T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2		
1.	**Accipitridae**											
	Ictinaetus malayensis	Black Eagle	6	-	4	-	3	6	7	5	31	Common
2.	**Timaliidae**											
	Alcippe castaneceps	Chestnutheaded Tit Babbler	-	2	-	2	4	4	3	6	21	Common
	Garrulax leucolophus	Whitecrested Laughing Thrush	3	4	1	3	10	4	5	6	36	Common
	G. affinis	Blackfaced Laughing Thrush	3	1	2	4	9	4	7	1	31	Common
	G. erythrocephalus	Readheaded Laughing Thrush	-	2	-	2	2	4	-	6	16	Commonl
	Dumetia hyperythra	Rufousbellied Babbler	2	-	1	-	4	4	-	2	13	Frequent
3.	**Sylviidae**											
	Seicercus castaniceps	Chestnutheaded Flycatcher Warbler	-	1	3	3	2	3	-	1	13	Frequent
	Phylloscopus magnirostris	Largebilled Leaf Warbler	2	-	3	-	4	1	2	-	12	Frequent
	P. inornatus	Plain Leaf Warbler	-	-	5	3	6	-	-	-	14	Frequent
	P. affinis	Tickell's Leaf Warbler	3	2	-	5	-	4	-	-	14	Frequent
	Seicercus xanthoschistos	Grayheaded Flycatcher Warbler	-	-	3	5	5	4	-	2	19	Common
	Phylloscopus trochiloides	Dull Green Leaf Warbler	-	1	3	3	2	5	4	-	18	Common
4.	**Paraidae**											
	Parus monticolus	Greenbacked Tit	3	3	6	1	7	9	4	6	39	Common
	Aegithalos concinnus	Redheaded Tit	2	2	-	7	3	10	2	5	31	Common
5.	**Dicaeidae**											
	Dicaeum ignipectus	Firebreasted Flowerpecker	4	-	3	4	11	2	6	3	33	Common
6.	**Ploceidae**											
	Passer montanus	Tree Sparrow	1	-	-	4	-	6	2	2	15	Frequent
7.	**Strunidae**											
	Acridotheres tristis	Common Myna	7	7	5	5	17	7	2	14	64	Common
8.	**Corvidae**											
	Cissa flavirostris	Yellowbilled Blue Magpie	-	2	3	3	-	7	5	3	23	Common
	Dendrocitta formosae	Himalayan Treepie	2	2	-	3	-	8	-	5	20	Common
9.	**Capitonidae**											
	Megalaima virens	Great Himalayan Barbet	3	-	-	6	5	3	7	1	25	Common
	M. asiatica	Bluethroated Barbet	1	1	5	1	6	5	-	7	26	Common
10.	**Columbidae**											
	Streptopelia orientalis	Rufous Turtle Dove	-	2	-	-	6	1	4	-	13	Frequent
	S. chinensis	Spotted Dove	3	4	-	1	6	6	-	9	29	Common
11.	**Cuculidae**											
	Cuculus sparverioides	Large Hawk Cuckoo	1	-	-	4	1	6	3	-	12	Frequent
	C. mircropterus	Indian Cuckoo	-	5	8	-	6	5	4	1	29	Common

12.	**Picidae**											
	Picoides darjellensis	Darjeeling Pied Woodpecker	2	1	-	-	5	3	5	-	13	Frequent
	Picus chlorolophus	Small Yellownaped Woodpecker	-	1	-	-	4	4	-	5	14	Frequent
13.	**Dicruridae**											
	Dicrurus leucophaeus	Ashy Drongo	-	5	-	1	2	5	4	1	18	Common
14.	**Pycnonotidae**											
	Pycnonotus striatus	Striated Bulbul	-	2	1	-	2	2	-	4	11	Frequent
15.	**Irenidae**											
	Chloropsis aurifrons	Goldenfronted Leafbird	-	-	-	-	2	-	-	2	4	uncommon
16.	**Strigidae**											
	Glaucidium cuculoides	Barred Owlet	-	1	-	-	-	3	-	-	4	uncommon

Table 5.4 Total Number of Bird Recorded in Undisturbed Site and their Abundance in Maenam Wildlife Sanctuary

S.N.	Family/Scientific Name	Local Name	Autumn		Winter		Spring		Summer		Total No.	Abundance
			T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2		
1.	**Capitonidae**											
	Megalaima virens	Great Himalayan Barbet	-	-	3	1	5	-	-	3	12	Frequent
2.	**Dicruridae**											
	Dicrurus leucophaeus	Ashy Drongo	2	-	1	1	2	3	3	-	12	Frequent
3.	**Psittacidae**											
	Psittacula himalayana	Slatyheaded Parakeet	-	-	-	-	-	2	-	1	3	Uncommon
4.	**Phasianidae**											
	Lophura leucomelana	Kalij Phesant	1	-	-	1	3	-	2	-	7	Occasional
	Tragopan satyra	Satyr Tragopan	-	1	-	-	-	2	-	-	3	Uncommon
5.	**Cuculidae**											
	Cuculus canorus	Eurasian Cuckoo	2	-	3	-	3	1	-	2	11	Frequent
6.	**Columbidae**											
	Treron sp	Green Pigeon	1	-	-	2	2	1	2	-	8	Occasional
	Streptopelia chinensis	Spotted Dove	-	-	-	-	3	-	1	-	4	Uncommon
7.	**Corvidae**											
	Dendrocitta formosae	Himalayan Tree Pie	2	-	4	-	2	3	-	2	13	Frequent
8.	**Sturnidae**											
	Acridotheres tristis	Common Myna	-	3	2	2	5	2	3	-	17	Common
9.	**Faclconidae**											
	Falco tinnunculus	Eurasian Kasterel	-	-	3	-	2	3	-	-	8	Occasional

Table 5.5 Comparison of Birds between Disturbed and Undisturbed Sites

Season	No. of species in disturbed site		Total No. of species	No. of species in undisturbed site		Total No. of species	T-test calculated	Remarks t=2.92, df=2, p=0.05
Autumn	T_1	48	98	T_1	7	11	29.3	Ho: Rejected
	T_2	50		T_2	4			
Winter	T_1	21	120	T_1	16	23	4.9	Ho: Rejected
	T_2	69		T_2	7			
Spring	T_1	134	269	T_1	27	44	22.5	Ho: Rejected
	T_2	135		T_2	17			
Summer	T_1	76	173	T_1	10	18	7.0	Ho: Rejected
	T_2	97		T_2	8			

5.3 Mammals

5.3.1 Species Richness and Abundance

Altogether fifteen mammalian species belonging to twelve families were found in the study area. Out of them, eight species belonging to eight families were in disturbed site, while thirteen mammalian species belonging to eleven families were in undisturbed site, and six species belonging to five families were common in both sites. Student's t-test showed no significant difference (t=2.92, df =2, p=0.05) between mammals of disturbed and undisturbed sites (Table 5.8). I observed eight uncommon species and five common species in undisturbed site (Table 5.6), while in disturbed site there were three common species, two uncommon species, and three frequent species (Table 5.7).

Among fifteen mammalian species recorded from both disturbed and undisturbed sites, two species *Funambulus sp.* and *Macaca assamensis* were observed only in disturbed site, seven species *Ailurus fulgens, Felis bengalensis, Suncus murinus caerulascens, Vulpes bengalensis, Ratufa bicolar, Viverra zibtta,* and *Viverricula indica* were observed only in undisturbed site and six species *Canis aureus, Muntiacus muntjak, Hystrix indica, Pteropus giganteus, Sus scrofa,* and *Nemorhaedus goral* were found in both sites.

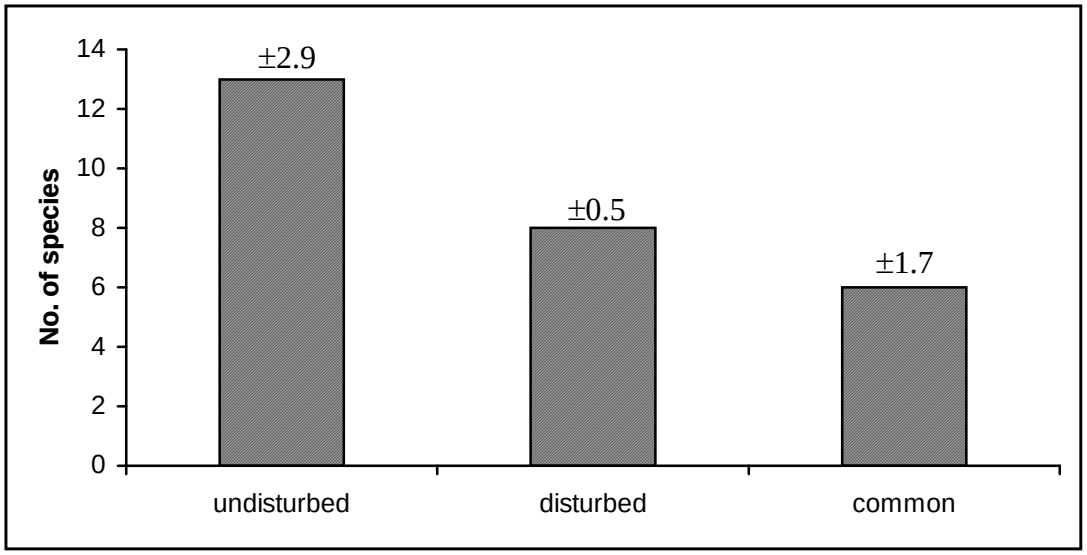

Figure 5.2 Species richness of mammals at different sites of study area

(Note: Figures on the top of bars indicate standard deviation)

Table 5.6 List of Mammalian Species Recorded in Undisturbed Site (Core)

Family	Scientific Name	Common Name	Autumn		Winter		Spring		Summer		Total No.	Abundance
			T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2		
Ailuridae	*Ailurus fulgens*	Red Panda	-	-	-	-	-	1	-	1	2	Uncommon
Felidae	*Felis bengalensis*	Leopard Cat	-	-	-	-	-	1	-	-	1	Uncommon
Soricidae	*Sncus murinus caerulascens*	Musk Rat	-	1	-	2	-	1	2	-	6	Common
Canidae	*Canis aureus*	Jackal	1	-	1	2	-	1	2	3	10	Common
	Vulpes bengalensis	Indian Fox	-	-	-	-	-	-	1	-	1	Uncommon
Cervidae	*Muntiacus muntjak*	Barking Deer	-	1	-	-	1	1	-	-	3	Uncommon
Erethizontidae	*Hystrix indica*	Porcupine	1	2	-	-	-	2	1	3	9	Common
Suidae	*Sus scrofa*	Wild Boar	-	3	-	-	1	-	2	-	6	Common
Seiuridae	*Ratufa bicolor*	Black Giant Squirrel	-	-	-	-	3	-	-	1	4	Uncommon
Pteropodidae	*Pteropus giganteus*	Flying Fox	-	-	-	-	-	-	1	-	1	Uncommon
Viverridae	*Viverra zibetta*	Large Indian Civet	-	-	1	-	-	1	-	-	2	Uncommon
	Viverricula indica	Small Indian Civet	-	-	-	-	-	1	-	1	2	Uncommon
Bovidae	*Nemorhaedus goral*	Goral	-	3	-	-	-	2	1	-	6	Common

Source: Field Survey 2004-05

Table 5.7 List of Mammalian Species Recorded in Disturbed Site

Family	Scientific Name	Common Name	Autumn		Winter		Spring		Summer		Total No.	Abundance
			T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2		
Canidae	*Canis aureus*	Jackal	-	4	2	4	-	1	-	-	11	Frequent
Cervidae	*Muntiacus muntjak*	Barking Deer	2	-	3	-	-	3	2	-	10	Common
Erethizontidae	*Hystrix indica*	Porcupine	1	3	-	4	-	3	2	-	13	Frequent
Pteropodidae	*Pteropus giganteus*	Flying Fox	-	-	-	2	-	-	3	-	5	Uncommon
Seiuridae	*Funambulus sp.*	Squirrel	3	4	3	5	1	3	-	-	18	Frequent
Suidae	*Sus scrofa*	Wild Boar	2	2	1	-	1	-	2	-	8	Common
Ceropithecidae	*Macaca assamensis*	Assemese Monkey	-	2	1	1	-	2	4	-	10	Common
Bovidae	*Nemorhaedus goral*	Goral	-	1	-	-	1	-	-	2	4	Uncommon

Source: Field Survey 2004-05

Table 5.8 Comparison of Mammals between Disturbed and Undisturbed Sites

Seasons	No. of species in disturbed site		Total No. of species	No. of species in undisturbed site		Total No. of species	T-test calculated value	Remarks t=2.92, df=2, p=0.05,
Autumn	T_1	8	24	T_1	2	12	1.1	Ho: Accepted
	T_2	16		T_2	10			
Winter	T_1	10	26	T_1	2	6	1.2	Ho: Accepted
	T_2	16		T_2	4			
Spring	T_1	3	15	T_1	5	16	0.1	Ho: Accepted
	T_2	12		T_2	11			
Summer	T_1	13	15	T_1	10	19	0.3	Ho: Accepted
	T_2	2		T_2	9			

5.4 Human Disturbances

5.4.1 Firewood Collection and Consumption

I found the extraction of firewood by local people mainly for heating, cooking, and for cowshed (feeder boiling and heating). The average use of firewood by local people for heating and cooking was 16kghh^{-1}day^{-1} and for cowshed (feeder boiling and heating) was 12kghh^{-1}day^{-1}. The use of firewood by each household for heating and cooking was 5670kghh^{-1}yr^{-1} and for cowshed (feeder boiling and heating) was 4230kghh^{-1}yr^{-1}. Collection of firewood was maximum in winter (3960kghh^{-1}) and minimum during summer (1350kghh^{-1}). The annual total collection of firewood by each household for heating, cooking, and for cowshed was 9900kghh^{-1}yr^{-1}.

Table 5.9 Seasonal and Total Annual Collection of Firewood by Settlements Adjoining to MWS

Resources	Average kghh^{-1} day^{-1}	kghh^{-1} in winter	kghh^{-1} in spring	kghh^{-1} in summer	kghh^{-1} in autumn	Annual total kghh-^{1}yr-^{1}
Firewood collection for cooking and heating	16	2340	1080	720	1530	5670
firewood for cowshed (feeder boiling and heating)	12	1620	810	630	1170	4230
Total	28	3960	1890	1350	2700	9900

Ravangla had the highest collection of firewood (3510kghh^{-1}yr^{-1}) followed by Yangang (2880kghh^{-1}yr^{-1}). Mangzing extracted the least firewood (1710kghh^{-1}yr^{-1}) among the four sites.

Table 5.10 Firewood Collection and Consumption from the Forest of MWS by Settlements

Village	Average kghh^{-1} day^{-1}	Winter kghh^{-1}	Spring kghh^{-1}	Summer kghh^{-1}	Autumn kghh^{-1}	Total kghh^{-1}yr^{-1}
Ravangla	38	1440	720	360	990	3510
Yangang	32	1170	540	450	720	2880
Mangzing	19	630	360	270	450	1710
Lingmoo	20	720	270	270	540	1800

5.4.2 Fodder Collection

Local people collected fodder from both their farms and forest. The average collection of fodder from the forest was 21kgday^{-1}hh^{-1} and from the farms was 16kgday^{-1}hh^{-1}. I found the maximum fodder collection from the forest during winter (2790kghh^{-1}) and minimum during summer (990kghh^{-1}), while fodder collection from farm was maximum during summer (1710kghh^{-1}) and minimum during winter (1260kghh^{-1}). The annual total collection of fodder from forest was 7380kg yr^{-1}hh^{-1}, while from farm was 5760kghh^{-1} yr^{-1}.

Table 5.11 Seasonal Collection of Fodder by Settlements adjoining to MWS

Fodder collection	Average Kghh^{-1}day^{-1}	Kghh^{-1} in winter	Kghh^{-1} in spring	kghh^{-1} in summer	kghh^{-1} in autumn	Annual total kghh^{-1}yr^{-1}
Forest	21	2790	1440	990	2160	7380
Farm	16	1260	1350	1710	1440	5760

Lingmoo had the highest fodder collection per household basis (3690 kghh-^{1}yr^{-1}) followed by Mangzing with the value (3420kghh^{-1}yr^{-1}). Ravangla extracted the least fodder (2880 kghh^{-1}yr^{-1}) among the four sites.

Table 5.12 Extraction of Fodder from Forest of MWS by Settlements

Village	Average kghh^{-1} day^{-1}	Winter kghh^{-1}	Spring kghh^{-1}	Summer kghh^{-1}	Autumn kghh^{-1}	Total kghh^{-1}yr^{-1}
Ravangla	32	900	630	540	810	2880
Yangang	35	990	630	720	810	3150
Mangzing	38	1080	720	630	990	3420
Lingmoo	40	1080	810	810	990	3690

6. DISCUSSION

Vegetation

I found higher mean number of trees per quadrat and tree density per hectare in undisturbed site than in disturbed site (Table 5.2). The findings was also similar to (Dhakal 2004) in the same study site. Student's t- test also showed a significant mean difference (t=1.94, df=6, p=0.05) between the vegetation structure in disturbed and undisturbed sites. This difference in structure and composition of vegetation might be due to disturbances regime, because the disturbed site closer to human settlements experienced more pressure in resource extraction such as firewood and fodder collection. Chettri et al. (2002) summarized that the collection of fodder, timber, and firewood from forest lead to the loss of tree species richness and tree density. Species like *Machilus edulis, Betula utilis, Symplocos laurina*, *Eugelherdtia sp.,* and *Elaeocarpus sikkimensis* had lower density in disturbed site than in undisturbed site (Table 5.1). This could be due to human activities such as firewood extraction, fodder collection, and timber harvesting. The ruthless destruction and use of forest for various human purposes like animal grazing, timber harvesting, and deforestation of forests for making agricultural land cause adverse impact on vegetation structure (Basnet 1992a). Deforestation and collection of wild plants lead to the extinction of valuable plant species (Sundriyal and Sharma 1996, Rai and Rai 2002).

Birds

Bird species was found higher in disturbed site than in undisturbed site. This could be due to maximum available foraging ground in disturbed site due to clear canopy. Finding was similar to (Chettri et al. 2001) in Yuksum-Dzongri trekking corridor in west Sikkim. Block (1989), Daniels (1989) summarized that an opening of canopy creates more ground for resources and all general species as well as species adjustable to such condition will exploit the area. The presence of large number of bird species in disturbed site could also be due to edge effect (Kinglo et al.1997). Human pressure has altered species

composition and canopy organization, which may result in avifauna species richness and abundance (Sultana and Khan 1999, Chettri et al.2001). Species like *Psittacula himalayana, Lophura lencomelana, Tragopan satyar* were observed only in undisturbed site, because they are forest interior birds which cannot tolerate disturbances. The highest number of species in spring season was probably due to flowering of vegetation and availability of sown seeds of crops in adjoining areas. The bird species like *Chloropsis aurifrons* and *Glaucidium cuculoids* were uncommon, *Cuculus micropterus* and *Megalaima asiatica* were common and *Passer montanus, Streptopelia orientalis* were frequent in disturbed site (Table 5.3) while *Tragopan satyra* and *Streptopelia chinensis* were uncommon, *Megalaima virens* and *Dicrurus leucophaeus* were frequent and *Acridotheres tristis* were common species in undisturbed site (Table 5.4). According to Inskipp (1989), though bird species were from a range of habitat types including agricultural land, bamboo grove, shrub land, forest, and village, highest sighting was in forest indicated the importance of forest habitat for nesting, foraging, and other life related activities for majority of species. I found large number of species restricted in disturbed site and significant difference ($t=2.92$, $df=2$, $p=0.05$) between disturbed and undisturbed site in terms of number of bird species in different seasons (Table 5.5). This could be due to the easy availability of feeding ground in agricultural land near forest. Many bird species could tolerate sub-optional conditions arising as a result of habitat degradation to some extent (Block and Brennan 1993, Rodewald and Yahner 2001). Bird community can be maintained by minimizing further degradation of habitats by regulating human activities (Johnsing and Joshu 1994).

Mammals

My research showed the presence of higher number of mammalian species in undisturbed site than in disturbed site. This difference in species number could be due to human disturbances such as habitat destruction and fragmentation. However some species which can tolerate such disturbances occurred in

disturbed sites they included *Macaca assamensis, Funambulus sp., Canis aureus* and *Sus scrofa*. During the field survey, activities like hunting, poaching grazing of livestock, and timber collection were observed. Such activities forced the mammalian species to move towards the undisturbed site. The destruction of even small forest areas can push the certain species into core areas where there is less/no disturbance (Wilson 1998). Species like *Aliurus fulgens* was observed through sign in undisturbed site only due to its nocturnal habit and it is a rare mammal, which cannot tolerate disturbances. To maintain viable population, large carnivores need large area with adequate prey densities and are therefore, threatened by habitat loss and fragmentation (Woodroffe and Ginsberg 1998). I found no significant difference ($t=2.92$, $df=2$, $p=0.05$) between mammals of disturbed and undisturbed sites, but there was variation in species number.

Human Disturbances

Wildlife habitat is regularly disturbed by local people by collecting firewood, fodder, and bedding materials. Heavy exploitation of resources coupled with crude and destructive extraction techniques have seriously deteriorated the habitat quality. The human activities within the forest also disturbed the wildlife's seasonal and daily activities including breeding. The maximum use of firewood was in heating and cooking and minimum for cowshed (feeder boiling and heating) (Table 5.9). Of the total annual collection, 57.2% of firewood was used for household (Heating and cooking) and 42.8% of firewood was used for cowshed (feeder boiling and heating). The finding was similar to (Dhakal 2004) in same study site. Collection of firewood was maximum during winter ($3960 kghh^{-1}$) and minimum during summer ($1350 kghh^{-1}$). The maximum collection of firewood during winter was due to extreme coldness. Moreover, most of the people used to collect the firewood during winter for future use too. The quantities and pattern of firewood consumption also varied due to climatic difference between higher and lower altitudes. Consumption at the higher altitude was almost twice as much as in

the lower altitudes. In the hills dependency on forest is higher in comparison to low land (Mahat 1985). The collection of firewood was the highest in Ravangla (3510kghh^{-1}) due to high population and extreme cold (about 15-18^{oC}) and the least collection in Mangzing (1710kghh^{-1}) due to sufficiency of firewood in their own lands.

The collection of fodder was maximum from forest and minimum from the farms (Table 5.11). The total annual collection of fodder from the forest was 56.1%, which was more than fodder collection from farms (43.9%). The finding was also similar to (Dhakal 2004) in the same study site. The fodder collection from the forest was maximum during winter (2790kghh^{-1}) and minimum during summer (990kghh^{-1}). This could be due to minimum availability of fodder in the farms during winter (1260 kghh^{-1}) and minimum collection of fodder from the forest during summer (990 kghh^{-1}) could be due to sufficient production of fodder in the farms (1710kghh^{-1}). The highest extraction of fodder from both forest and farms was in Lingmoo (3690kghh^{-1}yr^{-1}), while the least in Ravangla (2880kghh^{-1}yr^{-1}). The highest extraction of fodder in Lingmoo was mainly due to a large number of livestock and non availability of grazing lands, while the least extraction in Ravangla was due to illegal grazing of livestock in and around the Sanctuary.

7. CONCLUSION AND RECOMMENDATIONS

The study conducted during 2004-2005 in MWS showed human pressure in Wildlife. The mean number of trees (46 per quadrat) and tree density (1149.1 per hectare) in undisturbed site were higher than in disturbed site with mean number of trees (20per quadrat) and density (486.6 per hectare). Firewood extraction, fodder collection, and grazing of livestock were common practices which disturbed the habitats of wildlife and opened the canopy by cutting and chopping forests. There was a significant difference (t=1.94, df=6, p=0.05) between vegetation of disturbed and undisturbed sites which was an evidence of the human impact on vegetation structure.

Disturbed site had higher number of birds (31 species) as compared to undisturbed site (11 species), which showed tolerance capacity of birds in disturbed habitat to some extent. Disturbed site had significantly (t=2.92, df=2, p=0.05) higher number (31 species) of bird species than the undisturbed site. It showed that birds preferred canopy clear area or habitat.

The finding of higher species richness of mammals (13 species) in the undisturbed site showed that mammals required well developed habitat for feeding, breeding, and other life activities and they could not tolerate human disturbances. The disturbed and undisturbed sites had no significant difference (t=2.29, df=2 p=0.05) but there was a variation in sighting the number of species.

The collection of firewood was mainly for heating, cooking, and for cowshed (feeder boiling and heating) (Table 5.9). Seasonal collection of firewood was the highest during winter (3960kghh^{-1}) for avoiding coldness and minimum during summer (1350kghh^{-1}) due to the influence of rainy days. Collection of firewood was the highest in Ravangla (3510kghh^{-1}yr^{-1}) due to the dense population and this area is situated comparatively near from the Sanctuary and the least in Mangzing (1710 kghh^{-1}yr^{-1}), because this area is situated far from the Sanctuary and also due to the sufficiency of firewood in their own lands. Similarly, fodder collection was maximum from the forest and minimum from

the farms (Table 5.11). The highest collection of fodder was in Lingmoo (3690kghh^{-1}yr^{-1}), because of the lack of grazing land in this area, and the least in Ravangla (2880kghh^{-1}yr^{-1}) due to the grazing of livestock in and around the Sanctuary.

This study showed that the MWS is facing serious disturbances which need to be addressed through integrated community development programs of community based conservation.

Based on my research work, I derived following recommendations;

1. Firewood is the primary source of energy (fuel) in this area. Thus to protect forest from extreme degredation, local people should be attracted towards alternative source of energy like biogas, solar energy, improved chullo,etc.

2. Concept of community forest should be introduced at local levels which stresses both conservation of forest and local consumption.

3. Buffer zone should be decleared in Maenam Wildlife Sanctuary which will help in decreasing the conflict between local people and wildlife.

4. Periodic biological and socio-economic survey should be carried out, so that biodiversity and socioeconomic status and impacts can be identified.

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Annex I: Questionnaire for Household Survey

1. Respondent Name:…….....…..
   Age:…….....……..
   Sex: ……
   Occupation:…….
   Village: ……..
2. Number of family member in your family
   …….
3. Number of your livestock.
   a) Buffalo
   b) Cattle
   c) Goat and Sheep
   d) Total number
4. How do you feed your livestock?
   a) Stall feeding b) Fodder collection c) Grazing d) Other
5. Where do you usually graze your livestock?
   a) Own field b) Government Forest c) Other
6. Which season do you graze your livestock?
   a) Summer b) Winter c) spring d) autumn
7. Is here any practice of grazing livestock in government forest during the scarcity of fodder in private land?
   a) Yes b) No
8. If yes, which animal do you mostly graze in the government forest?
   a) Cattle b) Goat c) Sheep d) Other
9. Do you visit forest regularly? Yes/No
10. If yes, why do you visit?
    a) Pleasure d) fuel wood collection
    b) Trekking e) timber harvesting
    c) Fodder collection f) other
10. If fodder/timber collection, in which season do you mostly collect fodder/ timber?
    a) Summer b) Winter
    c) Spring d) Autumn

11. Which tree do you mostly prefer for timber and fodder collection, name the trees?

Timber	Fodder

12. Who goes for collection of fodder and timber in forest men/women/ children/all.
13. Is there any Goth inside the forest? Yes/ No.
    i) If yes, How many?
    ii) Number of animals.
    iii) Name of cattle herds.
    iv) Permanent or temporary.
14. Can we see wild animals during visit? Yes/No

_____

15. What kinds of wildlife can we see in this forest?
16. Can you name some birds and mammals that are present in this forest?

Birds	Mammals

17. Is there any seasonal difference in the presence and absence of wild birds and mammals in this forest?
18. Are you facing any problems of wild animals from this forest?
    Yes/No_____ if yes _____ (a) Human attract/livestock predation/crop loss other
19. Which animals are mostly problematic in your view and why?
20. Is there any change in sighting wildlife during last 10 years?
21. What are the major problems on wildlife conservation due to human activities?
    1.
    2.
    3.

Annex II: Bird Species Restricted in Disturbed and Undisturbed Sites with Common Species

Disturbed Site

Garrulax leucolophus (Whitecrested Laughing thrush)
Garrulax erythrocephalus(Redheaded Laughing Thrush)
Garrulax affinis(Blackfaced laughing Thrush)
Alcippe castaneceps(Chestnut Headed Tit Babbler)
Dumetia hyperythra(Rufousbellied Babbler)
Megalaima asiatica(Bluethroated Barbet)
Culculus sparverioides(Large Hawk Cuckoo)
Cuculus micropterus(Indian Cuckoo)
Streptopelia orientalis(Rufous Turtle Dove)
Seicercus xanthoschistos(Grayheaded Flycatcher Warbler)
Phylloscopus affinis(Tickell's Leaf Warbler)
Phylloscopus trochiloides(Dull Green Leaf Warbler)
Phylloscopus magnirostris(Largebilled Leaf Warbler)
Phylloscopus inornatus(Yellowbrowed Leaf Warbler)
Seicercus castaniceps(Chestnutheaded Flycatcher Warbler)
Aegithalos concinnus(Redheaded Tit)
Parus monticolus (Greenbacked Tit)
Dicaeum ignipectus(Firebreasted Flowerpecker)
Pycnonotus striatus(Striated Bulbul)
Cissa flavirostris(Yellowbilled Blue Magpie)
Picus chlorophus(Yellownaped woodpecker)
Picodies darjellensis(Darjelling Pied Woodpecker)
Glaucidium cuculoides(Barred Owlet)
Ictinaetus malayensis(Black Eagle)
Chloropsis aurifrons(Goldenfronted Leafbirds)
Passer montanus(Tree Sparrow)

Undisturbed Site

Psittacula himalayana(Slatyhaded Parakeet)
Lophura leucomelana(Kalij Phesant)
Tragopan satyra(Satyar Tragopan)
Cuculus canorus(Eurasian Cuckoo)
Treron sp.(Green Pigeon)
Falco tinnunculus(Eurasian Kasteral)

Common Species to Both Sites

Megalima virens(Great Himalayan Barbet)
Dicrurus leucophaeus(Ashy Drongo)
Streptopelia chinensis(Spotted Dove)
Dendrocitta formosae(Himalayan Treepie)
Aeridotheres tristis(Common Myna)

Source: Field Survey 2004-05