Carrying Capacity Study of Teesta Basin in Sikkim

Volume-VII

BIOLOGICAL ENVIRONMENT - FAUNAL ELEMENTS

Commissioned by :

Ministry of Environment & Forests, Government of India

Sponsored by :

National Hydroelectric Power Corporation Ltd., Faridabad

CENTRE FOR INTER-DISCIPLINARY STUDIES OF
MOUNTAIN & HILL ENVIRONMENT
CISMHE UNIVERSITY OF DELHI, DELHI

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&

Salim Ali Centre for Ornithology and Natural History, Coimbatore

An Ecological Study on Mammals, Birds, Herpertofauna and Butterflies in Teesta Basin, Sikkim







SACON

Salim Ali Centre for Ornithology and Natural History
Coimbatore

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- **Centre for Inter-disciplinary Studies of Mountain & Hill Environment, University of Delhi, Delhi**

- **Centre for Atmospheric Sciences, Indian Institute of Technology, Delhi**

- **Centre for Himalayan Studies, University of North Bengal, Distt. Darjeeling**

- **Department of Geography and Applied Geography, University of North Bengal, Distt. Darjeeling**

- **Salim Ali Centre for Ornithology and Natural History, Anaikatti, Coimbatore**

- **Water and Power Consultancy Services (India) Ltd., Gurgaon, Haryana**

- **Food Microbiology Laboratory, Department of Botany, Sikkim Government College, Gangtok**

VOLUMES INDEX*

*For Volume-wise Detailed Index – Refer to the end of the report

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1.1 INTRODUCTION

Among all the Indian states, Sikkim is undoubtedly the richest in biodiversity relative to its geographical area. Although Sikkim is only one twentieth of the Western Ghats in geographical area, the species richness of mammals, birds and butterflies is very high. The other faunal groups have been far less documented to make a comparison meaningful. The flora is also equally diverse at species and higher taxonomic levels, in habit and the associations that they form, orchids being a well-known example. This breathtaking diversity results from the geographical location of the state with overlap of three biogeographic realms namely Palaearctic, Indo-Chinese and Indo-Malayan, and an altitudinal and climatic regime that is unique in the world. That much of the biodiversity remain today is undoubtedly due to the low human population densities as well as the biodiversity dependent and diverse human life style.

The above diversity is best experienced if one traverses the course of river Teesta, from an altitude of about 234 m to about 6,000 m. From the remnant patches of tropical wet forest at the lowest altitudes, the vegetation changes rapidly along the course of the river reflecting altitude, precipitation, topography and aspect. The faunal assemblages also change rapidly from tropical to sub-tropical, temperate, alpine and finally to cold desert forms. It follows from this rapid transition that all the floral and faunal taxa in Sikkim have very small distribution ranges within the state. Another notable feature of biodiversity in Sikkim is the strong influence of seasonality, especially at higher altitudes. While some taxa (such as herpetofauna and

smaller mammals) hibernate in winter, others migrate locally (mountain ungulates) or over long distances (birds).

There are several threats to the biodiversity of Sikkim; among the most important are the increasing human population, ongoing and proposed hydel projects in river Teesta and resultant immigration of several thousand construction workers, seasonal influx of tourists, the presence of a army due to international borders, and increasingly unsustainable extraction of natural resources such as medicinal plants. Although Sikkim has the highest Protected Area coverage in India (34%), this is primarily due to one large protected area, the Khangchendzonga Biosphere Reserve. There are six other protected areas, most of them <100 sq km in area. However, with increasing human population and conflicting demands on land, it is becoming increasingly difficult to set aside large areas as national parks or sanctuaries (T.R. Sharma pers. comm). Therefore, the promotion of conservation outside protected areas (in Reserved Forests and private lands) is also critical. The designation and management of protected areas as well as conservation outside protected areas have been severely handicapped by a lack of information on the distribution and ecology of flora and fauna at a scale that is useful to the Forest Department and other agencies.

1.1.1 Objectives

The goal of this project is to fill the major information gaps referred to above. More specifically, the project would provide information on the following aspects:

- Distribution, abundance and ecology of mammals, birds, reptiles, amphibians and butterflies in major vegetation types along Teesta river basin,
- Impacts of various human activities on the above taxa, and major threats;
- Areas of high or unique biodiversity values; and
- Measures for management of biodiversity inside and outside Protected Areas.

The project would also develop local expertise in biodiversity research and monitoring. Apart from annual reports on major findings, a complete set of data (such as species inventory and abundance and photographs) would be deposited with the Forest Department and other agencies for their use.

1.2 STUDY AREA

1.2.1 Location

Sikkim, 27^{o} 10' to 28^{o} 5' N and 88^{o} 30' to 89^{o} E, the rugged mountain state of Indian Union situated in the Eastern Himalaya is surrounded by Nepal in the West, Bhutan in the South-East, Tibetan plateau in the North and North-East and Darjeeling district of Indian State West Bengal in the South.

The study was carried out in forests along the Teesta river basin in Sikkim. Teesta river originates as Chhombo Chhu from a glacial lake Khangchung Chho at an elevation of 5,280 m in the northeastern corner of the state and runs north south dividing Sikkim

into two halves and descends down to about 300 m at Rangpo within a distance of 150 km.

Distinct transition of vegetation occurs at about 900 m altitudes. The study area covered an altitudinal range between 300 m and 4,700 m. Major vegetation types/zones found in Sikkim (Plate 1a and 1b) are given below:

Zone-I (< 900 m): Tropical semi-decicuous forests, represented chiefly by deciduous plants such as *Ceiba malabarica, Ailanthes grandis, Terminalia myriocarpa, Shorea robusta, Duabanga sonneratoides, Schima wallichi, Gynocardia odorata, Amoora rohituka, Pandanus furcatus* and various species of shrubs such as *Strobilanthus, Polygonum* and *Tridax.*

Zone-II (900-1,800 m): Tropical moist and broad leaved forests, most of this zone is partially disturbed due to Cardamom plantation. The major tree species are *Engelhardtia spicata, Alnus nepaulensis, Schima* sp.*, Litsaea citrata, Acer campbelli* and *Castanopsis* sp. The shrub species representing the area are *Girardinia* sp.*, Maesa* sp.*, Melostoma* sp. and *Edgeworthia* sp.

Zone-III (1,800-2,800 m): Temperate broad-leaved forests, the dominant trees are *Quercus* spp*, Rhododendron* spp.*, Juglans regia, Ilex* sp.*, Acer* sp.*, Betula* sp. with dense cover of *Arundinaria* spp.

Zone-IV (2,800-3,800 m): Temperate coniferous and broad-leaved forests, dominated by *Abies* spp.*, Betula* sp.*, Acer* sp. and various species of *Rhododendron.*

Zone-V (>3,800m): Sub-alpine vegetation: Tree line ceases beyond 3,800 m. Plants such as *Juniperus,* dwarf species of *Rhododendron, Azalea* and many species of flowering herbs such as *Potentilla, Anemone, Primula, Ligularia* and *Pedicularis* are common.

Forests of lower altitudes (<900 m) of Sikkim are largely altered for agriculture, but still have patches of original tropical moist forest. Some of the common tree species are *Schima wallichi*, *Ficus* spp., *Bischofia javanica*, *Artocarpus lakoocha*, *Ailanthus* sp., *Albizia* spp., *Ceiba* spp., and *Toona ciliata*. Patches of original, but degraded, vegetation still remains in steep slopes and along streams. The main crops grown are mustard, potato and cardamom. The landscape is thus a mosaic of degraded forest patches, agricultural fields with several species of lopped native trees and a variety of seasonal crops, and fallow lands. This mosaic presents an interesting and common landscape in which we can examine the conservation of wild fauna outside protected areas. The forest between 900m and 1,800m is partially disturbed by cardamom plantation. Although the natural vegetation is maintained and the trees are intact, undergrowths are removed for plantation purposes. The vegetation in broadleaved forest between 1,800 and 2,800 m is luxuriant with many trees covered by climbers and the ground with dense undergrowth mainly bamboo, *Arundinaria* sp.

1.3 METHODS

1.3.1 Compilation of Secondary Information

Although considerable information is available on species occurrence in Sikkim, these have not been compiled systematically. A database was created with the altitudinal range of distribution and

these data were grouped in to five zones. The species lists were compiled to make a checklist of each group. Compilation and analysis of existing information were done to identify major gaps in information and to identify important areas.

A checklist of mammals has been compiled (Table 1.1, Annexure-I) for the state of Sikkim from various sources (Molur *et. al* 1998; Avasthe & Jha 1999; Nameer 2000; Agrawal 2000; Mandal 2003).

The literature available on birds of Sikkim was collected from various sources to the extent possible. The Book on "Birds of Sikkim" by Ali (1989) is the only exhaustive literature available till date except the recent ecological study in the West Sikkim (Chettri, 2000; Chettri et al. 2001). The database of recorded birds was made along with their altitudinal range based mainly on Ali (1989) and Ali & Ripley (2001) and clumped in to five altitudinal zones. The data were analysed to look in to the pattern of distribution and identify habitat specialists.

Table 1.1 Major source of secondary information on Mammals, birds, herpetofauna and butterflies of Sikkim

Taxa	S. No.	Authors
Mammals	1	Molur *et al.* (1998)
	2	Avasthe & Jha (1999)
	3	Nameer (2000)
	4	Agrawal (2000)
	5	Mandal (2003)
Birds	1	Ali (1989)
	2	Ganguli-Lachungpa (1990a)
	3	Ganguli-Lachungpa (1990b)
	4	Ganguli-Lachungpa (1990c)
	5	Ganguli-Lachungpa (1992)

	6	Ganguli-Lachungpa (1998a)
	7	Ganguli-Lachungpa (1998b)
	8	Ganguli-Lachungpa (1998c)
	9	Ganguli-Lachungpa & Lucksom (1998)
	10	Chettri (2000)
	11	Grimmet *et al*. (2001)
	12	Chettri *et al*. (2001)
	13	Ali & Ripley (2001)
	14	Birdlife International (2001)
Herpetofauna	1	Boulenger (1890**)**
	2	Das (1994)
	3	Das (1997)
	4	Molur & Walker (1998)
	5	Shaw & Barker (1999)
	6	Daniel (2002)
	7	Jha & Thapa (2002)
Butterflies	1	Haribal (1992)
	2	Chettri (2000)

Since there was no authentic literature available on herpetofauna of Sikkim, the information on presence of species was based largely on the distribution of northeast India (Molur *et.al*., 1998). The only available recent compilation was reviewed and crosschecked with Smith (1935) for confirmation. Subsequently a checklist of reptiles and of amphibians was made for the region. A recent book on “Amphibians and Reptiles of Sikkim” (Jha & Thapa, 2002) was used in shortlisting the already prepared checklist.

Checklist of the butterflies of Sikkim was prepared from the book, “The butterflies of Sikkim Himalaya” (Haribal, 1992). This book provides information on their distribution and natural history. Therefore, the database was prepared with altitudinal distribution. The five altitudinal zones identified for birds were chosen for butterflies to look at the distribution pattern with respect to altitude before the commencement of the field studies. Habitat/altitude specialists were also identified.

1.3.2 Field Sampling Protocol

Quantitative sampling of the selected taxa, namely mammals, birds, reptiles, amphibians and butterflies was done systematically covering different habitats and altitudinal zones namely the Tropical semi-deciduous (below 900 m) or the Zone-I, Tropical broadleaf (900-1,800 m) or the Zone-II, Temperate broadleaf (1,800-2,800 m) or the Zone-III, the Coniferous forest (2,800-3,800 m) or the Zone-IV and the Sub-alpine region (3,800-4,500 m) or Zone-V.

1.3.2.1 *Mammals*

The following methods were used to estimate species richness and abundance of mammals.

Open width transects: From May 2003 to August 2004, a total of 19 transects ranging from 180 m to 1,000 m were laid and sampled in the first four zones of vegetation types with different altitudes. Random observations were done in Zone-V which is >3,800 m. Transects were laid in existing forest trails and newly cut trails. Their length depended on the terrain and undergrowth varying from 180 m to 1,000 m. It was not possible to maintain same length for all transects due to the slope of the hills and to avoid overlap of vegetation types. Each transect laid did not cover more than 200 m of altitude range. Transects were laid for sightings of diurnal, arboreal and terrestrial mammals. Parameters such as altitude, time, and perpendicular distance to transect were recorded during sightings of any species. Transects were replicated three to five times.

Belt transects: The same transects were sampled to estimate the encounter rate of droppings with 2 m on either side. Droppings of mammals were collected along transects and photographed. Site of droppings, content, vegetation type and altitude were recorded at the same time along with the length and breadth of the droppings.

Opportunistic transects: Animal sightings and droppings were also recorded from trails, often through disturbed forests, leading to regular transects. The undisturbed patches nearby transects were also sampled. These were not replicated.

Night surveys: These were carried out along the roads and transects to the extent possible for sightings of nocturnal mammals such as the flying squirrels and carnivores. It was done both on foot and by a jeep.

Live trapping: Murid rodents and shrews, often referred to as the small mammals were sampled using Sherman traps baited with peanut butter. The open width transects were used for small mammal trappings. Along the length of the transect 40 – 60 traps were laid at 5 metres interval. The trapping duration in each transect lasted for three to five nights. Trapping sessions were repeated in transect when there was no capture in the first session. The traps were checked every morning and the captured rodents were measured, weighed, photographed and released away from transects.

Camera trapping: Two camera traps were set up to obtain photographic records of nocturnal mammals in transects where animal signs were seen. Banana, dry fish, chicken and rock salt were used as baits for the camera traps.

Opportunistic records: All sightings of wild mammals outside of the above sampling occasions were also recorded.

1.3.2.2 *Birds*

Circular Plot: Open width circular plot method was used along the predetermined transects considering the steepness and poor visibility in the study area. The counting of birds was conducted at every point distributed along transects in each zones following Javed & Kaul (2000) with necessary modifications. In all, there were 26 transects distributed over five zones of which 23 were regularly sampled. The number of points placed not less than 100m away varied from six to nine at each transect depending upon the accessibility and steepness of the terrain. In Zone-I there were 37 points placed over 5 transects. Similarly, 34 points (5 transects) in Zone-II, 39 points (5 transects) in Zone-III, 45 points (5 transects) in Zone-IV and 27 points (3 transects) in Zone-V were laid. The numbers of points laid in each habitat was based on some preliminary survey so that in each zone the total area sampled is almost the same. The numbers of points sampled in higher zones are relatively low because of high visibility.

Each point was replicated 2-3 times in each of the four seasons *viz*. winter, summer, rainy and autumn covering a total of 2257 points in 26 transects. In total 527 points were sampled in Zone-I, 555 points in Zone-II, 463 points in Zone-III, 442 points in Zone-IV and 270 points in Zone-V. Three additional transects consisting of 22 points were also laid and sampled once in Zone-IV but abandoned later due to difficulty in accessing and the logistics. All the five zones were

covered equally in summer, monsoon and autumn but only Zone-I and II were sampled in winter.

Count in each point was conducted for five minutes, and all the birds seen were recorded. Birds were identified using field guide, Grimmet *et.al*. (2001). The distance of the bird from the center of the point as well as the position on the canopy along with height from the ground was also noted. The regular sampling was conducted between 0600 hrs and 0930 hrs in the morning and occasionally in the evening. The sampling time in each point was changed to avoid chances of species being missed. Sampling was not done during rainy and foggy days due to the problem of poor visibility. The data presented here is based on surveys from June 2003 to November 2005 with a few interruptions.

Point count method was preferred over transect because of its easiness in laying and locating in steep difficult terrain (Bibby *et. al*. 1992, Raman 2001). In difficult terrain transects need more attention on the path being walked missing more birds unlike the case with point counts where full attention could be given for sampling. The study area being large more points could be completed per unit time than transects.

The data on breeding of birds were also collected to the extent possible randomly in each habitat. The breeding birds were recorded when they were found engaged in such activities as building nest or feeding chicks in or outside the nest. The nest was located following nesting activity of the birds. Nest searching was also done after bird count. If a nest was found, the species was identified and the date, place, altitude and other ecological parameters were recorded.

1.3.2.3 *Herpetofauna*

Visual Encounter Survey – Taking into account the landscape, topography and altitude of the study area, time constrained visual encounter survey (Heyer *et. al*. 1994) was used. Considering the activity of reptiles and climatic conditions this method was fixed for three hours from 0900/1000 to 1200/1300 hrs. Two persons did searching rigorously in particular habitat. Overlapping of habitat was avoided strictly during each sampling. All possible microhabitats such as boulders, fallen logs and epiphytes were thoroughly searched. In this method all species eighted during sampling were identified up to species and details such as encounter time, altitude, habit, habitat, height from ground and distance to water were noted. The forest was considered as macrohabitat and the location of species such as boulder, logs and grass were recorded as microhabitat. Morphometry of the encountered species was also recorded to the extent possible.

Forest transects: 2-4 belt transects (2m) of varying length depending upon the accessibility in the forest were laid in each habitat zones making total length of 2km in every zone. In total, there were 4 transects in Zone-I, 4 in Zone-II, 3 each in Zones-III and IV and 2 in Zone-V. Each transect was sampled once seasonally. Each transect was walked on slow pace observing animals within 2m on either side of it. On encountering animals various parameters such as species, individuals, encounter time, altitude and microhabitat were recorded.

Stream transects: 1km transects along 3 to 4 streams were marked in each habitat for surveying nocturnal amphibians. Due to

the steepness of the terrain, climatic condition and logistics only 1 km transects were possible in all habitat zones. During this sampling two people walked slowly along both sides of the stream after dusk. The habitat was not disturbed during this method, as amphibians are known to be habitat specific, especially during breeding season.

Opportunistic observation: Road kills, killed by local people and those species observed outside sampling area were considered as opportunistic observations. This information is used to prepare an inventory.

1.3.2.4 *Butterflies*

Collection of systematic data in the field was commenced in March, 2003. The preliminary study was done in various habitats of Zone-I in and around Dalep (Altitude-550 m; 88^{o} 28' N, 27^{o} 14' E), in South Sikkim. The study was conducted for three months in four habitat types, namely disturbed forest (DF), Cardamom Agro-forest (CAF), degraded agricultural land (DAL) and paddy field (PF) for three months. The DF was a small forest patch sandwiched between agricultural lands and was typical representative of moist tropical semi-decicuous forests. CAF was similar to DF but the trees were sparser and undergrowth was dense replaced by cardamom. The DAL was represented by cornfield with retention of some native tree species. The paddy field at the time of study was without any crops but was planted later. The study in other zones was commenced only from June, 2003 and the study sites on other four zones were same as that for birds.

Circular plot: Fixed width circular plot method was followed for butterfly count. Transects were laid as described for birds and point was placed at 50 m interval. In Zone-I, two transects of 250 m length containing six points each in all four habitat types mentioned above (DF, CAF, DAL and PF) were laid initially. In total, there were 12 points in each habitat type and all points were visited four times making 48 point counts per habitat. But after three months, only transects of DF were sampled with additional transects laid for birds. Five minutes count in each plot was done in good sunny days between 0900 to 1200 hrs. All the butterflies seen within the radius of 5m was identified following Haribal (1992). All the species and individuals seen within five minutes were recorded. The data from four habitats of Zone-I was analyzed separately.

1.4 DATA ANALYSIS

Sightings of mammals from open width transect, belt transects, night survey, opportunistic transects and records have been used to estimate encounter rates per unit distance, which was taken as an index of abundance. The number of species seen during the sampling was taken as an index of species richness.

For small mammals, data from live trapping were used to estimate species richness and abundance. Capture rate was taken as an index of abundance. Capture rate was estimated for transect as, Capture Rate = n/tn x 100; where, ‘n’ is the number of animals captured, ‘tn’ is the number of traps laid x number of days with trap sessions. Capture rate was estimated for all species together, and for each species separately. The number of species trapped in a

vegetation type or overall was taken as the observed species richness. This however does not give an accurate estimate of species richness. Species richness was also estimated using various estimators available (Colwell 1994) in the software EstimateS (Version 6.0b1). Among several models available, Jackknife 1 was selected because this estimate reached an asymptote. It has also been widely used for estimating the species richness in similar situations. In order to estimate the species richness, the number of days on which the traps were laid on transect (transect days) was considered as sampling effort.

For birds, species richness, abundances, diversity, exclusive species, similarity index and foraging guilds in each zone and season were calculated. Comparison of each aspect was done among different zones and the seasons. Spearman rank correlation was used to find out the relation between the bird species richness, abundance and percentage of exclusive species with altitudinal zones. The calculation was done using SPSS software (version 10.0.). Diversity of birds in different habitat was calculated using Shannon- Weiner index. Evenness (E) was calculated by formula E = H'/Hmax = H'/ln S, Where, H' is the Shannon-Weiner Index and S is the number of species observed. All other analysis for Species richness and abundance in different seasons, zones and foraging guild of birds was done using Microsoft Excel software.

Sightings from VES have been used to estimate encounter rates per hour of individuals and species of herpetofauna. The data from transects and stream surveys were excluded while calculating encounter rates because of very low sightings. The total number of

species seen during VES, forest transects and stream surveys were added to get species richness. Percentages of relative abundance were also calculated. The species richness and abundance comparisons were done among different zones. The calculation has been done to find out percentages of exclusive species, diversity and similarity index in different zones. Diversity of reptiles in different habitats was calculated using Shannon- Weiner Index (H') along with Evenness.

Family-wise species richness and abundances in total as well as in different habitat types and zones were calculated for butterflies. Diversity and evenness were calculated for different zones and habitats. Mann Whitney "U" test was performed to test the difference in species and abundances among habitat types and various zones using software SPSS (Version 10.0).

1.5 RESULTS

1.5.1 Secondary Information

1.5.1.1 *Mammals*

The compilation of inventory of 169 species of mammals (Annexure-I) shows that information on distribution and abundance is lacking in the case of mammals compared to birds and butterflies. Moreover, it is very likely that even species inventories for mammals (especially bats and rodents) might be incomplete and several species in the low altitude forests still remain to be reported. The altitudinal distribution of species shows two peaks in the case of mammals (Fig. 1.1). These peaks are evident despite the lack of information on most rodents and bats, which together make up nearly

50% of the mammalian fauna. The peak in the lower altitude is due to small mammals, while the peak in the higher altitudes is due to several species of mountain ungulates, marmots, and pikas and their predators such as snow leopard, Tibetan wolf, and Tibetan fox. According to the secondary data, the species richness of mammals is very high even in the higher altitudes.

1.5.1.2 *Birds*

The analysis of secondary data showed 540 species (Annexure-II) that maximum number of species occured in Zone-II and III but Zone-I possess maximum number of exclusive species (occurring in that particular zone only). The compilation of inventory showed that considerable (but by no means complete) information on altitudinal range was available on birds of Sikkim, which is primarily due to the work of Ali (1989) and Ali & Ripley (2001). The present database of birds contains 540 species of which distribution data on 118 is not available (Annexure-II). The secondary information indicated that the highest species richness was in the altitude between 900 m and 2,800 m (Fig. 1.2). Although each altitude zone has its own exclusive resident species, the most notable feature is the altitudinal migration that many species show. As a result, most species use different altitudinal zones in different seasons. The relatively high species richness of birds at high altitude zones is also notable.

Table 1.2 Bird species richness in different vegetation (altitudinal) zones of Sikkim (based on secondary data)

Zones	No. of species	Exclusive species
I	195	24 (12.3%)
II	271	12 (4.42%)
III	281	10 (3.35%)
IV	176	6 (3.40%)
V	129	14 (10.8%)

It was observed that species richness followed unimodel pattern peaking at mid altitude (Fig. 1.2). The numbers of habitat specialists are more in the lowest and highest altitudinal zones (Table 1.2).

The common and widespread species reported to occur in all the five zones are only four, namely (1) White-capped Water Redstart *Chaimarrornis leucocephalus,* (2) Green Sandpiper *Tringa ochropus,* (3) Brown- wood Owl *Strix leptogrammica* and (4) White Wagtail *Motacilla alba.*

Out of the 540 species reported from Sikkim nine are globally threatened (two critical and seven vulnerable) including two endemics (Table 1.3; Birdlife International, 2001). The altitudinal ranges of many of these threatened species were not recorded.

Table 1.3 Threatened species of birds recorded from Sikkim

Species	Status	Altitude category
White rumped Vulture, *Gyps bengalensis*	**Critical**	*
Long-billed Vulture, *Gyps indicus*	**Critical**	*
Chestnut-breasted Partridge, *Arborophila mandeilli*	**Vulnerable**	**I, II, III**
Rusty-bellied Shortwing, *Brachypteryx hyperythra*	**Vulnerable**	**IV**
Beautiful Nuthatch, *Sitta Formosa*	**Vulnerable**	**I, II, III**
Hodgson's Bushchat, *Saxicola insignis*	**Vulnerable**	*

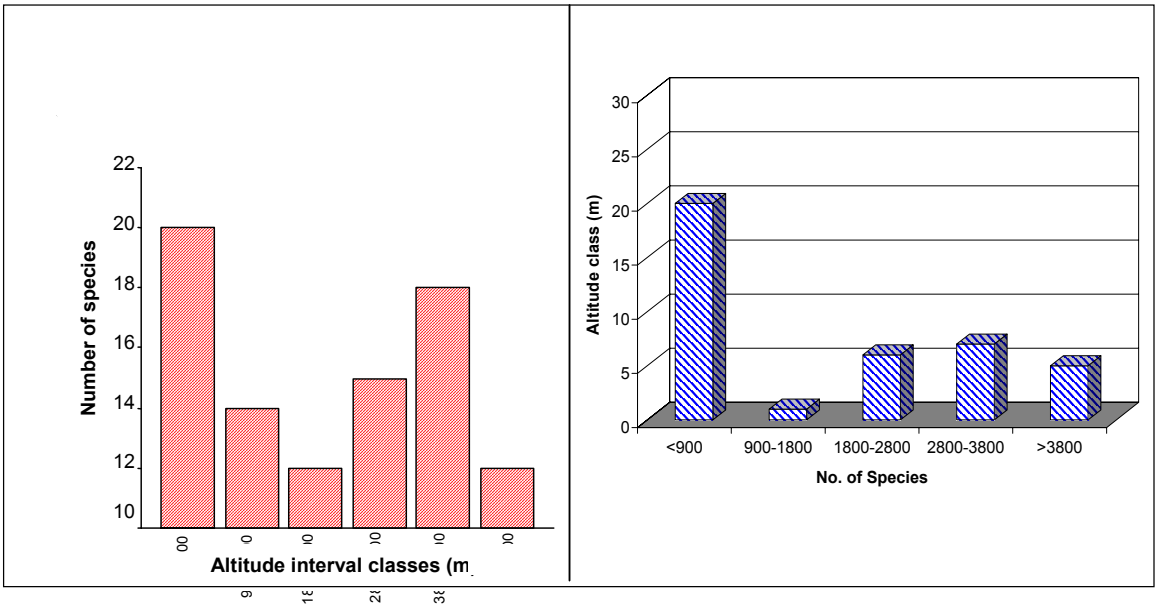

Fig.1.1 (a) Species richness in non-volant mammals in different altitude classes; and (b) the addition of new species with increasing altitude. Note that apart from bats, rodents also have been mostly excluded, due to paucity of data

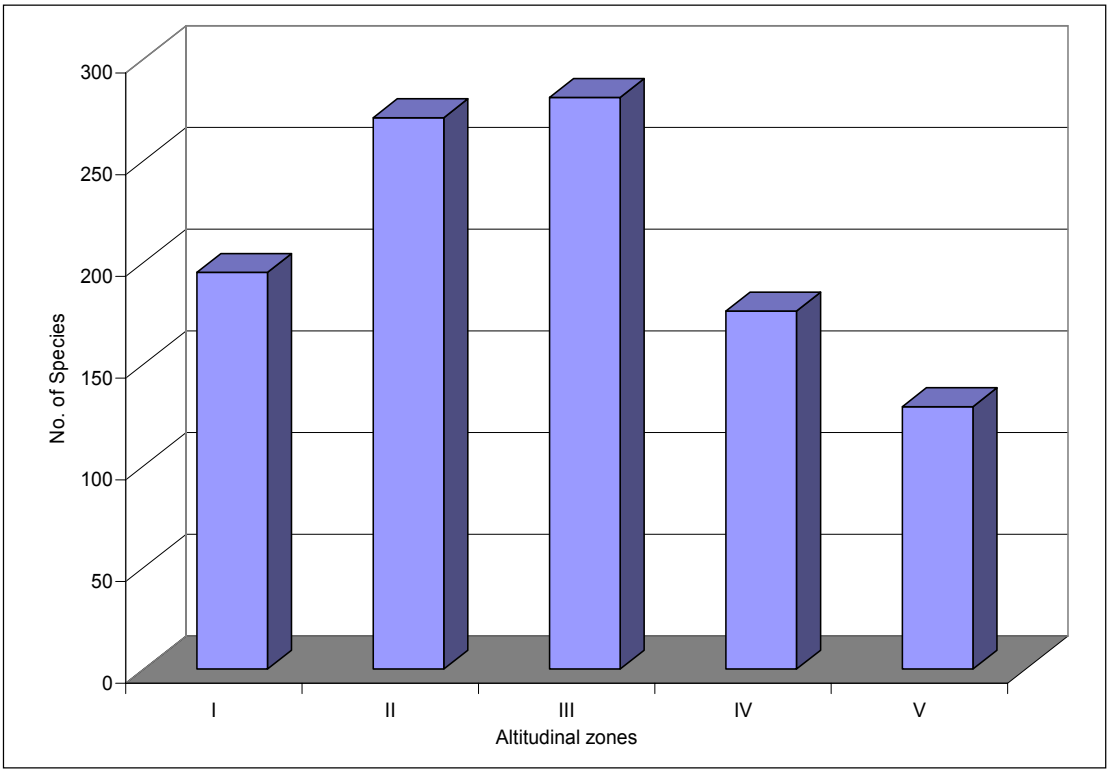

Fig.1.2 Bird species richness in different altitudinal zones of Sikkim

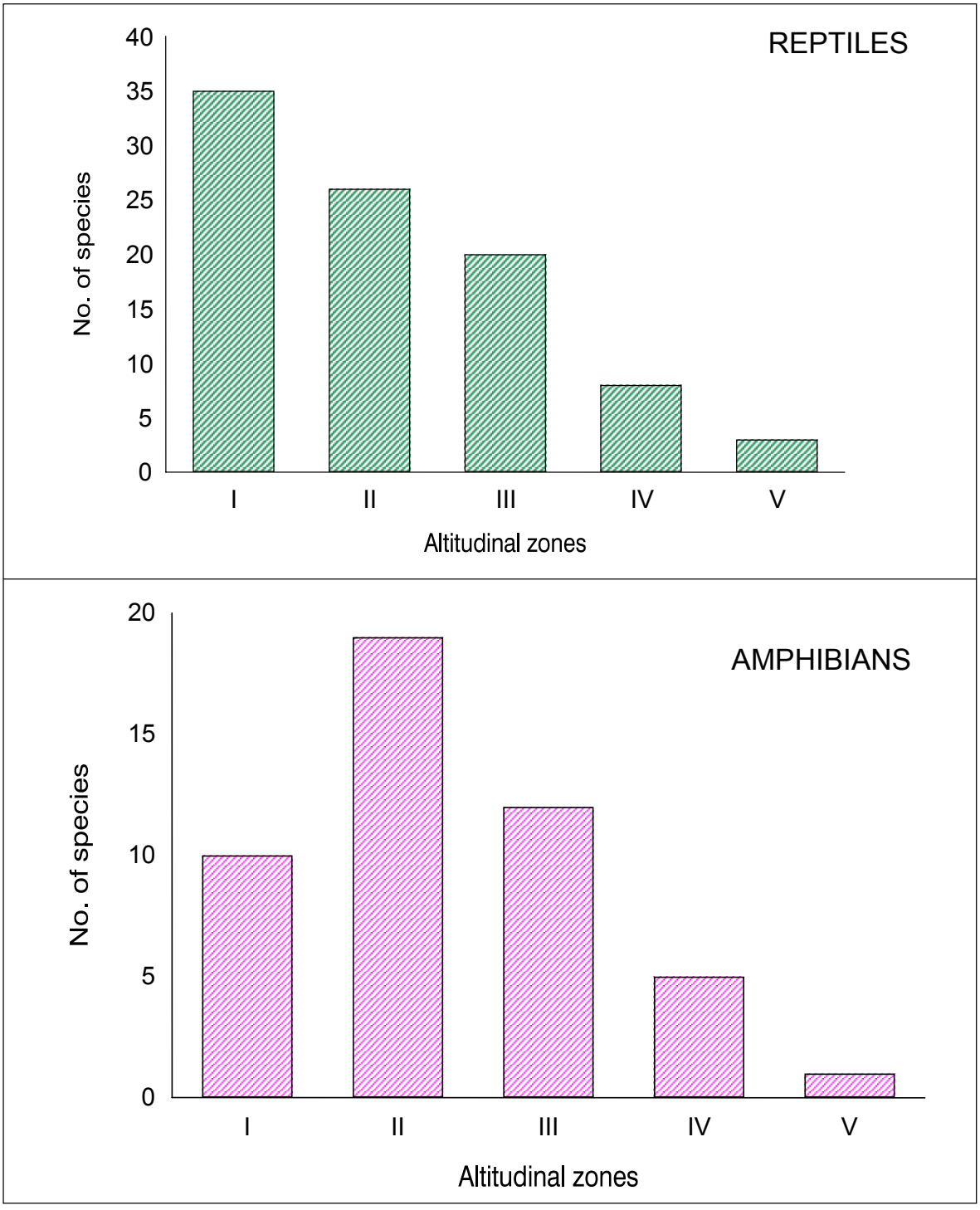

Fig.1.3 Reptile and Amphibian species richness in different habitat zones of Sikkim

Baer's Pochard, *Aythya baeri*	**Vulnerable**	*****
Black necked Crane, *Grus nigricollis*	**Vulnerable**	**V**
Wood Snipe, *Gallinago nemoricola*	**Vulnerable**	*****

*No data

Sikkim lies within the Eastern Himalayas Endemic Bird Area (Islam & Rahmani, 2004). Out of the 22 restricted range species 19 are confined to this region. The genus *Sphenocichla* is endemic to this Endemic Bird Area (Stattersfield *et.al.*, 1998). Of these 19 endemics, ten are reported to occur in Sikkim (Table 1.4). Among these endemics two species (*Brachypteryx hyperythra* and *Arborophila mandellii*) are threatened (BirdLife International 2001).

Table 1.4 Endemic birds of Sikkim with altitudinal distribution

Species	Altitudinal zones				
	I	II	III	IV	V
Rusty-bellied Shortwing (*Brachypteryx hyperythra)*				**1**	
Broad-billed Warbler (*Tickellia hodgsoni)*		**1**	**1**		
Hoary-throated Barwing (*Actinodura nipalensis)*			**1**	**1**	
Yellow-vented Warbler (*Phylloscopus cantator)*	**1**	**1**	**1**		
White-naped Yuhina (*Yuhina bakeri)*	**1**	**1**	**1**		
Chestnut-breasted partridge (*Arborophila mandellii)*	**1**	**1**	**1**		
Wedge-billed Wrenbabbler (*Sphenocichla humei)*				**1**	
Rufous-throated Wrenbabbler (*Spelaeornis caudatus)*	**-**	**-**	**-**	**-**	**-**
Ward's Trogon (*Harpactes wardii*)	**-**	**-**	**-**	**-**	**-**
Giant Babax (*Babax waddelli*)	**-**	**-**	**-**	**-**	**-**

The altitudinal distribution and habitats of three species of endemics, Rufous-throated Wrenbabbler (*Spelaeornis caudatus),* Ward's Trogon (*Harpactes wardii*) and Giant Babax (*Babax waddelli*) is still unknown.

1.5.1.3 *Herpetofauna*

Secondary data showed (Annexure-III) 61 species of reptiles and 20 species of amphibians in Sikkim (Jha & Thapa, 2002). The information on altitudinal distribution of herpetofauna is lacking. The compilation was done mostly based on the northeastern species (Molur & Walker, 1998; Molur *et al*. 1998) and recently published work on herpetofauna (Jha & Thapa, 2002). The Checklist of the Herpetofauna prepared for the North eastern region showed 167 species of reptiles and 70 species of amphibians.

The secondary information showed that species richness of reptiles was relatively higher in the lower two zones. Species richness pattern of amphibians and reptiles in various zones was different (Fig. 1.3**)**. Species richness of reptiles decreased with increasing altitude. This may be due to the decrease in temperature and available resources. However, species richness is also high in Zone-III primarily due to the addition of new species that are not found in the lower altitudes. In case of amphibians, the pattern was different showing unimodel distribution with Zone-II being the most species rich followed by Zone-III. Lower altitude (Zone-I) and the higher altitude Zones (IV and V) had relatively low species richness. The low species richness in both extremes may be due to extreme atmospheric temperatures and microhabitat limitations.

1.5.1.4 *Butterflies*

The present checklist of butterflies consists of 689 species, including 254 without specific distributional data (Annexure-IV). The secondary information indicated that the highest species richness was below 1800 m in Zones-I and II (Fig. 1.4). Zone-II is the most species rich harbouring about 60% species with six exclusive (Table 1.5). The Zone-I is devoid of any specialist species. The species richness, although low in Zone-V, 25% are exclusive or restricted to this zone.

Table 1.5 Species richness of butterflies of Sikkim in different vegetation (altitudinal) zones

Zones	No. of species	Exclusive species
I	343	0
II	395	6
III	126	3
IV	36	2
V	24	6

1.5.2 Primary Data

1.5.2.1 *Mammals*

a) *Species Richness and Diversity*

Species richness: A total of 47 species of mammals (i.e. eleven species of small carnivores, seven species of arboreal mammals, five species of ungulates and twenty four species of terrestrial mammals including one large carnivore, thirteen species of murids, one

hystricidae, six species of insectivores, one ground dwelling marmot and two lagomorph) were observed to occur in the five vegetation and altitudinal zones.

Habitat and vegetation Zones: The Zone with most high species diversity of mammals was Zone-III (1,800-2,800 m) with twenty eight species excluding the bats which are not being studied due to logistic constraints. Zone-III is followed by Zone-II (900-1,800 m) with eighteen species, Zone-IV (2,800-3,800 m) and Zone-I (up to 900 m) with sixteen species each and Zone-V (above 3,500 m) with four species. The Encounter rate/ km^2 for sightings of mammals other than the murid rodents and shrews showed different results with the highest rate in Zone-II (1.59), followed by Zone-I (1.04), Zone-III (0.83) and Zone-IV (0.71).

Table 1.6 Mammalian species richness with respect to the vegetation zones and altitude range along with the proposed Teesta hydel project stages in these ranges

Vegetation Zone	Altitude Zone	Mammalian species richness	Proposed Project Stages
1. Tropical semi-deciduous forest	Up to 900 m	16	V, VI
2. Tropical moist and broad leaved forest	900–1,800 m	18	III, IV
3. Temperate broad leaved forest	1,800–2,800m	28	II, III
4. Coniferous forests	2,800-3,800 m	16	II, I
5. Subalpine region	Above 3,800	4	-

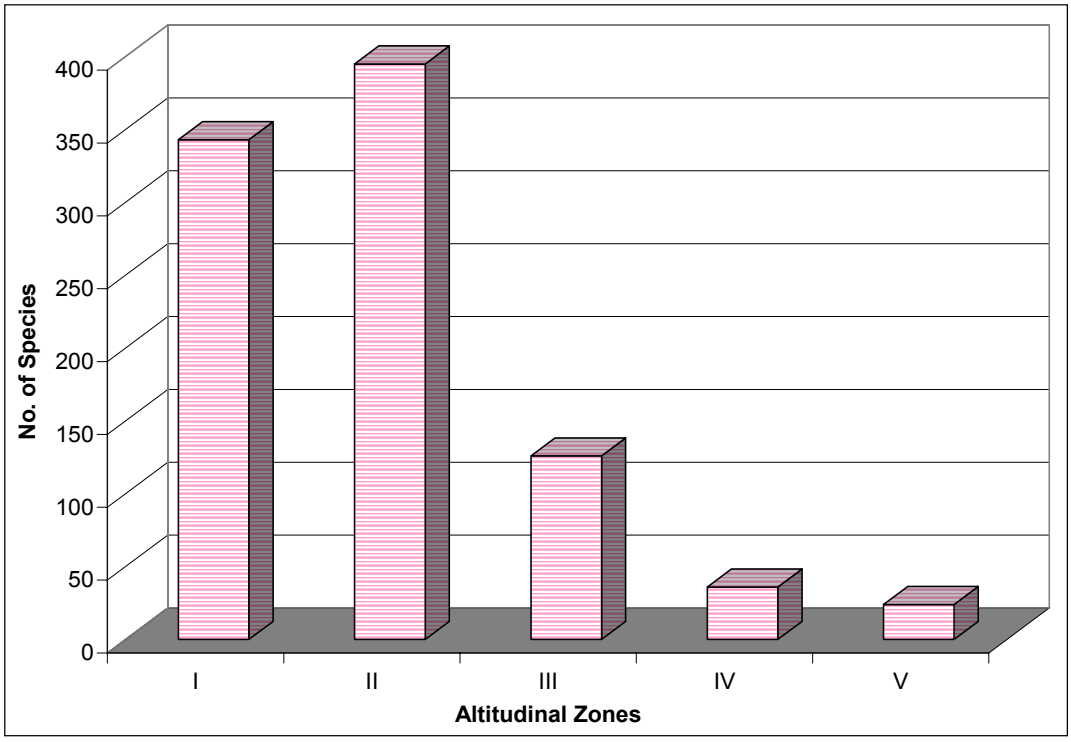

Fig.1.4 Distribution of butterflies in different vegetation (altitudinal) zones of Sikkim (based on literature)

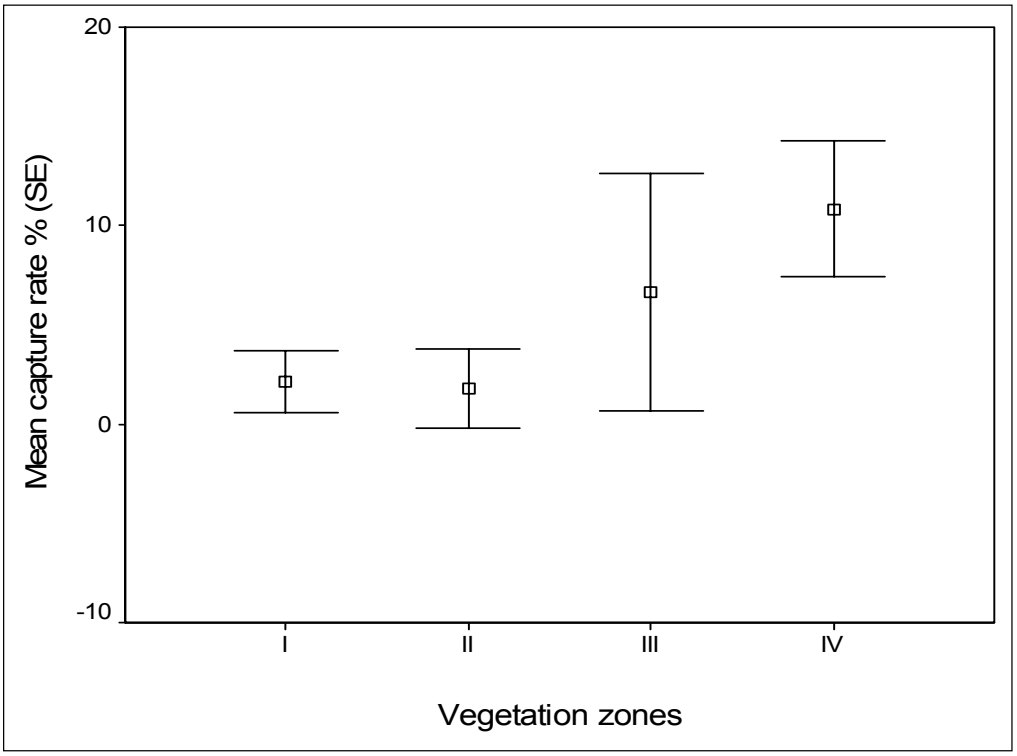

Fig.1.5 Standard error of mean capture rate of small mammals in four zones

Localities: The areas from Chungthang up to Lachen and Lachung are extremely rich for the mammals. In this region there are overlaps of temperate broad leaved forest and Coniferous forests which harbour species such as the Red Panda, Himalayan Black Bear. As shown in table 6, these regions have been proposed for the Stages II and III. The subalpine region shows only four species in the table but it is grossly due to constrains in sampling the area regularly. Even this region has a varied mammalian fauna which may be very sensitive to slight environmental disturbance.

b. Endemic/ Exclusive species in Himalayas or particular altitude zone:

A few mammalian species that were directly sighted or evidences of their presence found during the study are enlisted in Table 1.7. The Nepal Langur *Semnopithecus schistaiceus* is a recently elevated new species whose distribution is restricted to high altitudes of Sikkim (in and around Lachen), Nepal and Bhutan. It is only found in overlapping zones of Temperate broadleaf and Coniferous forests at an altitude of about 2,800 m.

The same region is also the habitat for the Red Panda *Ailurus fulgens* which is the state animal of Sikkim and is restricted to higher altitudes only. Serow found in Zone-III is restricted to Himalaya from Sikkim to Kashmir. The Marbled Cat *Pardofelis marmota* is an extremely rare and nocturnal species and has been reported to be locally found in and around Chungthang in Zone-III. Marbled Cat has been reported to occur in Chungthang Bop area only in the Teesta river basin. It is a Schedule-I species under the WPA (1972).

c. Local, National and International levels: Endangered species

The most endangered species among mammals in these areas is the Red Panda already listed as Endangered by IUCN and a Schedule-I species according to the Wildlife Protection Act, 1972. The Himalayan marmot is also an endangered species found in Sub-alpine zones above the tree line in the higher altitudes. Besides Sikkim it is found only in Ladakh.

Table 1.7 A few Endangered and Vulnerable mammalian species listed in Schedule 1& 2 in Wild life Protection Act (1972) and their distribution

Mammal Species	Altitudinal Range (m)	IUCN/WPA	Distribution
Naemorhedus sumatraensis	1,000-3,000	VN/ I	SK to K
Ailurus fulgens	>1,525	EN/ I	SK, WB, AS, AP
Pardofelis marmota	2,000	VN/ I	NE
Mustela erminea	3,200-4,200		Himalaya
Ursus thibetanus	3,000-6,000	VN/ I	Himalaya, JK to AS
Viverra zibetha	<2,000	VR/ II	NE, AI
Soriculus caudatus	1,800-3,600	VN	SK, JK, UP, WB, M
S. nigrescens	1,560-4,300	VN	SK, HP, AP
Macaca assamensis	<3,000	VN/II	NI, NE
Semnopithecus schistaceus	2,800		SK
Hystrix brachyuran		VN/ II	
Niviventer eha	4,000	VN/ V	SK, WB
Marmota himalayana	4,000-5,500	EN/ II	SK, LDK

INDIRECT EVIDENCES

Till November 2005 a total of 254 droppings were recorded, a few photographed and most were collected. The encounter rate for all

mammalian droppings found was 2.27/ km. These scats are being analyzed to identify species as well as food items contained in the scat. The encounter rate of mammalian droppings in different zones varied from 0.48/km to 5.21/km (Table 1.8). In the opportunistic transects the encounter rate was 1.71/km in the four vegetation zones (Table 1.9). Besides Zone I-IV, some areas of Zone-V i.e. above 3,800 m in the alpine shrubs and grasslands were also covered. Here the encounter rates of scats was 1.97.

Table 1.8 The sightings and encounter rate of mammalian droppings in transects in four vegetation zones

Zone	Length (km)	Altitude Range (m)	Replicates	No. of Droppings (150)	Encounter rate/km (Dropping)	Encounter rate/km (Sighting)
I	14.62	230-820	4	50	3.42	1.04
II	10.39	880-1,600	3	5	0.48	1.59
III	14.4	1,860-2,580	2-5	75	5.21	0.83
IV	5.67	3,340-3,700	2-3	20	3.53	0.71

Scats of at least four species of small carnivores were found along the transects, most probably Himalayan palm civet (*Paguma larvata*), Large Indian civet *(Viverra zibetha),* Leopard cat *(Prionailurus bengalensis)* and Jackal along with a few species of weasels and small cats. Evidences of Himalayan Palm Civet visiting the area have been found especially during the fruiting season of large cardamom.

Table 1.9 The sightings and encounter rate of mammalian droppings away from the transects (Opportunistic sighting) in four vegetation zones

ZONE	Length (km)	Altitude Range (m)	No. of droppings	Encounter rate/ km	Encounter rate/km (Sighting)
I	11.95	280-810	23	1.92	0.42
II	21.61	900-1,850	11	0.51	0.24
III	29	1,800-2,580	72	2.48	0.17
IV	4.07	3,380-3,600	8	1.97	1.48
TOTAL	**66.63**	**280-3,600**	**114**	**1.71**	**0.32**

Old and new scats of Jackals (*Canis aureus*) indicated their presence, besides their howling at dusk. Other indirect evidences of occurrence of mammalian species included hoof marks and horns of Serow, pug marks and scats of Himalayan black Bear, hairs and skeleton of a Red Panda (*Ailurus fulgens)*, and quills of porcupine (probably the Himalayan crestless porcupine, *Hystrix brachyura*). The most frequently encountered scat was that of Himalayan Palm Civet. The abundance of Serow seems to be high in some areas as shown by frequent encounter of their droppings.

1.5.2.2 *Small Mammals*

A total of 279 individuals of 20 species of small mammals were captured in 6497 trap nights. The number of trap nights in a trapping site varied from 79 to 399.

a. Species richness

The small mammals captured in the four vegetation types included thirteen species of murids, six species of insectivores and one lagomorph totaling to 20 species. The highest number of species was encountered in Zone-III and Zone-IV followed by Zone-I and Zone-II (Table 1.10).

Table 1.10 Species richness and abundance of small mammals in four vegetation types with standard deviation of capture rate in each zones

Vegetation types	Altitude range (m)	No. of Transects	Total traps nights	Total individuals	Capture Rate (%)	Species
Tropical semi-deciduous	< 900	6	1773	37	2.09	6
Tropical Broad leaf	900-1,800	8	1641	54	3.29	6
Temperate Broad leaf	1,800–2,800	6	1786	85	4.76	7
Coniferous	2,800-3,800	6	1297	103	7.94	7

1.5.2.3 *Abundance*

The capture rate overlapped considerably among the four zones. However the capture rate varied significantly among Zone-I, III and IV (ANOVA, F = 4.694, P = 0.026). Coniferous forest (7.94%) had a significantly higher capture rate than temperate broad leaf (4.76%), tropical broad leaf (3.29%) and tropical semi-deciduous (2.09%) (see Table 1.10).

The standard error bars showed high difference between Zone-I

and Zone-IV as there was virtually no overlap between these two zones. Zone-III had high variability, overlapping with Zone-I, Zone-II and to a certain extent Zone-IV (Fig 1.5). When compared between each pair of zones, difference between Zone-I and Zone-IV was significant (Scheffe, Multiple comparison analysis; P = 0.030). The capture rate contrasted drastically among transects, varying from 0% in T16 to as high as 19.49% in T1, with an overall unweighted mean of 5.20% (Table 1.11).

Table 1.11 Species richness and abundance of small mammals in each transect in four zones

Zone	Transect no.	Total trap nights	Capture Rate (%)	Species
I	13	200	01.00	2
I	14	197	04.06	2
I	15	188	02.13	2
I	16	397	0.50	2
I	17	399	1.50	2
I	18	392	3.82	3
II	19	192	06.25	4
II	20	200	0	0
II	21	200	0	0
II	22	198	0	0
II	23	197	0	0
II	24	79	1.27	1
II	27	158	2.53	2
II	28	120	4.17	2
III	1	118	19.49	4
III	2	118	06.78	3
III	3	349	00.86	1
III	4	249	00.40	1

III	5	316	00.94	2
III	6	298	01.33	2
III	25	225	14.22	3
III	26	119	9.24	3
IV	7	200	09.50	5
IV	8	199	11.56	5
IV	9	116	12.07	3
IV	10	119	12.61	2
IV	11	199	05.03	4
IV	12	119	14.29	5

1.5.2.4 *Species composition*

Among small mammals, the murids comprised the Chestnut rat *(Niviventer fulvescens*), Smoke - bellied rat (*N. eha*), White - bellied rat *(N. niviventer*), Sikkim rat *(Rattus sikkimensis*), Himalayan rat *(Rattus nitidus),* Sikkim mouse (*Mus pahari)*, Fawn cervicolor mouse *(Mus cervicolor),* House mouse *(Mus musculus),* White tailed wood rat (*Cremnomys blanfordi)* and Indian mole rat *(Bandicota benglensis).* Shrews included the Sikkim large clawed shrew (*Soriculus nigrescens),* Hodson's brown toothed shrew (*Soriculus caudatus),* Grey musk shrew (*Suncus murinus),* South Asian white toothed shrew (*Crocidura fulginosa)* and Tibetan shrew (*Sorex thibetanus).* The Northern Tree Shrew or the Malay Tree Shrew *(Tupaia belangeri)* and Forrest's pika *(Ochotona forresti)* was also encountered.

Six species were captured in Zone-I, four in Zone-II and seven each in Zone-III and Zone-IV. The genus Niviventer was the most common in all the four forest types. The most common species was

N. fulvescens found in three zones except Zone-IV i.e. the Coniferous forest. *Soriculus nigrescens* occurred in two zones i.e. Zone-III and Zone-IV. *N. fulvescens* is the most dominant species in Zone-II (41.67%), *N. eha* in Zone-IV (45.92%), *Niviventer* in Zone-III (28.57%) and *Mus* in Zone-I (51.72%). The composition of species differed among vegetation types except in the case of *N. fulvescens* which is the dominant species in Zone-II and is also found in Zone-I and Zone-III. Shrews formed 24.31% of the captured animals in all the four zones. 35.71% of captured animals in the coniferous forest were shrews, 16.67% in Temperate broad leaf, 8.33% in Tropical broadleaf and 3.45% in Tropical semi- deciduous forest (Fig 1.6).

1.5.2.5 *Birds*

a) Bird species richness and abundance

In total 307 species belonging to 43 families of birds were observed in the study area including 272 (18,884 individuals) during regular transects and 35 additional species outside transects. The mean number of species/ point in different altitudinal zones showed weak negative correlation with elevation (z = 0.6). Of the 307 species, 122 occurred below 900 m followed by 141, 148, 96 and 58 species respectively in Zones-II, III, IV and V (Table 1.12, Fig. 1.7).

The pattern of species richness followed unimodal distribution showing the peak at mid altitude. The observed number of species in different altitudinal zones did not show much difference in the middle two zones (Zones-II and III). There was sharp decline in species above Zone-III. The species richness was relatively low in Zones-IV and V (see Fig. 1.7). The result obtained is contrary to the secondary

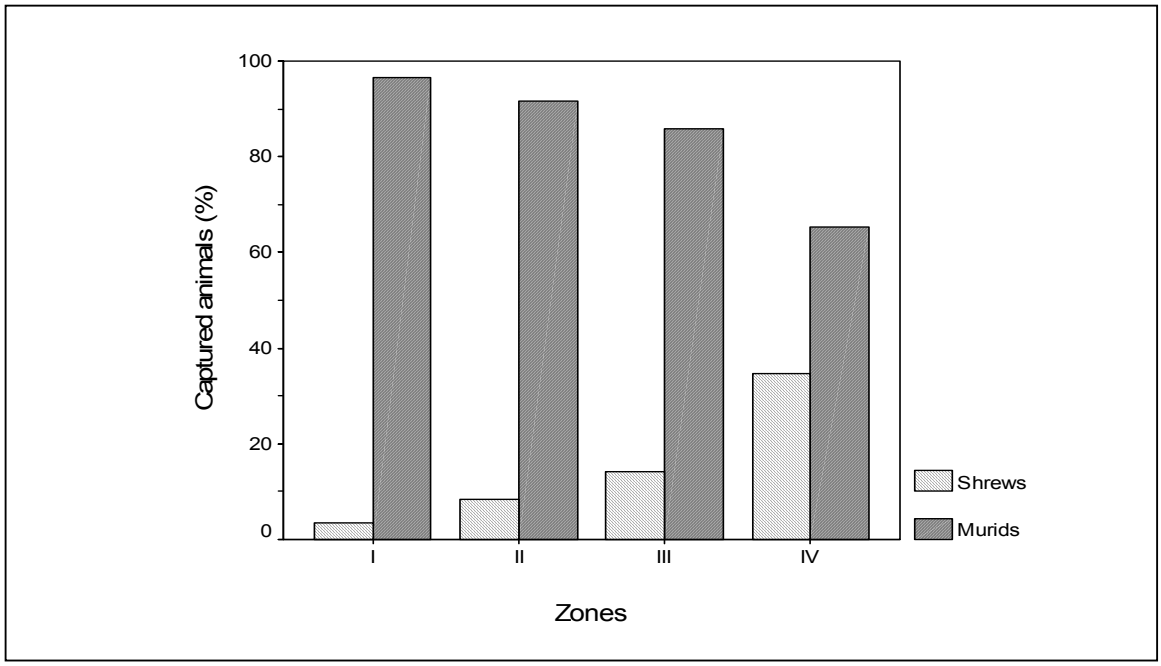

Fig.1.6 Percentage of captured shrews vs murids in various zones along the Teesta valley

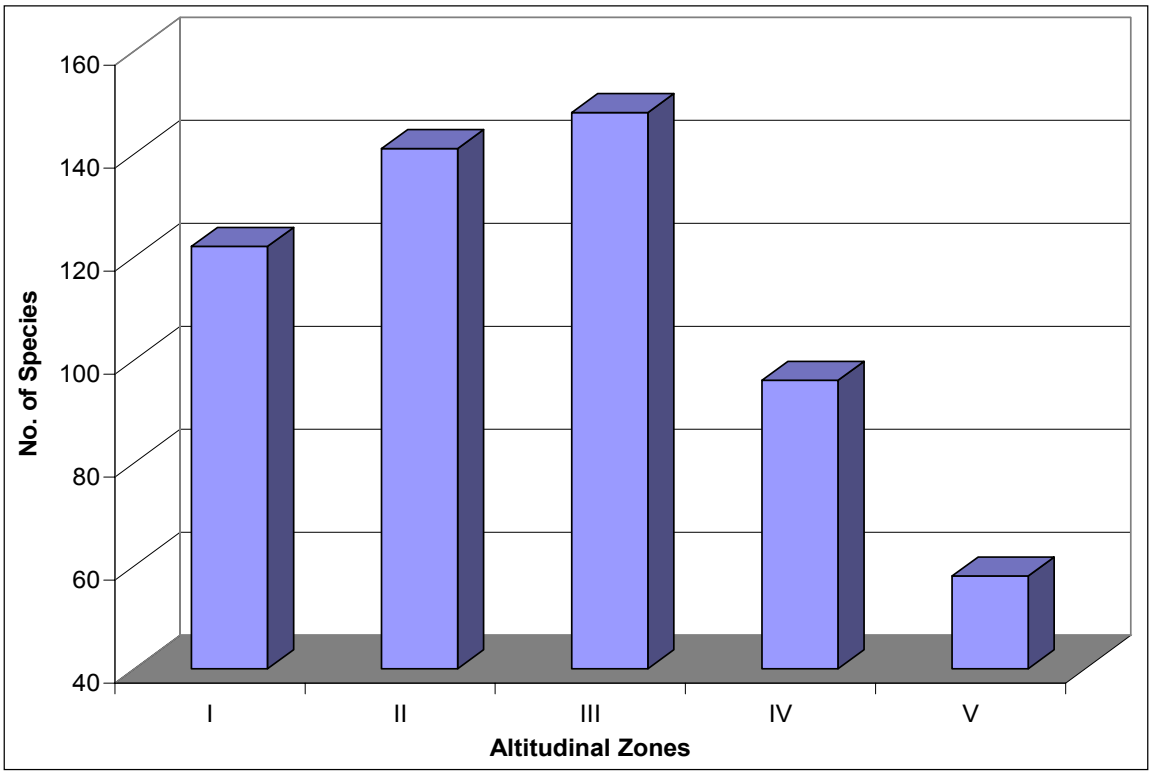

Fig.1.7 Observed species richness of birds in different altitudinal zones along the Teesta valley

information. The bird abundance showed a different pattern as compared to that of richness. The number of individual birds / point showed negative correlation with elevation ($z = 0.7$, $p < 0.05$). Zone-III was observed as the most abundant zone. The bird abundance was in the order of decreasing trend with rise in altitude except Zone-III (Fig. 1.8) which was the most abundant among all the zones. The density (species/hectare and individuals/hectare) is also highest in Zone-III. The Black Bulbul (*Hypsipetes leucocephalus)* was more abundant in Zones-I & II. Similarly, Rufous Sibia *(Heterophasia capistrata)* in Zone-III, Coal Tit (*Parus ater*) in Zone-IV and Grandala (*Grandala coelicolor*) in Zone-V were the most abundantly recorded species. Bird density was the highest in Zone-III and lowest in Zone-V (Table 1.12, 1.13).

Table 1.12 No. of Bird species and individuals observed in different vegetation (altitudinal) zones along the Teesta valley

Zones	Area sampled (ha)	Number of species	Number of Individuals	Species/ Ha	Individual/ Ha
I	23.82	122	5,248	5.12	220
II	25.85	141	4,452	5.45	172
III	16.15	148	5,818	9.16	360
IV	25.27	96	2,284	3.79	90
V	42.77	58	1,111	1.35	26

b) Species distribution

The distribution range of species varied from one (habitat specialist) to five zones (generalist). Out of 307 species, 150 (48.8%) were exclusive, restricted to one zone only. Only two species (Blue whistling Thrush and White-capped Water Redstart) were common to all the five altitudinal zones and six species to four zones. 31 species

were restricted to only Zone-I (Table 1.13). Similarly 26, 43, 31 and 19 species were restricted to Zones-II, III IV and V respectively. The percentage of exclusive species showed significant positive correlation with altitude ($z=0.8$, $p<0.05$).

Table 1.13 Mean number of species and their abundance in different vegetation (altitudinal) zones along the Teesta valley

Zones	Mean no. of sp/point	Mean no. of ind/point	Exclusive Species
I	0.231	9.958	31 (25.4%)
II	0.254	8.021	26 (18.43%)
III	0.319	12.565	43 (29.05%)
IV	0.217	5.167	31 (32.29%)
V	0.214	4.114	19 (32.75%)

The species composition in different habitats was found to be different although species richness was almost same. Zones-I and II shared most of their species followed by Zones-II & III. Zones-I and V shared least number of bird species.

Zones-I and II showed 39.76% similarity in species composition followed by 26.28% between Zones-II and III; 21.82% between III and I; 1.92 % between I & V (Table 1.14). The percentage of shared species in two consecutive zones was more in lower zones than in higher zones. The difference in percentage of similarity between Zones-I and II, II and III and III and IV decreased slowly; it was higher between IV and V. Hence, Zone-III is considered as the transition zone beyond which there is a rapid change in species composition.

Table 1.14 Similarities of bird species observed in different vegetation (altitudinal) zones along the Teesta valley

Zones	I	II	III	IV	V
I	-	68 (39.6%)	43 (21.8%)	10 (5.5%)	3 (1.9%)
II		-	51 (26.2%)	17 (9.5%)	5 (31.1%)
III			-	25 (14.6%)	7 (4.4%)
IV				-	20 (21%)
V					-

c) Seasonality

The study was conducted during all seasons (winter, summer, monsoon and autumn). All five zones were covered during summer, monsoon and autumn, whereas only Zones-I and II only were sampled in winter. Overall species richness as well as abundance was high during monsoon (Table 1.15). Both richness and abundance were high in Zone-I in summer whereas these were in monsoon in Zones-II, III and IV. Zone-V showed different pattern where species richness was more during monsoon but abundance was more in summer. Overall diversity was more in Zone-III (H' = 3.742). Species diversity was high in Zone-III during monsoon (H' = 3.560) and autumn (H' = 3.368), whereas it was in Zone-II (H' = 3.384) during summer. The overall evenness was more in Zone-V (E = 0.813). During summer (E = 0.827) and autumn (E = 0.821) evenness was high in Zone-II, whereas it was Zone-V during monsoon (E= 0.864; Table 1.16).

Table 1.15 Seasonal variation in species richness and abundance of birds in different vegetation (altitudinal) zones along the Teesta valley

Seasons	Altitudinal zones									
	I		II		III		IV		V	
	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.	Sp.	Ind	Sp.	Ind
Winter	54	672	38	432						
Summer	65	820	60	606	67	920	36	399	21	403
Monsoon	53	750	62	1098	86	1542	36	515	23	272
Autumn	63	634	52	684	61	1027	21	255	16	73

Table 1.16 Seasonal variation of species diversity (H') and evenness (E) of birds in different vegetation (altitudinal) zones along the Teesta valley

Seasons	Altitudinal zones									
	I		II		III		IV		V	
	H'	E	H'	E	H'	E	H'	E	H'	E
Winter	3.140	0.787	2.576	0.708						
Summer	3.20	0.767	3.384	0.827	3.456	0.822	2.863	0.799	2.284	0.750
Monsoon	3.365	0.848	3.275	0.794	3.650	0.819	2.972	0.829	2.708	0.864
Autumn	3.287	0.793	3.242	0.821	3.368	0.819	2.423	0.796	2.083	0.751
Overall	3.549	0.745	3.607	0.751	3.742	0.778	3.318	0.773	3.04	0.813

d) Foraging Guilds

Insectivores dominated in terms of species richness as well as number comprising more than 50% in all the habitat types. Omnivores came second in the list comprising 20% and 26% of species and individuals respectively (Fig. 1.9). The number of species of omnivores increased with altitude. In contrast, the species richness of granivores, frugivores and carnivores decreased with increase in altitude but there was not much change in the number of species of

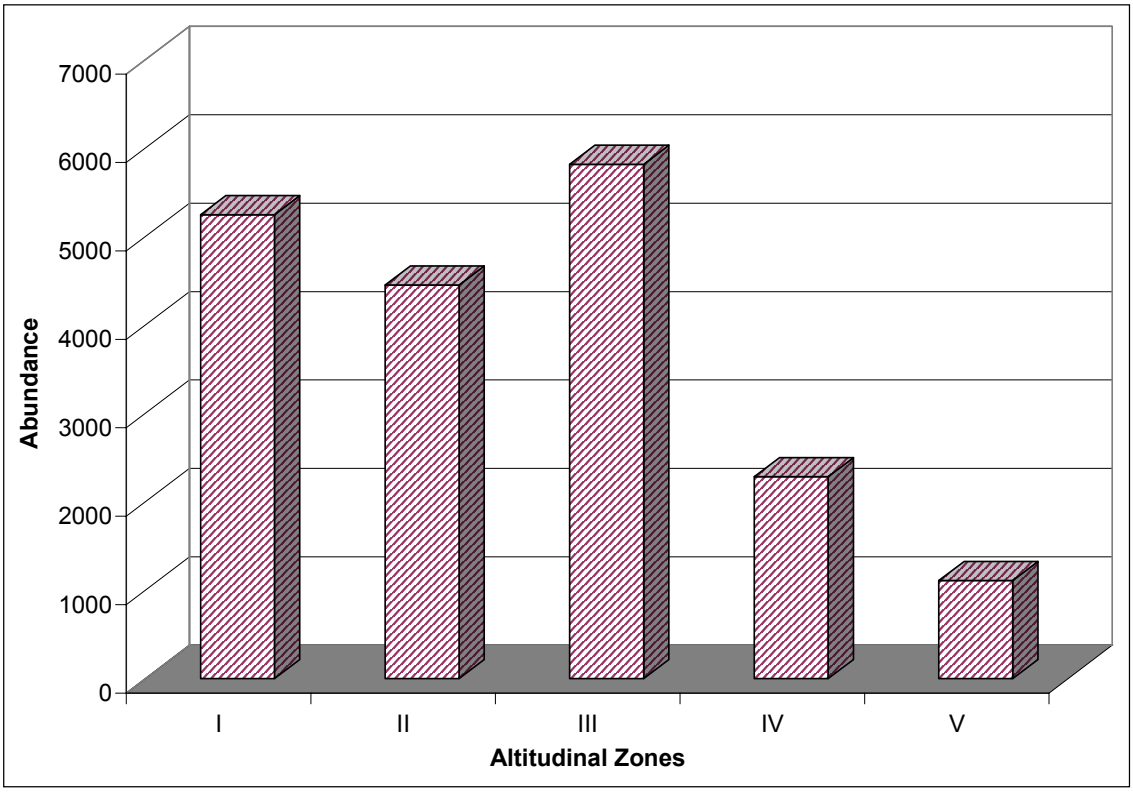

Fig.1.8 Bird abundance in different vegetation (altitudinal) zones along the Teesta valley

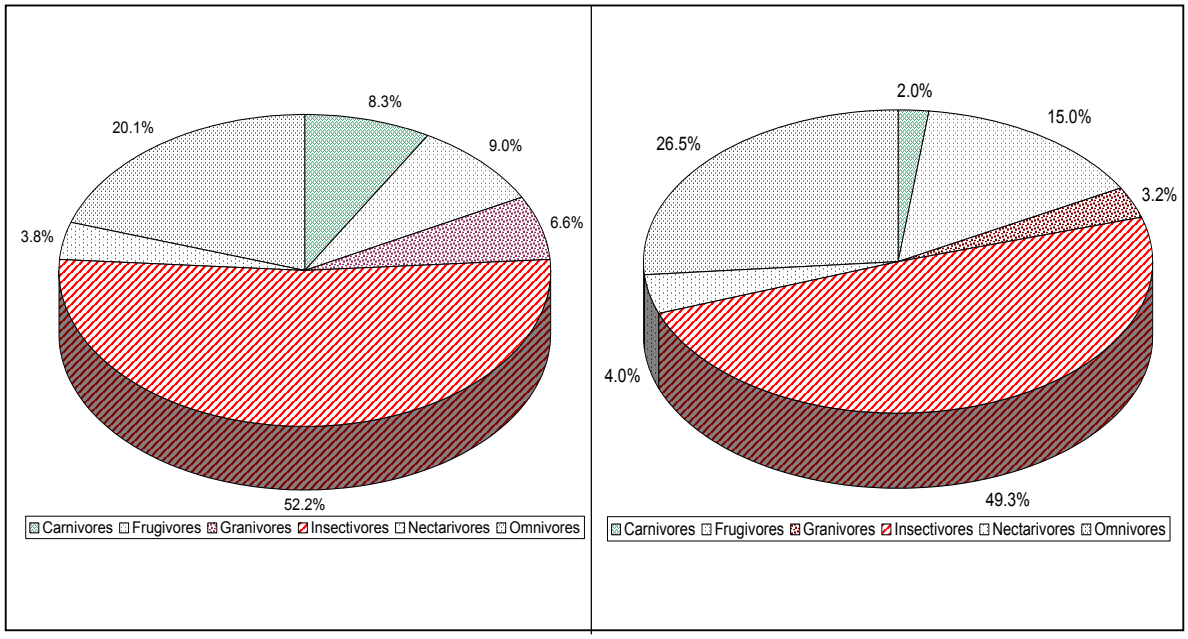

Fig.1.9 Species richness (left) and abundance (right) of birds in different guilds

insectivores with altitude. The species richness and abundance of nectarivores were relatively lower. The number of nectarivorous species increased upto Zone-III but was absent in two higher zones. The abundance of birds belonging to different foraging guilds showed variation in different zones. The abundance of granivores, omnivores and carnivores increased with increase in altitude. As in the case of species richness, the abundance of frugivores decreased with altitude. The insectivore abundance showed two peaks one in Zone-II and another one in Zone-IV (Table 1.17). The pattern of nectarivores abundance was corresponding with the species richness.

Table 1.17 Guildwise species richness and abundance of birds in different vegetation (altitudinal) zones along the Teesta valley

Foraging Guilds	Altitudinal zones											
	I		II		III		IV		V		Total	
	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.
Carnivores	11	136	9	31	6	20	7	34	3	65	24	277
Frugivores	14	1565	11	485	5	170	5	75	1	1	26	2043
Granivores	7	103	4	37	9	183	10	122	9	162	19	439
Insectivores	65	1538	72	1707	64	2108	40	1219	16	289	151	6715
Nectarivores	3	24	4	20	7	89	0	0	0	0	11	539
Omnivores	15	658	21	802	30	1603	10	106	12	288	58	3608

Ind= Individuals of birds

e) Breeding birds

Breeding of birds was also recorded as and when observed; 127 nests of 39 species were recorded in four zones with Zone-I having the highest number of nests (56). The breeding season observed was April to July, June being the peak breeding period

recording 68 nests of 26 species. In addition, breeding records of 30 species were also observed in different zones (Table 1.18).

Table 1.18 Number of breeding bird species and nests recorded in different altitudinal zones along the Teesta valley

Zones	No. of species	No. of nests
I	16	56
II	7	12
III	16	50
IV	6	9
V	0	0
Total	39	127

f) Endemic species

Out of eight endemic species recorded from Sikkim, five could be recorded during this study, namely Rusty-bellied Shortwing, Broad-billed Warbler, Hoary-throated Barwing, Yellow-vented warbler and White-naped Yuhina. Rusty- bellied Shortwing, a threatened endemic, seems to be rare as it was sighted only twice in Zone-IV, but the other four species are locally abundant and recorded frequently (Table 1.19). The distribution of endemics varied from one to three zones. No endemic bird species was seen in Zone-V. The five species namely Chestnut-breasted partridge, Wedge-billed Wrenbabbler, Rufous-throated Wrenbabbler, Ward's Trogon and Giant Babax were not seen during the course of study. Although, Chestnut-breasted partridge was reported by various workers from Zones-I, II and III, the distribution of the rest four species is not known.

Table 1.19 Abundances of endemic species of birds in different vegetation (altitudinal) zones along the Teesta valley

Species	Altitudinal Zones					Total
	I	II	III	IV	V	
Rusty-bellied Shortwing	-	-	-	2	-	2
Broad-billed Warbler	-	-	26	52	-	78
Hoary-throated Barwing	-	-	56	-	-	56
Yellow-vented Warbler	23	96	-	-	-	119
White-naped Yuhina	27	124	13	-	-	164
Chestnut-breasted partridge	-	-	-	-	-	
Wedge-billed Wrenbabbler	-	-	-	-	-	
Rufous-throated Wrenbabbler	-	-	-	-	-	
Wards Trogon	-	-	-	-	-	-
Giant Babax	-	-	-	-	-	-
Total	50	220	95	57	-	

(Number in the table indicates the total number of individual birds seen during the study.)

1.6 HERPETOFAUNA

Due to the secretive nature of reptiles and amphibians and restricted temporal activity, a few species were encountered during regular sampling. Large study area and steep terrain narrowed the possibility of other methods such as quadrat and pitfall traps. Hence, VES was followed for regular sampling though other methods were also used seasonally.

1.6.1 Species composition

A total of 36 species with 1,379 individuals of reptiles and 15 species with 835 individuals of amphibians were recorded during 1,860 hours of visual encounter survey. Seven families of reptiles were recorded (three lizards and four snakes) out of which Colubridae

dominated with 44.8% followed equally by Agamidae and Geckonidae. In the case of amphibians the present study could record only 4 families, as most of the amphibian species are nocturnal. The survey was carried out during day hours in which Ranidae dominated with 57.1% followed equally by 3 families, Bufonidae, Rhacophoridae and Megophryidae (Fig. 1.10).

1.6.2 Species accumulation pattern

The species accumulation pattern of reptiles (when plotted for all the zones) showed that the detection of species along the Teesta valley is near complete as the curve reached an asymptode (Fig. 1.11). The accumulation pattern of amphibian species shows a constant addition of species with respect to additional hours of effort indicating more species with further surveys (Fig. 1.12).

1.6.3 Relative abundance

Trachischium guentheri was relatively the most abunadant (29.016%) species found along the Teesta valley followed by *Leiolopisma sikkimense* (18.502%). Species such as *Typhlops* sp.*, Japalura variegata*, *Calotes versicolor* and *Sphenomorphus indicum* are other relatively common reptiles found along this valley (Table 1.20). Out of these 36 species, there were six venomous snakes namely *Naja kaouthia, Ophiophagus hannah, Trimeresurus monticola, Trimeresurus* sp., *Bungarus bungaroides* and *Bungarus niger*. Himalayan toad *Bufo himalayana* was the most abundant species, with respect to amphibians contributing maximum relative abundance (73.96%) followed by *Limnonectes limnocharis* (8.841%). *Bufo melanostictus* and *Rana* sp. were seen twice but *Rana* sp. was

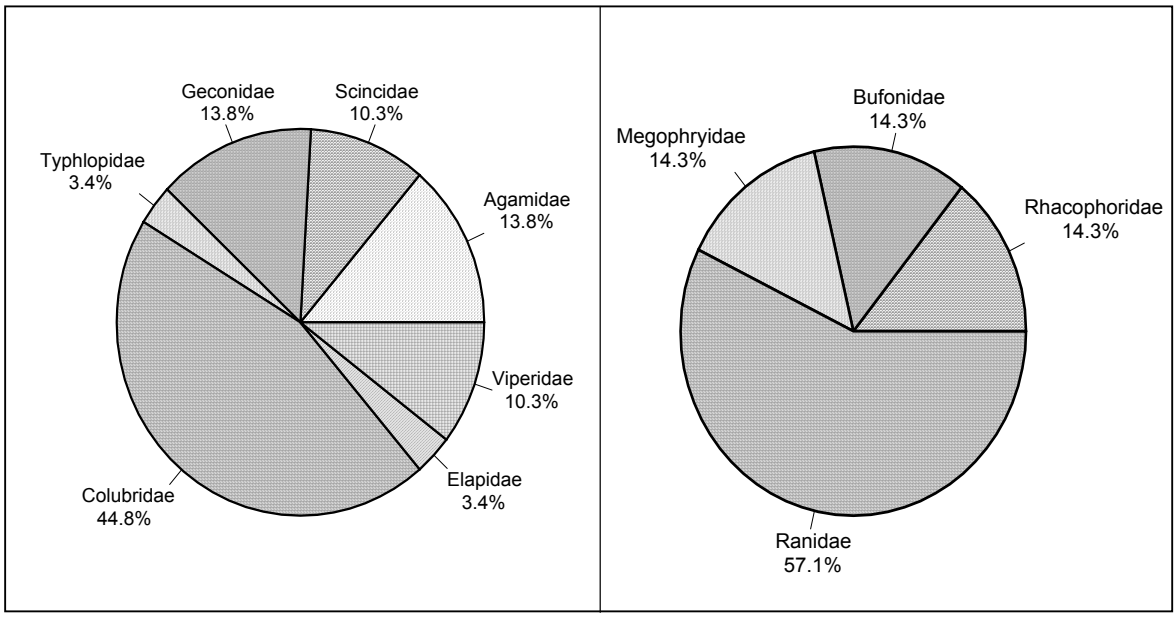

Fig.1.10 Familywise distribution of herpetofauna; Reptiles (A) and Amphibians (B) in different vegetation (altitudinal) zones along the Teesta valley

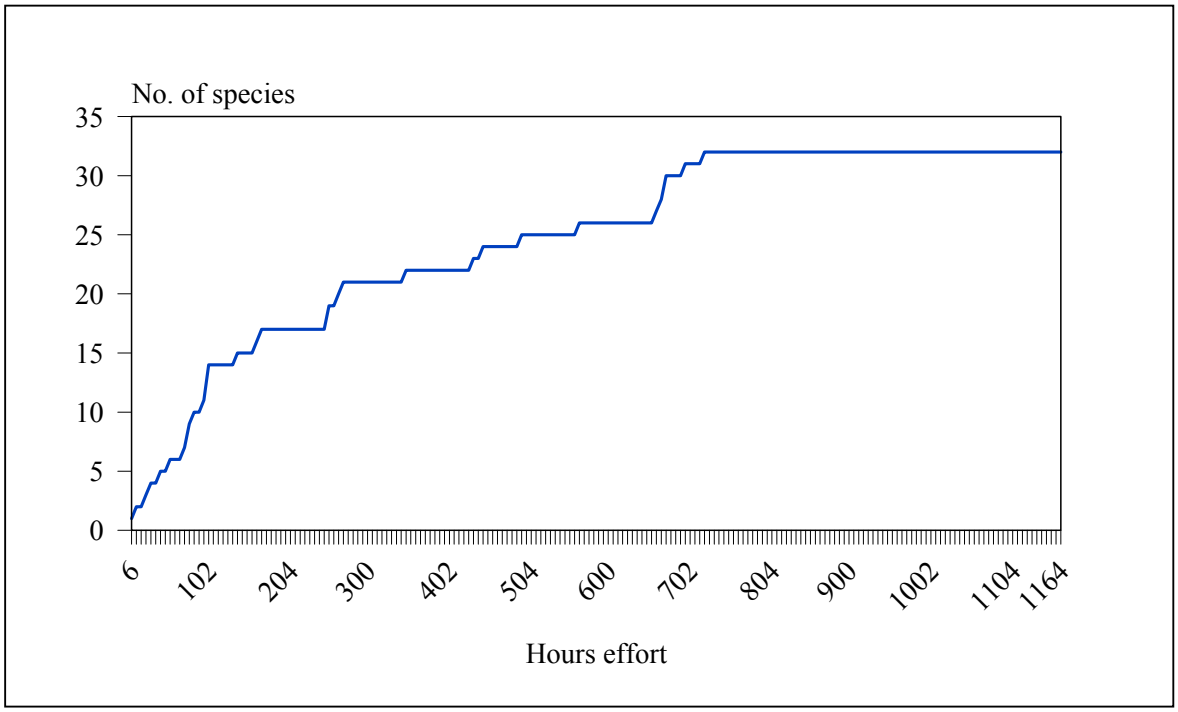

Fig.1.11 Species accumulation pattern of Reptiles along the Teesta valley

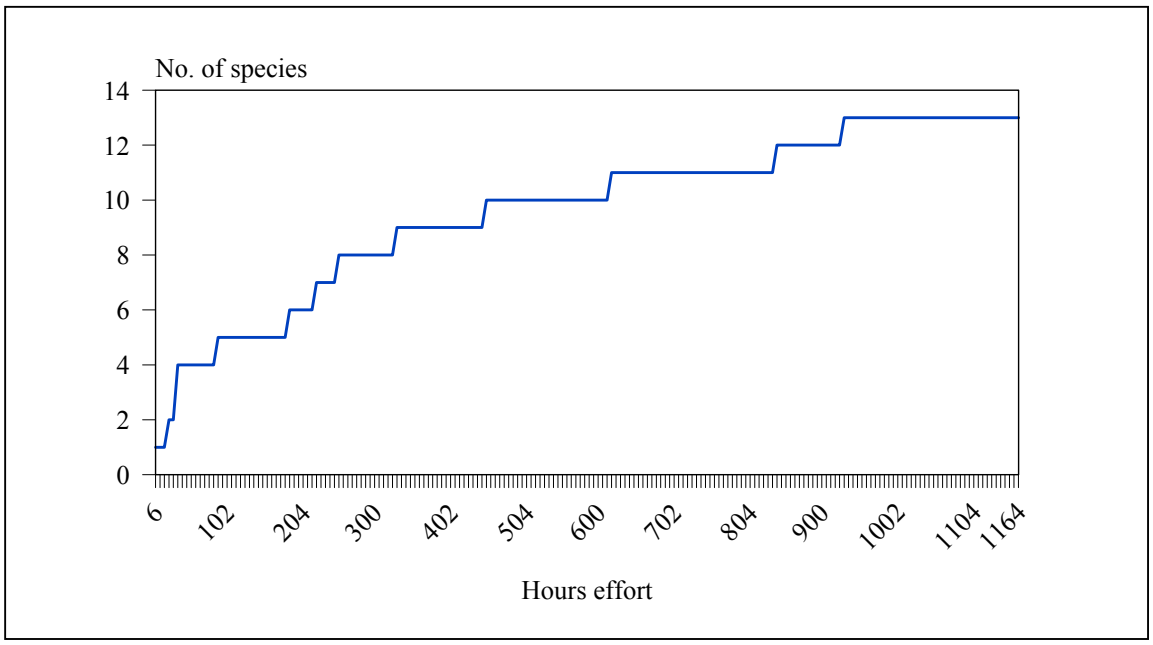

Fig.1.12 Species accumulation pattern of Amphibians along the Teesta valley

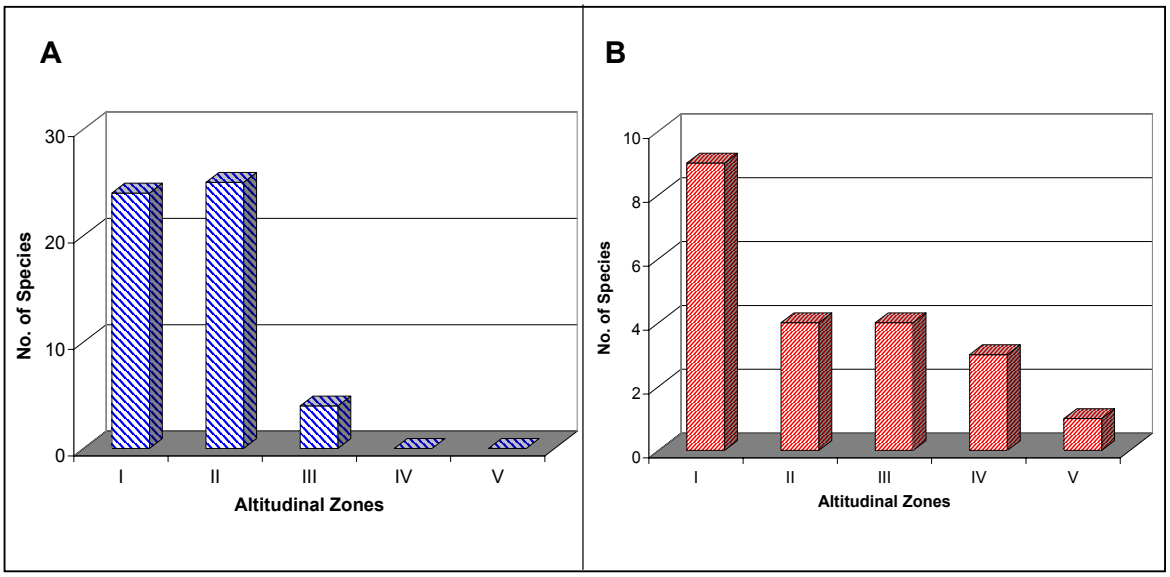

Fig.1.13 Observed reptile (A) and amphibian (B) species richness along the Teesta valley in different habitats

sighted only once (Table 1.21). The contrast in the relative abundances of two species of *Bufo*, namely *Bufo melanostictus* and *Bufo melanostictus* and *Bufo himalayana*, the former showing lowest and the later highest in high altitude and vice versa in lower altitude. *Bufo melanostictus* was restricted to Zone-I whereas *Bufo himalayana* showed wider distribution from Zones-II, III and IV. It may be noted that *Bufo melanostictus* may be marginally distributed as the range is taken over by its congener. All the five species of *Rana* observed during the study are yet to be identified. *Ichthyophis sikkimensis*, the only limbless amphibian reported from the North Indian region was observed opportunistically in the lower altitudes (~500 m). The Himalayan newt (*Tylototriton verrucosus*), though recorded fom Sikkim in the past could not be located during this study.

1.6.4 Distributional range

Among the lizards *Takydromus sexlineatus* was distributed in a very narrow range (300-700 m). The most widely distributed species was *Leiolopisma sikkimensis* (Table 1.22). Among the snakes, the most being sighted only once, range could not be documented. *Amphiesma platyceps* is distributed widely (800-2,600 m). Among the amphibians *Bufo himalayana* and *Scutiger sikkimensis* were the most widely distributed species along the Teesta valley. All other species showed very narrow range of distribution. From the data available it appears that species distributed in the lower altitude have narrow range compared to those found in the higher altitudes.

Table 1.20 Relative abundance of the reptiles found along the Teesta valley

Species	Individuals observed	Relative abundance (%)
Hemidactylus bowringi	3	0.252
Hemidactylus garnoti	4	0.336
Hemidactylus sp.	16	1.345
Gymnodactylus khasiensis	2	0.168
Calotes versicolor	67	5.635
Japalura variegata	178	14.97
Takydromus sexlineatus	16	1.345
Sphenomorphus maculatum	158	13.288
Sphenomorphus indicum	65	5.466
Leiolopisma sikkimense	220	18.502
Trimeresurus monticola	8	0.672
Trimeresurus sp1.	2	0.168
Trachischium guentheri	345	29.016
Amphiesma platyceps	22	1.50
Amphiesma himalayana	2	0.168
Rhabdophis subminiata	1	0.084
Elaphe cantoris	2	0.168
Elaphe radiata	1	0.084
Dendrolaphis pictus	1	0.084
Lycodon aulicus	4	0.336
Lycodon fasciatus	2	0.168
Ptyas korros	9	0.420
Oligodon juglandifer	5	0.362
Naja kaouthia	1	0.084
Typhlops oligolepis	42	3.532
Xenochrophis piscator	6	0.504
Oligodon albocinctus	1	0.084

Boiga sp.	1	0.084
Zoacys nigromarginatus	1	0.084
Sibynophis collaris	1	0.084
Pareas monticola	1	0.084
Bungarus bungaroides	1	0.084
Bungarus niger	1	0.084
Ophiophagus hannah	1	0.084
Total	**1189**	

UI- species to be identified

Table 1.21 Relative abundance of amphibians of Teesta valley

Amphibian species	No. of individuals observed	% of relative abundance
Amolops sp.	20	2.389
Bufo melanostictus	2	0.239
Bufo himalayana	619	73.955
Limnonectes limnocharis	74	8.841
Megophrys parva	4	0.478
Polypedates leucomystax	26	3.106
Rana sp1.*	37	4.421
Rana *sp2.**	5	0.597
Rana sp3.*	4	0.478
Rana sp4.*	2	0.239
Rana sp5.*	1	0.119
Rana liebigii	7	0.836
Scutiger sikkimensis	36	4.301

**Species to be identified.*

1.6.5 Species Richness and Diversity

Species richness and diversity (H') were calculated based on data from Visual Encounter Survey. The data from other methods were excluded because of the poor sightings. The highest number of

species was obtained in Zone-I and Zone-II. Reptile species encounter rate was high in Zone-I followed by Zone-II but individual encounter rate was high in Zone-III. Amphibians did not show any pattern of encounter rates with habitat. Both species as well as individual encounter rates were high in Zone-IV (Table 1.23).

Tropical broad leaved forest (Zone-II) holds maximum number of reptile species followed by Tropical semi-deciduous and wet forest of Zone-I whereas Zone-I hold the maximum number of amphibian species followed by Zone-II. The species richness showed decreasing trend with increasing altitude (Fig. 1.13).

Table 1.22 Herpetofaunal distributional range at atitudinal gradient

Lizards		Amphibians	
Species	**Range (m)**	**Species**	**Range (m)**
Hemidactylus bowringi	500-1000	*Amolops* sp.	450-1350
Hemidactylus garnotii	500-1000	Bufo melanostictus	450
Hemidactylus frenatus	500-1000	Bufo himalayana	1200-3100
Gymnodactylus khasiensis	500-1000	Limnonectes limnocharis	250-800
Calotes versicolor	250-1000	Megophrys parva	1700-2300
Japalura variegata	800-2300	Polypedates leucomystax	400-800
Leiolopisma sikkimense	1300-2800	*Rana* sp1.*	800
Sphenomorphus indicum	300-1500	*Rana* sp2.*	250
Sphenomorphus maculatum	300-2000	Rana *sp3.**	800
Takydromus sexlineatus	300-700	*Rana* sp4.*	800
		Rana sp5.*	1800-2300
Snakes			
Amphiesma himalayana	700-1100	*Rana liebigii*	1800-2600
Amphiesma platyceps	800-2600	*Scutiger sikkimensis*	2800-4800
Dendrelaphis pictus	400-700		
Elaphe porphyracea	550		
Elaphe cantoris	1700		
Elaphe radiata	500-1000		
Lycodon aulicus	300-550		
Lycodon fasciatus	800		
Naja kaouthia	550		
Oligodon juglandifer	1300-1700		
Ptyas korros	400-800		

Trimeresurus sp	1300-2000
Trimeresurus monticola	1400-2000
Trachischium guentheri	1700-2000
Typlops oligolepis	380-700
Xenochrophis piscator	300-550

**Species to be identified*

Table 1.23 Encounter rate of herpetofauna in various zones of Teesta valley

Zones	Reptiles		Amphibians	
	Species/hr	Individuals/hr	Species/hr	Individuals/hr
I	0.042	0.637	0.022	0.402
II	0.047	0.606	0.011	0.160
III	0.007	1.304	0.010	1.359
IV	0	0	0.024	0.435
V	0	0	0.015	0.412

The amphibian species richness was very low in Zone-IV and V but no species of reptiles were seen in these two zones (Table 1.24). Only one species of amphibian *Scutiger sikkimensis* was found in alpine and subalpine habitats whereas no reptiles were encountered beyond 2,800 m. The abundance showed somewhat different pattern. The highest abundance was in Zone-III for both reptiles and amphibians.

Table 1.24 Herpetofaunal distribution in various habitat (altitude) zones of the Teesta valley

Zones	No. of hours	No. of Reptile species	No. of Individuals	No. of Amphibian species	No. of Individuals
I	566	24	361	9	164
II	524	25	318	4	59
III	536	4	699	4	530

IV	160	0	0	3	54
V	74	0	0	1	28

Species diversity as well as evenness of reptiles was highest in Zone-I (H'=2.271; E= 0.735) and lowest in Zone-III (H'=0.809; E= 0.584). Lower reptile diversity in Zone-III could be due to colder climatic conditions and rapid increase of altitude. Similarly, amphibian species diversity and evenness was high in Zone-I (H'=1.473; E= 0.670) followed by Zone-IV (H'= 0.48; E= 0.437) and lowest in zone III (H'= 0.128; E=0.092; Table 1.25).

Table 1.25 Herpetofaunal diversity in various habitats of Teesta valley

Habitat	Reptiles		Amphibians	
	Species diversity (H)	Evenness (E)	Species diversity (H)	Evenness
Zone I	2.271	0.735	1.473	0.670
Zone II	1.894	0.643	0.318	0.229
Zone III	0.809	0.584	0.128	0.092
Zone IV	0		0.48	0.437
Zone V	0		0	

Both species richness and exclusive species were high in Zone-I followed by Zone-II for reptiles with no exclusive species beyond 2,800 m (Table 1.26). However, the number of amphibian species as well as exclusive although more in Zone-I, only one species was found exclusive to Zones IV and V which was probably because of the marshes near the hotspring.

Table 1.26 Herpetofauna exclusive to various altitudinal zones of Teesta valley

Zones	Reptiles		Amphibians	
	Number of species	Exclusive species	Number of species	Exclusive species
I	25	14	8	5
II	25	8	4	0
III	4	0	4	2
IV	0	0	3	1
V	0	0	1	0

Besides regular sampling, species such as *Dendrolaphis pictus*, *Elaphe radiata, Elaphe porphyracea, Boiga* sp.*, Naja kaoutia, Oligodon albocinctus, Pareas monticola, Sibynophis collaris, Bungarus bungaroides, Bungarus niger* were recorded opportunistically.

1.7 BUTTERFLIES

1.7.1 Species ricnness and abundance

All together, 266 species and 7065 individuals of butterflies were observed in the study area. In all 1,920 point counts including 784 in Zone-I, 558 in Zone-II, 458 in Zone-III and 60 each in Zones IV and V were done. The data collection in the middle and higher altitudes were commenced only in July 2003.

The density of Butterflies was the highest in Zone-I and lowest in Zone-V. The species and individuals per hectare decreased with increase in altitude (Table 1.27).

Table 1.27 Species richness and abundance of butterflies along the Teesta valley

Zones	Area sampled (ha)	Species /point	Individuals /point	Species /ha	Individual /ha
I	6.14	0.252	6.284	32.247	802.443
II	4.37	0.290	2.546	37.071	325.172
III	3.58	0.181	0.675	23.184	189.385
IV	0.47	0.1	0.4	12.8	51
V	0.47	0.067	0.367	8.5	47

1.7.2 Species diversity

Species/point as well as individuals/point showed negative correlation with altitude. Although the species richness (0.29 sp/ point) was relatively more in Zone-II the diversity was more in Zone-I (H'= 4.133).

1.7.3 Family-wise composition

Nymphalidae was the most dominant family in terms of species richness followed by Lycaenidae, but Pieridae was the next abundant family after Nymphalidae (Fig. 1.14). Nymphalidae dominated all the zones. The trends of other families were different in different zones. Pieridae was the second dominant family in Zone-I, Lycaenidae in Zones II and III and Papilionidae in Zones-IV and V. Pieridae was the second abundant family in all the zones. (Figs 1.15 and 1.16).

There was significant difference among species between Zones-I and IV ($U=0$; $p<0.01$), Zones-I and V ($U=0$; $p<0.01$), Zones-II and IV ($U=0$;$p<0.01$), Zones-II and V ($U=0$; $p=0.01$) and Zones-III and V ($U=0.5$; $p<0.01$). Similarly the significant difference in abundances

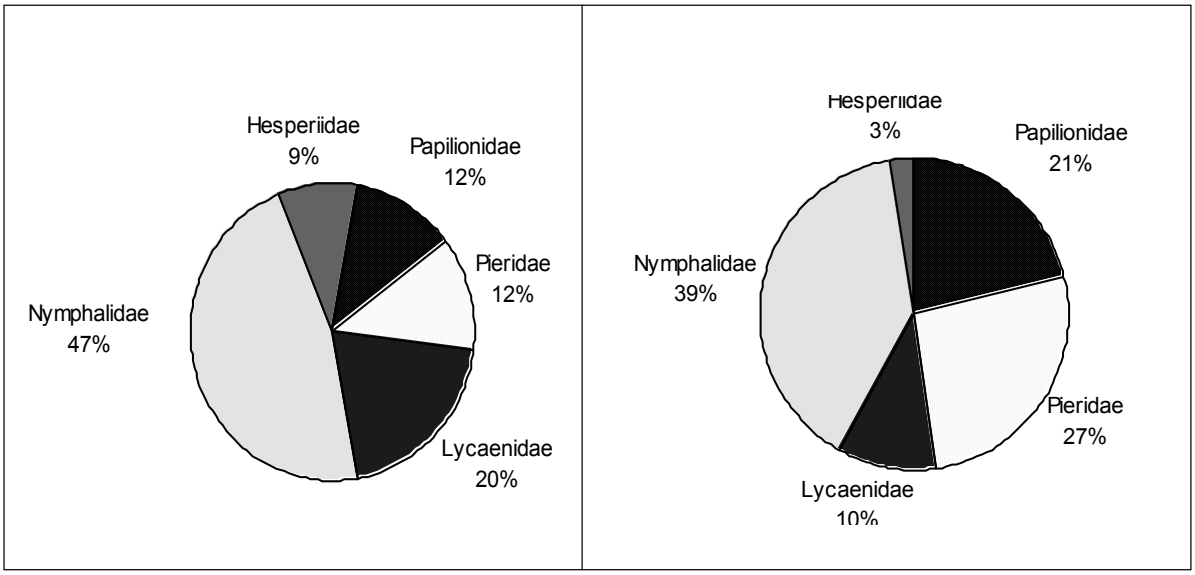

Fig.1.14 Composition of butterflies at family level Species (A) and abundance (B)

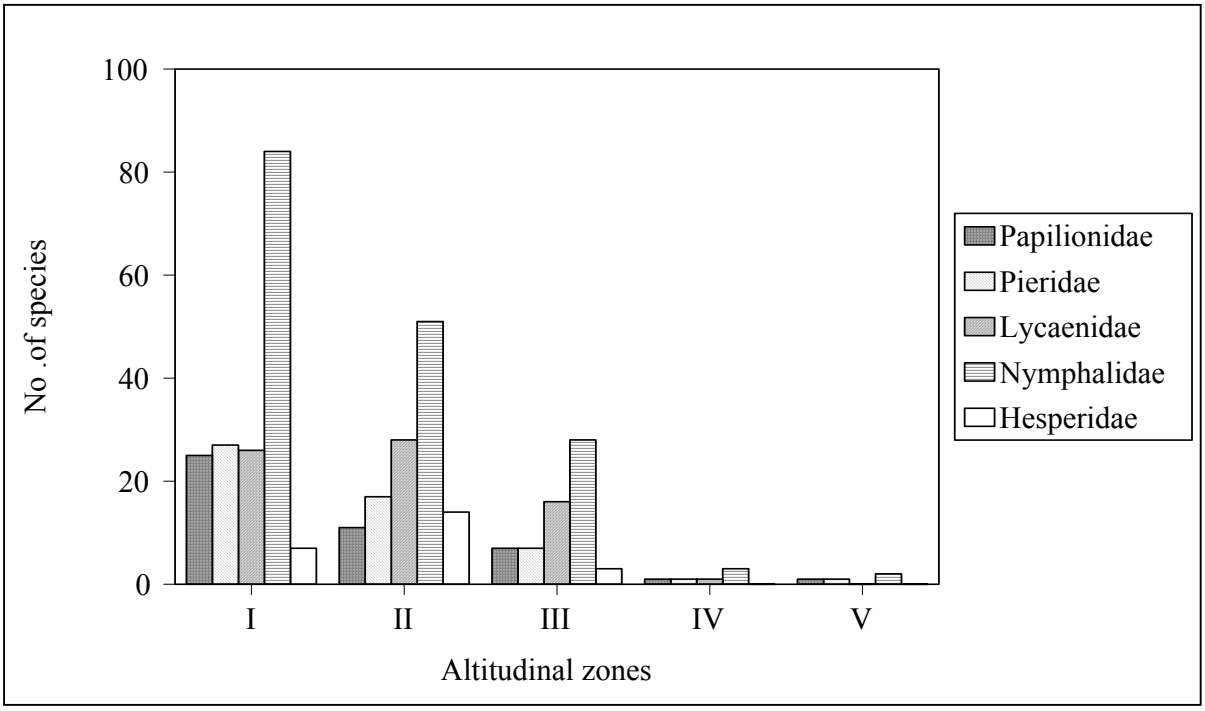

Fig.1.15 Familywise species richness of butterflies in different zones of Teesta valley

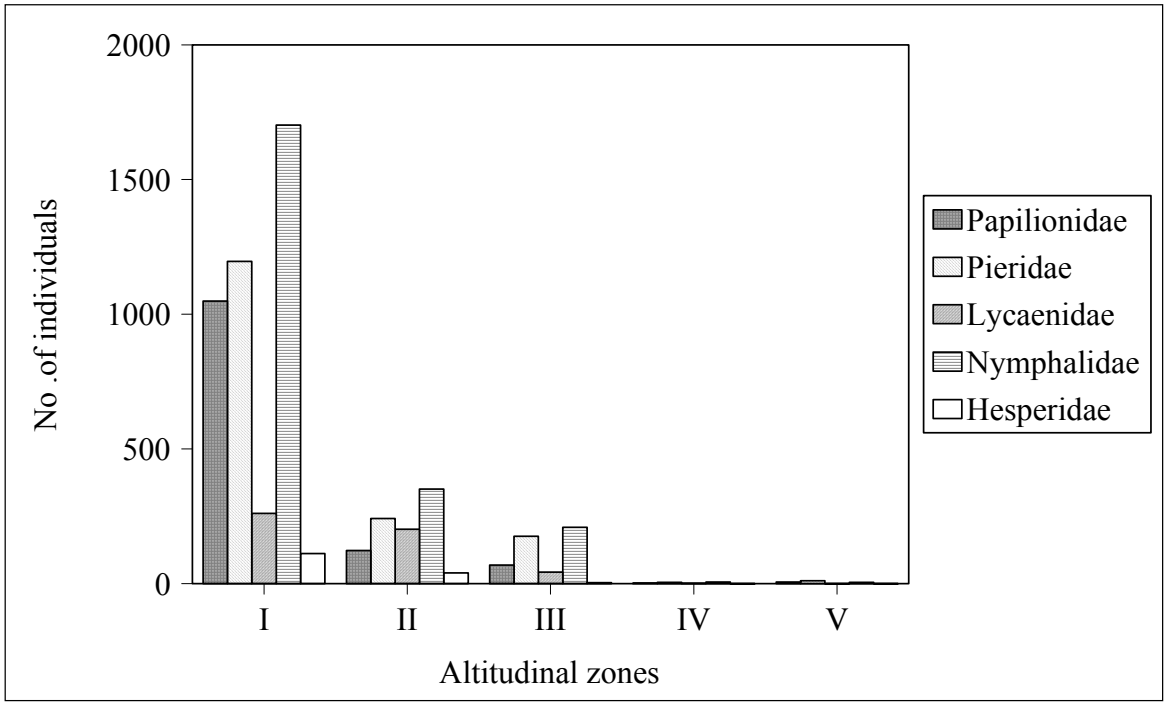

Fig.1.16 Family wise species abundance of butterflies in different zones of Teesta valley

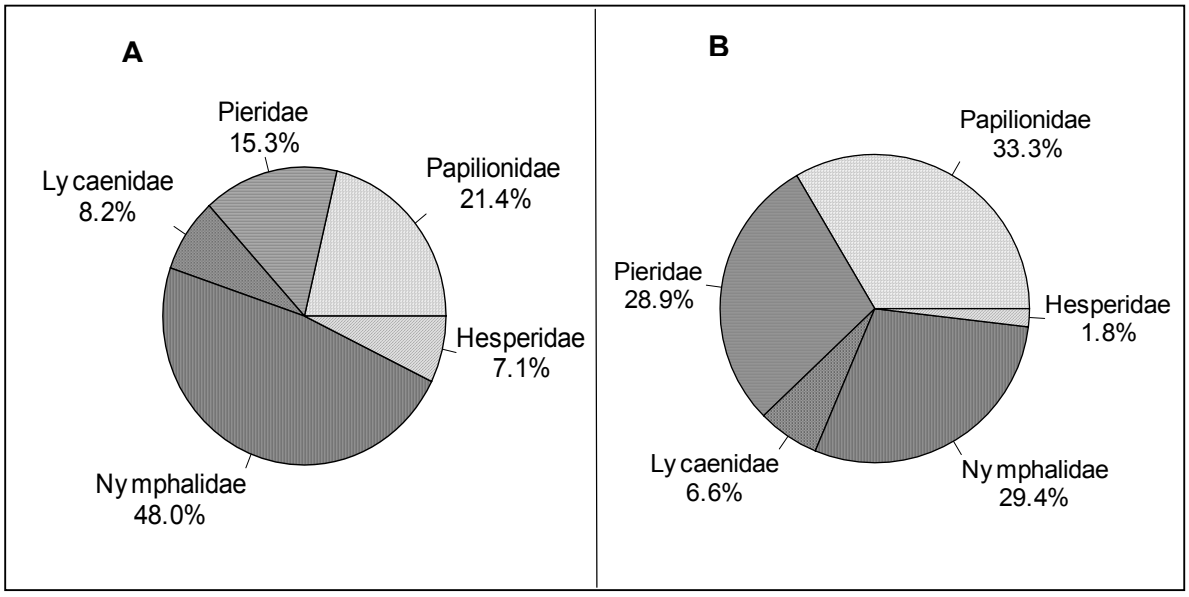

Fig.1.17 Family-wise species richness (A) and abundance (B) in Zone-I

was observed between Zones-I and III (U=2; p<0.05), Zones-III and IV (U=2;p<0.05), Zones-III and V (U=3; p<0.05) Zones-I and IV (U=0; p<0.01), Zones-I and V (U=0; p<0.01), Zones-II and IV (u=0, p<0.01) & Zones-II and V (U=0; p<0.01; Tables 1.28 and 1.29).

Table 1.28 Mann- Whitney 'U' Test showing difference in species richness of Butterflies in different zones

	I	II	III	IV	V
I		8.5, p=0.40	4.00, p=0.08	0, p= 0.01	0, p=0.009
II			5.50, p=0.14	0, p=.01	0, p=0.009
III				0.5, p=0.001	0, p=0.008
IV					10.00, p=0.572
V					

Table 1.29 Mann-Whitney 'U' Test showing difference in abundance of Butterflies in different zones

	I	II	III	IV	V
I		5.00, p=0.117	2, p= 0.028	0, p= 0.009	0, p=0.009
II			7.00, p=0.251	0, p=0.009	0, p=0.009
III				2.00, p= 0.028	3.00, p=0.047
IV					11.00, p=0.075
V					

1.7.4 Restricted species

Out of the 266 species of butterflies observed during the present study 116 species (43.6%) were habitat specialists. The percentage of

restricted range species decreased with increase in altitude. Zone-I had maximum number of exclusive species followed by Zones-II, III, IV and V. The percentage of restricted species was higher at lower and higher altitudes but less at middle altitudes (Table 1.30).

Table 1.30 Exclusive species of butterflies in different zones

Zones	Exclusive species	Percentage of exclusives
I	73	41
II	30	25
III	11	18
IV	1	17
V	1	25

Zones-I and II showed 57% similarity in species composition followed by Zones-II and III. The sharing of species was the least between Zones-I and V (Table 1.31). The percentage of shared species abruptly fell between Zones-III and IV and again rose between IV and V which showed that the species transition zone lies around 3,000 m altitude.

Table 1.31 Similarities of Butterfly species observed in different vegetation (altitudinal) zones along the Teesta valley

Zones	I	II	III	IV	V
I	-	109(57%)	42(21.2%)	2(1.09%)	1(0.54%)
II	-	-	47(34.8%)	2(1.6%)	2(1.62%)
III	-	-	-	4(6.34%)	3(4.8%)
IV	-	-	-	-	2(25%)
V	-	-	-	-	

1.8 DETAILED STUDIES IN ZONE-I

During the initial stage of the project, studies were conducted in the lower altitude between 550 and 650 m. This region had different types of habitats namely disturbed forest (DF), disturbed agricultural land (DAL), cardamom agroforest (CAF) and paddy field (PF). The count data is from March to May 2003.

In total 98 species and 2,531 individuals of butterflies were seen in the four habitat types covering 192 point counts. This showed an average of 0.51 sp./point. The most species rich family was Nymphalidae followed by Papilionidae and Pieridae. The abundance pattern was very different; Papilionidae was the most dominant family followed by Pieridae and Nymphalidae (Fig. 1.17).

DF was rich in terms of species as well as abundance. The second rich habitat was CAF. Species diversity was high in DF (H'= 3.579) followed by CAF (H'= 3.443). The two agricultural fields were relatively poorer in species richness as well as abundance. The disturbed agricultural land was the poorest in terms of butterflies.

In terms of species richness Nymphalidae dominated all the habitat types (Fig. 1.18). The second rich family was Papilionidae. The pattern of species richness among different families was same in all habitats. The species abundance showed different pattern as compared to richness. Papilionidae dominated DF, whereas it was Pieridae in DAL and PF and Nymphalidae in CAF. The DF and CAF were almost same in species richness and abundance (Fig. 1.19). There was no significant difference among the species and individuals in the different habitat types (Table 1.32 and 1.33).

Table 1.32 Mann- Whitney 'U' Test showing difference in species richness of butterflies between different habitats in zone-I

	DF	DAL	CAF	PF
DF		8, p=0.343	13, p=0.078	10.00, p=0.359
DAL			8.00, p=0.346	12.00, p=0.196
CAF				8.5, p=0.401
PF				

Table 1.33 Mann- Whitney 'U' Test showing difference abundance of butterflies between different habitats in zone-I

	DF	DAL	CAF	PF
DF		9.00,p=0.465	10.00, p=0.602	8.00, p= 0.347
DAL			10.00, p=0.602	11.5, p=0.834
CAF				10.00, p=0.602
PF				

1.9 DISCUSSION

According to the secondary data, 169 species of mammals are supposedly occurring in Sikkim. The survey for mammals in this study from May 2003 was done to look at the species richness, abundance and composition of various groups of mammals in different vegetation and altitudinal zones. But it was not possible to study the vast groups of mammalian species within a short time. More than 40 species of bats are found in Sikkim comprising the largest, Flying Fox *Pteropus giganteus* and perhaps the smallest, Little Bamboo Bat (Avasthe and Jha, 1999). The bats and high altitude ungulates accounting for most

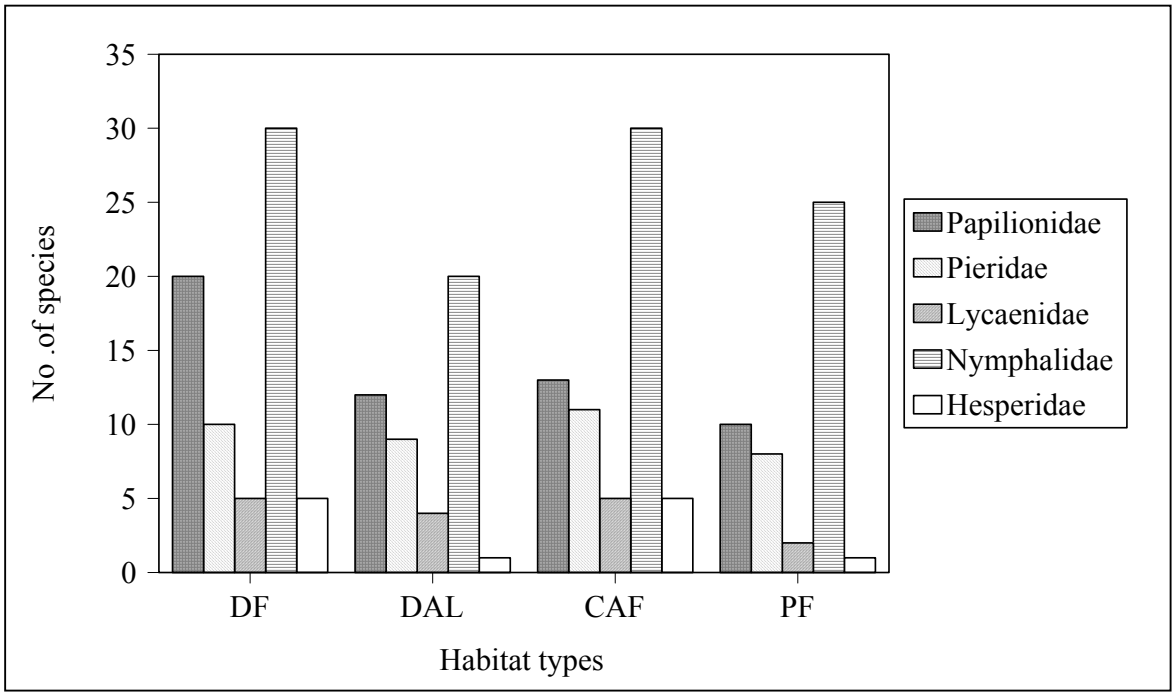

Fig.1.18 Family-wise species richness of butterflies in different habitats of Zone-I

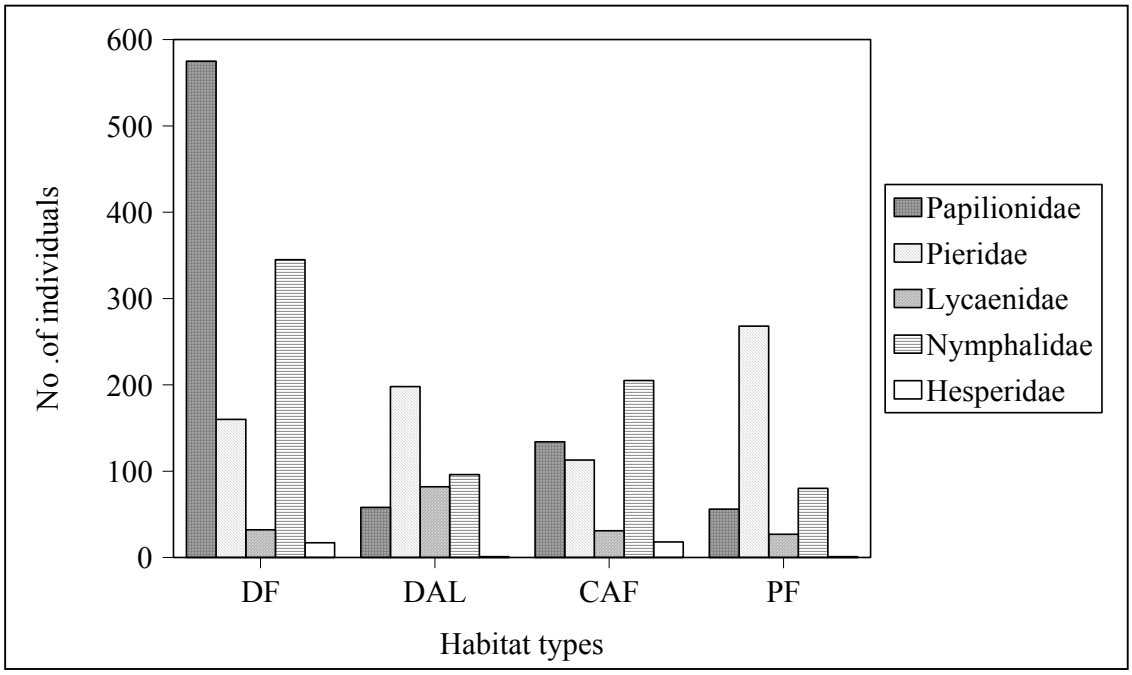

Fig.1.19 Family-wise abundance in different habitats of Zone-I

of the species already recorded from Sikkim were excluded from this study to focus on other groups for which no information was available from Sikkim. Though the methods required for studying bats differ, during this study there were a few sightings of bats in the Coniferous and the Temperate broadleaf forests.

Murid rodents are generally sampled by trapping in grids. But the slope of the area could not make it possible to lay grids. Therefore, traps were laid in line along the transect lines. Among all groups of mammals, shrews are highly localized species. They are extremely sensitive to slight fluctuation in temperature and other resources. Also due to their small size the movement is also limited locally.

The secondary data on mammals showed high species richness especially in Zone-I and Zone-II. But the richness estimated after our sampling shows that the Zones-III and IV are more speciose than the lower zones. This contrasting result could be due to the fact that the lower altitude forests below 900 m are completely converted into agricultural fields. In altitudes ranging from 900 m to 1,800 m, the major contributor to this cause is also the cardamom plantation. The patches of disturbed forest consists of one species of planted tree i.e. *Alnus nepalensis,* with cardamom. In Zone-III i.e. from 1,800 m to 2,800 m, the ground cover is completely removed to make way for cardamom, but the natural tree species are retained. The removal of shrubs can considerably affect the species composition and richness of small mammals. All the rodents are enlisted as Schedule-V species under the Wildlife Protection Act (WPA) but most of the rodent species occurring in Sikkim are Data Deficient under the IUCN

category. Among the captured insectivores *Soriculus caudatus* and *S. nigrescens* are the two species of shrews, which are categorized as Vulnerable.

Similarly in the case of carnivores, arboreal mammals and ungulates also the secondary information showed high species richness in the lower altitudes. But as already discussed the habitats in the lower altitudes are not suitable for these species and their very existence in Sikkim is threatened due to the proximity to humans in these areas. There has been a constant decrease in population or even local extinction of species in the lower altitudes due to pressure of human disturbances. Now only a few species which can adapt in the small fragmented patches of forests exist in Zone-I and Zone-II. For example, the squirrels have high abundance in the lower zones as they are not affected by the nearby human presence. *Macaca assamensis* are increasingly occupying the areas nearby the roadsides for easy food that is offered to them. The other group whose sighting was very few was the flying squirrels. In spite of probable occurrence of seven species only one species i.e. the Hodgson's flying squirrel was sighted on two occasions. A pair of Himalayan Stoat was sighted at an altitude of 2,100 m. Its present known altitude range is 3,200 m to 4,200 m.

One new species of particular interest is the Nepal Langur, occurring in only a few areas in the high altitudinal forest of pine and rhododendron. This is a recently elevated species and its distribution in India is restricted to high altitudes of Sikkim. The forest areas near Lachen, where this langur was sighted is an important area where several species of small cats also occur.

Zones-III and IV were the highest in species richness. The Red Panda which is listed in the Endangered category of IUCN and as Schedule-I species according to WPA occur in this altitude i.e. between 1,800 m to 3,800 m. Evidences of Vulnerable and Schedule I species were recorded in these two zones especially that of Serow, a forest ungulate. It has a restricted range from 1,000 m to 3,000 m altitude. As its habitat below 1,500 m is already destroyed any kind of disturbance in its habitat above 1,500 m will have an adverse effect. The high abundance of scats of leopard cat indicates its presence in zone III, which is also a Schedule I species according to the Wildlife Protection Act, 1972. The number of species with direct sightings and with indirect evidences makes it a total of forty-five species of mammals. However, with some additional sampling it is very likely that the number of species will increase.

Total species of birds recorded earlier was 540. A record of 307 species of birds within 22 months of the present study shows that Teesta valley still harbours good habitats. Although the species richness was same in middle two Zones i.e. II & III, species composition was different. In total 48.8% were habitat specialists. Zone-I was dominated by woodpeckers, kingfishers, bulbuls, and drongos; Zone-II by doves, yuhinas, sunbirds and minivets, whereas Zone-III was represented mostly by undergrowth species such as babblers, laughing thrushes and fulvettas. The similarity in species richness may be due to similarity in vegetation structure and forest cover. The relatively low species richness with abrupt changes in species composition including more number of habitat specialists in Zones-IV and V shows that the transition zone lies between Zones-III and IV at about 3,000 m. The observed result differs from the existing

one for Zone-V showing less number of species than expected probably because the zone was not equally covered in all seasons. The abundance in Zone-II was relatively lower as compared to other zones because this zone is mostly disturbed by cardamom plantation. Further, the undergrowths are removed and single species (*Alnus nepalensis)* tree dominated the forest reducing the quantity of resource available to the birds.

There was marked seasonal variation in richness as well as abundance of birds because of altitudinal movement. During rainy season most of the plant species were either flowering or fruiting supporting large populations of frugivorous species. Also, June being peak breeding season, presence of both migratory and resident species might have increased the number of total species during this season. Some of the lower altitude species showed upward migration for breeding.

Information available on herpetofauna (amphibians and reptiles) is far less or not available compared to the other taxa studied. The present checklist consists of 81 species, with several unconfirmed records (Annexure-III). The species richness is highest in lower two Zones (I & II). However, the abundance was high in Zone-III. As Zones-I and II have a warmer climate and tropical moist forest, conducive to reptiles and most amphibians, many of the species were seen exclusively in these zones making these the most diverse habitats. The highest abundance observed in Zone-III was due to the clumped distribution of some species, *Trachischium guntheri, Leiolopisma sikkimensis* and *Bufo himalayana.* Reptiles being cold-blooded animals they are sensitive to temperature and

ecophysiological constraints, which affect the range of the species. Climatic severity in higher altitude may be the probable reason for the low species richness (Navarro, 1992).

The maximum sharing between Zones-I and II may be due to overlapping habitat structure both having tropical climate which is conducive for herpetofauna. No reptile was recorded in Zones-IV and V which may be due to colder climatic condition. The species accumulation curve for all zones together has almost reached an asymptote but it is not the case when individual zones are considered separately. This might be due to rapid encountering of common species in the early sampling days. Although additional species were seen but the rate of sightings was very low because the species were rare. The other possible reason may be due to large sampling area. The seasonal fluctuation observed is the usual feature for herpetofauna. Most of the reptiles hibernate during winter and late autumn. Hence, low richness and abundance was observed in these seasons as compared to summer and rainy. The present study showed clear inverse pattern of number of species with altitude, as the altitude increased, number of species decreased. However, different zones have unique assemblage of species. The change in pattern from the existing data could be due to poor sampling for amphibians primarily during night stream survey as most of the streams are torrent.

Total species of butterflies recorded earlier was 689 species and the species recorded during this study was 266. The richness of species was high in the lower two zones than the higher zones showing that these habitats have got a great potential for

conservation. The occurrence of very rare and specialist butterflies in high altitude areas, especially the alpine habitats needs research attention and management.

Decrease in species richness of butterflies with increase in altitude was observed. This might be due to the narrow tolerance of butterflies to weather conditions especially cold and habitat suitability. Butterfly species appear to use warm and humid type of habitats. Hence, there were more species in Zone-I than higher zones. The reason is also supported by the number of exclusive species present in Zone-I. Most of the species present in Zone-I was not seen in any other zones. A few species were specialists of arid alpine and sub-alpine regions. The result obtained is consistent with the earlier records.

Dalep (Lower altitude) appears to be rich in butterflies both in terms of number of species and abundance. Record of 98 species within three months in lower altitude showed that the area harbors good habitat for butterflies. Haribal (1992) has reported 350 species of butterflies in low altitude area (below 900 m) from Sikkim. As compared with this number the total record from Dalep represents 20% of species, which reflects high conservation value of the low altitude agro forests of Sikkim. The reason for high species richness might be (1) patches of forest with good tree cover sandwiched between agricultural land represented mostly by *Ceiba* sp., *Ostodes* sp., *Terminalia* sp., *Duabanga* sp., *Ailanthes grandis* and *Schima wallichi* forming the major habitat for butterflies, (2) the fallow lands adjoining agricultural field covered with shrubs also act as habitat for some specific butterflies and (3) the presence of two rivers (Pabong

and Teesta) provides additional habitat for those species inhabiting moist habitats such as stream banks. Variety of crops grown in each season and the types of agricultural land it possesses also explains higher diversity of butterflies in this region.

1.10 LIMITATIONS OF THIS STUDY

The time allotted for the present study was more limited due to delay in getting permits for sampling. The permits were again cancelled during the study by the Sikkim Forest Department resulting in loss of field time and sampling seasons. More sampling is needed especially in the landscapes between temperate broad leaf and the coniferous forests. Due to the secretive nature, limited activity period (hibernation or aestivation) and size (small) of herpetofauna considerable difficulties are encountered in sampling these taxa. Apart from this, terrain (especially steepness) and diurnal and nocturnal activity of them prevented from using many standard sampling methods.

Sampling in the higher altitudes above 3,800 m could not be done regularly due to various reasons like the proximity of international borders and presence of security installations making it difficult to visit many areas. Massive landslides during the monsoon become problematic to sample the areas of North Sikkim.

1.11 SUMMARY AND RECOMMENDATIONS

1.11.1 Species diversity

In all, 798 vertebrates and 689 species of butterflies have been

reported from Sikkim including 169 mammals, 541 birds, 61 reptiles and 20 amphibians. During our present sampling, 375 species of vertebrates and 223 species of butterflies were observed. These records form 40.4% of the total species present in the state. The sampling area of the presnt study was restricted within two kilometers (on either side) from the vicinity of the Teesta river covering about 600 sq km, which is about 8.5% of the total area of Sikkim (7,096 sq km). The record of over 40% species within this small area within two years of field sampling indicates that Teesta valley is rich in terms of biodiversity. It is expected that further intensive and long-term sampling would result in more species. Hence, Teesta valley is vital for the conservation of biodiversity in Sikkim.

1.11.2 Important Altitude/ Habitat zone

Higher diversity of mammals, birds and reptiles were found in Zone-III (1,800-2,800 m) where Temperate broad leaved forest is common. Specific localities include areas around Chungthang, Lachen and Lachung and intervening forests connecting these localities. The higher two zones (IV &V), although possess relatively low species, form the habitat of many high altitude birds which we never see in any of the other zones (exclusive spcies to the altitude or forest type). These zones are the breeding grounds for many migratory waterfowl including the Black-necked crane.

1.11.3 Endemic/ Exclusive species specific to Himalayas or particular altitude zone

The Nepal Langur is a recently elevated new species whose distribution is restricted to high altitudes of Sikkim (in and around

Lachen), Nepal and Bhutan. It is only found in overlapping forests of Temperate broadleaf and Coniferous at an altitude of about 2,800m. The same region is also the habitat for the Red Panda, which is the state animal of Sikkim and is restricted to higher altitudes only. Serow found in Zone-III is restricted to Himalayas from Sikkim to Kashmir. The Marbled Cat is an extremely rare and nocturnal species and has been reported locally around Chungthang in Zone-III.

Five endemic bird species could be recorded during this study, namely Rusty-bellied Shortwing, Broad-billed Warbler, Hoary-throated Barwing, Yellow-vented warbler and White-naped Yuhina. Rusty-bellied Shortwing, a threatened endemic, seems to be rare as it was sighted only twice in Zone-IV, but the other four species are locally abundant and recorded frequently.

Several species of reptiles (e.g. pit vipers, skinks, and Himalayan agamids) are restricted to the middle altitude of the Sikkim and Eastern Himalaya. The snow toad (*Scutiger sikkimensis*) is an endemic amphibian of the region, along with several species belonging to the genus *Paa*. Both higher and lower altitudes had higher number of restricted species of butterflies.

1.11.4 Endangered Species

The most endangered species among mammals in these areas is the Red Panda already enlisted as Endangered under IUCN criteria and Schdule-I species according to the Wildlife Protection Act, 1972. The Himalayan marmot is also an endangered species found in subalpine zones above the tree line in the higher altitudes. Besides

Sikkim it is only found in Ladakh. Marbled Cat has been reported to occur in Chungthang area only in the Teesta river basin. It is a Schedule-I species under the WPA (1972). Among birds, the Rusty-bellied Shortwing and Chestnut-breasted Patridge were found in Zones-IV and V. Many species of birds protected by the Indian Wildlife Protection Act (1972) occur in Zones-III and IV. Large number of protected species of reptiles and butterflies are recorded from Zones-I and II.

1.11.5 Conservation Measures

Looking at the number of species of studied taxa and the endemic exclusive and endanged species of studied taxa, Zone-III is very sensitive, and if the development project (Stage-III) is executed in this zone (1,800-2,800, Temperate broadleavd forest, near Chungthang), an irreversible ecological damage is expected with respect to biological environs.

It is important to implement conservation measures in all the areas as most of the forests in these zones are not within any protected area except some areas in Chungthang, which falls under the buffer zone of Khangchendzonga Biosphere Reserve. Hence, effort may be taken to create additional protected areas.

Altitudes <900 m is an important zone, especially for small mammals, herpetofauna and butterflies. However, this zone currently has no protected area coverage. There is, perhaps, scope for ensuring protection maintaining these diverse land uses through community participation, as this zone is almost entirely inhabited by

people. The current land use in this zone predominantly consists of small patches of original forest (although degraded), a variety of seasonal crops grown with very little use of agro-chemicals, and the retention of several species of native trees in agricultural fields as source of timber and fodder. This pattern of land use is very conducive to the retention of several species of mammals, birds, herpetofauna and butterflies. The need to retain remnant patches of forest, native tree cover in agricultural fields and crop diversity is therefore obvious and necessary measures should be taken in consultation with various stakeholders.

There are number of cattle sheds between Lachung and Yumesamdong. Further, the local people of Lachung, Lachen and Chungthang collect firewood for cooking from the pine and Rhododendron forest of Singba and Yumthang which subsequently reduces the forest cover. The firewood of Rhododendron is much preffered than other species. Most of the local people collect leaves of *Rhododendron nivale* for incence. Hence, alternate livelihood should be developed for the people of this remote land.

One of the major threats especially to both large and small mammals, larger birds and amphibians (Paa spp.) is hunting which needs to be checked. In case of project implementation, influx of a large number of non-native labourers and project personnel would give additional pressure on forests and wildlife. Appropriate facilities such as fuel may be provided by the authorities, which would reduce pressure on natural resources.

Entirely new environments would be created by human activity

during and after the construction of the proposed hydel projects. If these sites were neglected, they would become dominated by exotic and weedy species resulting in biological communities that are unproductive, valueless from conservation perspective and unappealing. These sites need to be properly managed and native species reintroduced wherever required so that the original communities can be successfully restored with respect to species composition and vegetation structure.

Awareness programmes for locals, tourists and members of government mechinaries on wildlife and general up keeping the environment is required. This is one of the prime needs to conserve the rich faunal diversity of Sikkim.

Further monitoring with iniation of more extensive studies on individual species is required to understand their home ranges, behaviour, requirements and so on.

In conclusion, the present study shows that Zone-III (Stage-III) is very important with respect to conservation of the biodiversity of the region. Similarly, Zones-IV and V (Stages-I & II) have higher number breeding birds and exclusive species of the taxa studied. Hence, any development project would endanger them. Also, Zones above III are geologically vulnerable, and anthropogenic pressures would lead to natural disaters.

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PLATES

Yathang valley in Summer

View of sub-alpine region in Sikkim

View of pine forest near Yumthang

Broadleaved forest near Chungthang

Plate 1a. Major vegetation types of Teesta valley in Sikkim

Teesta river at Chungthang

Inner view of broadleaved forest

View of low altitude forest

Agricultural practice at higher altitude

Plate 1b. Vegetation types and agricultural practices along Teesta basin in Sikkim

Northern Tree shrew (*Tupaia belangeri)*

Himalayan palm civet (*Paguma larvata)*

Hoary bellied squirrel (*Callosciurus pygerythus)*

Nepal langur (*Semnopithecus schistacius)*

Pellet pile of Serow *(Naemorhedus sumatraensis),*

Himalayan marmot *(Marmota himalayana)*

Plate 2. Some mammals of Teesta Valley, Sikkim

Common Pochard (Aythya ferina)

Striated Bulbul (Pycnonotus striatus)

White-collared Blackbird (Turdus albocintus)

Green-backed Tit (Parus monticolus)

Chestnut-crowned Laughingthrush (Garrulax erythrocephalus)

Alpine Accentor (Prunella collaris)

Plate 3. Some birds of Teesta Valley, Sikkim

Elaphe sp. (Black striped trinket snake

Amphiesma sp. (Keelback)

Trachischium sp.
(Gunther's oriental slender snake)

Trimeresurus sp.
(Pit viper)

Cyrtodactylus sp.
(Eastern bent-toed gecko)

Japalura sp. (Japalura)

Plate 4. Some reptiles of the Teesta Valley, Sikkim

Paa liebigii (Liebig's frog)

Megophrys sp. (Pelobatid toad)

Scutiger sikkimensis (Sikkimese pelobatid toad

Bufo himalayana (Himalayan toad)

Plate 5. Some amphibians of Teesta Valley, Sikkim

Common Peacock (*Princeps polyctor*)

Striped Blue Crow (*Euploa mulciber*)

Green Comodore (*Limenitis daraxa*)

Queen of Spain Fritillary (*Issoria lathonia*)

Red Lacewing (*Cethosia bibles*)

Plate 6. Some butterflies of Teesta Valley, Sikkim

ANNEXURES

ANNEXURE I

Checklist of wild mammals (169 species) in Sikkim from secondary and primary source (1=present)

Source of secondary data: Avasthe & Jha (1999), Nameer (2000) and Mandal (2003)

Order	Family	Common name	Scientific name	Sighted species	Indirect evidence
Artiodactyla	Bovidae	Yak	*Bos grunniens*	1	
		Takin	*Budorcas taxicolor**		
		Himalayan Tahr	*Hemitragus jemlahicus*		
		Goral	*Naemorhedus goral*		1
		Serow	*N.sumatraensis*		1
		Blue sheep – Bharal	*Pseudois nayaur*	1	
		Nayan, argali	*Ovis ammon*		
		Tibetan gazelle	*Procapra picticauda*		
	Cervidae	Barking Deer	*Muntiacus muntjak*	1	
	Moschidae	Musk deer	*M.chrysogaster*		
		Musk deer	*Moschus fuscus*		
	Suidae	Indian wild boar	*Sus scrofa*		1
	Tragulidae	Mouse deer	*Moschiola meminna*		
	Ailuro-podidae	Red Panda	*Ailurus fulgens*		1
Carnivora	Canidae	Jackal	*Canis aureus*	1	
		Wolf (Tibetian wolf)	*Canis lupus*		
		Dhole	*Cuon alpinus*		
		Tibetian fox	*Vulpes montanus*	1	
	Felidae	Leopard	*Panthera pardus*		
		Snow leopard	*P.uncia*		
		Clouded leopard	*Neofelis nebulosa*		
		Leopard cat	*Prionailurus bengalensis*		1
		Marbled cat	*F.marmorata*		1
		Fishing cat	*F.viverrina*		

Order	Family	Common name	Scientific name	Sighted species	Indirect evidence
		Jungle cat	*F.chaus*		1
		Golden cat	*F.temminckii*		
		Pallas cat	*Otocolobus manul**		
	Herpesti-dae	Common mongoose	*Herpestes edwardsii*		
		Crab-eating mongoose	*H.urva*		
	Mustelidae	Clawless otter	*Aonyx cinerea*		
		Hog badger	*Arctonyx collaris*		
		Common otter	*Lutra lutra*		
		Himalayan yellow-throated marten	*Martes flavigula*	1	
Carnivora	Mustelidae	Beech marten	*Martes foina*	1	
		Himalayan stoat	*Mustela erminea*	1	
		Burmese ferret badger	*Melogale personata*		
		Yellow-bellied weasel	*Mustela kathiah*		
		Himalayan weasel	*M.sibirica*		
		Striped-backed weasel	*M.strigidorsa*		
	Ursidae	Himalayan black bear	*Ursus thibetanus*		1
		Sloth bear	*Melursus ursinus**		
		Brown bear	*Ursus arctos*		
	Viverridae	Binturong	*Arctictis binturong*		
		Small-toothed palm civet	*Arctogalidia trivirgata**		
		Himalayan palm civet	*Paguma larvata*	1	
		Spotted linsang	*Prionodon pardicolor*		
		Small Indian civet	*Viverricula indica*	1	
		Large Indian civet	*Viverra zibetha*		1
Chiroptera	Emballo-nuridae	Naked-rumped tomb bat	*Taphozous nudiventris*		
	Hipposide-ridae	Great Himalayan leaf-nosed bat	*Hipposideros armiger*		
		Fulvous leaf-nosed bat	*Hipposideros fulvus*		
		Andersen's Leaf-nosed bat	*H. Pomona*		
	Megader-	Indian false vampire bat	*Megaderma lyra*		

Order	Family	Common name	Scientific name	Sighted species	Indirect evidence
	matidae				
			Megaderma		
		Asian false vampire bat	*spasma**		
	Molossi-dae	European free-tailed bat	*Tadarida teniotis*		
		Wrinkled-lipped bat	*T.plicata**		
		European free-tailed bat	*T.teniotis*		
	Pteropo-		*Cynopteris sphinx*		
	Didae	Short-nosed fruit bat			
		Dawn bat	*Eonycteris spelaea*		
		Greater long-tongued fruit	*Macroglossus*		
		bat	*sobrinus*		
			Megaerops		
		Niphan's fruit bat	*niphanae*		
		Indian flying fox	*Pteropus giganteus*		
			Rousettus		
		Fulvous fruit bat	*leschenaulti*		
		Mountain fruit bat	*Sphaerias blanfordi*		
		Great Eastern horse-shoe	*Rhinolophus luctus*		
		bat			
	Rhinolo-		*Rhinolophus*		
	Phidae	Greater horseshoe bat	*ferrumequinum*		
		Horsfield's horseshoe bat	*R.pearsoni*		
		Rufous horseshoe bat	*R.rouxii*		
		Trefoil horse-shoe bat	*R.trifoliatus*		
		Least horse-shoe bat	*R.pusillus*		
	Rhinolo-	Little Indian horse-	*R.lepidus*		
Chiroptera	phidae	Shoe bat			
	Vesperti-		*Barbastella*		
	lionidae	Eastern barbestelle bat	*leucomelas*		
		Northern serotine bat	*Eptesicus nilssoni**		
		Silky serotine bat	*E.serotinus*		
		Sombre bat	*E.tatei*		
			Harpiocephalus		
		Hairy winged bat	*harpia lasyurus*		
		White bellied tube nosed bat	*Murina leucogaster*		
		Round eared tube nosed bat	*M.cyclotis*		
		Peter's tube nosed bat	*M.huttoni*		
		Scully's tube nosed bat	*M.tubinaris*		

Order	Family	Common name	Scientific name	Sighted species	Indirect evidence
		Little tube nosed bat	*M.aurata*		
		Painted bat	*Kerivoula picta*		
		Hardwicke's bat	*K.hardwickei*		
		Nepalese whiskered bat	*Myotis muricola*		
		Nepal bat	*M.mystacinus*		
		Hodgson's bat	*M.formosus*		
		Mandelli's mouse eared bat	*M.sicarius*		
		Small-toothed whiskered	*M.siligorensis*		
		Himalayan noctule	*Nyctalus montanus**		
		Common noctule	*N.noctula*		
		Babu pipistrelle	*Pipistrellus babu*		
		Indian pipistrelle	*P.coromandra*		
		Himalayan pipistrelle	*P.javanicus**		
		Pegu pipistrelle	*Pipistrellus peguensis*		
		Brown longeared bat	*Plecotus auritus*		
		Harlequin bat	*Scotomanes emarginatus*		
		Bamboo bat	*Tyloylonycteris pachypus*		
		Asian/Eastern barbestell	*Barbastella leucomela*		
Insectivora	Soricidae	Himalayan Water Shrew	*Chimmarogale himalayica*		
		Szechuan Water Shrew	*Nectogale elegans*		
		Asiatic shrew	*Soriculus caudatus*	1	
		Indian long-tailed shrew	*S.leucops*		
		Small long-tailed shrew	*S.macrurus*		
		Sikkim large-clawed shrew	*S.nigrescens*	1	
		Tibetian shrew	*Sorex thibethanus*	1	
		House shrew/Musk shrew	*Suncus murinus*	1	
		South asian white toothed shrew	*Crocidura fulginosa*	1	
	Talpidae	Blyth's mole	*Talpa leucura**		
		Eastern mole	*T. micrura*		
	Tupaiidae	Tree shrew	*Tupaia belangeri*	1	
Lagomorpha	Leporidae	Woolly hare	*Lepus oiostolus*	1	

Order	Family	Common name	Scientific name	Sighted species	Indirect evidence
		Blacknaped hare	*L. nigricolla*		
			Ochotona		
	Ochoto-nidae	Black-lipped pika	*curzoniae*		
		Forrester's pika	*O.forresti*	1	
		Large eared pika	*O.macrotis*		
		Mountain pika	*O.tibethana*		
		Nubra pika	*O.nubrica*		
		Himalayan pika	*O.royeli*		
Perissodactyla	Equidae	Kiang	*Equus kiang*		
Pholidota	Manidae	Chinese pangolin	*Manis pentadactyla*		
	Cercopi-		*Macaca*	1	
Primates	thecidae	Assamese macaque	*assamensis*		
		Rhesus macaque	*M.mulatta*		
			Semnopithecus	1	
		Common langur	*schistaceus*		
			Nycticebus		
	Lorisidae	Slow loris	*benghalensis**		
		Himalayan crestless	*Hystrix brachyura/*		1
Rodentia	Hystricidae	Porc	*hodgsoni*		
		Indian porcupine	*H.indica**		
	Muridae	Stocliczka's Mountain Vole	*Alticola stoliczka*		
		Thomas's Mountain Vole	*A.stracheyi*		
		Miller's wood mouse	*Apodemus rusiges**		
		Wood mouse	*A.sylvaticus**		
		Wroughton's wood mouse	*Apodemus wardi**		
		Indian mole rat	*Bandicota*	1	
			bengalensis		
		Bandicoot rat	*B.indica*		
		Bay bamboo rat	*Cannomys badius*		
		Large-toothed giant rat/	*Dacnomys millardi*		
		Edward's giant rat	*Leopolda edwardsii*		
			Microtus		
		Sikkim Vole	*sikkimensis*		
		Indian field mouse	*M.booduga**		
		Fawn-coloured mouse	*M.cervicolor*	1	
		House mouse	*M.musculus*	1	
		Sikkim mouse	*Mus pahari*	1	
		Short-tailed bandicoot	*Nesokia indica**		

Order	Family	Common name	Scientific name	Sighted species	Indirect evidence
		Rat			
		Smoke bellied rat	*Niviventer eha*	1	
	Muridae	Chestnut rat	*N.fulvescens*	1	
		Langbian rat	*N.langbianis**		
		White-bellied rat	*N.niviventer*	1	
		Himalayan rat	*Rattus nitidus*	1	
		Brown rat	*R.norvegicus*		
		Common house rat	*R.rattus*	1	
		Sikkim rat	*R.sikkimensis*	1	
		Turkestan rat	*R.turkestanicus*		
		Long-tailed tree mouse	*Vandeleuria oleracea*		
		Chinese Birch Mouse	*Sicista concolor**		
	Pteromyidae	Kashmir woolly flying squirrel	*Eupetaurus cinereus*		
		Particoloured flying squrrel	*Hylopetes alboniger*		
		Grey-headed flying squirrel	*Petaurista elegans*		
		Hodgson's flying squirrel	*P.magnificus*	1	
		Noble giant flying squirrel	*P.nobilis*		
		Giant red flying squirrel	*P.petaurista*		
		Hairy-footed flying squirrel	*Belomys pearsonii*		
			Marmota	1	
	Sciuridae	Himalyan marmot	*himalayana*		
		Eastern red marmot	*M.hemachalanus*		
		Malayan Giant squirrel	*Ratufa bicolor*		
			Callosciurus		
		Red-bellied tree squirrel	*erythraceus*		
		Hoary-bellied Himalayan squirrel	*C.pygerythrus*	1	
		Orange-bellied Himalayan squirrel	*Dremomys lokriah*	1	
		Pernyi's ground squirrel	*Dremomys pernyi**		
		Red-cheeked squirrel	*D.rufigenis**		
		Five-striped palm squirrel	*Funambulus pennanti**		
			Tamiops	1	
		Himalayan striped squirrel	*mcclellandii*		

ANNEXURE-II

Checklist of birds of Sikkim and their altitudinal distribution

(1= present, Blank= absent, - = no data, WPA= Wildlife Protection Act, 1972)

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
Phalacrocoracidae	Indian cormorant	*Phalacrocorax fuscicollis*	1					IV
	Great cormorant*	*P. carbo*	1					IV
	Black necked grebe	*Podiceps nigricollis*						IV
	Little grebe	*P. ruficollis*						IV
Aredeidae	Goliath heron	*Ardea goliath*						IV
	Cattle egret	*Bubulcus ibis*						IV
	Little heron	*Butorides striatus*						IV
	Chinese Pond Heron*	*Ardeola bacchus*						IV
Anatidae	Common Merganser	*Mergus merganser*	-	-	-	-	-	IV
	Tufted duck	*Aythya fuligula*	-	-	-	-	-	IV
	Northern pintail	*Anas acuta*						IV
	Common teal	*A. crecca*						IV
	Eurasian wigeon	*A. Penelope*						IV
	Gadwall	*A. strepera*						IV
	Mallard	*A. platyrhynchos*			1			IV
	Baer's pochard	*Aythya baeri*			1			IV
	Common pochard*	*A. ferina*						IV
	Ruddy shelduck	*Tadorna ferruginea*						IV
	Bar headed Goose	*Anser indicus*						IV
Accipitridae	Black kite	*Milvus migrans govinda*				1		IV
	Black kite	*M. lineatus*					1	IV
	Black shouldered kite	*Elanus caeruelus*						IV
	Northen Goshawk	*Accipiter gentilis*				1		I
	Bersa*	*A. virgatus affinis*		1	1			I
	Eurasian Sparrowhawk	*A. nisus melaschistos*		1	1			I
	Crested Goshawk*	*A. trivirgatus indicus*	1	1				I
	Long-legged Buzzard	*Buteo rufinus*		1				IV
	Common Buzzard	*B. buteo*	1	1	1			IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Mountain Hawk Eagle	*Spizaetus nipalensis nipalensis*	1	1	1			IV
	Bonelli's eagle	*Hieraaetus fasciatus*	1	1	1			IV
	Booted Eagle	*H. pennatus*	1	1	1			IV
	Rufous bellied eagle	*H. kienerii*						IV
	Black Eagle	*Ictinaetus malayensis*	1	1	1			IV
	Palla's Fish Eagle	*Haliaeetus leucoryphus*	1	1	1	1		IV
	Red-headed vulture	*Sarcogyps calvus*	1	1	1			IV
	Himalayan Griffon	*Gyps himalayensis*	1	1	1	1	1	IV
	Eurasian Griffon	*G. fulvus*						IV
	Long billed vulture	*G. indicus*						IV
	White rumped vulture	*Gyps bengalensis*						IV
	Jerdon’s Baza	*Aviceda jerdoni*						I
	Black Baza	*A. leuphotes*						I
	Oriental honeybazzard	*Pernis ptilorhyncus*						IV
	Osprey	*Pandion haliaetus*						IV
	Cinereous vulture	*Aegypius monachus*						IV
	Lammergeir	*Gypaetus barbatus*		1	1	1	1	I
	Hen Harrier	*Circus cyaneus*	1	1	1	1	1	IV
	Crested Serpent Eagle	*Spilornis cheela cheela*	1	1	1			IV
Falconidae	Collared Falconet	*Microhierax caerulescens*	1	1	1			IV
	Peregrine Falcon	*Falco peregrinus peregrinator*		1	1			I
	Common Kestrel	*F. tinnunculus*		1	1	1	1	IV
	Amur Falcon	*F. amurensis*						IV
	Eurasian hobby	*F. subbuteo*						IV
	Oriental hobby	*F. severus*						IV
Turnicidae	Small button Quail	*Turnix sylvatica*						IV
	Yellow legged button Quail	*T. tanki*						IV
	Barred button Quail	*T. suscitator*						IV
Rallidae	Ruddy breasted crake	*Porzana fusca*						IV
	Common Moorhen	*Gallinula chloropus*						IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Purple swamphen	*Porphyrio porphyrio*						IV
	Common coot	*Fulica atra*		1				IV
	Black necked crane	*Grus nigricollis*					1	I
Phasianidae	Snow partridge	*Lerwa lerwa*				1	1	IV
	Tibetan Snowcock	*Tetraogallus tibetanus*					1	IV
	Hill Partridge*	*Arborophila torqueola*			1	1		IV
	Himalayan snowcock	*Tetraogallus himalayensis*			1			IV
	Indian Pea-fowl	*Pavo cristatus*		1				IV
	Rufous Throated Partridge	*Arborophila rufogularis*		1	1			IV
	Chestnut breasted Hill partridge	*A. mandellii*	1	1	1			IV
	Blood Pheasant*	*Ithaginis cruentus*				1	1	I
	Satyr Tragopan	*Tragopan satyra*			1	1	1	IV
	Himalayan Monal*	*Lophophorus impejanus**					1	I
	Kaleej Pheasant*	*Lophura leucomelanos melanota*	1	1	1	1		IV
	Red junglefowl*	*Gallus gallus*	1	1	1			IV
Charadriidae	River lapwing*	*Vanellus duvaucelii*	1					IV
	White tailed lapwing	*V. leucurus*						IV
	Red wattled lapwing	*V. indicus*						IV
	Lesser Sand Plover	*Charadrius mongolus*	-	-	-	-	-	IV
	Little ring plover	*C. dubius*						IV
	European golden plover	*Pluvialis apricaria*						IV
	Woodsnipe	*Gallinago nemoricola*						IV
	Pintail snipe	*G. stenura*						IV
Pteroclididae	Tibetan sandgrouse	*Syrrhaptes tibetanus*						IV
Scolopacidae	Common Redshank	*Tringa totanus*					1	IV
	Green Sandpiper	*T. ochropus*	1	1	1	1	1	IV
	Common Sandpiper*	*Actitis hypoleucos*	1					IV
	Solitary Snipe	*Gallinago solitaria*				1	1	IV
	Eurasian Woodcock	*Scolopax rusticola*		1	1	1		IV
	Temminck's Stint	*Calidris temminckii*					1	IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
Recurvirostridae	Ibisbill*	*Ibidorhyncha struthersii*				1	1	IV
Columbidae	Pintailed Green pigeon*	*Treron apicauda*	1	1	1			IV
	Wedgetailed Green Pigeon*	*T. sphenura*	1	1	1			IV
	Snow Pigeon*	*Columba leconota*			1	1	1	IV
	Hill Pigeon	*C. rupestris*					1	IV
	Speckled Wood Pigeon*	*C. hodgsonii*		1	1	1	1	IV
	Ashy Wood pigeon*	*C. pulchricollis*		1	1	1		IV
	Barred Cuckoo dove*	*Macropygia unchall*	1	1	1	1		IV
	Spotted dove*	*Streptopelia chinensis suratensis*	1	1				IV
	Emerald dove*	*Chalcophaps indica*	1	1	1			IV
	Oriental Turtle-dove*	*Streptopelia orientalis*	1	1	1	1	1	IV
Psittacidae	Redbreasted Parakeet	*Psittacula alexandri*	1	1	1			IV
	Slatyheaded Parakareet	*P. himalayana*		1				IV
	Alexandrine parakeet	*P. eupatria*						IV
	Plum headed parakeet	*P. cynocephala*						IV
	Vernal hanging parot	*Loriculus vernalis*						IV
Cuculidae	Large hawk-cuckoo	*Hierococcyx sparverioides*		1	1			IV
	Hodgson's hawk-cuckoo*	*H. fugax*	1	1	1			IV
	Common hawk cuckoo*	*H. varius*						IV
	Indian Cuckoo	*Cuculus micropterus*	1	1	1			IV
	Eurasian Cuckoo*	*C. canorus*	1					IV
	Oriental Cuckoo*	*C. saturatus*		1	1	1		IV
	Lesser Cuckoo*	*C. Poliocephalus*		1	1			IV
	Plaintive Cuckoo*	*Cacomantis merulinus*	1	1	1			IV
	Asian Emerald Cuckoo	*Chrysococcyx maculates*		1				IV
	Drongo-Cuckoo	*Surniculus lugubris*		1	1			IV

Family	Common name (Inskipp *et. al.*, 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Chestnut winged cuckoo	*Clamator coromandus*	1					IV
	Pied cuckoo	*C. jacobinus*						IV
	Greater Coucal	*Centropus sinensis*						IV
	Lesser coucal	*C. bengalensis*						IV
	Sirkeer malkoha	*Phaenicophaeus leschenaultii*						IV
	Green-billed Malkoha*	*Phaenicophaeus tristis*	1	1	1			IV
Tytonidae	Oriental Bay Owl	*Phodilus badius*	1					IV
Strigidae	Collared scops owl	*Otus bakkamoena lettia*	1	1	1			IV
	Mountain scops owl	*O. spilocephalus*		1	1			IV
	Eurasian scops owl	*O. scops*						IV
	Spot-bellied eagle owl	*Bubo nipalensis*	1	1	1			IV
	Eurasian eagle owl	*B. bubo tibetanus*						IV
	Tawny Fish owl	*Ketupa flavipes*	1	1	1			IV
	Brown fish owl*	*K. zeylonensis*						IV
	Collared owlet	*Glaucidium brodiei*	1	1	1			IV
	Asian Barred owlet*	*G. cuculoides cuculoides*	1	1	1			IV
	Brown Wood Owl	*Strix leptogrammica newarensis*	1	1	1	1	1	IV
	Tawny owl	*S. aluco nivicola*			1	1	1	IV
	Short-eared Owl	*Asio flammeus*	1	1	1			IV
	Brown hawk owl	*Ninox scutulata*						IV
	Little owl	*Athene noctua*						IV
Podargidae	Hodgson's Frogmouth	*Batrachostomus hodgsoni*		1				I
Caprimulagidae	Grey Nightjar	*Caprimulgus indicus*		1	1	1		IV
	Large-tailed Nightjar	*C. macrurus*	1	1				IV
Apodidae	Himalayan Swiftlet*	*Collocalia brevirostris*		1	1			
	White-rumped Needle tail*	*Zoonavena sylvatica*	1	1				
	White-throated Needle tail	*Hirundapus caudacutus*				1	1	
	Fork-tailed Swift	*Apus pacificus*		1	1			
	House Swift	*A. affinis*		1	1			
	Alpine swift	*Tachymarptis melba*						

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
Trogonidae	Red-headed Trogon*	*Harpactes erythrocephalus*	1	1	1			IV
Alcedinidae	Crested Kingfisher*	*Megaceryle lugubris*		1				IV
	Blyth's Kingfisher	*Alcedo hercules*	1					IV
	Common kingfisher*	*A. atthis*	1					IV
	Blue-eared Kingfisher	*A. meninting*	1					IV
	Oriental Dwarf Kingfisher	*Ceyx erithacus erithacus*	1					IV
	Stork-billed Kingfisher	*Halcyon capensis*	1					IV
	Ruddy Kinfisher	*H. coromanda*	1					IV
	White throated Kingfisher*	*H. smyrensis*	1					IV
Meropidae	Blue-beared bee-eater	**Nyctyornis athertoni**	1	1				
	Green bee-eater	*Merops orientalis*						
	Chestnut headed bee-eater	*M. leschenaultii*						
Coraciidae	Dollarbird*	**Eurystomus orientalis**	1					
	Indian roller	*Coracias benghalensis*						IV
Upupidae	Common Hoopoe*	*Upupa epops*		1	1	1	1	
Bucerotidae	Rufous-necked Hornbill	*Aceros nipalensis*	1					IV
	Great Hornbill	*Buceros bicornis*	1	1				IV
	Oriental pied Hornbill*	*Anthracoceros albirostris*						IV
Capitonidae	Great Barbet*	*Megalaima virens*	1	1	1			IV
	Golden -throated Barbet*	*M. franklinii*		1	1			IV
	Blue-throated Barbet*	*M. asiatica*	1	1	1			IV
	Lineated Barbet	*M. lineata*						IV
	Blue-eared Barbet	*M. australis*						IV
Indicatoridae	Yellow-rumped Honeyguide	*Indicator xanthonotus*	-	-	-	-	-	
Picidae	Eurasian Wryneck	*Jynx torquilla*						IV
	Speckled Piculet	*Picumnus innominatus*	1	1	1			IV
	White-browed Piculet	*Sasia ochracea*	1	1	1			IV

Family	Common name (Inskipp *et. al.*, 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Rufous Woodpecker*	*Celeus brachyurus*	1	1	1			IV
	Grey-headed Woodpecker	*Picus canus*	1	1	1			IV
	Greater Yellownape*	*P. flavinucha*	1	1	1			IV
	Lesser Yellownape *	*P. chlorolophus chlorolophus*	1	1	1			IV
	Himalayan Flameback*	*Dinopium shorii*	1					IV
	Pale-headed Woodpecker*	*Gecinulus grantia*	1	1				IV
	Great Slaty Woodpecker	*Mulleripicus pulverulentus*	1					IV
	Rufous-bellied Woodpecker*	*Dendrocopos hyperythrus*			1	1	1	IV
	Crimson-breasted Woodpecker	*D. cathpharius*			1	1		IV
	Fulvous-breasted Woodpecker	*D. macei*	1	1				IV
	Darjeeling Woodpecker	*D. darjellensis*			1	1		IV
	Grey-capped Pygmy Woodpecker	*D. canicapillus*		1	1			IV
	Bay Woodpecker*	*Blythipicus pyrrhotis*	1	1	1			IV
	Greater Flameback*	*Chrysocolaptes lucidus*	1	1				IV
	White-naped Woodpecker*	*C. festivus*						IV
	Silver-breasted Broadbill	*Serilophus lunatus*	1	1				
Eurylaimidae	Long-tailed Broadbill*	*Psarisomus dalhousiae*	1	1	1			
Pittidae	Blue-naped Pitta	*Pitta nipalensis*	1	1	1			IV
	Indian Pitta	*P. brachyura*						IV
	Hooded Pitta	*P. sordida*						IV
	Hume's Short-toed Lark*	*Calandrella acutirostris*					1	IV
Alaudidae	Greater Short-toed Lark*	*C. brachydactyla*					1	IV
	Eurasian Skylark	*Alauda arvensis*		1				IV
	Oriental Skylark	*A. gulgula*						IV
	Horned Lark*	*Eremophila alpestris*		1			1	IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
		elwesi						
	Tibetan Lark	*Melanocorypha maxima*					1	IV
Hirundinidae	Barn Swallow	*Hirundo rustica*	1	1	1	1		
	Red-rumped Swallow	*H. daurica nipalensis*		1	1			
	Eurasian Crag Martin	*H. rupestris*						
	Plain Martin*	*Riparia paludicola*						
	Northern House Martin*	*Delichon urbica*				1	1	
	Nepal House Martin*	*D. nipalensis*	1	1	1			
Campephagidae	Black-winged Cuckooshrike*	*Coracina melaschistos*	1	1	1			
	Large Cuckooshrike	*C. macei*						
	Grey-chinned Minivet*	*Pericrocotus solaris*	1	1	1	1		IV
	Long-tailed Minivet*	*P. ethologus*	1	1	1	1		IV
	Short-billed Minivet*	*P. brevirostris*	1	1				IV
	Scarlet Minivet*	*P. flammeus*	1	1	1			IV
	Rosy Minivet	*P. roseus*						IV
	Bar-winged Flycatcher-shrike	*Hemipus picatus capitalis*	1	1				
	Large Woodshrike	*Tephrodornis gularis*	1	1				
	Golden-fronted Leafbird*	*Chloropsis aurifrons aurifrons*	1	1				IV
Irenidae	Orange-bellied Leafbird*	*C. hardwickii*	1	1	1			IV
	Asian Fairy Bluebird	*Irena puella*	1	1				IV
	Common Iora	*Aegithina tiphia*						IV
Pycnonotidae	Striated Bulbul*	*Pycnonotus striatus*		1	1			IV
	Black-crested Bulbul*	*P. melanicterus*	1	1				IV
	Himalayan Bulbul*	*P. leucogenys*	1	1	1			IV
	Red-vented Bulbul*	*P. cafer bengalensis*	1	1	1			IV
	Red-whiskered bulbul	*P. jocosus*						IV
	White-throated Bulbul	*Alophoixus flaveolus*	1	1				IV
	Mountain Bulbul	*Hypsipetes mcclellandii*		1	1			IV
	Ashy Bulbul*	*Hemixos flavala*	1	1				IV
	Black Bulbul*	*Hypsipetes leucocephalus*		1	1	1		IV
Muscicapidae	Black-naped Monarch	*Hypothymis azurea*						IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Dark-sided Flycatcher	*Muscicapa sibirica*	1	1	1	1	1	IV
	Ferruginous Flycatcher*	*M. ferruginea*		1	1			IV
	Brown-breasted Flycatcher	*M. muttui*						IV
	Slaty-backed Flycatcher	*Ficedula hodgsonii*		1	1	1		IV
	Rufous-gorgeted Flycatcher*	*F. strophiata*	1	1	1	1	1	IV
	White-gorgeted Flycatcher	*F. monileger monileger*	1	1	1			IV
	Snowy-browed Flycatcher*	*F. hyperythra*		1	1			IV
	Little Pied Flycatcher	*F. westermanni collini*		1	1			IV
	Ultramarine Flycatcher	*F. superciliaris aestigma*	1	1	1			IV
	Slaty-blue Flycatcher*	*F. tricolor*	1	1	1	1		IV
	Yellow-rumped Flycatcher*	*F. zanthopygia*						IV
	Sapphire Flycatcher*	*F. sapphira*	1	1	1			IV
	Verditer Flycatcher*	*Eumyias thalassina*	1	1	1	1		IV
	Large Niltava *	*Niltava grandis*		1	1			IV
	Small Niltava*	*N. macgrigoriae*		1	1			IV
	Rufous-bellied Niltava*	*N. sundara*	1	1	1	1		IV
	Pale Blue Flycatcher	*Cyornis unicolor*	1	1	1			IV
	Blue-throated Flycatcher	*C. rubeculoides*	1	1				IV
	Pale-chinned Flycatcher	*C. poliogenys*						IV
	Hill Blue Flycatcher*	*C. banyumas*						IV
	Pygmy Blue Flycatcher	*Muscicapella hodgsonii*	1	1	1	1		IV
	Grey-headed Canary Flycatcher*	*Culicicapa ceylonensis*	1	1	1			IV
	Yellow-bellied Fantail*	*Rhipidura hypoxantha*	1	1	1	1	1	IV
	White-throated Fantail*	*R. albicollis albicollis*	1	1	1	1		IV
	Puff-throated	*Pellorneum ruficeps*	1	1	1	1		IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Babbler*	*mandellii*						
	Rusty-cheeked Scimitar Babbler	*Pomatorhinus erythrogenys*	1	1	1			IV
	White-browed Scimitar Babbler	*P. schisticeps*	1	1	1			IV
	Streak-breasted Scimitar Babbler*	*P. ruficollis*	1	1	1	1		IV
	Coral-billed Scimitar Babbler	*P. ferruginosus*		1	1	1	1	IV
	Slender-billed Scimitar Babbler *	*Xiphirhynchus superciliaris*		1	1			IV
	Scaly-breasted Wren Babbler*	*Pnoepyga albiventer albiventer*		1	1	1		IV
	Pygmy Wren Babbler	*P. pusilla*	1	1	1			IV
	Rufuous-throated Wren Babbler	*Spelaeornis caudatus*				1		IV
	Spotted Wren Babbler	*S. formosus*			1			IV
	Wedge-billed Wren Babbler	*S. humei humei*	-	-	-	-	-	IV
	Long-billed Wren Babbler	*Rimator malacoptilus*		1				IV
	Rufous-capped Babbler	*Stachyris ruficeps*	1	1	1			IV
	Rufous-fronted Babbler	*S. rufifrons*	1	1				IV
	Golden Babbler*	*S. chrysaea*	1	1	1			IV
	Grey-throated Babbler	*S. nigriceps*	1	1	1			IV
	Striped Tit Babbler	*Macronous gularis*	1					IV
	Chestnut-capped Babbler	*Timalina pileata*	1	1				IV
	Abbott's Babbler	*Malacocincla abbotti*						IV
	Jungle Babbler	*Turdoides striatus*						IV
	White-throated Laughingthrush*	*Garrulax albogularis*			1	1		IV
	White-crested Laughingthrush*	*G. leucolophus*	1	1	1			IV
	Lesser Necklaced Laughingthrush	*G. monileger*	1	1				IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Greater Necklaced Laughingthrush*	*G. pectoralis*	1	1	1			IV
	Striated Laughingthrush*	*G. striatus*	1	1	1			IV
	Rufous-necked Laughingthrush	*G. ruficollis*	1	1	1			IV
	Rufous-chinned Laughingthrush	*G. rufogularis*	1	1	1	1	1	IV
	Spotted Laughingthrush*	*G. ocellatus*				1	1	IV
	Grey-sided Laughingthrush	*G. caerulatus*		1	1			IV
	Streaked Laughingthrush	*G. lineatus*		1				IV
	Blue-winged Laughingthrush	*G. squamatus*		1	1	1	1	IV
	Scaly Laughingthrush	*G. subunicolor*		1	1	1	1	IV
	Black-faced Laughingthrush*	*G. affinis*			1	1	1	IV
	Chestnut-crowned Laughingthrush*	*G. erythrocephalus*		1	1	1	1	IV
	Variegated Laughingthrush	*G. variegatus*						IV
	Red-faced Liocichla	*Liocichla phoenicea*	1	1	1			IV
	Silver-eared Mesia*	*Leiothrix argentauris*	1	1	1			IV
	Red-billed Leiothrix*	*L. lutea*		1	1			IV
	Fire-tailed Myzornis*	*Myzornis pyrrhoura*			1	1	1	
	Cutia*	*Cutia nipalensis*		1	1			
	Black-headed Shrike Babbler	*Pteruthius rufiventer*			1			IV
	White-browed Shrike Babbler *	*P. flaviscapis*	1	1	1	1		IV
	Green Shrike Babbler	*P. xanthochlorus*			1	1		IV
	Black-eared Shrike Babbler	*P. melanotis*	1	1	1	1		IV
	White-hooded Babbler	*Gampsorhynchus rufulus*	1					IV
	Hoary-throated Barwing*	*Actinodura nipalensis*			1	1		IV
	Rusty-fronted	*A. egertoni egertoni*		1	1			IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)				
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800 WPA
	Barwing						
	Red-tailed Minla*	*Minla ignotincta*	1	1	1	1	
	Chestnut-tailed Minla*	*Minla strigula*	1	1	1	1	1
	Blue-winged Minla*	*M. cyanouroptera*	1	1	1		
	Striated Yuhina*	*Yuhina castaniceps rufigenis*	1	1			
	White-naped Yuhina*	*Y. bakeri*	1	1	1		
	Whiskered Yuhina*	*Y. flavicollis flavicollis*	1	1	1	1	
	Stripe-throated Yuhina *	*Y. gularis*			1	1	1
	Rufous-vented Yuhina*	*Y. occipitalis*			1	1	1
	Black-chinned Yuhina *	*Y. nigrimenta*	1	1			
	White-bellied Yuhina	*Y. zantholeuca*	1	1	1		
	Golden-breasted Fulvetta*	*Alcippe chrysotis chrysotis*			1	1	
	Yellow-throated Fulvetta	*A. cinerea*		1	1		
	Rufous-winged Fulvetta	*A. castaneceps*		1	1	1	
	White-browed Fulvetta*	*A. vinipectus*			1	1	1
	Nepal Fulvetta*	*A. nipalensis*	1	1	1		
	Rufous-backed Sibia	*Heterophasia annectans*	1	1	1		
	Rufous Sibia *	**H. capistrata**	1	1	1	1	
	Long-tailed Sibia	**H. picaoides**	1	1			
	Great Parrotbill *	*Conostoma oemodium*			1	1	1
	Brown Parrotbill *	*Paradoxornis unicolor*			1	1	
	Grey-headed Parrotbill	*P. gularis*		1	1		
	Black-breasted Parrotbill	*P. flavirostris*			1		
	Fulvous Parrotbill	*P. fulvifrons*				1	1
	Black-throated	*P. nipalensis humii*		1	1	1	

Family	Common name (Inskipp *et. al.*, 2001)	Scientific name	Altitude classes (in metres)				
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800 WPA
	Parrotbill *						
	Lesser Rufous-headed Parrotbill	*P. atrosuperciliaris*			1		
	Greater Rufous-headed Parrotbill	*P. ruficeps ruficeps*	1	1			
	Chestnut-headed Tesia*	*Tesia castaneocoronata*				1	1
	Grey-bellied Tesia *	*T. cyaniventer*	1				
	Slaty-bellied Tesia	*T. olivea*					
	Pale-footed Bush Warbler	*Cettia pallidipes pallidipes*		1			
	Brownish-flanked Bush Warbler	*C. fortipes fortipes*		1	1		
	Chestnut-crowned Bush Warbler	*C. major*				1	1
	Aberrant Bush Warbler*	*C. flavolivacea*		1	1	1	
	Yellowish-bellied Bush Warbler*	*C. acanthizoides*				1	
	Grey-sided Bush Warbler	*C. brunnifrons*		1	1	1	1
	Spotted Bush Warbler	*Bradypterus thoracicus*		1	1	1	
	Brown Bush Warbler	*B. luteoventris*			1		
	Dusky Warbler	*Phylloscopus fuscatus*	1				
	Smoky Warbler *	*P. fuligiventer*					1
	Tickell's Leaf Warbler*	*P. affinis*			1	1	
	Buff-barred Warbler*	*P. pulcher*		1	1	1	1
	Ashy-throated Warbler	*P. maculipennis*	1	1	1	1	
	Yellow-browed Warbler	*P. nornatus*		1			
	Greenish Warbler*	*P. trochiloides*		1	1	1	1
	Large-billed Leaf Warbler	*P. magnirostris*			1	1	1
	Western Crowned Warbler	*P. occipitalis*	1	1	1		
	Blyth's Leaf Warbler*	*P. reguloides*	1	1	1		
	Yellow-vented	*P. cantator*	1	1	1		

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)				
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800 WPA
	Warbler						
	Lemon-rumped Warbler*	*P. chloronotus*					
	Hume's Warbler	*P. humei*					
	Goldcrest	*Regulus regulus*		1	1	1	1
	White-spectacled Warbler*	*Seicercus affinis*		1	1		
	Golden-spectacled Warbler	*S. burkii*	1	1	1		
	Grey-hooded Warbler*	*S. xanthoschistos*	1	1	1		
	Grey-cheeked Warbler*	*S. poliogenys*	-	-	-	-	-
	Chestnut-crowned Warbler*	*S. castaniceps*	1	1	1		
	Yellow-bellied Warbler	*Abroscopus superciliaris*	1	1			
	Black-faced Warbler*	*A. schisticeps*	1	1	1		
	Rufous-faced Warbler	*A. albogularis*					
	Thick-billed Warbler	*Acrocephalus aedon*					
	Grasshopper Warbler	*Locustella naevia*					
	Broad-billed Warbler*	*Tickellia hodgsoni*		1	1		
	Mountain Tailorbird *	*Orthotomus cuculatus*	-	-	-	-	-
	Common Tailorbird*	*O. sutorius*		1	1		
	Rufescent Prinia*	*Prinia rufescens*	1	1			
	Hill Prinia*	*P. atrogularis atrogularis*		1	1	1	
	Striated Prinia*	*P. criniger*					
	Ashy Prinia	*P. socialis*					
	Yellow-bellied Prinia*	*P. flaviventris*					
	Indian Blue Robin	*Luscinia brunnea*			1	1	
	White-tailed Rubythroat	*L. pectoralis tschebaiewi*					1
	Siberian Rubythroat*	*L. calliope*					1
	Golden Bush Robin *	*Tarsiger chrysaeus*	1	1	1	1	1
	Orange-flanked Bush Robin *	*T. cyanurus*		1	1	1	1
	White-browed Bush Robin *	*T. indicus*	1	1	1	1	1

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Rufous-breasted Bush Robin	*T. hyperythrus*		1	1	1	1	
	White-tailed Robin	*Myiomela leucura*						
	Blue-fronted Robin	*Cinclidium frontale*			1	1		
	Grandala *	*Grandala coelicolor*				1	1	
	White-bellied Redstart	*Hodgsonius phaenicuroides*		1	1	1		
	Blue-fronted Redstart*	*Phoenicurus frontalis*		1	1	1	1	
	White-throated Redstart	*P. schisticeps*		1	1	1	1	
	Hodgson's Redstart	**P. hodgsoni**	1	1	1			
	Daurian Redstart	*P. auroreus*						
	Black Redstart *	*P. ochruros rufiventris*		1	1	1	1	
	White-winged Redstart*	*P. erythrogaster*		1	1	1	1	
	Blue-capped Redstart*	*P. coeruleocephalus*					1	
	White-capped Water Redstart*	*Chaimarrornis leucocephalus*		1	1	1	1	
	Plumbeous Water Redstart*	*Rhyacornis fuliginosus*	1	1	1	1	1	
	Oriental Magpie Robin *	*Copsychus saularis*	1	1	1			
	White-rumped Shama	*C. malabaricus*						IV
	Eurasian Blackbird	*Turdus merula maximus*					1	IV
	White-collared Blackbird *	*T. albocinctus*			1	1	1	IV
	Grey-winged blackbird *	*T. boulboul*			1	1		IV
	Chestnut Thrush	*T. rubrocanus rubrocanus*			1	1		IV
	Kessler's Thrush	*T. kessleri*				1	1	IV
	Dark-throated Thrush	*T. ruficollis ruficollis*	-	-	-	-	-	IV
	Eyebrowed Thrush	*T. obscurus*						IV
	Dusky Thrush	*T. naumanni*						IV
	Tickell's Thrush*	*T. unicolor*						IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Pied Thrush	*Zoothera wardii*						IV
	Orange-headed Thrush	*Z. citrina*		1	1			IV
	Plain-backed Thrush*	*Z. mollissima*		1	1	1	1	IV
	Long-tailed Thrush	*Z. dixoni*		1	1	1		IV
	Scaly Thrush *	*Z. dauma*		1	1	1		IV
	Long-billed Thrush	*Z. monticola*	1	1	1	1		IV
	Dark-sided Thrush*	*Z. marginata*	1	1	1			IV
	Blue-capped Rock Thrush*	*Monticola cinclorhynchus*		1	1	1		IV
	Chestnut-bellied Rock Thrush*	*M. rufiventris*	1	1	1	1		IV
	Blue Rock Thrush	*M. solitarius pandoo*	1	1				IV
	Hodgson's Bushchat	*Saxicola insignis*	-	-	-	-	-	
	Common Stonechat*	*S. torquata*		1	1	1		
	Grey Bushchat*	*S. ferrea*		1	1	1		
	Pied Bushchat	*S. caprata*						
	Gould's Shortwing*	*Brachypteryx stellata*				1	1	
	Rusty-bellied Shortwing*	*B. hyperythra*				1		
	Lesser Shortwing	*B. leucophrys*		1	1	1	1	
	White-browed Shortwing*	*B. montana*	1	1	1	1		
	Blue Whistling Thrush*	*Myophonus caeruleus*	1	1	1	1	1	
	Purple Cochoa*	*Cochoa purpurea*				1		
	Green Cochoa	*C. viridis*	1	1				
	Little Forktail *	*Enicurus scouleri*	1	1	1	1		
	Black-backed Forktail*	*E. immaculatus*		1				
	Slaty-backed Forktail*	*E. schistaceus*	1	1	1			
	White-crowned Forktail	*E. leschenaulti*	1	1				
	Spotted Forktail*	*E. maculatus*	1	1	1	1		
Troglodytidae	Winter Wren*	*Troglodytes troglodytes nipalensis*			1	1	1	IV
Cinclidae	White-throated Dipper*	*Cinclus cinclus*				1	1	
	Brown Dipper*	*C. pallasii*	1	1	1	1		

Family	Common name (Inskipp *et. al.*, 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
Prunellidae	Alpine Accentor*	*Prunella collaris*			1	1	1	
	Altai Accentor	*P. himalayana*			1	1	1	
	Robin Accentor*	*P. rubeculoides*		1	1	1	1	
	Rufous-breasted Accentor*	*P. strophiata*		1	1	1	1	
	Maroon-backed Accentor*	*P. immaculata*			1	1	1	
	Brown Accentor	*P. fulvescens*						
Motacillidae	White Wagtail *	*Motacilla alba alboides*	1	1	1	1	1	
	White-browed Wagtail	*M. maderaspatensis*	1					
	Citrine Wagtail	*M. citreola*				1	1	
	Grey Wagtail*	*M. cinerea*	1	1	1			
	Forest Wagtail	*Dendronanthus indicus*						
	Blyth's Pipit*	*Anthus godlewskii*				1	1	IV
	Olive-backed Pipit *	*A. hodgsoni*	1	1	1	1	1	IV
	Rosy Pipit*	*A. roseatus*					1	IV
	Water Pipit	*A. spinoletta*						IV
	Long-billed Pipit*	*A. similis*						IV
	Paddyfield Pipit	*A. rufulus*						IV
Laniidae	Brown Shrike	*Lanius cristatus cristatus*	1	1				
	Longed-tailed Shrike*	*L. schach tricolor*		1	1			
	Grey-backed Shrike *	*L. tephronotus*			1	1	1	
Artamidae	Ashy Woodswallow	*Artamus fuscus*	1	1	1			
Dicruridae	Ashy Drongo*	*Dicrurus leucophaeus hopwoodi*	1	1	1	1		
	Bronzed Drongo *	*D. aeneus*	1	1	1			IV
	Lesser Racket-tailed Drongo*	*D. remifer*	1	1				IV
	Spangled Drongo*	*D. hottentottus*	1	1	1			IV
	Black Drongo*	*D. macrocercus*						IV
	Crow-billed Drongo*	*D. annectans*						IV
Oriolidae	Maroon Oriole*	*Oriolus traillii*	1	1	1			IV
	Black-naped Oriole*	*O. chinensis*						IV
	Eurasian Golden Oriole	*O. oriolus*						IV
Corvidae	Eurasian Jay	*Garrulus glandarius*			1	1	1	IV
	Yellow-billed Blue	*Urocissa flavirostris*		1	1	1		IV

Family	Common name (Inskipp *et. al*., 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Magpie *	*flavirostris*						
	Red-billed Blue Magpie	*U. erythrorhyncha*	1	1	1			IV
	Common Green Magpie*	*Cissa chinensis*	1	1	1			IV
	Grey Treepie*	*Dendrocitta formosae*	1	1	1			IV
	Collared Treepie	*D. frontalis*		1				IV
	Rufous Treepie	*D. vagabunda*						IV
	Black-billed Magpie	*Pica pica*				1	1	IV
	Hume's Groundpecker	*Pseudopodoces humilis*					1	IV
	Spotted Nutcracker*	*Nucifraga caryocatactes*				1	1	
	Red-billed Chough*	*Pyrrhocorax pyrrhocorax*				1	1	
	Yellow-billed Chough*	*P. graculus*					1	
	House Crow*	*Corvus splendens splendens*		1	1	1		V
	Large-billed Crow*	*C. macrorhynchos*			1	1	1	
	Common Raven*	*C. corax tibetanus*				1	1	
Sturnidae	Spot-winged Starling	*Saroglossa spiloptera*	1	1				IV
	Common Myna *	*Acridotheres tristis tristis*	1	1	1			IV
	Hill Myna *	*Gracula religiosa*	1					IV
Paridae	Rufous-vented Tit *	*Parus rubidiventris beavani*				1	1	IV
	Coal Tit *	*P. ater*				1	1	IV
	Grey-crested Tit*	*P. dichrous*				1	1	IV
	Green-backed Tit*	*P. monticolus*	1	1	1	1		IV
	Black-lored Tit	*P. xanthogenys*		1	1	1	1	IV
	Yellow-browed Tit	*Sylviparus modestus*		1	1	1		IV
	Sultan Tit *	*Melanochlora sultanea*	1	1	1			IV
Aegithalidae	Black-throated Tit*	*Aegithalos concinnus*		1	1			IV
	Rufous-fronted Tit	*A. iouschistos*			1	1	1	IV
Remizidae	Fire-capped Tit	*Cephalopyrus flammiceps*	1	1	1	1		IV
Sittidae	Wallcreeper*	*Tichodroma muraria*	1	1	1	1	1	
	Chestnut-bellied	*Sitta castanea*	1	1	1			

Family	Common name (Inskipp *et. al.*, 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Nuthatch*							
	White-tailed Nuthatch*	*S. himalayensis*		1	1	1		
	Velvet-fronted Nuthatch*	*S. frontalis*	1	1	1			
	Beautiful Nuthatch	*S. formosa*	1	1	1			
	Kashmir Nuthatch*	*S. cashmirensis*						
Certhiidae	Eurasian Treecreeper*	*Certhia familiaris mandellii*			1	1	1	
	Rusty-flanked Treecreeper*	*C. nipalensis*		1	1	1		
	Brown-throated Treecreeper	*C. discolor discolor*		1	1	1	1	
Dicaeidae	Yellow-bellied Flowerpecker	*Dicaeum melanoxanthum*		1	1	1		IV
	Thick-billed Flowerpecker*	*D. agile*						IV
	Yellow-vented Flowerpecker	**D. chrysorrheum**						IV
	Scarlet-backed Flowerpecker	*D. cruentatum*						IV
	Fire-breasted Flowerpecker *	*D. ignipectus*	1	1	1	1	1	IV
Nectariniidae	Mrs Gould's Sunbird*	*Aethopyga gouldiae gouldiae*		1	1	1		IV
	Green-tailed Sunbird*	*A. nipalensis*	1	1	1	1	1	IV
	Black-throated Sunbird *	*A. saturata*	1	1	1			IV
	Fire-tailed Sunbird*	*A. ignicauda*	1	1	1	1	1	IV
	Streaked Spiderhunter*	*Arachnothera magna*	1	1				IV
	Little Spiderhunter	*A. longirostra*						IV
	Purple sunbird	*Nectarinia asiatica*						IV
	Crimson sunbird*	*Aethopyga siparaja*						IV
Zosteropidae	Oriental White-eye*	*Zosterops palpebrosus*			1			IV
Passeridae	House Sparrow *	*Passer domesticus*						
	Russet Sparrow	*P. rutilans*	1	1	1			
	Eurasian Tree Sparrow	*P. montanus malaccensis*	1	1	1	1		

Family	Common name (Inskipp *et. al.*, 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Tibetan Snowfinch	*Montifringilla adamsi*					1	IV
	Rufous-necked Snowfinch	*Pyrgilauda ruficollis*					1	IV
	Plain-backed Snowfinch	*P. blanfordi*					1	IV
	Small Snowfinch	*P. davidiana*					1	IV
Estrildidae	White-rumped Munia*	*Lonchura striata*	1	1	1			IV
	Scaly-bellied Munia	*L. punctulata*			1			IV
Fringillidae	Yellow-breasted Greenfinch *	*Carduelis spinoides spinoides*		1	1	1	1	IV
	Tibetan Siskin *	*C. thibetana*		1	1	1		IV
	Plain Mountain Finch*	*Leucosticte nemoricola*				1	1	IV
	Brandt's Mountain Finch	*L. brandti*					1	IV
	Blanford's Rosefinch	*Carpodacus rubescens*		1	1	1	1	IV
	Dark-breasted Rosefinch*	*C. nipalensis*		1	1	1	1	IV
	Common Rosefinch*	*C. erythrinus roseatus*		1	1	1	1	IV
	Beautiful Rosefinch	*C. pulcherrimus*			1	1	1	IV
	Pink-browed Rosefinch *	*C. rodochrous*				1		IV
	Dark-rumped Rosefinch *	*C. edwardsii*			1	1	1	IV
	White-browed Rosefinch *	*C. thura*			1	1	1	IV
	Streaked Rosefinch	*C. rubicilloides*	-	-	-	-	-	IV
	Great Rosefinch	*C. rubicilla*	-	-	-	-	-	IV
	Red-fronted Rosefinch	*C. puniceus*					1	IV
	Crimson-browed Finch	*Propyrrhula subhimachala*				1	1	IV
	Scarlet Finch *	*Haematospiza sipahi*	1	1	1			IV
	Spectacled Finch	*Callacanthis burtoni*						IV
	Twite	*Carduelis flavirostris*						IV
	Red Crossbill	*Loxia curvirostra*		1	1	1		IV
	Brown Bullfinch	*Pyrrhula nipalensis*			1	1	1	IV
	Red-headed Bullfinch*	*P. erythrocephala*		1	1	1	1	IV
	Grey-headed	*P. erythaca*			1	1	1	IV

Family	Common name (Inskipp *et. al.*, 2001)	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Bullfinch							
	Collared Grosbeak	*Mycerobas affinis*				1	1	IV
	Spot-winged Grosbeak	*M. melanozanthos*	1	1	1	1	1	IV
	White-winged Grosbeak*	*M. carnipes*			1	1	1	IV
	Gold-naped Finch	*Pyrrhoplectes epauletta*		1	1	1	1	IV
Emberizinae	Crested Bunting	*Melophus lathami*	1	1	1			IV
	Little Bunting	*Emberiza pusilla*		1	1			IV
	Black-faced Bunting	*E. spodocephala*				1		IV
	Chestnut-eared Bunting	*E. fucata*						IV
	Yellow-breasted Bunting	*E. aureola*						IV
	Chestnut Bunting	*E. rutila*						IV

* Species recorded by the study

ANNEXURE III

Checklist of Herpetofauna (156 species) of Sikkim and their altitudinal distribution

(1= Present, Blank= absent, - = no data, WPA= Wildlife Protection Act 1972)

Source: Molur et al. (1998a), Jha and Thapa 2002)

Family	Scientific Name	Altitude classes (in metres)					
		<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
AMPHIBIA							
Ranidae	*Amolops afghanus*		1				*IV*
	A. formosus-	1	1	1			*IV*
	Chaparana sikkimensis		1				*IV*
	Limnonectes limnocharis	-	-	-	-		*IV*
	Euphlyctis cyanophlyctis	1	1			-	*IV*
	Rana macrodon		1				*IV*
	R. alticola	1	1	1	1		*IV*
	R. livida	1	1	1			*IV*
	R. annandalii	1	1	1			*IV*
	Paa liebigii	1	1	1	1		*IV*
Rhacophoridae	*Philautus jerdonii*	1					*IV*
	Polypedates leucomystax		1				*IV*
	Rhacophorus jerdoni		1	1			*IV*
	R. maximus		1	1	1		*IV*
	R. reinwardtii		1				*IV*
Bufonidae	*Bufo himalayana*	1	1	1			*IV*
	B. melanostictus	1	1	1	1		*IV*
Megophryidae	*Megophrys parva*	1	1	1			*IV*
	Scutiger sikkimensis		1	1	1	1	*IV*
Salamandridae	*Tylototrioton verrucosus*		1	1			*I*
Ichthyophidae	*Ichtjyophis sikkimensis*		1				*IV*

REPTILIA

Testudinidae	*Indotestudo elongata*	**?**					*IV*
Agamidae	*Calotes jerdoni*		1	1			*IV*
	C. versicolor						*IV*
	Japalura tricarinata	1	1				*IV*
	J. variegata	-	-	-	-	-	*IV*
	Draco blanfordi	1					
	Laudakia himalayana					?	*IV*
	Phrynocephalus theobaldi					?	*IV*
Gekkonidae	*Cosymbotes platyurus*	1	1	1			*IV*
	Hemidactylus bowringi	1					*IV*
	H. garnoti	1					*IV*
	H. flaviviridis	1					*IV*
Scincidae	*Mabuya carinata*	1	1				*IV*
	Sphenomorphus indicum			1			*IV*
	S. maculatum	1	1	1			*IV*
	Leiolopisma sikkimense		1	1	1		*IV*
Anguidae	*Ophisaurus gracilis*	1					*IV*
Varanidae	*Varanus bengalensis*	1					*II*
Typhlopidae	*Typhlops jerdoni*		1				*IV*
	T. oligolepis		1				*IV*
Boidae	*Python molurus*	-	-	-	-	-	*I*
	Eryx conicus	1					*IV*
Colubridae	*Ahaetulla prasina*	1	-	-			*IV*
	Amphiesma platyceps	-	-	-	-	-	*IV*
	A. parallela	-	-	-	-	-	*IV*
	Boiga gokool	-	-	-	-	-	*IV*
	B. trigonata	1	1				*IV*
	B. ochracea	-	-	-	-	-	*IV*
	Dendrelaphis cyanochloris	-	-	-	-	-	*IV*
	D. Pictus	-	-	-	-	-	*IV*
	Chrysopelea Ornate	1				-	*IV*
	Dinodon gammiei				1		
	Elaphe prasina	1	1	1	-		

	E. hodgsoni	1	-	-	-	-	*IV*
	E. radiata	1					*IV*
	E. porphyracea	1	1	1	-	-	*IV*
	E. cantoris	1					*IV*
	Liopeltis stoliczkae		1	1			*IV*
	L. rappi	1	1	1			*IV*
	Oligodon albocinctus	1	1	1			*IV*
	Pareas monticola	-	-	-	-	-	*IV*
	Pseudoxenodon macrops			1	1		*IV*
	Psammodynastes pulverulentus	1					*IV*
	Ptyas mucosus	1	1				*IV*
	P. korros	1					*IV*
	Zocys nigromarginatus	1	1	1	1		*IV*
	Argyrogena fasciolata	1					*IV*
	Rhabdophis subminiata		1				*IV*
	R. himalayana		1	1			*IV*
	Trachischium fuscum			1	1		*IV*
	T. guentheri			1			*IV*
	T. tenuiceps			1			*IV*
	Xenochrophis piscator	1	1				*II*
Elapidae	*Bungarus bungaroides*	-	-	-	-	-	*IV*
	B. caeruleus	1	1				*IV*
	Callophiss macclellandi	1	1	1	1		*IV*
	Naja kaouthia	1					*II*
	Ophiphagus hannah	1	1				*IV*
Viperidae	*Vipera russelli*	1	1	1			*II*
	Gloydius himalayanus		1	1	1	1	*IV*
	Trimeresurus gramineus	1	1				*IV*
	Ovophis monticola	1	1				*IV*
	Protobothrops jerdonii-			?	?	?	

ANNEXURE IV

Checklist of Butterflies of Sikkim and their altitudinal distribution

(1= present, Blank= absent, - = no data, WPA= Wildlife Protection Act, 1972)

Source: Haribal (1992)

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
Papilionidae	Apollo	*Parnassius acdestis*	-	-	-	-	-	
	Imperial Apollo	*P. imperator agustus*				1		I
	Varnished Apollo	*P. acco*	-	-	-	-	-	
	Hannyngton's Apollo	*P. acco hunningitoni*	-	-	-	-	-	I
	*Common Blue Apollo	*P. hardwickii virdicans*			1	1		
	Common Red Apollo	*P. epaphus sikkimensis*					1	II
	Blackedged Apollo	*P. simo*	-	-	-	-	-	
	Bhutan Glory	*Bhutanitis lidderdalii lidderdalii*			1	1		II
	Brown Gorgon	*Meandrusa gyas gyas*	-	-	-	-	-	
	Yellow Gorgon	*M. payeni evan*		1	1			
	Kaiser-I-Hind	*Teinopalpus imperialis imperialis*			1			II
	Sixbar Swordtail	*Pazala eurous sikkimica*	1	1	1			
	Spectacle Swordtail	*P. mandarinus paphus*	1	1				
	Chain Swordtail	*Pathysa aristeus anticrates*	1	1				
	Fivebar Swordtail	*P. antiphates pompilius*	1	1				
	Fourbar Swordtail	*P. agetes agetes*	1	1				
	Spot Swordtail	*P. nomius nomius*	1	1				
	*Great Zebra	*P. xenocles phrontis*	1	1				
	*Lesser Zebra	*P. macareus indicus*	1	1				
	Spotted Zebra	*P. megarus megarus*	-	-	-	-	-	
	*Common Bluebottle	*Graphium sarpedon sarpedon*	1	1				
	*Glassy Bluebottle	*G. cloanthus*	1	1	1			
	*Tailed Jay	*G. agammemnon agammemnon*	1	1				
	Veined Jay	*G. bathycles Chiron*	1	1				
	Great Jay	*G. eurypylus cheronus*	1	1				II

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	*Common Jay	*G. doson axion*	1	1				
	Pemberton's Windmill	*Atrophaneura plutonius pembertoni*	1	1				
	*Rose Windmill	*A. latreillei*	1	1	1			
	*Common Windmill	*A. polyeuctes*		1	1			
	Great Windmill	*A. dasarada dasarada*	1	1	1			
	*Lesser Batwing	*A. aidoneus*	1	1				
	*Common Batwing	*A. varuna astorion*	1	1				
	Common Rose	*Pachliopta aristolochiae*	1	1				
	Crimson Rose	*P. hector*	1	1				I
	Golden Birdwing	*Triodes aeacus*	1	1				
	*Common Birdwing	*T. helena cereberus*	1	1				
	Blue Striped Mime	*Chilasa slateri slateri*	1	1				
	Lesser Mime	*C. epycides epycides*	1	1				II
	Twany Mime	*C. agestor agestor*		1	1			
	*Common Mime	*C. clytia clytia*	1	1	1			I
	*Yellow Swallowtail	*Papilio machaon sikkimensis*			1	1	1	II
	Lime Butterfly	*Princeps demoleus*	1	1				
	*Spangle	*P. protenor euprotenor*		1	1			
	Tailed Redbreast	*P. janaka*	1	1				
	*Redbreast	*P. alcmenor*	1	1				
	Blue Mormon	*P. polymnestor*	-	-	-	-	-	
	*Great Mormon	*P. memnon agenor*	1	1	1			
	*Common Mormon	*P. polytes romulus*	1	1				
	*Red Helen	*P. helenus helenus*	1	1				
	*Yellow Helen	*P. nephelus chaon*	1	1				
	*Common Raven	*P. castor polas*	1	1				
	*Common Peacock	*P. polyctor ganesa*	1	1				
	*Paris Peacock	*P. paris paris*	1	1	1			
	*Blue Peacock	*P. arcturus arcturus*	1	1	1	1		
	*Krishna Peacock	*P. krishna*		1	1			
Pieridae	*Psyche	*Leptosia nina nina*	1	1				
	Butler's Dwarf	*Baltia butleri sikkima*				1		I
	Thibet Blackvein	*Aporia peloria*	-	-	-	-	-	

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Great Blackvein	*A. agathon agathon*		1				IV
	Chumbi White	*Pieris dubernardi chumbiensis*				1	1	
	Greenvein White	*P. montana verity*				1	1	
	Chumbi Greenvein White	*P. melaina*	-	-	-	-	-	
	*Indian Cabbage White	*P. canidia indica*	1	1	1	1	1	
	*Large Cabbage White	*P. brassicaenepalensis*	1	1	1	1	1	
	*Spotted Swatooth	*P. thestylis thestylis*	1	1				
	Redspot Swatooth	*P. clemanthe clemanthe*	-	-	-	-	-	
	Pioneer	*Anapheis aurota aurota*	1	1				
	Orange Albatross	*Appias nero galba*	1	1				IV
	Chocolate Albatross	*A. lyncida elenora*	1	1				II
	*Plain Puffin	*A. indra indra*	1	1				II
	*Spot Puffin	*A. lalage durvasa*	1	1				
	*Common Albatross	*A. albina darada*	1	1				II
	Common Wanderer	*Pareronia valeria hippia*	1	1				
	Pale Wanderer	*P. avatar avatar*	1	1				
	*Common Gull	*Cepora nerissa nerissa*	1	1				II
	*Lesser Gull	*C. nadina nadina*	1	1				II
	*Yellow Orangetip	*Ixias pyrene familiaris*	1	1				
	*Great Orangetip	*Hebomoia glaucippe glaucippe*	1	1				
	*Common Jezebel	*Delias eucharis*	1	1				
	*Hill Jezebel	*D. belladona ithiela*	1	1	1			
	Redspot Jezebel	*D. descombesi descombesi*		1	1			
	*Yellow Jezebel	*D. agostina agostina*	1	1	1			
	Pale Jezebel	*D. samaca oreas*	-	-	-	-	-	I
	Dark Jezebel	*D. berinda boyleae*	-	-	-	-	-	
	*Redbreast Jezebel	*D. thysbe pyramus*	-	-	-	-	-	
	Painted Jezebel	*D. hyparete indica*	1	1				
	*Redbase Jezebel	*D. aglaia*	1	1	1			
	*Common Emigrant	*Catopsilia Pomona*	1	1	1			

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	*Mottled Emigrant	*C. pyranthe*	1	1	1			
	*Tailed Sulphur	*Dercas verhuelli doubledayi*	1	1	1			
	Plain Sulphur	*D. lycoris lycoris*	1	1				II
	Common Brimstone	*Gonepteryx rhamni nepalensis*			1	1	1	
	*Tree Yellow	*Gandaca harina assamica*	1	1				
	*Small Grass Yellow	*Eurema brigitta rubella*	1	1				
	*Spotless Grass Yellow	*E. laeta sikkima*	1	1				
	*Three Spot Grass Yellow	*E. blanda silhetana*	1	1				
	*Common Grass Yellow	*E. hecabe contubernalis*	1	1				
	Scarce Grass Yellow	*E. jordani*	-	-	-	-	-	
	Onespot Grass Yellow	*E. andersoni andersoni*	1	1				II
	Chocolate Grass Yellow	*E. sari sodalis*		1				
	Orange Clouded Yellow	*Colias stoliczakana miranda*	-	-	-	-	-	II
	Everest Clouded Yellow	*C. berylla*	-	-	-	-	-	
	Fawcett's Clouded Yellow	*C. nina nina*	-	-	-	-	-	
	Dwarf Clouded Yellow	*C. dubia*	-	-	-	-	-	I
	*Dark Clouded Yellow	*C. fieldii*	1	1	1	1	1	
Lycaenidae	Common Gem	*Poritia hewitsoni hewitsoni*	1	1				II
	Moth Butterfly	*Liphyra brassolis*	1	1				I
	Common Brownie	*Miletus boisduvali assamensis*	1	1				
	Crenulate Darkie	*Allotinus drumila*	-	-	-	-	-	I
	Great Darkie	*A. multistrigatus multistrigatus*	-	-	-	-	-	

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Forest Pierrot	*Taraka hamada mendesia*	1	1				
	Apefly	*Spalgis epius epius*	1	1				
	Bright Sunbeam	*Curetis bulis*	1	1				
	*Angled Sunbean	*C. dentata*	1	1				
	Metallic Green Hairstreak	*Chrysozephyrus duma*		1				
	Metallic Green Hairstreak	*C. sikkimmensis*	-	-	-	-	-	
	Powdered Hairstreak	*C. zoa*	1	1				
	Silver Hairstreak	*C. syla assamica*			1	1		
	Kirbari Hairstreak	*C. kirbarensis*	-	-	-	-	-	
	Lilac Oakblue	*Narathura camadeo*	1	1				
	Doherty's Dull Oakblue	*N. khamti*	-	-	-	-	-	
	Indian Oakblue	*N. alemon*	-	-	-	-	-	
	Powdered Oakblue	*N. bazalus*		1				
	Large Oakblue	*Arhopala amantes*	1	1				
	Green Oakblue	*A. eumolphus*	1	1				
	Dark Himalayan Oakblue	*A. paramuta*						
	Aberrant Bushblue	*A. abseus indicus*	1	1				
	Bifid Plushblue	*Flos diardi*	-	-	-	-	-	
	Shining Plushblue	*F. fulgida*	-	-	-	-	-	
	Spangled Plushblue	*F. asoka*	1	1				
	Chinese Plushblue	*F. chinensis*	-	-	-	-	-	
	Tailless Plushblue	*F. areste*	-	-	-	-	-	
	Variegated Plushblue	*Nilasera adriana*	1	1				
	Spotless Oakblue	*Narathura fulla ignara*	-	-	-	-	-	
	*Centaur Oakblue	*Nilasera centaurus pirithous*	1	1				
	Yellow Disc Oakblue	*Panchala singla*	1	1				
	Yellow Disc Tailless Oakblue	*Arhopala perimuta perimuta*	-	-	-	-	-	
	*Dusky Bushblue	*Acesina paraganesa*	1	1				

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
		paraganesa						
	*Common Acacia Blue	*Surendra quercetorum quercetorum*	1	1				
	Silverstreaked Acaciablue	*S. todara distorta*	1	1				II
	Sylhet Oakblue	*Amblypodia silhetensis*	-	-	-	-	-	II
	Singapore Oakblue	*A. yendava*	-	-	-	-	-	II
	Common Leaf Blue	*A. anita*	1	1				
	*Hewitson's Dull Oakblue	*Narathura aenea*	1	1				
	Dark Himalayan Oakblue	*N.rama*	1	1				
	Silverstreak	*Iraota timoleon*	1	1				
	Common Tinsel	*Catapaecilma elegans major*	1	1				
	Dark Tinsel	*C. delicatum*	1	1				
	*Yamfly	*Loxura atymnus continentalis*	1	1				
	Branded Yamfly	*Yasoda tripunctuata*	1	1				II
	Common Onyx	*Horaga onyx onyx*	1	1				
	Yellow Onyx	*H. moulmenia*	-	-	-	-	-	
	Brown Onyx	*H. viola*	-	-	-	-	-	
	Monkey Puzzle	*Rathinda amor*	1	1				
	Common Imperial	*Cheritra freja freja*	1	1				
	Truncate Imperial	*Cheritrella truncipennis*	1	1				II
	Blue Imperial	*Ticherra acte*	1	1				
	Blue Posy	*Biduanda melisa cyara*	1	1				
	Khaki Shot Silverline	*Spindasis ictis*	1	1				
	Common Silverline	*S. vulcans fusca*	1	1				
	Silvergrey Silverline	*S. sani*	1	1				
	Khaki Silverline	*S. rukmini*	1	1				I
	Club Silverline	*S. syama peguanus*	-	-	-	-	-	
	Elwes's Silverline	*S. elwesi*	1	1				I
	Longbranded	*S. iohita himalayanus*	1	1	1			II

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Silverline							
	Straightline Royal	*Iolaus diaeus*	-	-	-	-	-	
	Dark Blue Royal	*Pratapa icetas extensa*	1	1				II
	Pallid Royal	*Tajuria albiplaga*	-	-	-	-	-	II
	Chestnut And Black Royal	*T. yajna isotroidea*	-	-	-	-	-	I
	Branded Royal	*T. melastigma*	-	-	-	-	-	II
	Spotted Royal	*T. maculata*	1	1				
	Slate Royal	*Maneca bhotea*	1	1	1			
	Pale Grand Imperial	*Jacoona fabronia*	-	-	-	-	-	
	Banded Royal	*Charana (=Rachana) jalindra indra*	1	1				II
	Mandarinus Blue	*Charana mandarinus*	1	1				
	White Royal	*Tajuira illurgis*	1	1				
	Chocolate Royal	*Ramelana jangala ravata*	1	1				
	Bi-Spot Royal	*Ancema ctesia*	1	1	1			
	Whitebanded Royal	*A. (=Pratapa) cotys*		1	1			
	Silver Royal	*A. blanka argentea*	1	1	1			
	Broad Tail Royal	*Camena cleobis*	1	1				
	White Royal	*C. deva lila*	1	1				
	Common Tit	*Hypolycaena erylus himavantus*	1					
	Blue Tit	*Chliaria kina cachara*	1	1				
	Orchid Tit	*C. othona*	1	1				
	*Fluffy Tit	*Zeltus amasa*	1	1				
	Cornelian	*Deudorix epijarbus amatius*	1	1	1			
	Green Flash	*Artipe eryx*		1	1			II
	Common Guava Blue	*Virachola isocrates*	1	1	1			
	Large Guava Blue	*V. perse perse*	1	1	1			
	Pale Spark	*Sinthusa virgo*	-	-	-	-	-	I
	Broad Spark	*S. chandrana grotei*	-	-	-	-	-	

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Narrow Spark	*S. nasaka amba*	1	1				
	Witch	*Araotes lapithis*	1	1				II
	Plane	*Bindahara phocides phocides*	1	1				II
	Indigo Flash	*Rapala varuna oresis*	1	1				II
	Refulgent Flash	*R. refulgens*	1	1	1			II
	Slate Flash	*R. manae schistacea*	1	1	1			
	Scarce Slate Flash	*R. scintilla*	-	-	-	-	-	II
	Shot Flash	*R. buxaria*	-	-	-	-	-	II
	Common Red Flash	*R. jarbas* (=*iarbas*)	-	-	-	-	-	
	Common Flash	*Bidaspa nissa nissa*	-	-	-	-	-	
	Copper Flash	*Vadebra petosivis*	-	-	-	-	-	
	Chumbi Green Underwing	*Lycaena younghusbandi*				1	1	
	Lister's Hairstreak	*Pamela dudgeoni*	-	-	-	-	-	-
	Common Copper	*L. phalaeas flavens*	-	-	-	-	-	-
	*Purple Sapphire	*Heliophorus epicles indicus*		1	1	1		
	*Golden Sapphire	*H. brahma*		1	1			
	*Hybrid Sapphire	*H. hybrida*	-	-	-	-	-	I
	*Azure Sapphire	*H. androcles moorei*		1	1			II
	Powdery Green Sapphire	*H. tamu*		1	1			
	Ciliate Blue	*Anthene emolus*	-	-	-	-	-	-
	Straightwing Blue	*Orthomiella pontis pontis*	-	-	-	-	-	II
	Pointed Pierrot	*Niphanda cymbia*	-	-	-	-	-	II
	Dingy Line Blue	*Petrelaea dana*	-	-	-	-	-	-
	Large 4-Lineblue	*Nacaduba pactolus continentalis*	1	1				II
	Violet-4-Lineblue	*N. pavana vajuva*	-	-	-	-	-	-
	Pointed Lineblue	*N. helicoin meriguiana*	-	-	-	-	-	II
	*Pale 4-Lineblue	*N. hermus nabo*	1	1				II

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	*Transparent 6-Lineblue	*N. kurava euplea*	1	1				
	Opaque 6-Lineblue	*N. beroe gythion*	1	1				
	*Banded Lineblue	*Prosotas aluta coelestis*	1	1				
	Bhutya Lineblue	*P. bhutea*	1	1				
	*Tailless Lineblue	*P. dubiosa sivoka*	1	1				
	Angled Pierrot	*Caleta caleta decidia*	1	1				
	Elbowed Pierrot	*C. elna noliteia*	1	1				
	*Common Cerulean	*Jamides celeno celeno*	1	1				
	*Metallic Cerulean	*J. alecto eurysaces*	1	1				II
	*Forget-Me-Not	*Catochrysops strabo*	1	1				
	*Peablue	*Lampides boeticus*	1	1				II
	*Dark Cerulean	*Jamides bochus*	1	1	1			
	*Glistening Cerulean	*J. elpis palissa*	1	1				
	*Zebra Blue	*Syntarucus plinius*	1	1				
	Common Pierrot	*Castalius rosimon rosimon*	1	1				I
	Striped Pierrot	*Tarucus nara*	1	1				
	*Dark Pierrot	*T. ananda*	1	1				IV
	Assam Pierrot	*T. venosus dharata*	1	1				II
	Pointed Pierrot	*T. callinara*	-	-	-	-	-	II
	Dark Grass Blue	*Zizeeria knyasna*	-	-	-	-	-	-
	*Grass Jewel	*Z. trochilus*	1	1				
	Pale Grass Blue	*Pseudozizeeria maha*	1	1				
	*Tiny Grass Blue	*Zizula hylax*	-	-	-	-	-	-
	Tailed Cupid	*Everes argiades hellotia*	-	-	-	-	-	-
	Chapman's Cupid	*E. hugelli dura*	-	-	-	-	-	-
	Dusky Blue Cupid	*E. dipora*	-	-	-	-	-	
	Forest Quaker	*Pithecops corvus*	-	-	-	-	-	-
	*Bright Babul Blue	*Azanus ubaldus*	1	1				
	Dull Babul Blue	*A. uranus*	-	-	-	-	-	-
	Margined Hedge Blue	*Lycaenopsis marginata*		1	1			

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	White Banded Hedge Blue	*L. transpectus*	1	1	1			
	*Quaker	*Neopithecops zalmora*	1	1				
	Malayan	*Megisba malaya sikkima*	1	1				
	Albocerulean	*Celastrina albocerulea*	1	1				
	*Plain Hedge Blue	*C. lavendularis placida*	1	1	1			
	Pale Hedge Blue	*C. cardia dilecta*		1	1			
	Large Hedge Blue	*C. hugelii oreana*		1	1			
	Hill Hedge Blue	*C. argiolus sikkima*		1	1			
	Hill Hedge Blue	*C. argiolus jyntea*	-	-	-	-	-	-
	*Common Hedge Blue	*Acetolepis puspa gisca*	1	1	1	1		
	Gram Blue	*Euchrysops cnejus*	1	1				
	Chumbi Argus	*Polyommatus semiargus annulata*					1	
	Common Meadow Blue	*P. eros arene*	-	-	-	-	-	-
	Mountain Blue	*Albulina pheretes pharis*					1	
	Chapman's Blue	*Everes diporides*	-	-	-	-	-	II
	Azure Mountain Blue	*Albulina pheretes arcaseia*					1	
	Lime Blue	*Chilades laius*	1	1	1			
	Plain's Cupid	*Edales pandava*	1	1				
	*Punchinello	*Zemeros flegyas indicus*		1	1			
	*Lesser Punch	*Dodona dipaea dipaea*		1	1			II
	*Tailed Punch	*D. eugenes venox*	1	1	1			
	*Mixed Punch	*D. ouida ouida*		1	1			
	*Striped Punch	*D. adonira adonira*		1	1			II
	*Orange Punch	*D. egeon*		1	1			II
	*Dark Judy	*Abisara fylla*	1	1				
	Tailed Judy	*A. neophron neophron*	1	1				
	Spot Judy	*A. chela chela*	1	1				

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	*Plum Judy	*A. echerius suffusa*	1	1				
Nymphalidae	Common Faun	*Faunis canens arcesilaus*	1	1				
	Yellow Dryad	*Aemona amathusia*	-	-	-	-	-	II
	Chocolate Junglequeen	*Sticopthalma nourmahal nourmahal*	1	1				II
	Northern Junglequeen	*S. camadeva*	1	1				
	Jungle Glory	*Thaumantis diores*	1					
	Kohinoor	*Amathuxidia amythaon*	1					
	*Common Duffer	*Discophora sondiaca*	1					
	Great Duffer	*D. timora timora*	1					II
	Red Caliph	*Enispe euthymius*	1					
	Blue Caliph	*E. cyncus*	1					II
	*Common Evening Brown	*Melanitis leda ismene*	1					
	*Dark Evening Brown	*M. phedima bela*	1	1	1			
	*Great Evening Brown	*M. zitenius zitenius*	1	1				
	Branded Evening Brown	*Cyllogenes suradeva*	-	-	-	-	-	II
	Common Palmfly	*Elymnias hypermnestra undularis*	1					
	Tiger Palmfly	*E. nesaea timandra*	-	-	-	-	-	-
	*Spotted Palmfly	*E. malelas malelas*	1	1				II
	Blue Striped Palmfly	*E. patna patna*	1	1				
	Jezebel Palmfly	*E. vasudeva vasudeva*	-	-	-	-	-	II
	White-Edged Woodbrown	*Lethe visarava*	1	1				
	Scarce Woodbrown	*L. siderea*		1	1			
	Common Woodbrown	*L. sidonis sidonis*		1	1	1		
	*Small Woodbrown	*L. nicetella*		1	1			
	Barred Woodbrown	*L. maithrya*			1			
	Yellow Woodbrown	*L. nicetas*		1	1			
	Spotted Mystic	*L. tristigmata*	-	-	-	-	-	-
	Dismal Mystic	*L. ocellata lyncus*	-	-	-	-	-	I

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	*Bamboo Treebrown	*L. europa niladana*	1	1				I
	Common Treebrown	*L. rhoria rhoria*	1	1				
	Bhutan Treebrown	*L. margarita*	-	-	-	-	-	I
	Common Red Forester	*L. mekara mekara*	1	1				
	*Angled Red Forester	*L. chandica*	1	1				
	Scarce Red Forester	*L. distans*	1	1				I
	Common Forester	*L. insana dinarbas*	1	1	1			II
	Brown Forester	*L. serbonis serbonis*			1	1		II
	Brown Forester	*L. serbonis teesta*	-	-	-	-	-	II
	Black Forester	*L. vindhya*	1	1				
	Bamboo Forester	*L. kansa*	1	1				
	Tailed Red Forester	*L. sinorix*	1	1				
	*Blue Forester	*L. scanda*		1	1			II
	Pale Forester	*L. latiaris*		1	1			II
	Forester	**L. bhairava**	-	-	-	-	-	II
	*Straight Banded Treebrown	*Neope verma sintica*		1	1			
	*Banded Treebrown	*N. confusa confusa*		1	1			
	*Veined Labyrinth	*N. pulaha pulaha*		1	1			
	Scarce Labyrinth	*N. pulahina*		1	1			
	*Tailed Labyrinth	*N. bhadra*		1	1			
	*Dusky Labyrinth	*N. yama yama*		1	1			
	*Small Silverfork	*Zophoessa jalaurida elwesi*			1	1		
	*Moeller's Silverfork	*Z. moelleri*		1	1	1		
	Small Goldenfork	*Z. atkinsonia*			1	1		
	Large Goldenfork	*Z. goalpara goalpara*			1	1		
	*Lilacfork	*Z. sura*			1			
	Scarce Lilacfork	*Z. dura gammiei*	-	-	-	-	-	-
	*Treble Silverstripe	*Z. baladeva baladeva*		1	1			
	*Single Silverstripe	*Z. ramadeva ramadeva*	-	-	-	-	-	-
	*Chumbi Wall	*Chonala masoni*			1	1		
	Large Tawny Wall	*Raphicera satricus*			1	1		

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Small Twany Wall	*Raphicera moorei mantra*			1	1		
	Tiger Brown	*Orinoma damaris*		1	1			
	Dusky Diadem	*Ethope himachala*	1	1				
	*Yellow Owl	*Neorina hilda*	1	1				II
	Whitebar Bushbrown	*Mycalesis anaxias oemate*	1	1				II
	*Lilacine Bushbrown	*M. franscica Santana*	1	1				
	Chinese Bushbrown	*M. gotama charaka*	-	-	-	-	-	II
	*Common Bushbrown	*M. perseus blasius*	1	1				
	*Darkbrand Bushbrown	*M. mineus*	1	1				
	*Long-Brand Bushbrown	*M. visala visala*	1	1				
	Wood-Mason's Bushbrown	*M. suavolens tylteri*	-	-	-	-	-	
	White-Edged Bushbrown	*M. mestra vetus*	1	1				II
	*Moore's Bushbrown	*M. heri*	1	1				II
	Salmon Branded Bushbrown	*M. misenus*	-	-	-	-	-	II
	*Bright Eye Bushbrown	*M. nicotia*	1	1				
	*Whiteline Bushbrown	*M. malsara*	1	1				II
	*Nigger	*Orsotrioena medus*	1	1				
	Ringlet	*Ragdia crisilda crito*	1	1				
	*Dark Catseye	*Zipoetis scylax*	1	1				
	*Himalayan Fivering	*Ypthima sakra*		1	1			
	Variegated Fivering	*Y. methora methora*	1	1				II
	*Eastern Fivering	*Y. persimilis*	-	-	-	-	-	
	*Common Fivering	*Y. baldus baldus*	1	1				
	Jewel Four Ring	*Y. avanta*	-	-	-	-	-	
	*Common Three Ring	*Y. asterope maharatta*	1	1				
	*Common Four Ring	*Y. hubenri hubenri*	1	1				
	Large Three Ring	*Y. newara*	1	1				

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Pallid Argus	*Callerbia scanda scanda*	1	1				
	*Pallid Argus	*C. scanda opima*	-	-	-	-	-	-
	Ringed Argus	*C. ananda ananda*	-	-	-	-	-	-
	Ringed Argus	*C. ananda caeca*	-	-	-	-	-	-
	Mottled Argus	*C. narasingha narasingha*	-	-	-	-	-	-
	Mountain Argus	*Paraoeneis pumilus bicolor*				1	1	
	Arctic Argus	*P. palaearcticus sikkimensis*				1	1	
	Narrow Banded Satyr	*Aulocera brahminus brahminiodes*			1	1		
	Great Satyr	*A. padma padma*			1	1		
	Great Satyr	*A. padma loha*	-	-	-	-	-	-
	Common Satyr	*A. swaha swaha*		1	1			
	Striated Satyr	*A. saraswati*		1	1			
	*Freak	*Calinaga buddha gautama*		1	1			II
	Tawny Rajah	*Charaxes polyxena hierax*	1	1				II
	Scarce Twany Rajah	*C. aristogiton*	1	1				II
	Yellow Rajah	*C. marmax*	1	1				II
	Variegated Rajah	*C. kaharuba*	-	-	-	-	-	II
	Black Rajah	*C. fabius fabius*	1	1				II
	*Common Nawab	*Polyura athamas athamas*	1	1				
	Pallid Nawab	*P. arja*	1	1				
	Malayan Nawab	*P. moori sandakanus*	-	-	-	-	-	-
	Jeweled Nawab	*P. delphis delphis*	-	-	-	-	-	-
	*Stately Nawab	*P. dolon centralis*	1	1				
	Great Nawab	*P. eudamippus eudamippus*	1	1				
	White Emperor	*Helcyra hemina*	1	1				I
	Golden Emperor	*Dilipa morgiana*	1	1				
	Sordid Emperor	*Apatura sordida*	1	1				II

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
		sordida						
	Sergeant Emperor	*A. chevana*	1	1				II
	*Indian Purple Emperor	*A. ambica ambica*	1	1				
	*Black Prince	*Rohana parisatis parisatis*	1	1				
	Brown Prince	*R. parvata*	1	1				
	*Pasha	*Herona marathus marathus*	1	1				
	*Eastern Courtier	*Sephisa chandra*	1	1				
	Painted Courtesan	*Euripus consimilis consimilis*	1	1				
	Courtesan	*E. halitheres*	1	1				
	*Circe	*Hestina nama*	1	1				
	Siren	*H. persimilis persimilis*	1	1				
	*Popinjay	*Stibochiona nicea nicea*	1	1				
	Constable	*Dichorragia nesimachus*	1	1				
	Yellow Kaiser	*Penthema lisrada lisrada*	-	-	-	-	-	II
	*Tabby	*Psuedergolis wedah*	1	1				
	Angled Castor	*Ariadne ariadne pallidior*	1	1	1			
	Common Castor	*A. merione assama*	1	1	1			
	Rustic	*Cupha erymanthis lotis*	1	1				
	Common Leopard	*Phalanta phalantha*	1	1				
	Small Leopard	*P. alcippe alcippoides*	1	1				
	*Large Yeoman	*Cirrochroa aoris aoris*	1	1				
	*Common Yeoman	*C. tyche mithila*	1	1				
	Vagrant	*Issoria sinha sinha*	1	1				
	*Queen Of Spain Fritillary	*I. lathonia issaea*		1	1	1	1	
	*Indian Fritillary	*Argyreus hyperbius hyperbius*	1	1	1			
	*Large Silverstripe	*Childrena childreni childreni*		1	1			

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Common Silverstripe	*Fabriciana kamala*	-	-	-	-	-	-
	Silverstreak	*Melitaea clara*	-	-	-	-	-	-
	Blackvein Fritillary	*M. arcesia thibetana*	-	-	-	-	-	-
	Blackvein Fritillary	*M. arcesia sikkimensis*					1	
	*Gem Silverspot	*Argynnis gemmata gemmata*				1	1	
	Mountain Silverspot	*A. gemmata altissima*					1	
	Straightwing Silverspot	*Boloria pales eupales*	-	-	-	-	-	-
	Yellow Pansy	*Precis hierta magna*	1	1	1			
	Blue Pansy	*P. orithya ocyale*	1	1	1			
	*Lemon Pansy	*P. lemonias lemonias*	1	1	1			
	*Peacock Pansy	*P. almana almana*	1	1				
	*Grey Pansy	*P. atlites atlites*	1	1				
	*Chocolate Soldier	*P. iphita iphita*	1	1	1			
	*Indian Red Admiral	*Vanessa indica indica*		1	1	1		
	*Painted Lady	*Cynthia cardui*	1	1	1	1	1	
	*Blue Admiral	*Kaniska canace canace*		1	1			
	Eastern Comma	*Polygonia egea agnicula*	-	-	-	-	-	-
	*Mountain Tortoiseshell	*Aglais urticae rizana*					1	
	Ladakh Tortoiseshell	*A. ladakensis*	-	-	-	-	-	-
	*Indian Tortoiseshell	*A. cachmirensis aesis*	1	1	1	1	1	
	Camberwell Beauty	*Nymphalis antiopa yedanula*	-	-	-	-	-	-
	*Common Jester	*Symbrenthia lilaea khasiana*		1	1			
	Himalayan Jester	*S. hypselis cotanda*		1	1	1		
	*Bluetail Jester	*S. niphanda niphanda*	1	1				II
	*Danaid Eggfly	*Hypolimnas misippus*	1	1				I
	*Great Eggfly	*H. bolina*	1	1				
	*Autumn Leaf	*Doleschallia bisaltide indica*	1	1				II
	Blue Oakleaf	*Kallima horsfieldi*	1	1				

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	*Orange Oakleaf	*K. inachus inachus*	1	1				
	Marbled Map	*Cyrestis cocles cocles*	-	-	-	-	-	II
	*Common Map	*C. thyodamas thyodamas*	1	1				
	*Common Maplet	*Chersonesia risa risa*	1	1				
	Chestnut Streaked Sailer	*Neptis jumbah jumbah*	1	1				
	Himalayan Sailer	*N. mahendra*	-	-	-	-	-	-
	*Common Sailer	*N. hylas varmona*	1	1	1			
	Common Sailer	*N. sappho astola*	1	1	1			
	Sullied Sailer	*N. soma soma*	1	1	1			II
	Clear Sailer	*N. clinia susruta*	1	1				
	Yerburi's Sailer	*N. yerburi*		1	1			
	*Broad Banded Sailer	*N. sankara amba*	1	1				I
	Dingy Sailer	*N. pseudovikasi*	1	1				
	Dingiest Sailer	*N. harita harita*		1	1			
	Plain Sailer	*N. cartica cartica*	1	1				
	Rich Sailer	*N. nashona nashona*	-	-	-	-	-	II
	Yellow Sailer	*N. ananta ochracea*	1	1				
	*Small Yellow Sailer	*N. miah miah*	1	1				
	Variegated Sailer	*N. antilope elba*	-	-	-	-	-	I
	Pale Hockeystick Sailer	*N. manasa manasa*	-	-	-	-	-	I
	Hockey Stick Sailer	*N. nycteus*	-	-	-	-	-	I
	Broad Stick Sailer	*N. narayana nana*		1	1			II
	Great Yellow Sailer	*N. radha radha*		1	1			II
	Pale Green Sailer	*N. zaida bhutanica*		1				II
	*Yellow Jack Sailer	*Lassipa viraja viraja*	1	1				
	Short Branded Sailer	*Phaedyma columella ophiana*	1	1				
	Common Lascar	*Pantoporia hordonia hordonia*	1	1				
	*Orange Staff Sergeant	*Parathyma cama*	1	1				
	*Colour Sergeant	*P. nefte inara*	1	1				
	*Blackvein Sergeant	*P. ranga ranga*	1	1				

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Studded Sergeant	*P. asura asura*	1	1				
	Common Sergeant	*P. perius*	1	1				
	Staff Sergeant	*P. selenophora selenophora*	1	1				
	Small Staff Sergeant	*P. zeroca*	1	1				
	Hill Sergeant	*P. opalina orientalis*	1	1				
	Bhutan Sergeant	*P. jina jina*	-	-	-	-	-	-
	Commander	*Moduza procris procris*	1	1				
	Commodore	*Limenitis danava*	1	1				
	*Bicolour Commodore	*L. zayla*	1	1				
	Green Commodore	*L. daraxa*	1	1				
	White Commodore	*L. dudu*	1	1				II
	Scarce White Commodore	*L. zulema*	1	1				I
	Clipper	*Parthenos sylvia gambrisius*	1	1				II
	Knight	*Labadea martha martha*	1	1				
	Panther	*Neurosigma doubledayi doubledayi*	1	1				II
	Sergeant Major	*Abrota ganga ganga*	1	1				
	Archduke	*Lexias khasiana*	-	-	-	-	-	-
	*Grey Count	*Tanaecia lepidea lepidea*	1	1				
	*Common Earl	*T. julii appiades*	1	1				
	Plain Earl	*T. jahnu jahnu*	-	-	-	-	-	
	Powdered Baron	*Euthalia kesava arhat*	1	1				
	Grey Baron	*E. anosia saitapherne*	-	-	-	-	-	
	*Blue Baron	*E. telchinia*		1	1			I
	*Common Baron	*E. aconthea suddhodana*	1	1				
	*Streaked Baron	*E. jama jamida*	1	1				
	*White-Edged Blue Baron	*E. phemius*	1	1				
	Gaudy Baron	*E. lubentina indica*	1	1				IV
	French Duke	*E. franciae franciae*	1	1				II

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	*Blue Duchess	*E. duda*	1	1				II
	Blue Duke	*E. durga durga*	-	-	-	-	-	I
	Bronze Duke	*E. nara nara*	1	1				II
	*Green Duke	*E. sahadeva sahadeva*	1	1				
	Grand Duke	*E. iva*	-	-	-	-	-	I
	Baronet	*Symphaedra nais*	1	1				
	Cruiser	*Vindula erota erota*	1	1				
	*Red Lacewing	*Cethosia biblis tisamena*	1	1				
	*Leopard Lacewing	*C. cyane*	1	1				
	*Tawny Coster	*Acraea violae*	1	1				
	*Yellow Coster	*Pareba vesta*	1	1				
	*Glassy Tiger	*Parantica aglea melanoides*	1	1	1			
	*Chestnut Tiger	*P. sita sita*	1	1	1			
	Chocolate Tiger	*P. melaneus platiniston*	1	1				
	*Blue Tiger	*Tirumala limniace leopardus*	1	1				
	*Dark Blue Tiger	*T. septentrionis*		1				
	*Common Tiger	*Danaus (Salathura) genutia*	1	1				
	*Plain Tiger	*Danaus (Anosia) chrysippus*	1	1				
	Double Branded Crow	*Euploea sylvester hopei*	1	1				
	*Striped Blue Crow	*E. mulciber mulciber*		1	1			
	Blue Spotted Crow	*E. midamus rogenhoferi*		1	1			II
	*Blue King Crow	*E. klugii klugii*	1	1				
	Magpie Crow	*E. radmanthus*	1	1				
	*Srriped Black Crow	*E. doubledayi*	1	1				
	Long Branded Blue Crow	*E. algea deione*	1	1				
	*Common Crow	*E. core core*	1	1	1			IV
	Common Beak	*Libythia lepita lepita*		1	1			
	*Club Beak	*L. myrrha myrrha*		1	1			
Hesperiidae	Branded Orange	*Bibasis oedipodea*	-	-	-	-	-	

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Awlet	*athena*						
	Orange Awlet	*B. jaina jaina*	1	1				
	Plain Orange Awlet	*B. anadi*	-	-	-	-	-	
	Unknown	*B. harisa harisa*	-	-	-	-	-	
	Green Awlet	*B. vasutana*	-	-	-	-	-	
	Small Green Awlet	*B. amara*	-	-	-	-	-	
	Pale Green Awlet	*B. gomata gomata*	-	-	-	-	-	
	Pale Green Awlet	*B. sena sena*	-	-	-	-	-	
	Unknown	*Hasora anura anura*	-	-	-	-	-	
	White Banded Awl	*H. taminatus bhavara*	-	-	-	-	-	
	*Common Awl	*H. badra badra*	-	-	-	-	-	
	Plain Banded Awl	*H. vitta indica*	-	-	-	-	-	IV
	Brown Awl	*Badamia exclamationis*	1	1				
	Branded Awlking	*Choaspes plateni stigmata*	-	-	-	-	-	
	Indian Awlking	*C. benjaminii japonica*	-	-	-	-	-	
	Awlking	*C. xanthopogon*	-	-	-	-	-	
	Awlking	*C. hemixanthus furcata*	-	-	-	-	-	
	Lidderdale's Dawnfly	*Capila lidderdali*	-	-	-	-	-	
	Palestriped Dawnfly	*C. zennara*	-	-	-	-	-	
	Striped Dawnfly	*C. jayadeva*	-	-	-	-	-	
	Marbled Flat	*Lobocla liliana liliana*	-	-	-	-	-	
	Bhutan Flat	*Celaenorrhinus flavocincta*	-	-	-	-	-	
	Double Spotted Flat	*C. pyrrha*	-	-	-	-	-	
	Unknown	*C. ratna tytleri*	-	-	-	-	-	
	*Multispotted Flat	*C. pulomaya pulomaya*			1	1		
	Mussouri Pied Flat	*C. pero lucifera*	-	-	-	-	-	
	Pied Flat	*C. morena*	-	-	-	-	-	
	De Niceville's Spotted Flat	*C. plagifera*	-	-	-	-	-	
	Moore's Spotted Flat	*C. sumitra*	-	-	-	-	-	
	Large Spotted Flat	*C. patula*	-	-	-	-	-	

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	*Common Spotted Flat	*C. leucocera*	1	1	1			
	Common Spotted Flat	*C. putra putra*	-	-	-	-	-	
	Himalayan Spotted Flat	*C. munda munda*	-	-	-	-	-	
	Himalayan Spotted Flat	*C. munda maculicornis*	-	-	-	-	-	
	Small Banded Flat	*C. nigricans nigricans*	-	-	-	-	-	
	Scarce Banded Flat	*C. badia*	-	-	-	-	-	
	Himalayan Yellow Flat	*C. dhanada dhanada*	-	-	-	-	-	
	Hairy Angle	*Darpa hanria*	-	-	-	-	-	
	Zigzag Flat	*Odina decoratus*	-	-	-	-	-	
	*Fulvous Pied Flat	*Coladenia dan festa*	-	-	-	-	-	
	Fulvous Pied Flat	*C. dan fauta*	-	-	-	-	-	
	Fulvous Pied Flat	*C. dan fabia*	-	-	-	-	-	
	Tricoloured Pied Flat	*C. indrani indrani*	1	1				
	Brown Pied Flat	*C. agni agni*	-	-	-	-	-	
	*Small Common Flat	*Sarangesa dasahara dasahara*	1	1	1			
	Tytler's White Flat	*Satarupa zulla zulla*	-	-	-	-	-	
	Large White Flat	S. gopala	-	-	-	-	-	
	Himalayan White Flat	*Seseria dohertyi dohertyi*	-	-	-	-	-	
	Sikkim White Flat	*S. sambara sambara*	-	-	-	-	-	
	Olive Flat	Chamunda chamunda	-	-	-	-	-	
	White Yellowbreast Flat	*Daimio sinica narada*	-	-	-	-	-	
	*Dusky Yellowbreast Flat	*D. phisara phisara*	-	-	-	-	-	
	Unknown	*Tagiades japetus ravi*	-	-	-	-	-	
	Large Snow Flat	*T. gana athos*	-	-	-	-	-	
	Large Snow Flat	*T. parra gala*	-	-	-	-	-	
	*Water Snow Flat	*T. litigiosa litigiosa*	1	1	1			

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Spotted Snow Flat	*T. menaka menaka*	-	-	-	-	-	
	Flat	*T. cohaerens cynthia*	-	-	-	-	-	
	Yellow Flat	*Mooreana trichoneura pralaya*	-	-	-	-	-	
	Tawny Angle	*Ctenoptilum vasava vasava*	1	1				
	Chestnut Angle	*Odontoptilum angulata angulata*	1	1				
	Spotted Angle	*Caprona agama agama*	-	-	-	-	-	
	*Indian Skipper	*Spialia galba*	1	1				
	Unknown	*Carterocephalus avanti avanti*	-	-	-	-	-	
	Forest Hopper	*Astictopterus jama olivascens*	-	-	-	-	-	
	Atkinson's Bob	*Arnetta atkinsoni*	-	-	-	-	-	
	Tiger Hopper	*Ochus subvittatus subradiatus*	1	1				
	Hedge Hopper	*Baracus vittatus septentrionum*	-	-	-	-	-	
	Blue Spotted Scrub Hopper	*Aeromachus kali*	-	-	-	-	-	
	Veined Scrub Hopper	*A. stigmata stigmata*	-	-	-	-	-	
	*Grey Scrub Hopper	*A. jhora jhora*	-	-	-	-	-	
	Tufted Ace	*Sebastonyma dolopia*	-	-	-	-	-	
	Grahm's Ace	*Sovia grahami*	-	-	-	-	-	
	Luca's Ace	*S. lucasii separata*	-	-	-	-	-	
	Mussoorie Bush Bob	*Pedesta masuriensis masuriensis*	-	-	-	-	-	
	Brown Bush Bob	*P. pandita*	-	-	-	-	-	
	Northern Spotted Ace	*Thoressa astigmata cerata*	-	-	-	-	-	
	Olive Ace	*Thoressa gupta gupta*	-	-	-	-	-	
	Gharwal Ace	*T. aina*	-	-	-	-	-	
	Banded Ace	*Halpe zema zema*	-	-	-	-	-	

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Plain Ace	*H. kumara*	-	-	-	-	-	
	Knyvetti's Ace	*H. knyvetti*	-	-	-	-	-	
	Sikkim Ace	*H. sikkima*	-	-	-	-	-	
	Indian Ace	*H. homolea molta*	-	-	-	-	-	II
	Ace	*H. acruata*	-	-	-	-	-	
	Light Straw Ace	*Pithauria stramneipennis stramneipennis*	-	-	-	-	-	
	Dark Straw Ace	*Pithauria murdava*	-	-	-	-	-	
	Branded Straw Ace	*P. marsena*	-	-	-	-	-	
	*Chestnut Bob	*Lambrix salsala salsala*	1	1				
	Dark Velvet Bob	*Koruthaialos butleri*	-	-	-	-	-	
	Unknown	*Stimula swinhoei swinhoei*	-	-	-	-	-	
	*Chocolate Demon	*Ancistroides nigrita diocles*	1	1				
	Common Banded Demon	*Notocrypta paralysos asawa*	-	-	-	-	-	
	*Spotted Demon	*N. fiesthamelii alysos*	1	1	1			
	*Grass Demon	*Udaspes folus*	1	1				
	Forest Bob	*Scobura cephala*	-	-	-	-	-	
	Forest Bob	*S. isota*	-	-	-	-	-	
	Grass Bob	*Suada swerga swerga*	-	-	-	-	-	
	Indian Palm Bob	*Suastus gremius gremius*	1	1				
	Ceylon Palm Bob	*S. minuta aditia*	-	-	-	-	-	
	*Wax Dart	*Cupitha purreea*	-	-	-	-	-	
	Purple And Gold Flitter	*Zographetus satwa*	-	-	-	-	-	
	Purple Spotted Flitter	*Z. ogygia ogygia*	-	-	-	-	-	
	*Tree Flitter	*Hyarotis adrastus praba*	1	1				IV
	Spotted Yellow Lancer	*Plastingia noemi*	-	-	-	-	-	

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Giant Red Eye	*Gangara thyrsis thyrsis*	1	1				
	Banded Red Eye	*G. lebadea lebadea*	-	-	-	-	-	
	Palm Red Eye	*Erionata torus*	-	-	-	-	-	
	Palm Red Eye	*E. thrax thrax*	-	-	-	-	-	
	Red Eye	*E. acroleucus apex*	-	-	-	-	-	
	*Common Red Eye	*Matapa aria*	1	1	-	-	-	
	Dark Brand Red Eye	*M. druna*	-	-	-	-	-	
	Grey Brand Red Eye	*M. cresta*	-	-	-	-	-	
	Black Veined Red Eye	*M. sasivarna*	-	-	-	-	-	
	Purple Red Eye	*M. purpurascens*	1	1				
	Spotted Red Eye	*Pudicitia pholus*	-	-	-	-	-	
	Green Striped Palmer	*Piradana hyela major*	-	-	-	-	-	
	Nonsuch Palmer	*Cyrina cyrina cyrina*	-	-	-	-	-	
	Sub-Hyaline Darter	*Ochlodes subhyalina pasca*	-	-	-	-	-	
	Assam Darter	*O. siva siva*	-	-	-	-	-	
	Himalayan Dark Dart	*Taractrocera danna*	-	-	-	-	-	
	Common Grass Dart	*T. maevius sagara*	-	-	-	-	-	
	Common Dartlet	*Oriens goloides*	-	-	-	-	-	
	*Common Dartlet	*O. gola pseudolus*	1	1				
	Branded Dartlet	*Potanthus rectifasciata*	-	-	-	-	-	
	Common Dart	*P. pallida*	-	-	-	-	-	
	*Common Dart	*P. pseudomaesa*	-	-	-	-	-	
	Common Dart	*P. sita*	-	-	-	-	-	
	Chinese Dart	*P. confucius dushta*	-	-	-	-	-	
	Sikkim Dart	*P. mara mara*	-	-	-	-	-	-
	Dart	*P. nesta nesta*	-	-	-	-	-	-
	Dart	*P. pava pava*	-	-	-	-	-	-
	Palm Dart	*Telicota colon colon*	-	-	-	-	-	-
	Dark Palm Dart	*T. linna linna*	-	-	-	-	-	-
	Dark Palm Dart	*T. ancilla bambusae*	-	-	-	-	-	-
	Dark Palm Dart	*T. ohara jix*	-	-	-	-	-	-
	Plain Palm Dart	*Cephrenes chrysozona oceanica*	-	-	-	-	-	-

Family	Common Name	Scientific name	Altitude classes (in metres)					
			<900	900 - 1800	1800 - 2800	2800 - 3800	>3800	WPA
	Straight Swift	*Parnara guttatus mangala*	-	-	-	-	-	-
	Straight Swift	*P. naso bada*	-	-	-	-	-	-
	Rice Swift	*Borbo cinnara*	-	-	-	-	-	-
	Beavan's Swift	*B. bevani*	-	-	-	-	-	-
	Large Branded Swift	*Pleopidas sinensis*	-	-	-	-	-	-
	Small Branded Swift	*P. agna agna*	-	-	-	-	-	-
	Small Branded Swift	*P. thrax masta*	-	-	-	-	-	-
	Large Branded Swift	*P. subochracea subochracea*	-	-	-	-	-	-
	Small Branded Swift	*P. mathias mathias*	-	-	-	-	-	-
	Great Swift	*P. assamensis*	-	-	-	-	-	-
	Swift	*Polytremis lubricans lubricans*	-	-	-	-	-	-
	Himalayan Swift	*P. discreta discreta*	-	-	-	-	-	-
	Yellow Spot Swift	*P. eltola eltola*	-	-	-	-	-	-
	Paint Brush Swift	*Baoris farri farri*	-	-	-	-	-	IV
	Swift	*B. pencillata unicolor*	-	-	-	-	-	-
	Figure Of 8 Swift	*B. pagana*	-	-	-	-	-	-
	Yellow Fringed Swift	*Caltoris aurociliata*	-	-	-	-	-	-
	Austen's Swift	*C. cahira austeni*	-	-	-	-	-	-
	Swift	*C. confusa*	-	-	-	-	-	-
	*Blank Swift	*C. kumara moorei*	-	-	-	-	-	-
	Purple Swift	*C. tulsi tulsi*	-	-	-	-	-	-
	Tufted Swift	*C. plebeia*	-	-	-	-	-	-
	Unknown	*C. philippina philippina*	-	-	-	-	-	-
	Common Wight	*Iton semamora*	-	-	-	-	-	-

* Recorded by present study

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