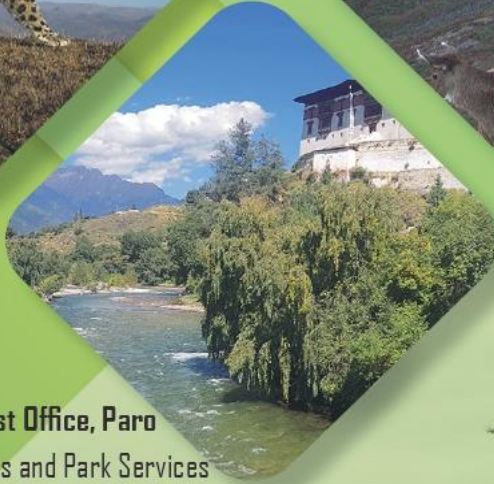




BIODIVERSITY ASSESSMENT REPORT



Divisional Forest Office, Paro
Department of Forests and Park Services
Ministry of Energy and Natural Resources



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Divisional Forest Office, Paro
Department of Forests and Park Services
Ministry of Energy and Natural Resources

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Layout, Designed and Printed at:

Bhutan Printing Solutions (www.prints.bt)

Suggested citation

Divisional Forest Office (2024). *Biodiversity Assessment Report of the Divisional Forest Office, Paro*. Department of Forests and Park Services, Ministry of Energy and Natural Resources. Royal Government of Bhutan.

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ROYAL GOVERNMENT OF BHUTAN
MINISTRY OF ENERGY & NATURAL RESOURCES
DEPARTMENT OF FORESTS & PARK SERVICES




Foreword

The Department of Forests and Park Services is pleased to present the report of the Biodiversity Assessment conducted by the Divisional Forest Office at Paro under the auspices of the Department of Forests and Park Services. This endeavor represents a significant milestone in our ongoing commitment to understanding and safeguarding the natural resources of Bhutan.

Bhutan's extensive forest cover has long been established and recognized as one of the biodiversity hotspots with conservation ingrained in national policies. Over half of the nation is designated as Protected Areas to ensure the preservation of its diverse ecosystems. The Living Landscapes Project of WWF funded by the German Federal Ministry for Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) through the International Climate Initiative (IKI) helped conserve and manage biodiversity in the IKI Landscape beyond the PAs. Biodiversity assessment is one of the many conservation activities funded by the project.

The biodiversity assessment conducted in the Division and supplemented by past national surveys and other documents provided invaluable insights into the Division's biodiversity. About 333 species of plants belonging to 86 families; 30 mammal species belonging to 28 genera and 14 families; and 212 species of birds belonging to 140 genera under 52 families were recorded so far. This indicates the commendation, protection and conservation activities implemented in the Division.

This assessment serves not only as a baseline data for future research but also for better conservation and management planning. I extend my commendation to all those involved in this endeavor and hope that the insights gained from the assessment will help guide future efforts to conduct similar assessment and preserve the ecological integrity of Bhutan for generations.


Director
Department of Forests and Park Services
Thimphu

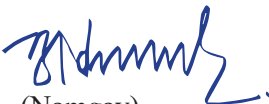
Acknowledgment

The management of the Divisional Forest Office (DFO), Paro would like to express our sincere gratitude to the Living Landscapes Project of WWF funded by the German Federal Ministry for Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) through the International Climate Initiative (IKI) for their generous funding and unwavering support. Their contributions have been instrumental in bringing the Biodiversity Report to fruition. The IKI Project's commitment to environmental conservation and sustainability has enabled this office to undertake a comprehensive survey that significantly contributes to understanding biodiversity in this crucial region.

The DFO, Paro also would like to commend the diligent staff who contributed to data collection. Their hard work, dedication, expertise, and passion was vital in gathering the necessary information for this report. Their unwavering commitment to the cause deserves the deepest gratitude.

Additionally, we extend our heartfelt gratitude to Mr. Ngawang Gyeltshen, Sr. Forest Ranger of DFO, Wangdue for his invaluable contribution throughout the data analysis process. His expertise and dedication in producing precise and comprehensive results have been indispensable.

The DFO, Paro is thankful to all organizations and individuals whose efforts have contributed to the successful completion of this report.



(Namgay)

Chief Forestry Officer

Divisional Forest Office, Paro

Acronyms and Abbreviations

| | |
|-----------------|--|
| BC | Biological Corridor |
| B2C2 | Bhutan Biological Conservation Complex |
| BFL | Bhutan for Life |
| BMP | Biodiversity Monitoring Protocol |
| CFO | Chief Forestry Officer |
| CITES | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| CMP | Conservation Management Plan |
| DBH | Diameter at Breast Height |
| DFO | Divisional Forest Office |
| DoFPS | Department of Forests and Park Services |
| EN | Endangered |
| FMID | Forest Monitoring and Information Division |
| FNCRR | Forest and Nature Conservation Rules and Regulations |
| FNCA | Forest and Nature Conservation Act |
| FRPMD | Forest Resources Planning and Management Division |
| HWC | Human Wildlife Conflict |
| IKI | International Climate Initiative |
| IUCN | International Union for Conservation of Nature |
| JDNP | Jigme Dorji National Park |
| JKSNR | Jigme Khesar Strict Nature Reserve |
| km ² | Square Kilometer |
| LC | Least Concern |
| m ² | Meter Square |
| MoENR | Ministry of Energy and Natural Resources |

| | |
|-------|---------------------------------------|
| NCD | Nature Conservation Division |
| NT | Near Threatened |
| NFI | National Forest Inventory |
| NSLS | National Snow leopard Survey |
| NTS | National Tiger Survey |
| NWFP | Non-Wood Forest Product |
| QRT | Quick Response Team |
| RBA | Rapid Biodiversity Survey |
| RD | Relative Density |
| SD | Standard Deviation |
| SMART | Spatial Monitoring and Reporting Tool |
| VU | Vulnerable |
| WWF | World Wildlife Fund |

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Executive summary

The comprehensive Biodiversity Assessment which was carried out for the first time under DFO, Paro collected information on plants, mammals, and birds based on the systematic surveys for plants and birds and pooling data from previous national surveys and individual records. The biodiversity survey was carried out in 28 grids, and data from 76 camera stations from NTS and NSLS were pooled.

A total of 333 plant species belonging to 86 families were recorded across the seven forest types. These species exhibit nine major life forms: conifer trees, evergreen trees, deciduous trees, evergreen shrubs, deciduous shrubs, perennial herbs, annual herbs, biennial herbs, and spore-bearing plants. The trees and shrubs represent 27 families with 61 species, spanning altitudinal gradients from 2400 to 4649 meters(m). The ground vegetation comprises 66 families and 272 species, including 26 annual herbs, 10 biennial herbs, 188 perennial herbs, and 48 species of spore-bearing plants. Through cluster analysis, seven forest types were identified: Fir, Juniper, Broadleaved, Hemlock, Evergreen Oak, Spruce, and Blue Pine Forest.

In general, all Gewogs showed a higher prevalence of young trees within the DBH class of 1cm-20cm and the lowest occurrence of mature trees of DBH from 121cm-140cm. Samar Gewog showed the highest number of trees with DBH from 1-20cm. Notably, Shaba Gewog has no trees above DBH class of 61-80cm. These patterns suggest that major portion of forests in all the Gewogs are predominantly young stands.

A total of 30 mammal species were recorded belonging to 28 genera and 14 families. Of the 30 species, five are Endangered, eight are Vulnerable, five are Near-Threatened, and 12 are of Least Concern according to the International Union for Conservation of Nature (IUCN) Red List. Significantly, the Woolly hare (*Lepus oiostolus*), Tibetan wolf (*Canis lupus chanco*), and Thorold's deer (*Cervus albitrostris*) have been documented within the Division for the first time.

Around 83 species of birds belonging to 52 genera and 30 families were recorded from the 28 survey grids across an altitudinal range from 2188 to 5663m. Furthermore, with additional records reported by Mr. Chench Wangdi in 2020 and 2021, Paro now hosts 212 species of birds, belonging to 140 genera under 52 families. Among these recorded species, one species is classified as Vulnerable, eight as Near-Threatened, and 203 are categorized as Least Concern according to the IUCN Red List. Approximately 78% of the recorded bird species were identified as forest birds, while the remaining 22% were water birds.

1. Background

1.1. Introduction

The Divisional Forest Office (DFO) at Paro is one of the 14 Divisional Forest Offices in the country under the Department of Forests and Park Services and it covers an area of 1609km². It was established in 1991 from the erstwhile Paro Logging Division, which was managed by the DFO, Thimphu. The DFO, Paro encompasses 10 Gewogs in Paro and four Gewogs in Haa Dzongkhag. About 61% of the Division is under forest cover (DoFPS, 2022). The Division has four major area-based management regimes namely Forest Management Unit (FMU), Community Forest (CF), Local Forest Management Area (LFMA) and Biological Corridor (BC 01). Additionally, the Division implements other cross-cutting management programs such as Non-Wood Forest Products (NWFPs), Payment of Environmental Services (PES), Plantation and Nursery programs.

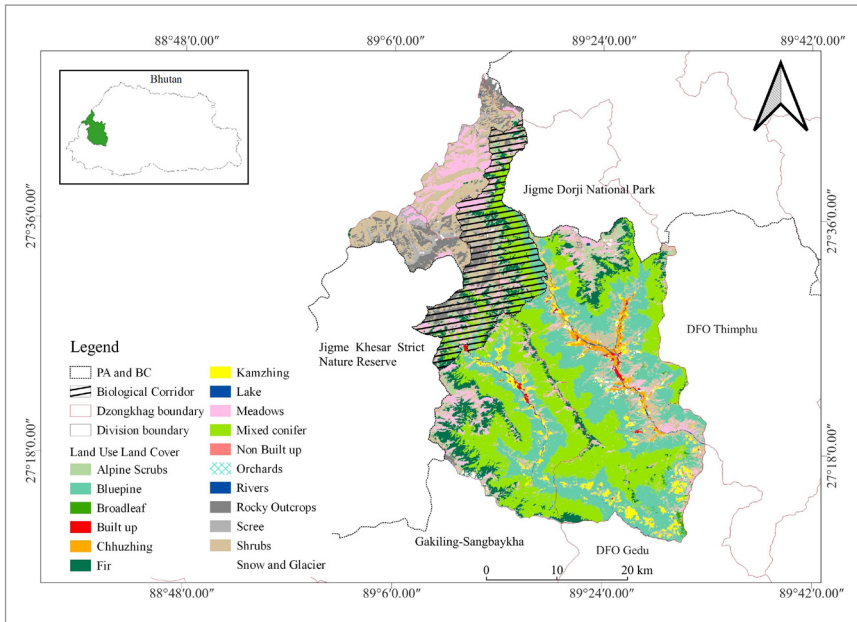


Figure 1: Land Use Land Cover map of Divisional Forest Office, Paro along with BC 01 (LULC 2016)

The Division lies between the two Protected Areas (PAs): Jigme Khesar Strict Nature Reserve (JKSNR) and Jigme Dorji National Park (JDNP). The BC 01 runs through Tsento and Bji Gewogs of Paro and Haa Dzongkhags respectively, connecting JDNP and JKSNR (Figure 1). The Division shares its boundaries with Thimphu DFO to the east, JDNP in the north east, Gedu Division in the south and JKSNR in the west. The Division has rich biodiversity with charismatic mammal species such as Tiger (*Panthera tigris tigris*), Snow leopard (*Panthera uncia*), Red Panda (*Ailurus fulgens*), Himalayan musk deer (*Moschus leucogaster*) and Bhutan takin (*Budorcas taxicolor whitei*). Until 2022, no biodiversity assessment was conducted in the Division except for BC 01 which was conducted for BC management planning. Therefore, biodiversity assessment was initiated in September 2022 with support from the IKI Project, WWF Bhutan. The primary objective of this initiative was to assess vegetation, mammals and birds in the Division but outside BC 01.

1.2. Objectives

The main objective of the biodiversity assessment was to collect information on the richness of biodiversity such as species, vegetation structure and floristic composition of all forest types along the altitudinal gradient, as well as information on mammals and birds. The assessment will not only serve as a baseline data but also help in making management and conservation plan for the Division in ensuring sustainable use of natural resources.

2. Materials and Method

2.1. Study Area

The survey was conducted in 28 grids located in 11 Gewogs namely Dogar, Doteng, Hungrel, Lungnyi, Naja, Shaba and Tsento under Paro Dzongkhag and Bji, Essu, Katsho and Samar under Haa Dzongkhag. The survey grids covered forest types such as Alpine forests, Blue Pine, Broadleaved, Fir and Mixed Conifer forests (Figure 2) between an elevation of 2408m to 4649m covering approximately 83,623.77 hectares (Table 1). The survey was conducted for vegetation, mammals and birds simultaneously

considering the resource constraint. The survey area excluded BC 01 as it had already been surveyed for developing the Conservation Management Plan (CMP).

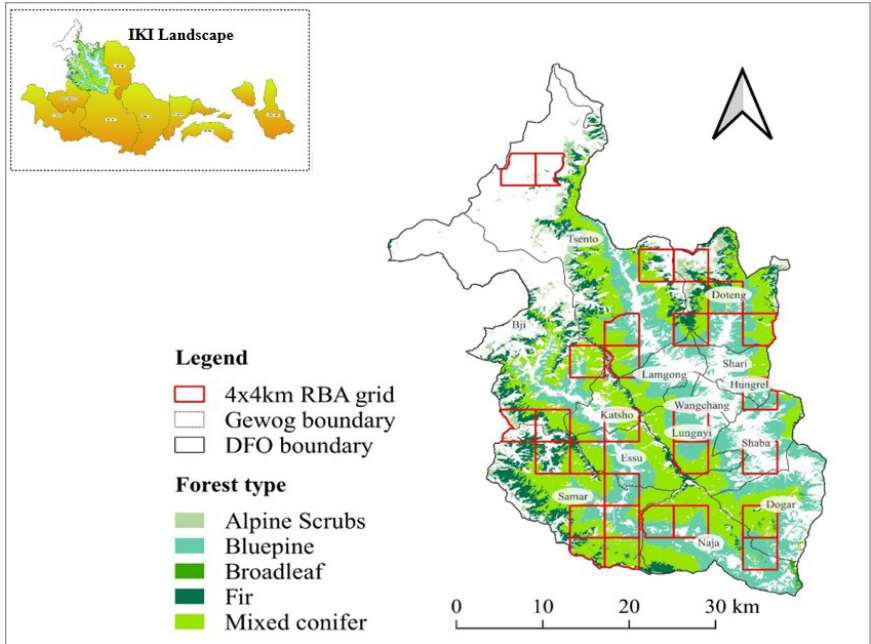


Figure 2: 4x4km Rapid Biodiversity Assessment (RBA) grids within Divisional Forest Office, Paro

2.2. Sample Design and Survey

2.2.1. Flora Diversity

The forest area in the Division was stratified into five different forest types. Out of total 86 grids, 28 grids were selected representing 30% of the total study area using random sampling (Table 1). Each grid followed standard size of 4x4km designed during the National Forest Inventory by the Forest Management and Information Division (FMID) in 2022. This decision was made exclusively due to logistical and time constraints. The number of grids sampled was based on the area of each forest type, stratified for the assessment.

Table 1: Number of grids determined for each forest type within Divisional Forest Office, Paro

| Forest type | Area(ha) | Area in % | 30% of total grid |
|---------------|-----------------|-------------|-------------------|
| Fir | 32687.24 | 39 | 9 |
| Mixed conifer | 18632.31 | 22 | 7 |
| Blue pine | 20947.65 | 25 | 8 |
| Broadleaf | 6376.26 | 8 | 2 |
| Alpine areas | 4980.31 | 6 | 2 |
| | 83623.77 | 100% | 28 |

Vegetation composition was surveyed along the altitudinal gradients from 2408 to 4649m in the selected grids. A total of 168 sampling plots were randomly selected which were distributed along the altitudinal gradients for trees and shrubs as well as ground vegetation including epiphytes and spore bearing plants.

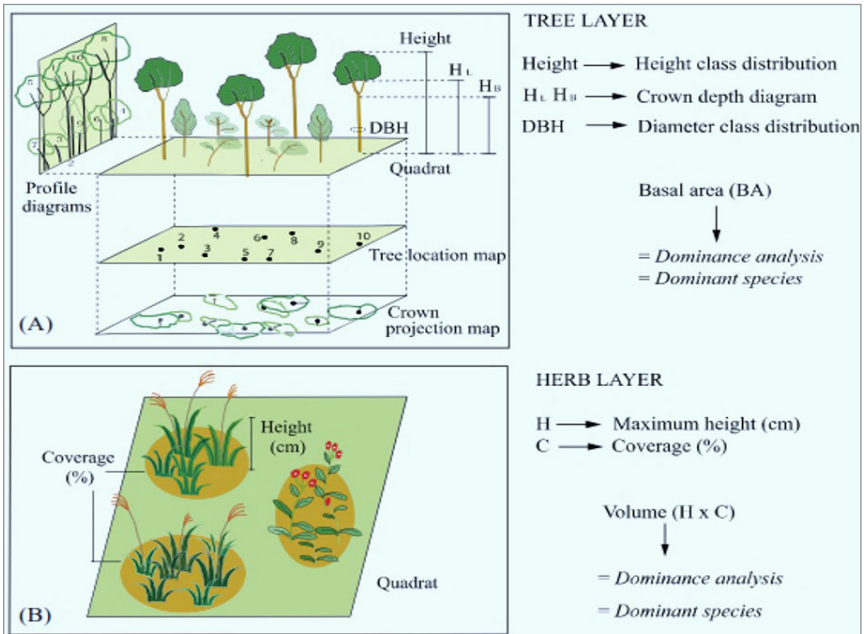


Figure 3: Vegetation survey plot design.

Sample plot size of 20x20m was established at different altitudinal ranges for trees and shrubs to include at least 0.01% of the study area. Sub-plot measuring 2x2m was established inside the tree sample plots to enumerate herbaceous (ground layer) species including epiphytes and spore bearing plants (DoFPS, 2020). Vegetation survey was conducted at two levels (Figure 3 A & B): (A) for trees and shrubs layer and (B) for ground/herb/epiphyte layer enumeration inside each plot. All free-standing plants (herbs, epiphytes, spore bearing plants) with stem DBH less than 1cm were recorded. For trees and shrubs, all individuals occurring within the quadrant attending a height of more than 1.3m were measured. DBH was measured to determine the Basal Area (BA) and DBH class distribution. In the ground layer, herbs were identified, and the tallest height of each species was measured. The coverage AOO (Area of Occurrence) of each species in percent was recorded. In addition, variables such as altitude, aspect, and slope were also recorded in each plot (Table 2).

Field equipment such as a compass, clinometer, Global Positioning System (GPS) device, diameter tape, measuring tape, and smartphones were used for measuring and recording the data.

Table 2: Dependent and independent variables along with their measurement scales

| Dependent Variable | Measurement Scale | Independent Variable | Measurement Scale |
|-------------------------------|--------------------------|-----------------------------|--------------------------|
| DBH (cm) | Interval | Slope (degree) | Interval |
| Height (m) | Interval | Aspect (degree) | Interval |
| Basal Area (cm ²) | Interval | Altitude (meters) | Interval |
| Species diversity | Nominal | | |
| Species composition | Nominal | | |
| Stem Density (No) | Ratio | | |
| Species richness (No) | Ratio | | |

2.2.2. Mammal Diversity

Information on mammals was collected from the past data of National Forest Inventory (2022), National Tiger Survey (2023) and National Snow Leopard Survey (2023) reports. In addition, information was generated from the SMART (Spatial Monitoring and Reporting Tool) data of the Division and other available reports.

2.2.3. Avifauna Diversity

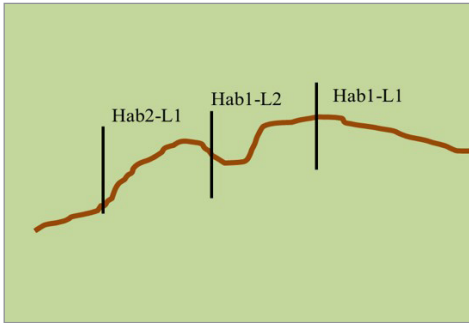


Figure 4: Avifauna survey plot design.

Survey transects of minimum of 1km length run through various habitats. Trail transects consist of walking along an existing trail such as a footpath, animal tracks and roads. The evidence of birds such as sightings and calls were recorded in the plots laid for observation along the trails (Figure 4).

Data was collected in the data collection format prescribed in

the Biodiversity Monitoring Protocol (BMP) for birds. MacKinnon List method was deployed for listing all birds heard or sighted in chronological order of detection (DoFPS, 2020). This method helps derive abundance indices of individual species by calculating the proportion of samples in which each species occurred. Additional bird list was derived from the field report by Mr. Chench Wangdi in the year 2020 and 2021.

2.3. Data Analysis

2.3.1. Flora Diversity

Based on relative frequency, relative density and relative dominance (cover) values, Importance Value Index (IVI) was obtained (Brown & Curtis, 1952). DBH of individual trees was divided into various classes and formed the individual heights. Height-class graphs of tree and shrub species in each plot were prepared using the ceiling functions of Microsoft Excel (MS) 2016. IVI values of different species were then arranged in decreasing order. Species richness was determined by using the Shannon-

Weiner Index- H' (1963). Shannon-Wiener Diversity Index (H') was calculated using Relative Basal Area data.

$$\text{Relative Basal Area} = \left\{ \frac{\sum_i^x}{nBA} \right\}$$

Where \sum_i^x = sum of basal area of i^{th} species in a plot and nBA = Total basal area of all individuals of all species in a plot.

$$\text{Evenness}(J) = \frac{H'}{\log N2}$$

$$\text{Shannon - Wiener Diversity Index } (H') = \sum_{i=1}^s (P_i \times \ln P_i)$$

Basal Area (BA) of each tree species (BA in cm^2) was calculated using the DBH data and then the relative proportion of each species' relative basal area in percent (RBA%) was calculated. The BA for each tree species was computed using the DBH data and subsequently, relative proportion of each species' basal area as percentage (RBA%) was determined. DBH data was used for analyzing DBH class distribution of each tree species. Similarly, height class was analyzed using the tree height data of each species. Species abundance was expressed in stem density and BA. Relative basal area of each species was used as an abundance measure of species in a community/ecosystem/environment. Dominant species along the altitudinal gradient in each plot were determined based on the dominance analysis in PC-ORD.

Preliminary data were processed using the pivot-table of MS Excel 2016. Once the data was processed, species composition was compiled. The processed data was analyzed using PC-ORD version 5.1. (McCune & Grace, 2002) and Cluster analysis was performed using the distance measure of Relative Sorensen (Bray-Curtis method) and Wards as linkage method (Pakgozar et al., 2021). Through this method, classification of different natural communities of forest or vegetation types was classified based on the floristic composition.

2.3.2. Fauna Diversity

The field-acquired data underwent comprehensive compilation and analysis, employing a diverse set of tools, including MS Excel 2016. The analysis integrated multiple software applications including pivot-table and Camera Trap R Shiny package to execute essential tasks such as figure generation and conducting significance tests. Within the scope of the analysis, Geographic Information System (GIS) software QGIS 3.26 was deployed for the production of maps.

2.3.3. Avifauna Diversity

Data derived from the transect survey underwent cleaning and organization in MS Excel 2016, utilizing the pivot-table function. Species diversity, richness and evenness were assessed using the Shannon-Wiener equation (Margalef, 1968) to determine abundance relative to different forest types. Additionally, graphical representation illustrating family-wise bird species richness was generated through the latest stable release of the R package, version 4.3.3.

3. Results and Discussion

3.1. Flora Diversity

A total of 333 species belonging to 86 families were recorded during the survey. Out of the 333 recorded species, 272 were ground vegetation including epiphytes and spore bearing plants, while the remaining 61 species were trees and shrubs. Trees and shrubs were recorded from 168 sampling plots whereas ground vegetation including epiphytes was recorded from 206 sampling plots.

3.1.1. Floristic Composition of trees and shrubs

Tree and shrub vegetation consisted of 61 species belonging to 27 families. The floristic composition of the 11 Gewogs along the altitudinal gradients is presented and arranged into major lifeform groups (Figure 5). These groups consist of Conifer (71.1%), Evergreen trees (10.7%), Deciduous trees (6.7%), Evergreen shrubs (4.1%) and Deciduous shrubs (1.4%).

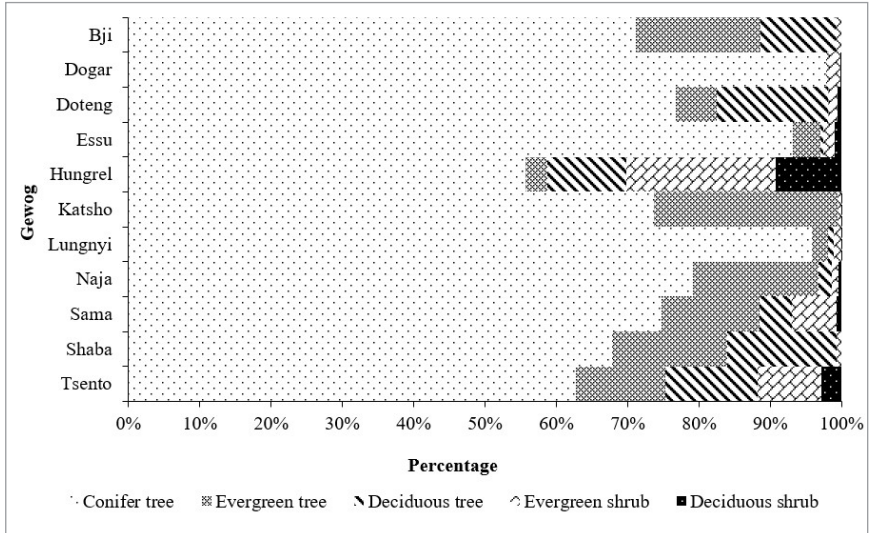


Figure 5: Floristic composition of trees and shrubs.

The composition of trees and shrubs was mostly dominated by Conifer species of *Pinus wallichiana*, *Picea spinolusa*, *Abies densa* and *Tsuga dumosa* followed by evergreen tree species of *Quercus semicarpifolia*, *Rhododendron arboretum* and *Phoebe lanceolata*. Deciduous trees were mostly dominated by *Acer campbelli* and *Populus ciliata*. Species such as *Pieris formosa* and *Rhododendron* species form the evergreen shrubs while species such as *Viburnum* sp. and *Enkianthus deflexus* form the deciduous shrubs.

3.1.2. Floristic Composition of the ground vegetation and epiphytes

The total ground vegetation comprised of 272 species belonging to 66 families of which 188 species were perennial herbs, 26 species were annual herbs, 10 species were biannual herbs and 48 species were spore bearing plants. Ground layer species composition in 11 Gewogs are arranged by lifeform groups (Figure 6). Perennial herbs consisted of 71.5%, annual herbs 9.7%, biennial herbs 1.1% and spore bearing plants 17.6% respectively.

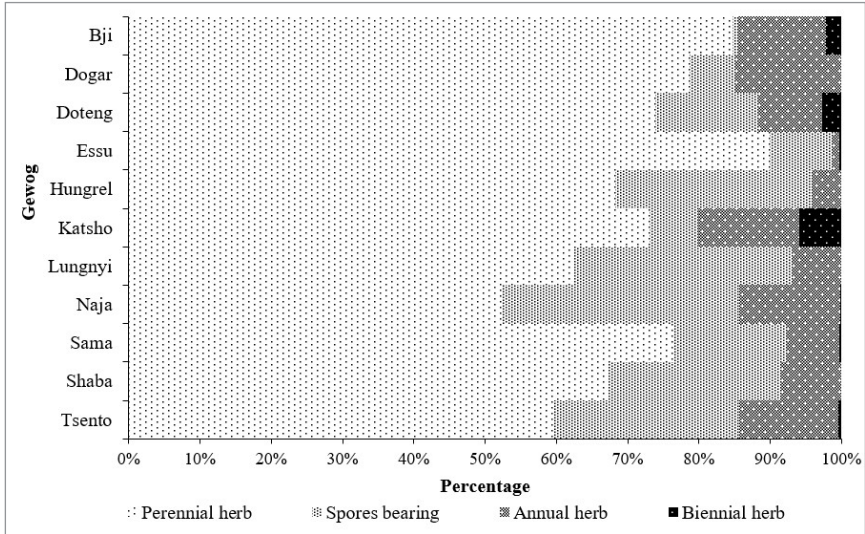


Figure 6: Floristic composition of the ground vegetation and epiphytes including spore bearing plants.

3.1.3. Forest Zone classification

Among the 11 forest types found in Bhutan, seven forest types exhibit distinct patterns according to the cluster analysis performed for the Division (Figure 7).

a. Fir Forest

Fir Forest was found between an altitude of 3100-3300m and precipitation of 1300-2000mm. The indicator species was *Abies densa* ($P^*0.0002$) along with *Prunus* sp. ($P^*0.0002$). Fir trees were found dominant in Doteng, Essu and Tsento Gewogs.

b. Juniper Forest

Juniper Forest was found mostly in Dogar, Doteng and Tsento Gewogs of Paro Dzongkhag between an altitude of 3700-4200m. The dominant species recorded were *Juniperus* species ($P^*0.0002$) and *Larix grifithii* ($P^*0.0002$).

c. Broad-leaved Forest

Broad-leaved Forest was found between an altitude of 1000-2900m. The indicator species for this type of forest were *Acer campbellii* (P*0.0002), and *Betula alnoides* (P*0.0012). These species were found dominant in Bji Gewog of Haa, and Doteng, Hungrel and Tsento Gewogs of Paro Dzongkhag.

d. Hemlock Forest

Hemlock Forest were found between an altitude of 2800-3100m and precipitation of 1300-2000mm. The indicator species recorded was *Tsuga dumosa* (P*0.0002) and was mostly found in Doteng, Lungnyi and Naja Gewogs of Paro and, Essu and Samar Gewogs of Haa Dzongkhag.

e. Evergreen Oak Forest

Evergreen Oak Forest was found in Katsho and Samar Gewogs of Haa, and Naja and Shaba Gewogs of Paro Dzongkhag between an elevation of 1800-2000m (2600m) and precipitation of 2000-3000mm. The indicator species recorded was *Quercus semicarpifolia* (P*0.0002).

f. Spruce Forest

Spruce Forest was found in Dogar, Doteng, Hungrel and Lungnyi Gewogs of Paro Dzongkhag and Katsho and Samar Gewogs of Haa Dzongkhag at an altitude between 2500-3100m and precipitation of 500-1000mm. The most significant indicator species recorded were *Picea spinulosa* (P*0.0002) and *Pieris formosa* (P*0.0438). It was also reported that *Picea spinulosa* trees were mostly infested by the bark beetle (*Ips schmutzenhoferi*) in Paro and Haa areas.

g. Blue Pine Forest

Blue pine Forest was mostly found in Shaba, Hungrel, Lungnyi and Naja Gewogs. The indicator species recorded were *Pinus wallichiana* (P*0.0002) and *Populus ciliata* (P*0.0122). Blue pine tree is the most preferred timber for construction and for making furniture. This forest type was found between an altitude of 2100-3000m.

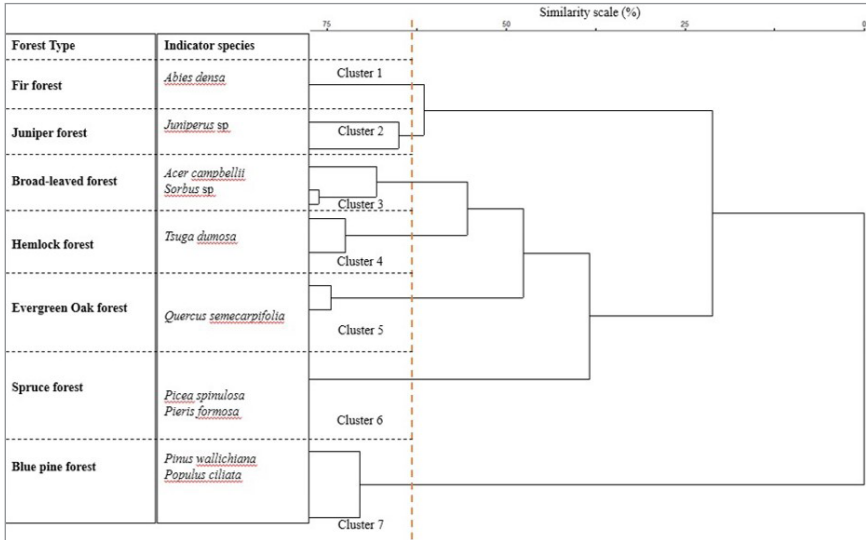


Figure 7: Cluster dendrogram depicting 7 cluster solutions with indicator species and forest types. The similarity index scale (%) is arbitrarily marked at 68% with dashed lines

3.1.4. Forest structure features along the altitudinal gradient

Structural traits along the altitudinal gradients were described based on six features such as maximum height, maximum DBH, BA, species number and species diversity (Annexure 3). Species richness was accessed in two different vegetation layers: trees and shrubs, and ground vegetation including epiphytes and spore bearing plants. The Diversity Index (H') ranges from 0.55 to 1.03 in 11 Gewogs (Annexure 3). The forest stands structural feature was derived from DBH class and height class distribution at an interval of 20cm each with seven (Figure 8) and six classes (Figure 9).

3.1.5. Species Dominance Curve

The dominance curve depicts the distribution pattern of trees and shrubs ordered by abundance using Relative Basal Area percentage (RBA%). The most dominant species in descending order were *Pinus wallichiana*, *Picea spinulosa*, *Abies densa* and *Tsuga dumosa*. The least dominant species were *Acer* sp., *Berberis aristata*, *Lindera angustifolia* and *Piptanthus nepalensis* (Figure 10).

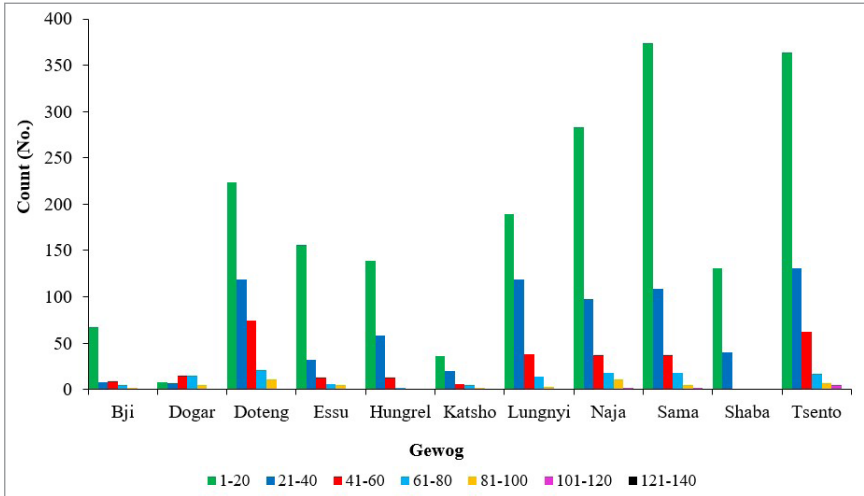


Figure 8: Diameter at Breast Height (DBH) class distribution arranged at an interval of 20cm with seven classes

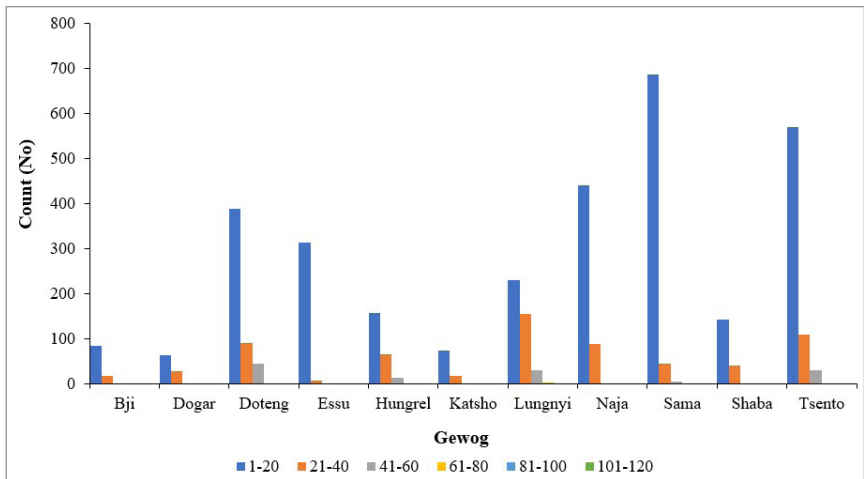


Figure 9: Height class distribution arranged at an interval of 20m with six classes.

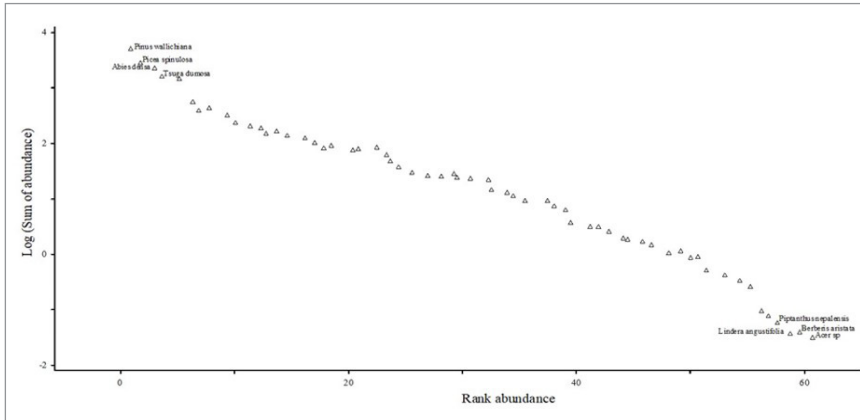


Figure 10: Species dominance curve of trees and shrubs.

3.1.6. Species Area Curve

Species-area curve was generated for 168 sampling plots using the PC-ORD employing the Relative Sorensen (Bray-Curtis Method). The resulting curve indicated inadequate sampling as it did not reach the asymptotic point. It implies that the increasing number of sampling plots could reveal a higher diversity of plant species beyond the current count of 61 species (Figure 11). First-order Jackknife estimates suggested 72 species, while second-order estimates indicated 77 species within the study area. Among the recorded species, 12 species exhibited single occurrence, while 7 species showed two occurrences.

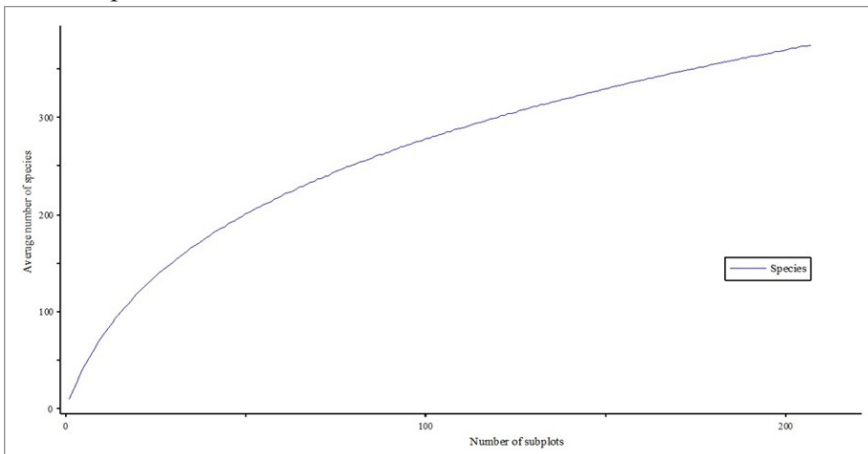


Figure 11: Species-area curve generated through employing Relative Sorensen.



Figure 12: Vegetation diversity; (A) Fern, (B) *Gentiana depressa*, (C) *Quercus semicarpifolia* and (D) *Rhododendron cinnabarinum*

3.2. Fauna Diversity

3.2.1. Abundance and Diversity of Mammal

A total of 30 mammal species were recorded belonging to 28 genera and 12 families including Felidae, Bovidae, Canidae and Cervidae (Figure 15). Of the 30 species, five are Endangered, eight are Vulnerable, five are Near-Threatened and 12 are of Least Concern according to IUCN Red List status (Figure 14). The five endangered species of mammals are Tibetan wolf, Asiatic wild dog, Tiger, Himalayan musk deer and Red Panda; the vulnerable species are Snow leopard, Common leopard, Asiatic black bear, Bhutan takin, Sambar deer, Thorold's deer, Himalayan serow and Gaur, and Near-Threatened species are Asiatic golden cat, Marbled cat, Assamese macaque, Himalayan weasel and Goral. The species list also includes the new records to the Division; Woolly hare (*Lepus oiostolus*) which was recorded during the NTS in 2023 and NSLS in 2023. During the NSLS 2023, Tibetan wolf (*Canis lupus filchneri*) and Thorold's deer (*Cervus albitrostris*) were also recorded from Nubri area.

3.2.2. Detection and Occupancy rate of mammal

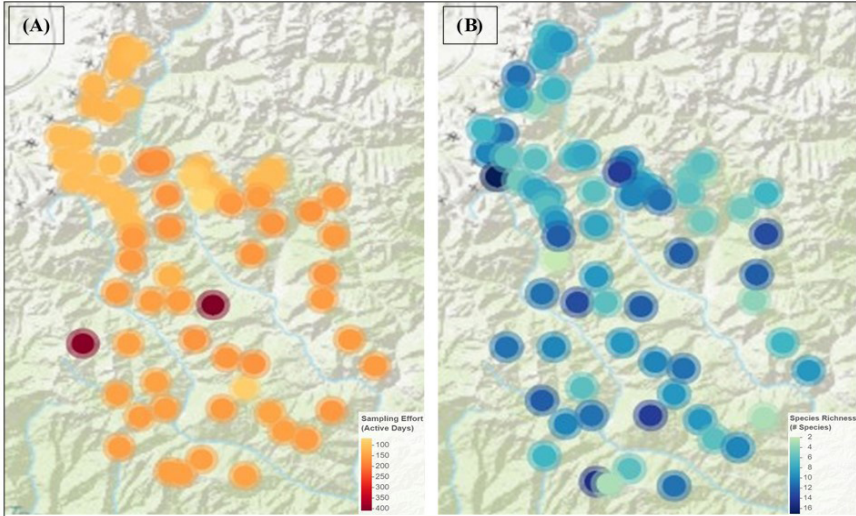


Figure 13: (A) Sampling effort and (B) Species richness.

Considering 30 camera trap days as an occasion, Asiatic golden cat, Himalayan marmot, Asiatic black bear, Takin, Sambar deer, Red Panda, Gaur, Marbled cat, and Tiger displayed notably high detection rates. Conversely, Blue sheep, Tibetan wolf, Thorold's deer, Musk deer, Serow, and Grey langur exhibited the highest occupancy rates (Annexure 7). The detection of various species and their richness appeared uniformly distributed across all camera trap stations (Figure 13).

3.2.3. Occurrence and Significance of Predator

The Division is endowed with faunal diversity with predators at the apex. These magnificent predators play vital role in maintaining the ecological equilibrium of the forest and shaping the behaviors and populations of prey species which indicates the overall health of the ecosystem. The predators such as Tiger, Snow leopard, Tibetan wolf and Asiatic wild dog (Figure 16) roam freely in the Division. The occupancy rate for Snow leopard (0.99), Tibetan wolf (1) and Asiatic wild dog (0.99) was relatively higher than Asiatic black bear (0.5). However, the detection rate of the Asiatic black bear (0.49) was observed higher than the other three predators (Annexure 7).

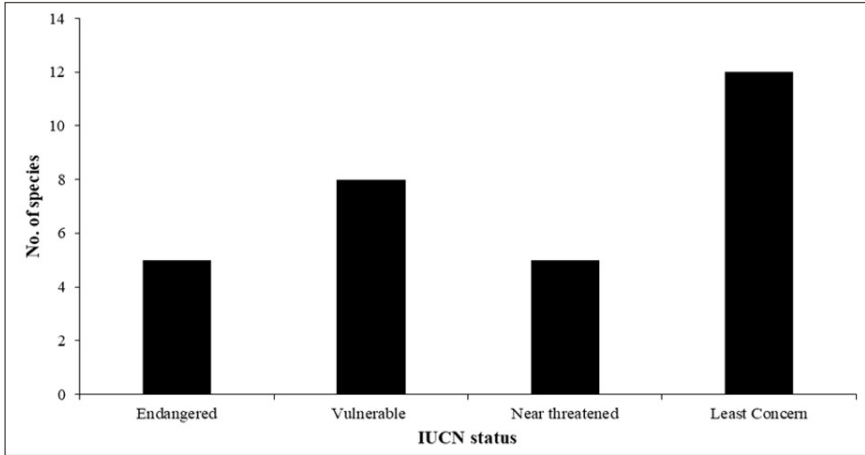


Figure 14: International Union for Conservation of Nature (IUCN) Red list status of the mammal species

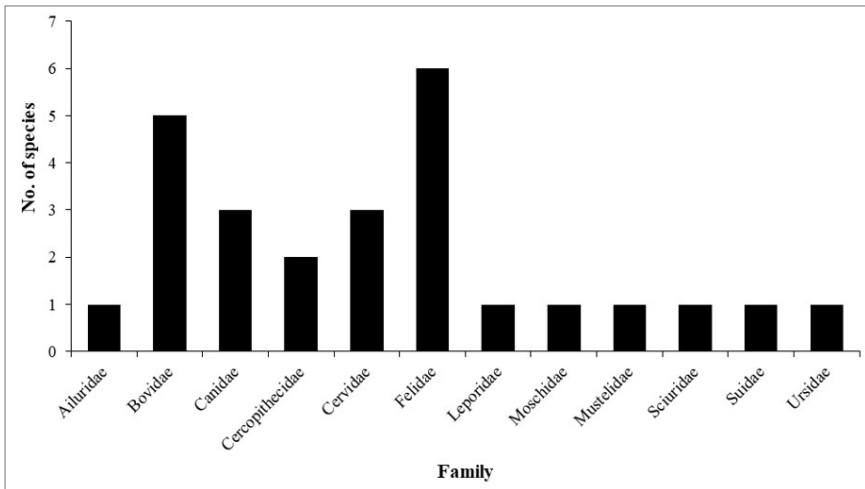


Figure 15: Mammal diversity determined through camera traps

3.2.4. Occurrence and Significance of Prey species

The Division is home to diverse prey species including Barking deer, Sambar, Blue sheep, Takin, Musk deer, Serow, Goral, Himalayan marmot and Wild pig. These species play crucial role in the forest ecosystem by serving as prey for large predators and the predators regulate the population of prey animals, thereby maintaining the balance in the food chain. Animals such as Barking deer, Sambar, Serow, Goral and Wild pig contribute significantly to the mammal diversity and ecological dynamics in the lower region of the Division, while Blue sheep and Himalayan marmot known for their adaptability to high altitudes play important role as key herbivore and prey base in the mountainous terrain (Figure 18). Their presence underscores the importance of conservation efforts in protecting these species and ensuring the overall health and stability of the forest ecosystem in the region.

3.2.5. Activity pattern of the Predator and Prey

An assessment of the activity patterns of different species was done by analyzing the frequency and timing of individual photographs acquired for each specific species in the camera traps. These photographs with their timestamps constituted a comprehensive dataset illustrating the active and inactive phases of each animal. Analysis of these photos showed the distribution and distinctive activity patterns of different species thereby enhancing our understanding of behavioral patterns of mammals in the mountain ecosystem.

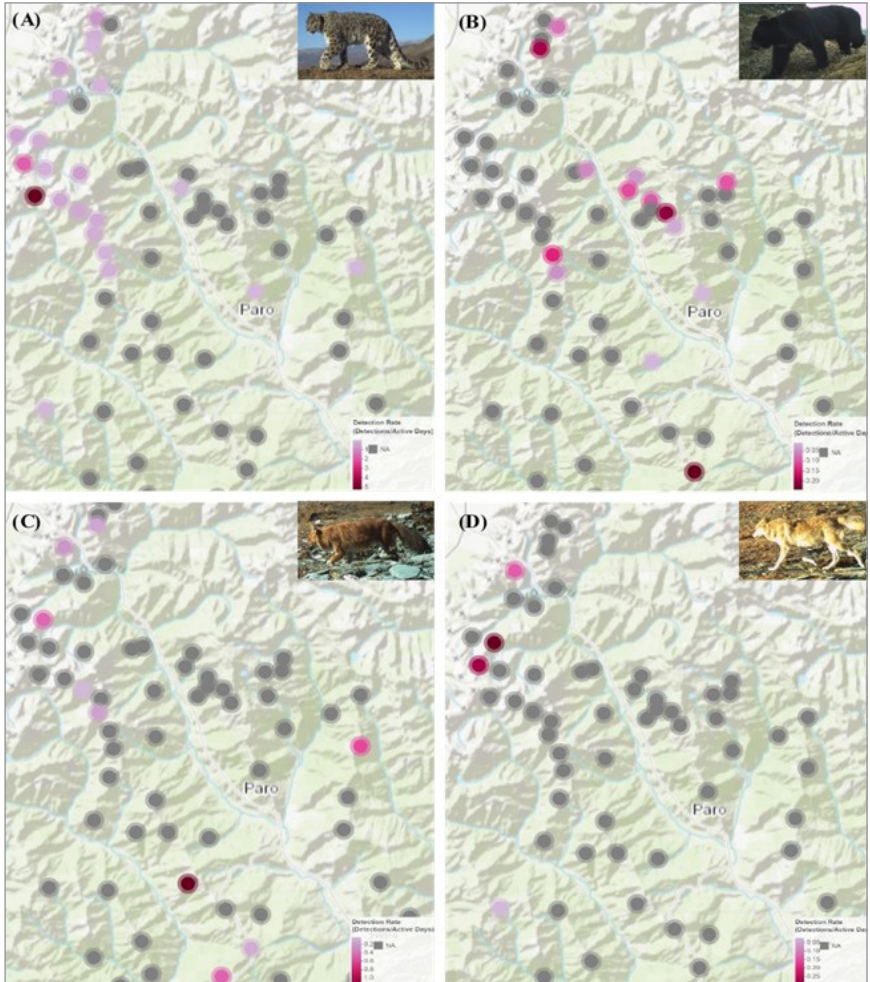


Figure 16: Distribution and detection rate of predators; (A) Snow leopard, (B) Asiatic black bear, (C) Asiatic wild dog and (D) Tibetan wolf

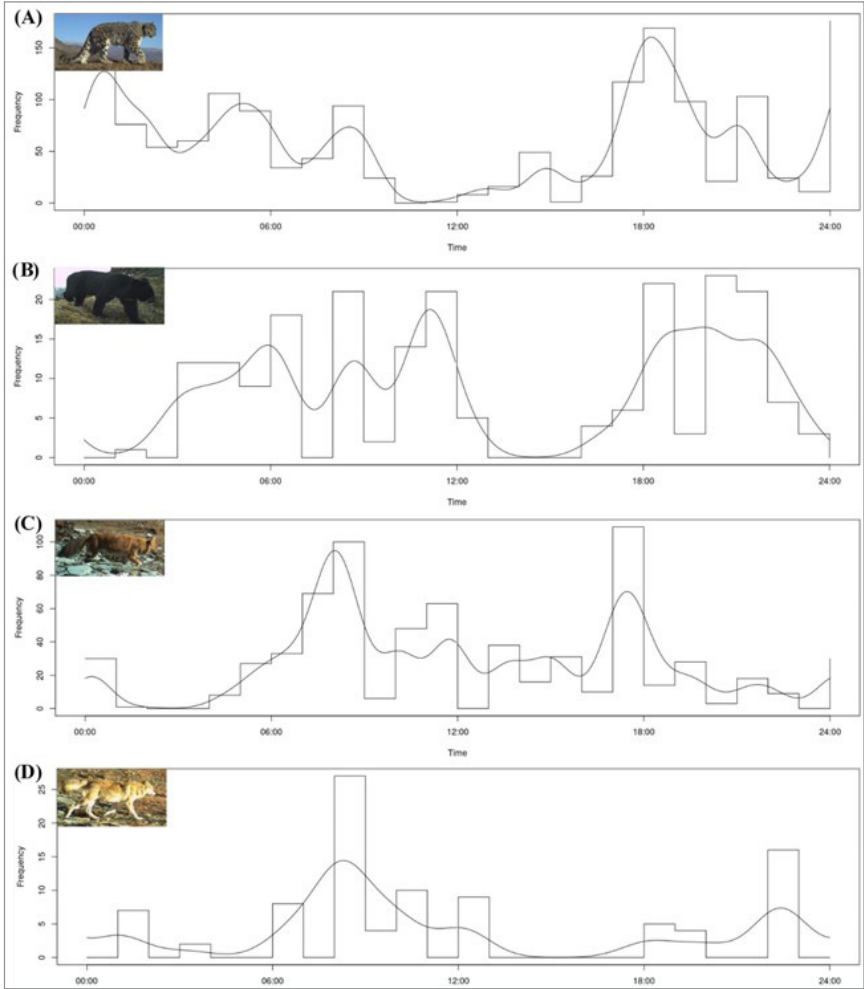


Figure 17: Activity pattern of the predators; (A) Snow leopard, (B) Asiatic black bear, (C) Asiatic wild dog and (D) Tibetan wolf

3.2.5.1. Activity Pattern of the Predators

Predators like Asiatic wild dog and the Tibetan wolf displayed similar activity patterns. These species were observed to be active from early morning to afternoon hours, while the Asiatic black bear was primarily active during morning and evening hours. In contrast, Snow leopard exhibited crepuscular behavior, being active in the late evening and from midnight to early morning (Figure 17A).

Consequently, conducting comprehensive surveys or research in subsequent phases is found important to understand the intricacy of predator-prey relationships. Understanding these dynamics will help prepare and implement conservation management plans thereby enabling effective preparation and implementation of human-wildlife conflict to coexistence strategy.

3.2.5.2. Activity Pattern of the Prey species

Wild pig, Blue sheep and Barking deer showed similar activity patterns of diurnal behaviour. This finding indicates that these prey species predominantly exhibit temporal overlap activity with that of Asiatic black bear, Asiatic wild dog and Tibetan wolf (Figure 19; A, B & D). Conversely, Sambar showed nocturnal behavior primarily active during night time sharing a high activity overlap with the Snow leopard (Figure 19; C).

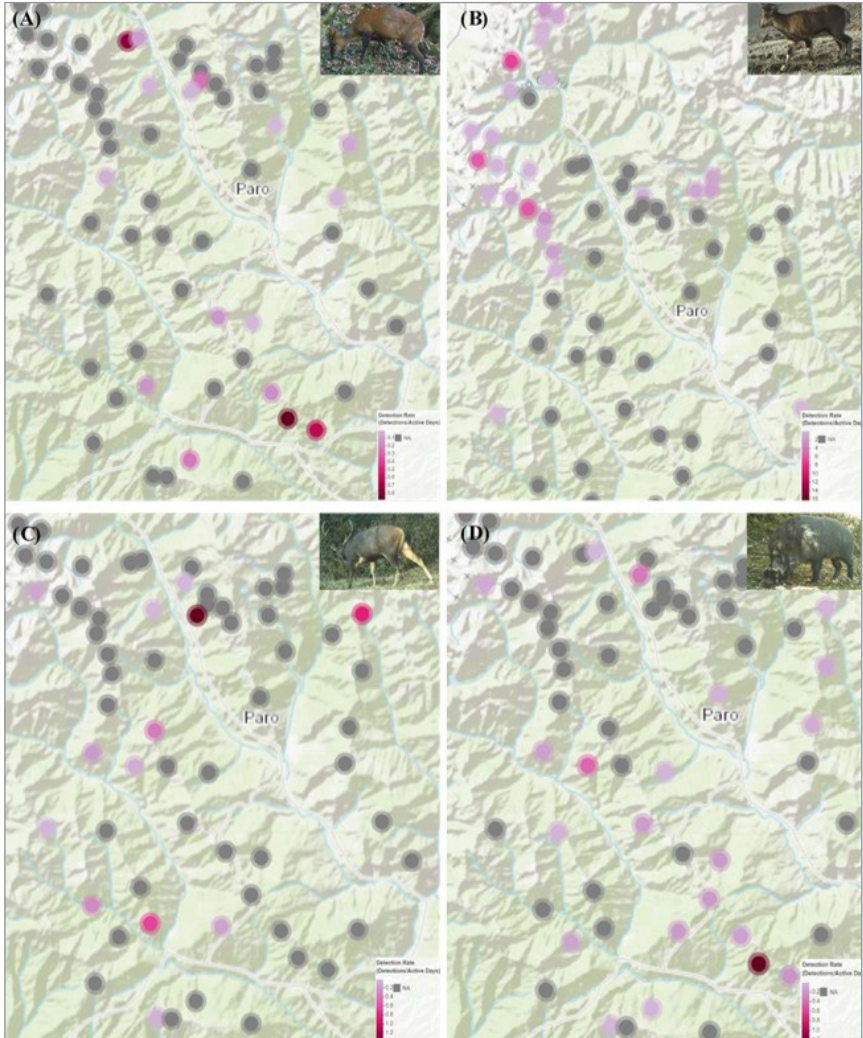


Figure 18: Distribution and detection rate of prey species; (A) Barking deer, (B) Blue sheep, (C) Samber deer and (D) Wild pig

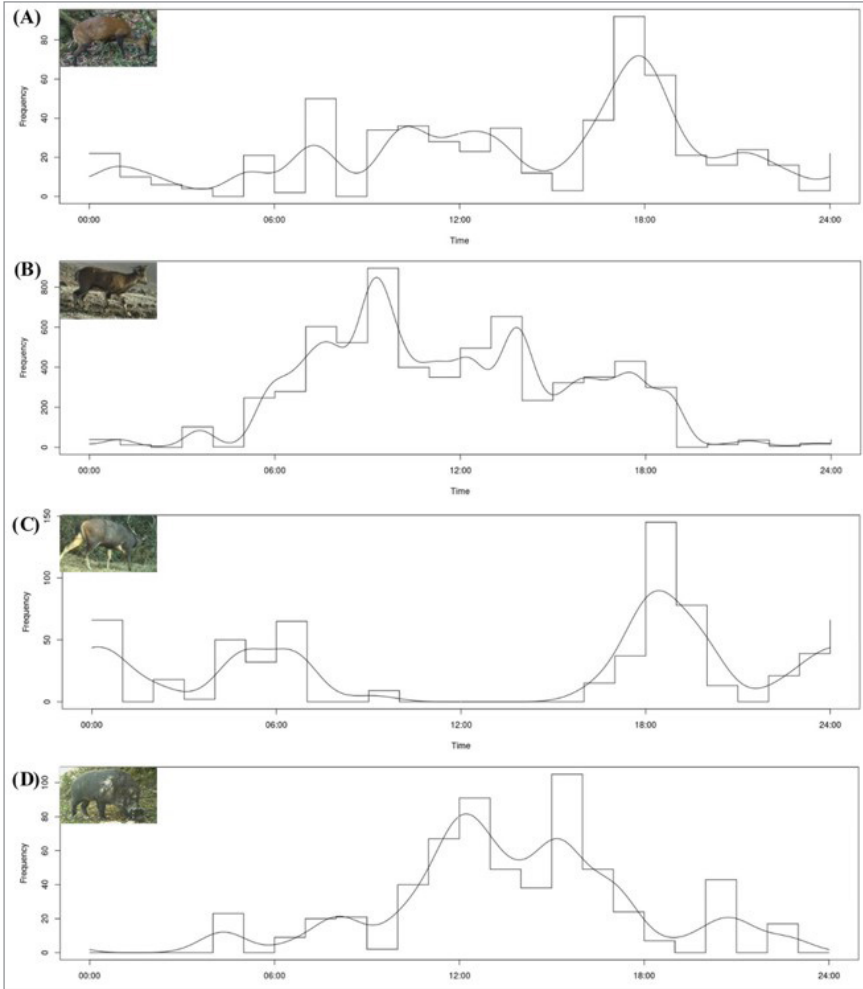


Figure 19: Activity pattern of the prey species; (A) Barking deer, (B) Blue sheep, (C) Sambar deer and (D) Wild pig

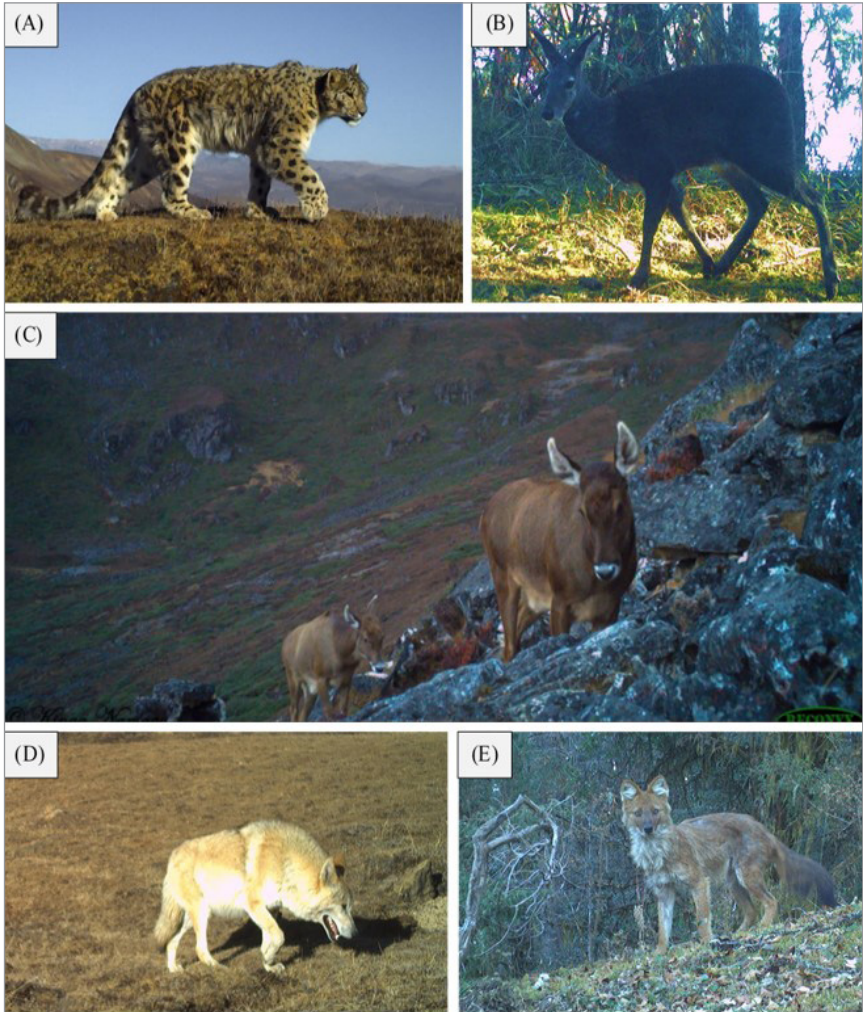


Figure 20: Predator and Prey species; (A) Snow leopard, (B) Musk deer, (C) Thorolds' deer, (D) Tibetan wolf and (E) Asiatic wild dog

3.3. Avifauna Diversity and Richness

A total of 83 bird species belonging to 30 families were recorded from different forest types and an elevation ranging from 2188 to 5663m during the rapid biodiversity assessment. Major forest types covered were Alpine forests, Blue Pine, Broadleaved, Fir and Mixed Conifer forests. The highest cumulative number of species observed during the field survey was from the Mixed Conifer Forest followed by Fir and other forest habitats (Figure 21). The bird data was combined with the reports of Mr. Chenchu Wangdi, who conducted the study along the Pachhu River in 2020 and 2021. Thus, the total record of birds in the Division is 212 species belonging to 140 genera and 52 families. The highest number of species recorded belonged to the Muscicapidae family followed by Fringillidae and Anatidae (Figure 22).

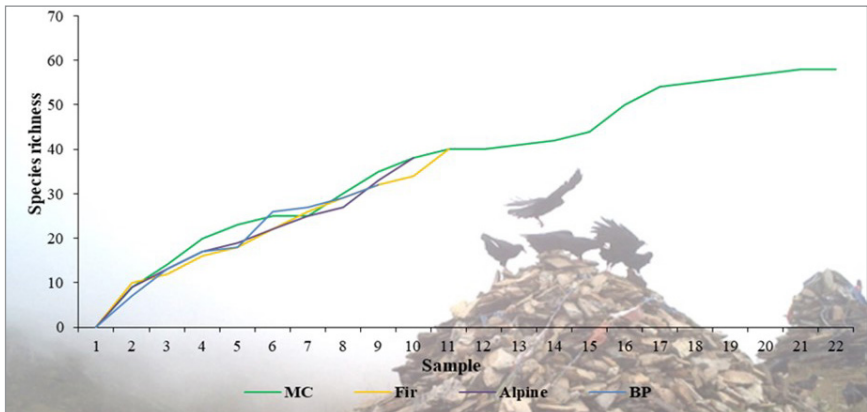


Figure 21: Species richness in different forest type.

Out of 212 species recorded in the Division, one (0.5%) is Vulnerable (Wood snipe), eight (3.8%) are Near-threatened (Bearded vulture, Black-necked crane, Ferruginous duck, Himalayan vulture, River lapwing, Satyr tragopan, Ward's trogon, Yellow-rumped honeyguide) and 203 are Least Concern (95.7%) according to the IUCN Red List of Threatened Species (Figure 23A). Of the 212 species of birds recorded, about 78% were forest birds which were predominantly found in forest habitats and 22% were water birds residing mostly near water bodies and along streams and rivers (Figure 23B). In total, about 212 species of birds have been recorded in the Division.



Figure 24: Bird species; (A) Satyr tragopan, (B) Rufous-bellied woodpecker, (C) Common kestrel, (D) White-browed rosefinch, (E) Blue-fronted redstart and (F) Winter wren

4. Conclusion

The Biodiversity Assessment provided invaluable insights into the diverse ecosystems and biodiversity in the Division. The survey has recorded 333 plant species across distinct forest types, shedding light on their distribution, life forms, and altitudinal gradients. The identification of seven unique forest types further underscores the ecological diversity and complexity of the region.

The structural feature analysis of trees reveals predominance of younger trees, particularly within the 1-20cm DBH class. This pattern suggests ongoing forest regeneration and highlights the need for sustained conservation efforts to ensure long-term health and resilience of these forest ecosystems. Absence of larger trees in certain Gewogs such as Shaba warrants further investigation and conservation strategies tailored to address specific ecological challenges.

The mammalian fauna recorded in the Division is equally impressive with 30 species being listed including several species that are of conservation concern according to the IUCN Red List status. Additional new record of three species such as Woolly hare, Tibetan wolf and Thorold's deer represents significant additions to the Division's biodiversity records as well for Bhutan.

The avian diversity documented in the survey is commendable with 83 bird species identified across varying altitudinal ranges during the RBA. The status of the Division as a hotspot for bird diversity is further solidified with a total of 212 species. Majority of recorded bird species were classified as forest birds underscoring the critical importance of maintaining and conserving forest habitats to support avian biodiversity.

Therefore, the biodiversity assessment served as a foundational step towards understanding and conserving the Division's unique and invaluable biodiversity. The data will be instrumental in developing future conservation strategies, facilitating evidence-based decision-making. This will also help fostering a deeper appreciation and understanding of the Division's ecological richness for stakeholders and the broader community.

5. Management Recommendations

- 1) Future biodiversity assessment attempt in the Division should increase sampling efforts to better understand the biodiversity. Special focus on rare and recently documented species such as Tibetan wolf, Woolly hare, and Thorold's deer. Study on predator-prey dynamics will shed more light interaction between wild animals and local communities which will help develop strategies for conserving key species and addressing potential human-wildlife conflicts.
- 2) Prioritize conservation of different forest habitats and water bodies to enhance bird diversity. Regular monitoring of bird populations will reveal population change and trend for further conservation initiative. Pheasants like Satyr tragopan, Himalayan monal, and Blood pheasant are highly sought by bird watchers however, these birds are also frequently targeted for illegal poaching due to their meat and feathers, necessitating additional protective measures. In addition, involvement of local communities in conservation initiatives through knowledge sharing and active participation will enhance conservation efforts.
- 3) Lastly, the Division should focus on strategies emphasizing the protection of dominant species such as Conifers and Evergreen trees, while also safeguarding ground vegetation to ensure long term conservation while practicing sustainable forest management. Prioritization should be based on species dominance and diversity indices with habitat management considering factors such altitude, aspect, slope, precipitation and other ecological requirements. In addition, adaptive management is crucial focusing on forest structural features and monitoring forests using DBH and height class distributions. It is important to address pest and disease management and promote sustainable timber harvesting.

6. Reference

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7. Annexure

Annexure 1: Floristic composition of trees and shrubs along the altitudinal gradients and plot details.

| Species | Tsento | Doteng | Hungrel | Lungnyi | Shaba | Naja | Dogar | Sama | Essu | Katsho | Bji |
|-----------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| (Lifeform- Conifer tree) | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA |
| <i>Pinus wallichiana</i> | 29.73 | 0.67 | 40.23 | 38.02 | 60.14 | 35.22 | 10.66 | 28.64 | 22.27 | 31.11 | 34.52 |
| <i>Abies densa</i> | 19.44 | 28.58 | | 16.00 | | 1.33 | 19.03 | 3.71 | 35.49 | 0.34 | 8.13 |
| <i>Juniperus</i> sp. | 6.85 | 14.99 | | | | | | | | | |
| <i>Tsuga dumosa</i> | 2.65 | 9.14 | 1.73 | 14.27 | | 25.93 | 1.27 | 14.94 | 11.95 | 0.18 | 4.21 |
| <i>Picea spiculosa</i> | 2.18 | 15.90 | 13.65 | 20.06 | 7.62 | 16.43 | 60.50 | 25.44 | 8.94 | 42.06 | 15.79 |
| <i>Larix griffithiana</i> | 1.77 | 2.56 | | 7.43 | | 0.00 | 2.45 | 1.26 | 14.23 | | 0.85 |
| <i>Taxus baccata</i> | 0.07 | 4.96 | | | | 0.23 | | 0.67 | | | 7.70 |
| <i>Juniperus recurva</i> | | | | 0.07 | | 0.01 | 3.93 | | | | |
| <i>Juniperus squamata</i> | | | | | | | | 0.01 | | | |
| <i>Juniperus pseudosabina</i> | | | | | | | | | 0.22 | | |
| Sub-Total | 62.68 | 76.80 | 55.61 | 95.84 | 67.77 | 79.14 | 97.84 | 74.68 | 93.10 | 73.69 | 71.20 |
| (Lifeform- Deciduous shrub) | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA |
| <i>Viburnum</i> sp. | 2.09 | 0.25 | | | | | | 0.09 | | | |
| <i>Enkianthus deflexus</i> | 0.51 | | | 0.01 | | | | 0.11 | 0.77 | | |
| <i>Viburnum nervosum</i> | 0.12 | | | | | 0.33 | | 0.05 | | | |
| <i>Corylus ferox</i> | 0.05 | 0.04 | | | | | | | | | |
| <i>Rosa</i> sp. | 0.02 | | | | | | | 0.01 | 0.03 | | |
| <i>Lonicera</i> sp. | 0.01 | 0.03 | | | | | | | | | |
| <i>Hydrangea</i> sp. | | 0.32 | | | | | | | 0.15 | | |
| <i>Rhus</i> sp. | | | 9.22 | | | | | | | | |
| <i>Berberis asiatica</i> | | | | | | 0.05 | | | | | |
| <i>Rosa sericea</i> | | | | | | 0.01 | 0.15 | | | 0.03 | |
| <i>Berberis aristata</i> | | | | | | | 0.00 | | | | |
| <i>Corylus</i> sp. | | | | | | | | 0.34 | | | |

| | | | | | | | | | | | |
|------------------------------------|--------------|--------------|--------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|--------------|
| <i>Euonymus</i> sp. | | | | | | | | 0.14 | | | |
| Sub-Total | 2.80 | 0.65 | 9.22 | 0.01 | 0.00 | 0.39 | 0.15 | 0.74 | 0.94 | 0.03 | 0.00 |
| (Life-form-Deciduous tree) | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA |
| <i>Acer campbellii</i> | 6.00 | 5.85 | | | | 0.83 | | 0.85 | | | 9.83 |
| <i>Sorbus</i> sp. | 3.13 | 0.09 | 10.23 | | | | | | | | |
| <i>Betula utilis</i> | 1.02 | 2.51 | | | | | | | | | |
| <i>Betula</i> sp. | 0.82 | 4.21 | | | | | | 0.26 | | | |
| <i>Populus ciliata</i> | 0.81 | 0.13 | 0.23 | 0.28 | 15.40 | 0.54 | | | | | 0.60 |
| <i>Prunus cerasoides</i> | 0.58 | 0.14 | | | | | | 0.22 | | | |
| <i>Prunus</i> sp. | 0.49 | 0.10 | | | | | | 0.34 | 0.03 | | |
| <i>Salix alba</i> | 0.08 | 2.05 | 0.01 | 0.55 | | | 0.05 | | | | |
| <i>Fraxinus</i> sp. | 0.02 | 0.53 | | | | | | | | | 0.04 |
| <i>Populus</i> sp. | | | 0.65 | | | | | 1.54 | | | |
| <i>Phyllanthus emblica</i> | | | | | | 0.45 | | | | | |
| <i>Elaeagnus parvifolia</i> | | | | | | 0.02 | | 0.28 | | 0.03 | |
| <i>Salix</i> sp. | | | | | | | | 0.80 | 0.35 | | |
| <i>Malus</i> sp. | | | | | | | | 0.12 | 0.09 | | |
| <i>Lindera</i> sp. | | | | | | | | 0.04 | | | |
| <i>Magnolia</i> sp. | | | | | | | | 0.02 | | | |
| <i>Acer</i> sp. | | | | | | | | | 0.00 | | |
| Sub-Total | 12.94 | 15.60 | 11.11 | 0.83 | 15.40 | 1.83 | 0.05 | 4.47 | 0.47 | 0.03 | 10.47 |
| (Life-form-Evergreen shrub) | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA |
| <i>Rhododendron</i> sp. | 8.16 | 0.64 | 0.17 | 0.31 | | 0.58 | 1.26 | 0.93 | 0.45 | 0.07 | 0.26 |
| <i>Ilex dipyrrena</i> | 0.67 | 0.24 | | | | 0.06 | | | | | 0.19 |
| <i>Pieris formosa</i> | 0.09 | 0.04 | 9.24 | 0.08 | | 0.35 | 0.38 | 1.90 | 0.82 | 0.49 | |
| <i>Lyonia ovalifolia</i> | 0.09 | 0.26 | 10.88 | 0.75 | 0.70 | 0.01 | 0.22 | 0.21 | 0.23 | | |
| <i>Benthamidia capitata</i> | 0.03 | 0.04 | | | | | | | | | 0.42 |
| <i>Ilex</i> sp. | | | 0.65 | | | | | 0.00 | | | |
| <i>Daphne bholua</i> | | | | | | | 0.10 | | | | |
| <i>Rhododendron falconeri</i> | | | | | | | | 3.13 | | | |

| | | | | | | | | | | | |
|-----------------------------------|--------------|-------------|--------------|-------------|--------------|--------------|-------------|--------------|-------------|--------------|--------------|
| <i>Daphne</i> sp. | | | | | | | | 0.08 | | | |
| <i>Rhododendron barbatum</i> | | | | | | | | 0.01 | | | |
| <i>Rhododendron triflorum</i> | | | | | | | | 0.00 | | | |
| <i>Lynonia aungusfiloa</i> | | | | | | | | 0.00 | | | |
| <i>Rhododendron cinnabarinum</i> | | | | | | | | | 0.06 | | |
| <i>Piptanthus nepalensis</i> | | | | | | | | 0.00 | 0.01 | | |
| <i>Rhododendron campylocarpum</i> | | | | | | | | | 0.01 | | |
| Sub-Total | 9.05 | 1.23 | 20.94 | 1.13 | 0.70 | 0.99 | 1.96 | 6.27 | 1.58 | 0.56 | 0.88 |
| (Life-form-Evergreen tree) | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA | RBA |
| <i>Quercus semecarpifolia</i> | 7.52 | 1.82 | | 2.18 | 15.68 | 14.45 | | 12.17 | 2.51 | 25.70 | 3.92 |
| <i>Symplocos</i> sp. | 2.66 | | | | | 0.08 | | 0.26 | | | |
| <i>Rhododendron arboreum</i> | 2.00 | 3.15 | 1.88 | | 0.45 | | | 0.86 | 1.39 | | 13.53 |
| <i>Gamblea ciliata</i> | 0.35 | 0.75 | | | | | | | | | |
| <i>Quercus</i> sp. | | | 1.24 | | | | | 0.54 | | | |
| <i>Phoebe lanceolata</i> | | | | | | 3.11 | | | | | |
| Sub-Total | 12.54 | 5.72 | 3.12 | 2.18 | 16.13 | 17.64 | 0.00 | 13.83 | 3.90 | 25.70 | 17.45 |
| Grand Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Annexure 2: Floristic composition of ground vegetation including spores bearing along the altitudinal gradients and plot details.

| Species | Bji | Dogar | Doteng | Essu | Hungrel | Katsho | Lungnyi | Naja | Sama | Shaba | Tsento |
|-------------------------------|------|-------|--------|------|---------|--------|---------|------|------|-------|--------|
| Spore bearing | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% |
| <i>Artemisia</i> sp. | 0.00 | 0.00 | 0.32 | 0.00 | 0.00 | 0.00 | 1.00 | 3.44 | 0.27 | 0.00 | 0.00 |
| <i>Artemisia thellungiana</i> | 0.00 | 7.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.29 | 0.00 | 0.00 | 0.00 |
| <i>Aster</i> sp. | 0.19 | 0.12 | 0.07 | 0.00 | 0.16 | 0.00 | 0.92 | 0.42 | 0.00 | 0.00 | 0.28 |
| <i>Drymaria</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Eleusine indica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.40 | 0.00 | 0.00 | 0.00 |
| <i>Euphorbia</i> sp. | 0.00 | 2.48 | 0.00 | 0.00 | 3.45 | 0.00 | 0.15 | 1.49 | 0.03 | 0.00 | 0.03 |

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|---------------------------------|--------------|--------------|-------------|-------------|-------------|--------------|-------------|--------------|-------------|-------------|--------------|
| <i>Euphrasia melanosticta</i> | 0.74 | 0.00 | 0.00 | 0.00 | 0.00 | 1.02 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 |
| <i>Fagopyrum</i> sp. | 0.00 | 0.00 | 0.76 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Galinsoga parviflora</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.02 | 0.00 | 0.00 | 0.00 |
| <i>Galium aparine</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.08 | 0.05 | 0.00 | 0.00 | 0.00 |
| <i>Galium</i> sp. | 0.00 | 2.69 | 0.05 | 0.00 | 0.00 | 0.38 | 0.00 | 0.35 | 0.21 | 0.00 | 0.00 |
| <i>Gentiana</i> sp. | 3.62 | 0.00 | 0.19 | 0.00 | 0.00 | 3.07 | 0.09 | 0.00 | 0.63 | 0.00 | 1.90 |
| <i>Geranium</i> sp. | 5.24 | 0.00 | 0.42 | 0.31 | 0.00 | 2.05 | 0.33 | 0.00 | 0.08 | 0.00 | 0.79 |
| Grass | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 2.07 | 0.00 | 8.67 | 7.78 |
| <i>Hackelia</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.65 | 0.00 | 0.00 | 0.23 | 0.00 | 0.00 |
| <i>Impatiens</i> sp. | 0.00 | 0.00 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.06 |
| <i>Oxalis</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.06 |
| <i>Persicaria</i> sp. | 0.38 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.33 |
| <i>Pilea</i> sp. | 0.00 | 2.44 | 2.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 1.44 |
| <i>Primula denticulata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.71 | 0.00 | 0.00 |
| <i>Primula smithiana</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.48 | 0.00 | 0.00 |
| <i>Primula</i> sp. | 0.00 | 0.00 | 1.70 | 0.61 | 0.30 | 0.59 | 1.14 | 0.17 | 2.56 | 0.00 | 0.13 |
| <i>Ranunculus</i> sp. | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Senecio</i> sp. | 2.28 | 0.00 | 2.48 | 0.00 | 0.00 | 5.49 | 2.10 | 0.00 | 1.05 | 0.00 | 0.62 |
| <i>Sonchus</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.52 |
| <i>Torilis japonica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sub-total | 12.44 | 15.02 | 9.08 | 0.92 | 4.12 | 14.26 | 6.90 | 14.18 | 7.35 | 8.67 | 13.94 |
| (Habitat-Bien-nial herb) | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% |
| <i>Cirsium</i> sp. | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 |
| <i>Cynoglossum furcatum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 |
| <i>Cynoglossum</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Heracleum nepalense</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 |
| <i>Heracleum wallichii</i> | 0.00 | 0.00 | 2.59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Oenanthe javanica</i> | 1.32 | 0.00 | 0.00 | 0.00 | 0.00 | 2.46 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Pleurospermum sikkimense</i> | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Pleurospermum</i> sp. | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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|--------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <i>Taraxacum eriopodum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.20 | 0.00 | 0.00 | 0.31 | 0.00 | 0.31 |
| <i>Taraxacum parvulum</i> | 0.57 | 0.00 | 0.00 | 0.31 | 0.00 | 1.23 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 |
| Sub-total | 2.23 | 0.00 | 2.74 | 0.31 | 0.00 | 5.89 | 0.10 | 0.18 | 0.35 | 0.00 | 0.45 |
| (Habitat-Perennial herb) | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% |
| <i>Abelmoschus manihot</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.19 | 0.00 | 0.00 |
| <i>Acanthocalyx nepalensis</i> | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| <i>Acmella uliginosa</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 |
| <i>Aconogonon hookeri</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.57 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Aconogonon polystachyum</i> | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Aconogonon sp.</i> | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 |
| <i>Ainsliaea aptera</i> | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.70 | 0.00 | 0.04 | 0.14 | 0.00 | 0.06 |
| <i>Ainsliaea latifolia</i> | 0.00 | 0.00 | 7.16 | 0.00 | 1.29 | 0.00 | 5.06 | 0.19 | 4.22 | 0.00 | 2.41 |
| <i>Ajania nubi-gena</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Aletris pauciflora</i> | 0.44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.42 | 0.00 | 0.00 | 5.61 |
| <i>Allium sp.</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.86 | 0.00 | 0.00 |
| <i>Allium wallichii</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.15 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Ananas comosus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 |
| <i>Anaphalis margaritacea</i> | 0.00 | 0.00 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 | 3.35 | 0.00 | 0.00 | 2.75 |
| <i>Anaphalis nepalensis</i> | 0.00 | 0.00 | 1.64 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Anaphalis sp.</i> | 0.00 | 0.42 | 0.62 | 0.09 | 7.62 | 2.35 | 2.20 | 3.25 | 5.84 | 0.00 | 0.19 |
| <i>Anemone demissa</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.64 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Anemone sp.</i> | 0.00 | 0.00 | 1.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 |
| <i>Artemisia indica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 2.09 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Astilbe rivularis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| <i>Astragalus sp.</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.97 | 0.00 |
| <i>Bergenia sp.</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.38 | 0.00 | 0.00 |
| <i>Bistorta macrophylla</i> | 4.53 | 0.00 | 0.00 | 3.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.54 | 0.00 | 3.12 |

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|--|-------|-------|-------|-------|------|------|------|------|-------|-------|------|
| <i>Bistorta</i> sp. | 1.68 | 0.00 | 0.92 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 |
| <i>Bistorta vacciniifolia</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 |
| <i>Bistorta vivipara</i> | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Bryocarpum himalaicum</i> | 0.00 | 0.00 | 0.00 | 0.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Bupleurum candollei</i> | 0.00 | 0.00 | 0.03 | 0.00 | 2.28 | 0.82 | 0.54 | 0.00 | 0.12 | 0.00 | 1.08 |
| <i>Calanthe</i> sp. | 0.00 | 0.07 | 0.00 | 0.00 | 0.68 | 0.00 | 0.00 | 0.59 | 0.00 | 0.00 | 0.03 |
| <i>Caltha palustris</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| <i>Campanula</i> sp. | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.00 | 0.00 |
| <i>Carex duthiei</i> | 0.00 | 0.00 | 0.00 | 0.25 | 0.00 | 0.07 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 |
| <i>Carex</i> sp. | 47.04 | 19.47 | 18.16 | 36.00 | 3.32 | 3.52 | 9.17 | 2.42 | 17.19 | 15.50 | 4.22 |
| <i>Chusua pauciflora</i> | 0.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Circaea alpina</i> subsp. <i>Imaicola</i> | 0.00 | 0.00 | 1.33 | 0.00 | 0.00 | 0.00 | 0.66 | 0.00 | 0.00 | 0.00 | 0.21 |
| <i>Clematis montana</i> | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0.01 |
| <i>Clematis</i> sp. | 0.00 | 0.00 | 0.00 | 0.73 | 0.00 | 0.00 | 0.66 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Clinopodium umbrosum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.32 | 0.00 | 0.68 | 0.17 | 0.02 | 0.00 | 0.00 |
| <i>Clintonia udensis</i> | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 |
| <i>Cortella hookeri</i> | 0.15 | 0.00 | 0.02 | 0.00 | 0.00 | 0.76 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Corydalis juncea</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.37 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 |
| <i>Corydalis</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 |
| <i>Cremanthodium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 |
| <i>Cyananthus incanus</i> | 0.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Cyananthus lobatus</i> | 0.60 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.34 |
| <i>Cyananthus</i> sp. | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.32 |
| <i>Cynanchum auriculatum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Cynodon</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.41 | 0.00 | 0.00 | 0.00 |
| <i>Danthonia</i> sp. | 1.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Digitaria</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.00 |

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|----------------------------------|------|-------|------|------|------|------|------|------|------|------|------|
| <i>Dubyaea hispida</i> | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 |
| <i>Elatostema lineolatum</i> | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.71 |
| <i>Elatostema</i> sp. | 0.00 | 0.00 | 0.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.30 | 0.00 | 1.15 |
| <i>Elsholtzia</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 |
| <i>Elsholtzia strobilifera</i> | 0.00 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 | 0.00 | 0.00 |
| <i>Epiglossum</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Epilobium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Equisetum diffusum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 |
| <i>Eupatorium nodiflorum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.90 | 0.00 |
| <i>Euphorbia griffithii</i> | 0.00 | 0.00 | 0.33 | 0.00 | 0.00 | 0.00 | 0.87 | 0.00 | 2.00 | 8.12 | 0.09 |
| <i>Festuca</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Fragaria nubicola</i> | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 |
| <i>Fragaria</i> sp. | 0.00 | 0.22 | 1.35 | 0.00 | 2.38 | 3.52 | 1.56 | 0.00 | 5.43 | 0.00 | 0.08 |
| <i>Gentiana algida</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 |
| <i>Gentiana urnula</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| <i>Goodyera</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| <i>Gueldenstaedtia himalaica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 |
| <i>Halenia elliptica</i> | 0.57 | 0.66 | 0.14 | 3.68 | 1.32 | 8.34 | 0.66 | 1.49 | 0.34 | 0.00 | 1.68 |
| <i>Hedera nepalensis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.65 | 0.34 | 0.00 | 0.00 | 0.00 |
| <i>Hedychium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.78 | 0.00 | 0.00 | 0.00 | 0.33 |
| <i>Hemiphragma heterophyllum</i> | 0.38 | 0.00 | 0.14 | 0.00 | 0.00 | 0.00 | 0.12 | 0.12 | 0.84 | 0.00 | 0.53 |
| <i>Herninium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Holboellia latifolia</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| <i>Houttuynia cordata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.00 | 0.00 | 0.00 |
| <i>Hydrangea</i> sp. | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Hypoxis aurea</i> | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 |
| <i>Inula hookeri</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 |
| <i>Iris clarkei</i> | 0.00 | 14.83 | 0.00 | 0.00 | 0.00 | 8.21 | 0.00 | 0.99 | 1.86 | 0.00 | 0.00 |
| <i>Iris</i> sp. | 0.00 | 0.00 | 0.00 | 3.61 | 0.00 | 0.00 | 3.89 | 0.00 | 2.98 | 0.00 | 0.00 |

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|--|------|------|------|-------|------|-------|------|------|------|-------|------|
| <i>Juncus</i> sp. | 4.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.00 | 5.28 | 0.00 | 0.00 |
| <i>Lagotis</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| <i>Leontopodium</i> sp. | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Lepedeza gerardiana</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.84 | 0.00 |
| <i>Leucas ciliata</i> | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Ligularia atkinsonii</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 10.68 | 0.00 | 0.00 | 2.05 | 0.00 | 0.00 |
| <i>Ligularia mortonii</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.70 | 0.00 | 0.00 | 0.71 | 0.00 | 0.00 |
| <i>Ligularia</i> sp. | 0.00 | 0.00 | 0.25 | 10.19 | 0.00 | 0.00 | 0.00 | 0.00 | 1.55 | 0.00 | 1.84 |
| <i>Lobelia</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.09 | 0.00 |
| <i>Lomatogonium brachyantherum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.29 |
| <i>Lomatogonium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.02 |
| <i>Lomatogonium stapfii</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.29 |
| <i>Maianthemum</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.04 |
| <i>Meconopsis paniculata</i> | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Meconopsis</i> sp. | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Meeboldia</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.30 | 0.00 | 0.00 |
| <i>Megacodon stylophorus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 |
| <i>Mentha spicata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| <i>Microstegium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Microstegium vimineum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 18.08 | 0.00 |
| <i>Mulgedium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Myriactis nepalensis</i> | 0.00 | 0.00 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 |
| <i>Myriactis wallichii</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.52 | 0.00 |
| <i>Nardostachys grandiflora</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.70 | 0.00 | 0.00 |
| <i>Neopicrorhiza scrophulariiflora</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 |
| <i>Nepeta</i> sp. | 0.00 | 0.00 | 0.00 | 0.37 | 0.00 | 3.43 | 0.00 | 0.10 | 0.53 | 0.00 | 0.00 |
| <i>Onosma hookeri</i> | 0.00 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

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| <i>Ophiopogon</i> sp. | 0.00 | 0.00 | 5.12 | 0.00 | 7.63 | 0.00 | 0.09 | 5.63 | 0.00 | 0.00 | 0.39 |
| <i>Ophiopogon</i> <i>wallichianus</i> | 0.00 | 0.00 | 1.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Osmanthus</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 | 0.00 |
| <i>Oxygraphis</i> <i>endlicheri</i> | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Oxytropis</i> <i>lapponica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.09 |
| <i>Panax pseu-</i> <i>do-ginseng</i> | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| <i>Parasenecio</i> <i>palmatisectus</i> | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Parasenecio</i> sp. | 0.00 | 0.00 | 1.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Parnassia</i> <i>chinensis</i> | 1.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.46 | 0.00 | 0.00 | 0.15 | 0.00 | 0.00 |
| <i>Pedicularis</i> <i>megalantha</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.38 | 0.00 | 0.00 |
| <i>Pedicularis</i> <i>siphonantha</i> | 3.46 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.43 | 0.00 | 0.00 |
| <i>Pedicularis</i> sp. | 2.76 | 0.00 | 0.26 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.05 | 0.00 | 0.14 |
| <i>Phaeonychium</i> <i>parryoides</i> | 0.00 | 0.00 | 0.00 | 0.00 | 6.72 | 0.00 | 2.65 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Phlomis rotate</i> | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.32 |
| <i>Phlomis</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 1.06 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |
| <i>Phyllanthus</i> <i>virgatus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 |
| <i>Plantago</i> <i>depressa</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| <i>Plantago</i> <i>erosa</i> | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 |
| <i>Plantago</i> sp. | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.43 | 0.01 | 0.00 | 0.00 |
| <i>Poa</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 |
| <i>Polygonatum</i> sp. | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 |
| <i>Potentilla</i> <i>anserina</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 |
| <i>Potentilla</i> <i>coriandrifolia</i> | 0.46 | 0.00 | 0.00 | 0.61 | 0.00 | 8.20 | 0.00 | 0.00 | 0.09 | 1.34 | 3.44 |
| <i>Potentilla</i> <i>cuneata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| <i>Potentilla</i> <i>fruticosa</i> | 0.00 | 0.00 | 0.41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Potentilla</i> <i>peduncularis</i> | 0.00 | 0.00 | 0.00 | 1.23 | 0.00 | 0.37 | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 |
| <i>Potentilla</i> sp. | 5.57 | 0.00 | 3.46 | 0.98 | 0.00 | 0.00 | 0.33 | 0.73 | 1.35 | 0.00 | 2.99 |

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|------------------------------|------|-------|------|-------|------|------|------|-------|------|------|------|
| <i>Prangos</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Prunella vulgaris</i> | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 |
| <i>Pterisanthes</i> sp. | 0.00 | 0.00 | 0.82 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Pyrola rotundifolia</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 |
| <i>Pyrola</i> sp. | 0.00 | 0.00 | 0.00 | 14.81 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 |
| <i>Rheum nobile</i> | 0.00 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Rhodiola</i> sp. | 3.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.91 |
| <i>Roscoea</i> sp. | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Rubia manjith</i> | 0.00 | 1.93 | 0.00 | 0.00 | 0.00 | 0.00 | 2.13 | 0.00 | 0.00 | 0.00 | 0.10 |
| <i>Rubia</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 5.31 | 0.00 | 0.26 | 0.28 | 0.00 | 0.00 | 0.09 |
| <i>Rubus calycinus</i> | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Rubus fockeanus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Rubus fragarioides</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.80 | 0.00 | 0.00 | 0.00 |
| <i>Rubus</i> sp. | 0.00 | 2.31 | 6.11 | 12.51 | 2.84 | 0.76 | 7.33 | 14.39 | 7.49 | 0.00 | 2.73 |
| <i>Rumex nepalensis</i> | 0.00 | 0.00 | 2.52 | 0.00 | 0.62 | 0.00 | 0.38 | 0.74 | 0.00 | 0.00 | 0.00 |
| <i>Rumex</i> sp. | 2.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 |
| <i>Salvia campanulata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Salvia</i> sp. | 0.00 | 29.56 | 3.25 | 0.00 | 0.00 | 0.00 | 4.92 | 3.88 | 0.85 | 0.00 | 3.27 |
| <i>Sambucus adnata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.46 | 0.00 | 0.00 | 0.00 | 0.05 |
| <i>Sanicula elata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Saussurea auriculata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.55 | 0.00 | 0.00 |
| <i>Saussurea nishiokae</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.18 | 0.00 | 0.00 |
| <i>Saussurea</i> sp. | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.55 | 0.00 | 0.00 | 0.08 | 0.00 | 0.78 |
| <i>Saxifraga</i> sp. | 0.71 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Selinum candollei</i> | 0.00 | 0.00 | 1.38 | 0.00 | 1.64 | 5.34 | 1.23 | 0.12 | 0.23 | 0.00 | 2.24 |
| <i>Selinum wallichianum</i> | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.01 |
| <i>Senecio laetus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| <i>Senecio raphanifolius</i> | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 |
| <i>Senecio royleanus</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 |
| <i>Senecio scandens</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 |

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|-----------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <i>Smilax</i> sp. | 0.00 | 2.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.44 | 0.00 | 0.00 | 0.00 |
| <i>Soroseris hookeriana</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 |
| <i>Soroseris</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.62 |
| <i>Spenceria parviflora</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.63 | 0.00 | 0.00 |
| <i>Stellaria</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.70 | 0.00 |
| <i>Streptopus simplex</i> | 0.00 | 0.00 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Strobilanthes</i> sp. | 0.00 | 0.00 | 2.67 | 0.00 | 0.70 | 0.00 | 0.53 | 0.00 | 0.00 | 0.00 | 1.40 |
| <i>Swertia bimaculata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.51 | 0.00 | 0.00 | 0.24 |
| <i>Swertia hookeri</i> | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Swertia multicaulis</i> | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Swertia</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.63 | 0.00 | 0.00 |
| <i>Synotis</i> sp. | 0.00 | 0.00 | 4.34 | 0.05 | 14.96 | 0.00 | 4.74 | 0.00 | 0.00 | 7.03 | 3.83 |
| <i>Synotis wallichii</i> | 0.00 | 0.00 | 3.23 | 0.00 | 0.00 | 5.87 | 0.00 | 0.00 | 1.33 | 0.00 | 0.46 |
| <i>Thalictrum foliolosum</i> | 0.00 | 6.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 |
| <i>Thalictrum reniforme</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.62 | 0.00 | 3.14 | 0.68 |
| <i>Thalictrum</i> sp. | 0.00 | 0.00 | 0.56 | 0.00 | 2.25 | 0.00 | 0.45 | 1.55 | 0.00 | 0.00 | 0.32 |
| <i>Trifolium repens</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.38 | 0.59 | 0.00 | 0.00 |
| <i>Triosteum himalaynum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.51 | 0.58 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 |
| <i>Urtica dioica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 |
| <i>Utricularia</i> sp. | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Veronica</i> sp. | 0.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 |
| <i>Vincetoxicum hirsundinaria</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.70 | 0.00 |
| <i>Viola biflora</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.41 | 0.00 | 0.00 | 0.32 | 0.00 | 0.00 |
| <i>Viola</i> sp. | 0.00 | 0.00 | 0.11 | 0.00 | 0.01 | 0.00 | 1.39 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Waldheimia glabra</i> | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sub-total | 84.76 | 78.66 | 73.92 | 89.96 | 68.24 | 73.05 | 62.41 | 52.52 | 76.57 | 67.16 | 59.50 |

| (Habitat-Spore bearing) | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% | RD% |
|----------------------------------|------|------|------|------|-------|------|------|-------|------|-------|------|
| <i>Athyrium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 |
| <i>Atrichum undulatum</i> | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Bazzania tirlobata</i> | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| <i>Breutelia</i> sp. | 0.00 | 0.00 | 0.98 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Cladonia</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.20 | 0.00 | 0.00 | 0.00 | 0.34 |
| <i>Conocephalum</i> sp. | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Dicranum scoparium</i> | 0.00 | 0.00 | 0.22 | 0.00 | 11.88 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 4.56 |
| <i>Dicranum</i> sp. | 0.00 | 0.00 | 1.35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.89 |
| <i>Drynaria</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.05 | 0.00 | 0.00 | 0.00 |
| <i>Dryopteris</i> sp. | 0.00 | 6.21 | 0.81 | 0.00 | 0.00 | 0.00 | 0.00 | 11.84 | 0.00 | 0.00 | 4.38 |
| <i>Entodon</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 |
| <i>Helodium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.06 | 0.00 | 0.00 | 0.00 | 0.15 |
| <i>Hymenophyllum</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.47 |
| <i>Hypnum cupressiforme</i> | 0.00 | 0.00 | 0.35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Hypnum</i> sp. | 0.00 | 0.00 | 0.37 | 0.00 | 3.18 | 0.00 | 6.86 | 0.00 | 0.00 | 16.63 | 3.62 |
| <i>Lepisorus</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.79 | 0.09 | 0.00 | 0.00 | 0.00 |
| <i>Lobaria</i> sp. | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Lycopodium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 |
| <i>Metzgeria furcata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 |
| <i>Neckera</i> sp. | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Onychium cryptogrammoides</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 |
| <i>Onychium</i> sp. | 0.00 | 0.00 | 0.93 | 0.00 | 0.00 | 0.00 | 0.38 | 0.44 | 0.00 | 0.00 | 0.00 |
| <i>Osmunda cinnamomea</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.22 | 0.00 | 0.00 | 0.00 |
| <i>Osmunda</i> sp. | 0.00 | 0.00 | 0.03 | 0.00 | 0.04 | 0.00 | 0.61 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Peltigera</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.47 | 0.00 |
| <i>Philonotis fanacata</i> | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Philonotis</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Plagiochila</i> sp. | 0.00 | 0.00 | 0.28 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Plagiomnium</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |

| | | | | | | | | | | | |
|----------------------------------|-------------|-------------|--------------|-------------|--------------|-------------|--------------|--------------|--------------|--------------|--------------|
| <i>Plagiomnium undulatum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 |
| <i>Pogonatum</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Polystichum</i> sp. | 0.00 | 0.00 | 1.21 | 0.00 | 0.00 | 0.00 | 0.15 | 0.74 | 0.00 | 0.00 | 1.55 |
| <i>Polytrichum</i> sp. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 |
| <i>Polytrichum commune</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 |
| <i>Pteridium aquilinum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.98 | 0.00 | 6.81 | 0.00 | 0.00 | 0.00 |
| <i>Pteridium</i> sp. | 0.00 | 0.00 | 2.75 | 2.46 | 11.52 | 0.00 | 6.88 | 0.00 | 6.71 | 0.00 | 4.91 |
| <i>Pteris cretica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 5.36 | 0.00 | 0.00 | 0.00 |
| <i>Pteris</i> sp. | 0.00 | 0.00 | 0.16 | 0.00 | 0.00 | 0.00 | 5.60 | 0.00 | 0.00 | 0.00 | 0.29 |
| <i>Ptilium crista-castrensis</i> | 0.00 | 0.00 | 2.39 | 0.00 | 0.00 | 0.00 | 2.90 | 0.00 | 0.00 | 0.00 | 0.45 |
| <i>Rhodobryum giganteum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.73 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.02 |
| <i>Rhodobryum roseum</i> | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.27 |
| <i>Rhytidium rugosum</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.73 | 0.00 |
| <i>Selaginella</i> sp. | 0.00 | 0.00 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 5.36 | 0.00 | 0.00 | 0.00 |
| <i>Sphagnum</i> sp. | 0.57 | 0.00 | 0.00 | 6.36 | 0.00 | 0.82 | 0.00 | 0.00 | 9.02 | 0.00 | 0.71 |
| <i>Thamnia vermicularis</i> | 0.00 | 0.00 | 1.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| <i>Thelypteris</i> sp. | 0.00 | 0.00 | 0.24 | 0.00 | 0.28 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 1.68 |
| <i>Thuidium</i> sp. | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.63 | 0.00 | 0.00 | 6.34 | 1.36 |
| <i>Woodwardia unigemmata</i> | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sub-total | 0.57 | 6.32 | 14.26 | 8.82 | 27.63 | 6.80 | 30.58 | 33.12 | 15.72 | 24.17 | 26.12 |
| Grand total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Annexure 3: Plot summary for eleven Gewogs

| Gewog | Bji | Dogar | Doteng | Eusu | Hungrel | Katsho | Lungnyi | Naja | Samar | Shaba | Tsento |
|---------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| No. of plots | 4 | 9 | 23 | 6 | 10 | 4 | 18 | 29 | 25 | 8 | 32 |
| Altitude Range(m) | 3039-4834 | 1955-3900 | 2270-5552 | 2527-4085 | 2210-3752 | 2658-4134 | 2200-4110 | 1925-4107 | 2474-4597 | 2113-4003 | 2496-5213 |
| Tree plot size(m ²) | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| Herb plot size(m ²) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| B _{Acm} ² | 67176 | 133815 | 352443 | 121487 | 103761 | 55653 | 323098 | 329195 | 331913 | 43993 | 356039 |
| B _{Am} ² | 6.72 | 13.38 | 35.24 | 12.15 | 10.38 | 5.57 | 32.31 | 32.92 | 33.19 | 4.40 | 35.60 |

| | | | | | | | | | | | |
|----------------------|------|------|------|------|------|------|------|------|------|------|------|
| Diversity H' | 1.3 | 1.09 | 1.76 | 1.29 | 0.97 | 0.93 | 1.42 | 1.47 | 1.81 | 1.36 | 1.67 |
| Diversity H' (Whole) | 0.95 | 0.55 | 0.95 | 0.76 | 0.59 | 0.60 | 0.84 | 0.74 | 1.03 | 0.76 | 0.83 |
| Diversity (No) | 14 | 13 | 28 | 21 | 16 | 9 | 13 | 21 | 37 | 6 | 30 |
| Max. DBH(cm) | 105 | 105 | 120 | 103 | 72 | 85 | 110 | 130 | 135 | 53 | 118 |
| Max. Ht(m) | 37 | 33 | 85 | 30 | 52 | 28 | 64 | 60 | 120 | 48 | 63 |

Annexure 4: List of mammals.

| Common name | Scientific name | Family |
|---------------------|---|-----------------|
| Alpine marmot | <i>Marmota marmota</i> | Sciuridae |
| Asiatic black bear | <i>Ursus thibetanus</i> | Ursidae |
| Asiatic Golden Cat | <i>Catopuma temminckii</i> | Felidae |
| Barking deer | <i>Muntiacus muntjak</i> | Cervidae |
| Bengal Tiger | <i>Panthera tigris ssp.tigris</i> | Felidae |
| Bhutan Takin | <i>Budorcas taxicolor ssp. Whitei</i> | Bovidae |
| Blue Sheep | <i>Pseudois nayaur</i> | Bovidae |
| Common Leopard | <i>Panthera pardus</i> | Felidae |
| Gaur | <i>Bos gaurus</i> | Bovidae |
| Goral | <i>Naemorhedus goral</i> | Bovidae |
| Grey Langur | <i>Semnopithecus entellus</i> | Cercopithecidae |
| Himalayan Musk Deer | <i>Moschus leucogaster</i> | Moschidae |
| Himalayan Serow | <i>Capricornis sumatraensis ssp. thar</i> | Bovidae |
| Leopard Cat | <i>Prionailurus bengalensis</i> | Felidae |
| Assam macaques | <i>Macaca assamensis</i> | Cercopithecidae |
| Marbled Cat | <i>Pardofelis marmorata</i> | Felidae |
| Red fox | <i>Vulpes vulpes</i> | Canidae |
| Red Panda | <i>Ailurus fulgens</i> | Ailuridae |
| Sambar deer | <i>Rusa unicolor</i> | Cervidae |
| Snow leopard | <i>Panthera uncia</i> | Felidae |
| Thorold's deer | <i>Cervus albirostris</i> | Cervidea |
| Tibetan Wolf | <i>Canis lupus ssp. filchneri</i> | Canidae |
| Wild boar | <i>Sus scrofa</i> | Suidae |
| Wild dog | <i>Cuon alpinus</i> | Canidae |
| Woolley Hare | <i>Lepus oiostolus</i> | Leporidae |

| | | |
|------------------------|-------------------------|------------|
| Yellow-throated Marten | <i>Martes flavigula</i> | Mustelidae |
|------------------------|-------------------------|------------|

Annexure 5: List of herpetofauna

| Common name | Scientific name | Family |
|-----------------------------|-----------------------------------|------------|
| Himalayan Mountain Keelback | <i>Amphisma platyceps</i> | Colubridae |
| False Wolf snake | <i>Dinodon spp</i> | Colubridae |
| Himalayan Toad | <i>Duttaphrynus himalayanus</i> | Bufoidea |
| Asian Common Toad | <i>Duttaphrynus melanostictus</i> | Bufoidea |
| Indian forest skink | <i>Sphenomorphus indicus</i> | Scincidae |
| Sikkim false wolf snake | <i>Lycodon spp</i> | Colubridae |
| Himalayan Keelback | <i>Rhadophis himlayanus</i> | Colubridae |
| Eastern Keelback | <i>Herpetoreas platyceps</i> | Colubridae |
| Himalayan Pit Viper | <i>Protobothrops himalayanus</i> | Viperidae |

Annexure 6: List of birds

| Common Name | Scientific Name | Family | ICUN Category |
|----------------------------|----------------------------------|----------------|---------------|
| Alpine Accentor | <i>Prunella collaris</i> | Prunellidae | LC |
| Alpine Chough | <i>Pyrrhocorax graculus</i> | Corvidae | LC |
| Alpine Thrush | <i>Zoother mollissima</i> | Turdidae | LC |
| Altai Accentor | <i>Prunella himalayana</i> | Prunellidae | LC |
| Ashy Drongo | <i>Dicrurus Leucophaeus</i> | Dicruridae | LC |
| Ashy-throated Warbler | <i>Phylloscopus Maculipennis</i> | Phylloscopidae | LC |
| Asian Barred Owllet | <i>Glaucidium cuculoides</i> | Strigidae | LC |
| Bar-headed Goose | <i>Anser indicus</i> | Anatidae | LC |
| Barn Owl | <i>Tyto alba</i> | Tytonidae | LC |
| Bearded vulture | <i>Gypaetus barbatus</i> | Accipitridae | NT |
| Bhutan Laughingthrush | <i>Trochalopteron imbricatum</i> | Leiothrichidae | LC |
| Black Bulbul | <i>Hypsipetes leucocephalus</i> | Pycnonotidae | LC |
| Black Eagle | <i>Ichneutes malaiensis</i> | Accipitridae | LC |
| Black Kite | <i>Milvus migrans</i> | Accipitridae | LC |
| Black Stork | <i>Ciconia nigra</i> | Ciconiidae | LC |
| Black- throated Thrush | <i>Turdus atrogularis</i> | Turdidae | LC |
| Black-crowned Night Heron | <i>Nycticorax nycticorax</i> | Ardeidae | LC |
| Black-faced Laughingthrush | <i>Trochalopteron affine</i> | Leiothrichidae | LC |
| Black-necked Crane | <i>Grus nigricollis</i> | Gruidae | NT |

| | | | |
|---------------------------------|--|----------------|----|
| Black-tailed Crake | <i>Zaporina bicolor</i> | Rallidae | LC |
| Black-winged Cuckooshrike | <i>Lalage melaschistos</i> | Campephagidae | LC |
| Blood Pheasant | <i>Ithaginis cruentus</i> | Phasianidae | LC |
| Blue Whistling-Thrush | <i>Myophonus caeruleus</i> | Muscicapidae | LC |
| Blue-fronted Redstart | <i>Phoenicurus frontalis</i> | Muscicapidae | LC |
| Blue-rock Thrush | <i>Monticola solitarius</i> | Muscicapidae | LC |
| Blyth's Leaf Warbler | <i>Phylloscopus reguloides</i> | Phylloscopidae | LC |
| Brown Dipper | <i>Cinclus pallasii</i> | Ciconiidae | LC |
| Brown Parrotbill | <i>Cholornis unicolor</i> | Sylviidae | LC |
| Brown Shrike | <i>Lanius cristatus</i> | Laniidae | LC |
| Brown-headed Gull | <i>Chroicocephalus brun-nicephalus</i> | Laridae | LC |
| Brown-throated Fulvetta | <i>Fulvetta ludlowi</i> | Sylviidae | LC |
| Buff-barred Warbler | <i>Phyllocopus pulcher</i> | Phylloscopidae | LC |
| Cattle Egret | <i>Bubulcus ibis</i> | Ardeidae | LC |
| Chestnut-bellied Rock Thrush | <i>Monticola rufiventris</i> | Muscicapidae | LC |
| Chestnut-crowned Laughingthrush | <i>Trochalopteron erythrocephalum</i> | Leiothrichidae | LC |
| Chestnut-crowned Warbler | <i>Phylloscopus castaniceps</i> | Phylloscopidae | LC |
| Chestnut-tailed Minla | <i>Minla strigula</i> | Leiothrichidae | LC |
| Citrine Wagtail | <i>Motacilla citreola</i> | Motacillidae | LC |
| Coal Tit | <i>Pariparus ater</i> | Paridae | LC |
| Collared Grosbeak | <i>Mycerobas affinis</i> | Fringillidae | LC |
| Collared Owlet | <i>Taenioptynx brodiei</i> | Strigidae | LC |
| Common Buzzard | <i>Buteo buteo</i> | Accipitridae | LC |
| Common Kestrel | <i>Falco tinnunculus</i> | Falconidae | LC |
| Common Kingfisher | <i>Alcedo atthis</i> | Alcedinidae | LC |
| Common Moorhen | <i>Gallinula chloropus</i> | Rallidae | LC |
| Common Myna | <i>Acridotheres tristis</i> | Sturnidae | LC |
| Common Quail | <i>Coturnix coturnis</i> | Phasianidae | LC |
| Common Raven | <i>Corvus corax</i> | Corvidae | LC |
| Common Reshank | <i>Tringa totanus</i> | Scolopacidae | LC |
| Common Rosefinch | <i>Carpodacus erythrinus</i> | Fringillidae | LC |
| Common Sandpiper | <i>Actitis hypoleucos</i> | Scolopacidae | LC |
| Common Teal | <i>Anas crecca</i> | Anatidae | LC |

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|------------------------------|---------------------------------|--------------------|----|
| Creamson-breasted Woodpecker | <i>Dryobates cathpharius</i> | Picidae | LC |
| Crested Kingfisher | <i>Megaceryle lugubris</i> | Alcedinidae | LC |
| Crimson-browed Finch | <i>Carpodacus subhimachalus</i> | | LC |
| Crow-bellied Drongo | <i>Dicrurus annectens</i> | Dicruridae | LC |
| Darjeeling Woodpecker | <i>Dendrocopos darjellensis</i> | Picidae | LC |
| Dark-breasted Rosefinch | <i>Procarduelis nipalensis</i> | Fringillidae | LC |
| Dark-rumped Rosefinch | <i>Carpodacus edwardsii</i> | Fringillidae | LC |
| Dark-sided Flycatcher | <i>Muscicapa sibirica</i> | Muscicapidae | LC |
| Eurasian Coot | <i>Fulica atra</i> | Rallidae | LC |
| Eurasian Cuckoo | <i>Cuculus canorus</i> | Cuculidae | LC |
| Eurasian Hoopoe | <i>Upupa epops</i> | Upupidae | LC |
| Eurasian Jay | <i>Garrulus glandarius</i> | Corvidae | LC |
| Eurasian Sparrowhawk | <i>Accipiter nisus</i> | Accipitridae | LC |
| Eurasian Tree Sparrow | <i>Passer montanus</i> | Passeridae | LC |
| Eurasian Treecreeper | <i>Certhia familiaris</i> | Certhiidae | LC |
| Eurasian Wigeon | <i>Mareca penelope</i> | Anatidae | LC |
| Eurasian Woodcock | <i>Scolopax rusticola</i> | Scolopacidae | LC |
| Eurasian Wren | <i>Troglodytes troglodytes</i> | Troglodytidae | LC |
| European Golden Plover | <i>Pluvialis apricaria</i> | Charadriidae | LC |
| Ferruginous Duck | <i>Aythya nyroca</i> | Anatidae | NT |
| Fire-tailed Myzornis | <i>Myzornis pyrrhoura</i> | Sylviidae | LC |
| Fire-tailed Sunbird | <i>Aethopyga ignicauda</i> | Nectariniidae | LC |
| Gadwall | <i>Mareca strepera</i> | Anatidae | LC |
| Goldcrest | <i>Regulus regulus</i> | Regulidae | LC |
| Golden Eagle | <i>Aquila chrysaetos</i> | Accipitridae | LC |
| Golden-naped Finch | <i>Pyrrhoptectes epauletta</i> | Fringillidae | LC |
| Goosander | <i>Mergus merganser</i> | Anatidae | LC |
| Grandala | <i>Grandala coelicolor</i> | Turdidae | LC |
| Great Bittern | <i>Botaurus stellaris</i> | Ardeidae | LC |
| Great Cormorant | <i>Phalacrocorax carbo</i> | Phalacrocoraciidae | LC |
| Greater White-fronted Goose | <i>Anser albifrons</i> | Anatidae | LC |
| Green Sandpiper | <i>Tringa onchropus</i> | Scolopacidae | LC |
| Green Shrike-babbler | <i>Pteruthius xanthochlorus</i> | Vireonidae | LC |
| Green-backed Tit | <i>Parus monticolus</i> | Paridae | LC |

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|----------------------------------|----------------------------------|-----------------|----|
| Greenish Warbler | <i>Phylloscopus trichiloides</i> | Phylloscopidae | LC |
| Green-tailed Sunbird | <i>Aethopyga nipalensis</i> | Nectariniidae | LC |
| Grey Bushchat | <i>Saxicola ferreus</i> | Muscicapidae | LC |
| Grey Heron | <i>Ardea cinerea</i> | Ardeidae | LC |
| Grey Nightjar | <i>Caprimulgus jotaka</i> | Caprimulgidae | LC |
| Grey Wagtail | <i>Motacilla cinerea</i> | Motacillidae | LC |
| Grey-backed Shrike | <i>Lanius tephronotus</i> | Laniidae | LC |
| Grey-crested Tit | <i>Lophophanes dichrous</i> | Paridae | LC |
| Grey-sided Bush Warbler | <i>Cettia brunnifrons</i> | Scotocercidae | LC |
| Grey-winged Blackbird | <i>Turdus boulboul</i> | Turdidae | LC |
| Hill Partridge | <i>Arborophila torqueola</i> | Phasianidae | LC |
| Himalayan Beautiful Rosefinch | <i>Carpodacus pulcherrimus</i> | Fringillidae | LC |
| Himalayan Bluetail | <i>Tarsiger rufilatus</i> | Muscicapidae | LC |
| Himalayan Monal | <i>Lophophorus impejanus</i> | Phasianidae | LC |
| Himalayan Vulture | <i>Gyps himalayensis</i> | Accipitridae | NT |
| Himalayan White-browed Rosefinch | <i>Carpodacus thura</i> | Fringillidae | LC |
| Himalayan Wood Owl | <i>Strix nivicolom</i> | Strigidae | LC |
| Hodgson Redstart | <i>Phoenicurus hodgsoni</i> | Muscicapidae | LC |
| Hodgson's Treecreeper | <i>Certhia hodgsoni</i> | Certhiidae | LC |
| Horned Lark | <i>Eremophila alpestris</i> | Alaudidae | LC |
| House Sparrow | <i>Passer domesticus</i> | Passeridae | LC |
| Ibisbill | <i>Ibidorhyncha struthersii</i> | Ibidorhynchidae | LC |
| Indian Pond Heron | <i>Ardeola grayii</i> | Ardeidae | LC |
| Indian Roller | <i>Coracias benghalensis</i> | Coraciidae | LC |
| Indian-blue Robin | <i>Larvivora brunnea</i> | Muscicapidae | LC |
| Isabelline Wheatear | <i>Oenanthe isabellina</i> | Muscicapidae | LC |
| Kalij Pheasant | <i>Lophura leucomelanos</i> | Phasianidae | LC |
| Large Hawk Cuckoo | <i>Hierococcyx sparverioides</i> | Cuculidae | LC |
| Large-billed Crow | <i>Corvus macrorhynchos</i> | Corvidae | LC |
| Large-billed Leaf Warbler | <i>Phylloscopus magnirostris</i> | Phylloscopidae | LC |
| Lemon-rumped Warbler | <i>Phylloscopus chloronotus</i> | Phylloscopidae | LC |
| Little Bunting | <i>Emberiza pusilla</i> | Emberizidae | LC |
| Little Forktail | <i>Enicurus scouleri</i> | Muscicapidae | LC |

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|--------------------------|----------------------------------|----------------|----|
| Little Owl | <i>Athene noctua</i> | Strigidae | LC |
| Long bellied Thrush | <i>Zoother monticola</i> | Turdidae | LC |
| Long-billed Plover | <i>Charadrius placidus</i> | Charadriidae | LC |
| Long-legged Buzzard | <i>Buteo rufinus</i> | Accipitridae | LC |
| Long-tailed Minivet | <i>Pericrocotus ethologus</i> | Campephagidae | LC |
| Long-tailed Shrike | <i>Lanius schach</i> | Laniidae | LC |
| Mallard | <i>Anas platyrhynchos</i> | Anatidae | LC |
| Mandarin Duck | <i>Aix galericulata</i> | Anatidae | LC |
| Maroon-backed Accentor | <i>Prunella immaculata</i> | Prunellidae | LC |
| Mrs. Gould's Sunbird | <i>Aethopyga gouldiae</i> | Nectariniidae | LC |
| Northern Goshawk | <i>Accipiter gentilis</i> | Accipitridae | LC |
| Northern Lapwing | <i>Vanellus vanellus</i> | Charadriidae | LC |
| Northern Pintail | <i>Anas acuta</i> | Anatidae | LC |
| Olive-backed Pipit | <i>Anthus hodgsoni</i> | Motacillidae | LC |
| Oriental Cuckoo | <i>Cuculus optatus</i> | Cuculidae | LC |
| Oriental Hobby | <i>Falco severus</i> | Falconidae | LC |
| Oriental Honey Buzzard | <i>Pernis ptilorhynchus</i> | Accipitridae | LC |
| Oriental Skylark | <i>Alauda gulgula</i> | Alaudidae | LC |
| Oriental Turtal Dove | <i>Stroptopelia orientalis</i> | Columbidae | LC |
| Oriental White Eye | <i>Zosterops palpebrosus</i> | Zosteropidae | LC |
| Osprey | <i>Pandion haliaetus</i> | Pandionidae | LC |
| Pacific Golden Plover | <i>Pluvialis fulva</i> | Charadriidae | LC |
| Paddyfield Pipit | <i>Anthus rufulus</i> | Motacillidae | LC |
| Pallas's Gull | <i>Ichthyaeetus ichthyaeetus</i> | Laridae | LC |
| Peregrine Falcon | <i>Falco peregrinus</i> | Falconidae | LC |
| Plain Mountain Finch | <i>Leucosticte nemoricola</i> | Fringillidae | LC |
| Plumbeous Water Redstart | <i>Phoenicurus fuliginosus</i> | Muscicapidae | LC |
| Red Crossbill | <i>Loxia curvirostra</i> | Fringillidae | LC |
| Red-billed Chough | <i>Pyrrhocorax pyrrhocorax</i> | Corvidae | LC |
| Red-billed Leiothrix | <i>Leiothrix lutea</i> | Leiothrichidae | LC |
| Red-breasted Thrush | <i>Tarsiger migratorius</i> | Turdidae | LC |
| Red-crested Pochard | <i>Netta rufina</i> | Anatidae | LC |
| Red-headed Bullfinch | <i>Pyrrhula erythrocephala</i> | Fringillidae | LC |
| Red-vented Bulbul | <i>Pycnonotus cafer</i> | Pycnonotidae | LC |
| Red-wattled Lapwing | <i>Vanellus indicus</i> | Charadriidae | LC |

| | | | |
|----------------------------------|-------------------------------------|-----------------|----|
| River lapwing | <i>Vanellus duvaucell</i> | Charadriidae | NT |
| Robin Accentor | <i>Prunella rubeculoides</i> | Prunellidae | LC |
| Rock Pigeon | <i>Columba livia</i> | Columbidae | LC |
| Rosy Pipit | <i>Anthus roseatus</i> | Motacillidae | LC |
| Ruddy Shelduck | <i>Tadorna ferruginea</i> | Anatidae | LC |
| Ruddy-breasted Crake | <i>Zaporina fusca</i> | Rallidae | LC |
| Rufous Sibia | <i>Heterophasia capistrata</i> | Leiotherichidae | LC |
| Rufous-bellied Niltava | <i>Niltava sundara</i> | Muscicapidae | LC |
| Rufous-bellied Woodpecker | <i>Dendrocopos hyperythrus</i> | Picidae | LC |
| Rufous-breasted Accentor | <i>Prunella strophciata</i> | Prunellidae | LC |
| Rufous-fronted Tit | <i>Aegithalos iouschistos</i> | Aegithalidae | LC |
| Rufous-gorgeted Flycatcher | <i>Ficedula strophciata</i> | Muscicapidae | LC |
| Rufous-vented Tit | <i>Periparus rubidiventris</i> | Paridae | LC |
| Rufous-vented Yuhina | <i>Yuhina occipitalis</i> | Zosteropidae | LC |
| Russet Sparrow | <i>Passer cinnamomeus</i> | Passeridae | LC |
| Rusty-flanked Treecreeper | <i>Certhia nipalensis</i> | Certhiidae | LC |
| Satyr Tragopan | <i>Tragopan satyra</i> | Phasianidae | NT |
| Scaly-breasted Munia | <i>Lonchura punctulata</i> | Estrildidae | LC |
| Short-billed Minivet | <i>Pericrocotus brevirostris</i> | Campephagidae | LC |
| Silver-eared Laughingthrush | <i>Trochalopteron melanostigma</i> | Leiotherichidae | LC |
| Slaty-blue Flycatcher | <i>Ficedula tricolor</i> | Muscicapidae | LC |
| Snow Pigeon | <i>Columba leuconota</i> | Columbidae | LC |
| Solitary Snipe | <i>Gallinago solitaria</i> | Scolopacidae | LC |
| Speckled Wood Pigeon | <i>Columba hodgsonii</i> | Columbidae | LC |
| Spotted Dove | <i>Spilopelia chinensis</i> | Columbidae | LC |
| Spotted Laughingthrush | <i>Ianthocincla ocellata</i> | Leiotherichidae | LC |
| Spotted Nutcracker | <i>Nucifraga caryocatactes</i> | Corvidae | LC |
| Streak-breasted Scimitar Babbler | <i>Pomatorhinus ruficollis</i> | Timaliidae | LC |
| Stripe-throated Yuhina | <i>Yuhina gularis</i> | Zosteropidae | LC |
| Tibetan Partridge | <i>Perdix hodgsoniae</i> | Phasianidae | LC |
| Tibetan Snowcock | <i>Tetraogallus tibetanus</i> | Phasianidae | LC |
| Tickell's Leaf Warbler | <i>Phylloscopus affinis affinis</i> | Phylloscopidae | LC |
| Ultramarine Flycatcher | <i>Ficedula superciliaris</i> | Muscicapidae | LC |
| Verditer Flycatcher | <i>Eumyias thalassinus</i> | Muscicapidae | LC |

| | | | |
|-------------------------------|-----------------------------------|----------------|----|
| Wallcreeper | <i>Tochodroma muraria</i> | Tichodromidae | LC |
| Ward's Trogon | <i>Harpactes wardi</i> | Trogonidae | NT |
| Water Pipit | <i>Anthus spinoletta</i> | Motacillidae | LC |
| Whiskered Tern | <i>Chlidonias hybrida</i> | Laridae | LC |
| Whiskered Yuhina | <i>Yuhina flavicollis</i> | Zosteropidae | LC |
| Whistler's Warbler | <i>Phylloscopus whistleri</i> | Phylloscopidae | LC |
| White browed starling | <i>Grafisia torquata</i> | Sturnidae | LC |
| White collared blackbird | <i>Turdus albocinctus</i> | Turdidae | LC |
| White Wagtail | <i>Motacilla alba</i> | Motacillidae | LC |
| White-browed Bush Robin | <i>Tarsiger indicus</i> | Muscicapidae | LC |
| White-browed Fulvetta | <i>Fulvetta vinipectus</i> | Sylviidae | LC |
| White-capped Redstart | <i>Phoenicurus leucocephalus</i> | Muscicapidae | LC |
| White-tailed Nuthatch | <i>Sitta himalayensis</i> | Sittidae | LC |
| White-throated Fantail | <i>Rhipidura albicollis</i> | Rhipiduridae | LC |
| White-throated Laughingthrush | <i>Pterorhinus albobularis</i> | Leiothrichidae | LC |
| White-throated Redstart | <i>Phoenicurus schisticeps</i> | Muscicapidae | LC |
| White-winged Grosbeak | <i>Mycerobas carnipes</i> | Fringillidae | LC |
| White-winged Redstart | <i>Phoenicurus erthrogasterus</i> | Muscicapidae | LC |
| Winter Wren | <i>Troglodytes hiemalis</i> | Troglodytidae | LC |
| Wood Snipe | <i>Gallinago nemoricola</i> | Scolopacidae | VU |
| Yellow-bellied Fantail | <i>Chelidorhynch hypoxanthus</i> | Stenostiridae | LC |
| Yellow-billed Blue Magpie | <i>Urocissa flavirostris</i> | Corvidae | LC |
| Yellow-breasted Green Finch | <i>Chloris spinoides</i> | Fringillidae | LC |
| Yellow-rumped Honeyguide | <i>Indicator xanthontus</i> | Indicatoridae | NT |

Note: LC – Least Concern, NT – Near Threatened, VU – Vulnerable

Annexure 7: Detection rate and occupancy of the mammal species

| Species | Detection | SE | Lower CI | Upper CI | Occupancy |
|----------------------|-----------|------|----------|----------|-----------|
| Blue sheep | 0.01 | 0.00 | 0.00 | 0.01 | 1.00 |
| Hare | 0.07 | 0.06 | 0.01 | 0.32 | 0.04 |
| Red fox | 0.05 | 0.03 | 0.02 | 0.14 | 0.20 |
| Snow leopard | 0.00 | 0.00 | 0.00 | 0.01 | 0.99 |
| Wild dog | 0.00 | 0.00 | 0.00 | 0.01 | 0.99 |
| Wolf | 0.00 | NA | NA | NA | 1.00 |
| Marmot | 0.49 | NA | NA | NA | 0.00 |
| Himalayan black bear | 0.49 | NA | NA | NA | 0.00 |
| Thorold's deer | 0.00 | NA | NA | NA | 1.00 |
| Asiatic golden cat | 0.49 | NA | NA | NA | 0.00 |
| Goral | 0.00 | NA | NA | NA | 1.00 |
| Musk deer | 0.00 | NA | NA | NA | 1.00 |
| Serow | 0.05 | 0.03 | 0.02 | 0.14 | 0.20 |
| Takin | 0.49 | NA | NA | NA | 0.00 |
| Barking deer | 0.07 | 0.06 | 0.01 | 0.32 | 0.04 |
| Sambar | 0.49 | NA | NA | NA | 0.00 |
| Wild pig | 0.00 | 0.00 | 0.00 | 0.01 | 0.99 |
| Common leopard | 0.49 | NA | NA | NA | 0.00 |
| Red panda | 0.49 | NA | NA | NA | 0.00 |
| Leopard cat | 0.07 | 0.06 | 0.01 | 0.32 | 0.04 |
| Gray langur | 0.00 | NA | NA | NA | 1.00 |
| Gaur | 0.49 | NA | NA | NA | 0.00 |
| Marbled cat | 0.49 | NA | NA | NA | 0.00 |
| Tiger | 0.49 | NA | NA | NA | 0.00 |

Divisional Forest Office,
Paro was established in 1991
covering an area of 1609km²

Encompasses 10 Gewogs of
Paro and four Gewogs of Haa districts

DFO, Paro has 11 adult
individual Snow leopards.

About 61% of the total area
under forest cover with four
major area-based management
regimes.

DFO, Paro is home to
212 bird species.

Divisional Forest Office, Paro
Department of Forests and Park Services
Ministry of Energy and Natural Resources

