

Plant diversity and conservation status of Himalayan Region Poonch Valley Azad Kashmir (Pakistan)

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Abstract: The plant diversity of Himalayan region has been reduced to greater extent due to environmental degradation and human exploitation. Anthropogenic disturbance was the major factor responsible for fragmentation of forest vegetation into small patches. Little research has been conducted in the Himalayan region of Poonch Valley of North eastern Pakistan with reference to plants biodiversity and its conservation. The present research was carried out to provide a checklist of vegetation for biodiversity conservation. A total of 430 vascular and 5 nonvascular plant species with 5 species of Bryophytes (5 families), 13 species of Pteridophytes (6 families), 4 species of Gymnosperms (1 family) and 413 species of angiosperms (95 families) were enumerated from the Poonch valley Azad Kashmir. The genera were classified into three categories according to the number of species. 25 plant communities with phytosociological parameters and diversity indices were reported. Present study revealed that there were 145 threatened, 30 endangered, 68 vulnerable and 47 rare species. It is recorded that extensive grazing, uprooting of plants and soil slope erosion intensify the environmental problems. Since there is maximum exploitation of vegetation, the valley showed a decline in plant diversity. The study was also indicated that the main threats to the biodiversity are expansion of settlement and army installations in the forest area of the valley. For sustainable use In-situ and Ex-situ conservation, controlled harvesting and afforestation may be the solution. Moreover, forest area should be declared prohibited for settlements and army installations.

Keywords: Plant biodiversity, conservation, flora, indigenous communities, Poonch, Himalayan region

INTRODUCTION

Loss of biodiversity of tropical forests is mainly due to degradation and destruction of habitat by human activities, is now recognized as a global problem (Wilson, 1998). One of the important challenging tasks for ecologists is to understand the relationship between biodiversity and functioning of ecosystems (Davis and Richardson, 1995). Reorientation of the attitudes of people towards maintaining biodiversity is of utmost important (Ramakrishnan *et al.* 1998, Mishra *et al.* 2003).

Pakistan supports a wide array of ecosystem. All corners of the country comprise a variety of natural environments. The North is the most unique area as for as its environment and variety of habitats concern.

Justification and objectives for the study

Azad Kashmir has a very small forest area comprising only 12% of its total area as compared to the world's average of about 33% (Azad Kashmir Statistical Book 1998). The coniferous forests in the hilly regions are the largest natural forest resources due to favorable ecological conditions (Siddiqui and Khan, 1991). There is an intense pressure by increasing population (more than million people with 2% growth rate) for goods and services

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associated with the forests; as a result forest resources had been considerably depleted over the years. Forests are most important contributors to the economics and social well being of people. The coniferous forests of the valley are source of good timber wood and firewood for the local inhabitants.

Topographically, the scrub forest of the lower altitudes, especially of the Mandhole, Kelot, Tian, Thorar, Azad Patten study sites, occupy more or less flat areas, and are more prone to conversion to other land uses such as urban encroachment and agricultural land. In some places' formerly forested area have been completely transformed to bare land due to heavy pressure of tree cutting for fuel and house construction by the local communities as well as by heavy grazing pressure by their cattle. This situation will become worse if the present rate of deforestations is continued and new reforestation efforts on a large scale are not made. This is particularly true for the site selected in this project. It is therefore, necessary to pay special attention to protect, preserve and maintain the natural forests.

The main aims of the research are as follows:

1. To compile the inventory of the flora and to develop awareness among local inhabitants for biodiversity conservation.

2. To obtain information on vulnerable, threatened and endangered plants of the area.

Study area-A historical outline

From the end of 17th century up to 1837 A.D. different Rajas of Loran ruled Poonch. It then fell into the hands of the Raja Faiz Talib Khan of Rajori. In 1846, this area was handed over to Maharaja Ghulab Singh under the treaty of Amritsar. Before this transfer Poonch was considered a district of Lahore. Maharaja Ghulab Singh handed over Poonch and some other areas to his nephews, Jawahar Singh and Moti Singh, with the condition that they would not make any administration changes without the consent of the Maharaja of Kashmir. Poonch was annexed and converted into Jagir by Maharaja Hari Singh in 1935-36 by deposing Raja of Poonch. The Dogras always found it difficult to establish their rules in Poonch. In 1947, the people of Poonch started armed struggle against the Dogra and Indian forces and were liberated. The area that is now administratively stands divided into three districts namely Poonch, Sudhnoti, and Bagh (Net Mag-IT and Kashmir, 2005 and P.N.K. Bamzai 1995). The study area is now confined to the present district Poonch, Sudhnoti and the adjacent part of district Bagh.

Physical geography/ topography

The study area includes the Poonch valley of District Poonch, Sudhnoti and the adjacent eastern part of the district Bagh. The area is situated between 33°-36° North latitude and 73°-75° East longitude, guarded by occupied Poonch district of central Kashmir on the east, Rawalpindi city on the west, Tatta Pani and Kotli on the south and Suddhen Gali Muzaffarabad on the north. The total area is 8.5×10^4 km² and from administrative point of view, it covers Poonch, Sudhnoti and part of Bagh districts respectively. The region has got an average height of 1750-2500 meter from mean sea level, sloping from south north to north east.

The climate

The climate of the area is of temperate. The average annual rainfall of the area is about 1600mm. the southwest monsoon advances into the area in the later half of June with 93% of the annual rainfall during July-September. The mean maximum humidity is 95.16% and the means minimum humidity is 56.75%. Cold season starts by mid October and lasts up to mid March, December and January being the coldest months. The average minimum and maximum temperature during the year varies from 3C° to 26C°. During the summer months temperature rises to as high as 40C° to 45C°, with the onset of monsoon there is an appreciable drop in temperature. There is heavy snowfall during December to February and is approximately 30 to 90 cm deep and completely covers the area. River Poonch flows in the east boarder of the investigated area. There are many springs and small streams and nullahs.

Socio-economic condition

The people of Poonch are poor and the area is highly under developed. Local people are primarily farmers or tenants. They also rear livestock. The area, particularly, the foothills and plains, has an agricultural economy mainly dependent on rainfall. Maize, wheat and rice are the main crops while beans and peas are also cultivated in the area. Among fruits; apples, apricots, peaches, walnuts, plumps, pears, and citrus are grown and are exported. Some people collect medicinal plants and morel and sell it in local markets, thus earn their livelihood. The people also earn by selling handicrafts such as Namda, Gubba, Patto, Woolen shawls etc.

Plant Diversity of the Poonch Valley

Poonch valley is being a part of one of the six phytogeographical regions, is much lower in the number of species per genus than the global average. The Kashmir Himalayas in particular are identified as a global center of plant diversity and endemism. Almost 80% of Pakistan endemic flowering plants are confined to northern and western mountains (Ali and Qaiser 1986). The vegetation of the area generally reflects mixed deciduous type forests, with clear indication of the adverse effect of climate edaphically and biotic factors on the plants communities present in various locations of the area and influencing the floristic diversity of those spots. The forests of the area show the altitudinal zonation of the vegetation to the extent that *Abies pindrow*, *Aesculus indica*, *Pinus wallichiana*, *Salix denticulata*, *Cedrus deodara*, *Viburnum foetans*, *Sarcococca saligna*, *Lonicera quinquelocularis*, *Achillea millefolium* and *Buxus papilosa* are abundant at the top of the mountains. While *Quercus incana*, *Pinus roxburghii*, *Pyrus pashia*, *Citharaxylum spinosa*, *Diospyrus lotus* are abundant in the middle zone while *Morus alba*, *Melia azedarach*, *Dalbergia sissoo*, *Acacia modesta*, *Berberis lycium*, *Punica granatum*, *Ziziphus nummularia*, *Viola biflora*, *Taraxacum officinale*, *Cynodon dactylon* are abundant at the foot of the hills. The area has a natural vegetation and propagation of medicinal plants.

The Poonch valley is lying adjacent to the Himalyan range and enjoying a climate favorable for the growth of good forests. Geographically, two forest types were observed in the area: Moist temperature forests and subtropical pine forest. These, according to the vegetation, can be divided into sub types:

- 1) *Pinus wallichiana* forest. This is the principal type, covering about 60 percent of the forest area. The dominant species is *Pinus wallichiana* associated with *Quercus dilatata*, *Aesculus indica*, *Populus ciliata* provide a useful vegetation cover and a good timber wood and firewood.
- 2) *Abies pindrow* (Tung) forest. This sub type forest occurs mostly in pure patches and sometimes mixed with other species and occupies about 2 percent of

the forest area. It is found in the northeast region of the valley.

- 3) *Quercus incana* forest. It is associated with pure patches and also mixed with *Populus ciliata*, *Rhododendron arboreum* and *Citharexylum spinosa*.
- 4) Sub-tropical evergreen forest. Found on the higher elevation and is associated with *Cornus papilosa*, *Populus ciliata*, *Bauhinia variegata*, *Buxus papilosa*.

Mixed miscellaneous forest: This occurs between the elevations of 3500 to 5000 feet. The dominant species are *Acacia modesta*, *Dalbergia sissoo*, *Carissa caranta* and *Dodonaea viscosa*.

Threats to biodiversity of the area: It has been felt for quite some time that for different kinds of plants and animals the threats of extinction grows as human demands increase on the limited sources of this planet. Over the last few decades, the main human threat to biodiversity has been hunting/cutting and introduction of alien species (UNEP, 1995). The main threats to the biodiversity of the area are: human impact, free collection of medicinal plants, soil erosion, land sliding, expansion of settlements and army installations in the forest area of the valley.

METHODS

Before collection of the data a general visit was made to obtain an over view of the area in order to gain familiarity with different vegetation types, the local flora, the topography and land use per cover pattern. As vegetation of the area exhibit random pattern, therefore, a stratified random sampling design was adopted (Gilbertson *et al.*, 1985). Quadrat method was used for sampling the vegetation. The total research area was divided into 45 sites of vegetation potential. Each site was divided into sampling stands of thick vegetation.

Quadrat of 20×20m² for trees, 5×5m² for shrubs and 1×1m² for herbs layer respectively. Total number of quadrat in all stands was 5 for trees, 10 for shrubs and 20 for herbs respectively. The plants were collected, dried in blotting papers/ newspapers. These plants were later identified and preserved. The plants were mounted on herbarium sheets and deposited in herbarium of Quaid-i-Azam University Islamabad (ISL).

Bryophytes, Pteridophytes, Gymnosperms and Angiosperms were collected during different seasons of the year. The plants were assigned to their relevant families and a checklist of the flora of the Poonch was documented. The checklist was then compared with available literature (Stewart, 1972, Nasir & Ali 1971-95, Ali and Qaiser, 1986).

Measurement of Phytosociological Parameters

Absolute density, Relative density, Absolute frequency, Relative frequency, Absolute abundance, Relative

abundance, Basal area, Importance Value Index (IVI) and Summed dominance ratio (SDR), (Ravindranath *et al.*, 1992; Muller-Dombios and Ellenberg 1974) phytosociological parameters were computed from the data.

Measurement of Species Diversity

Following measurements were made for assessing the biodiversity of the area: Index of similarity and dissimilarities, species diversity (Simpson's index and Shannon-wiener formula), floristic richness, floristic diversity and floristic evenness (Williams 1987; Magurran 1988).

Species Richness

It is the expression of simple ratio between number of species and square root of the total number of individuals of all species. The species richness (d) was calculated as follow:

$$d = \frac{s}{\sqrt{n}}$$

Where s = number of species and

n= number of individuals of all the species

The changing pattern of diversity can be examined by calculating the Shannon – wiener diversity and Simpson's index/McIntosh's diversity index (U).

The Shannon diversity index (Simpson 1949)

Index based on the assumption that individuals were randomly sampled from an infinitely large population. The Shannon diversity index was calculated from the formula.

$$\text{Diversity } H' = - \sum_{i=1}^s P_i \ln P_i$$

Where

s= number of species.

P_i = the proportion of the individuals or the abundance of the species expressed as a proportion of total cover.

ln = log base

McIntosh's diversity (McIntosh, 1967)

McIntosh's index was calculated with the formula

$$U = \sqrt{\sum_{i=1}^s n_i^2}$$

Where

U = McIntosh diversity index.

s = the number of species.

n = number of individuals or abundance of the ith species in the sample.

Index of dominance

The index of dominance (D) is dependent on the total abundance of the quadrat sample (N) and was calculated as follows:

$$D = \frac{N - U}{N - \sqrt{N}}$$

Index of Evenness

Evenness was computed with the formula:

$$E = \frac{N U}{N - N/\sqrt{s}}$$

The higher the values of E, the more even the species are in their distribution between the quadrats.

Plant conservation

In Poonch, the plant resources are utilized ruthlessly and thus most of the threatened plants are of ethnobotanical importance. In order to study the conservation status of ethnobotanically important flora, transect walks were made during different seasons throughout the area, which covered all slopes aspects and latitudes. Local people especially plant collectors provided valuable information about plant abundance, distribution and localities of their maximum availability. The information's were confirmed through field visits. Personal observations were made in the field keeping several parameters in consideration. Field observations include, range extent and area of occupancy, exploitation level, plants availability, habitat alternation, conservation efforts, plant collection techniques, part collected, invasive plants, threats (pollution, lack of awareness, deforestation etc.). The plant species were then categorized into critically endangered, vulnerable, rare, near threatened and secure.

Criteria developed for conservation status assessment

A plant is assigned global rank (G-rank) which applies across its entire range, a national rank (N-rank) for each nation in its range and a sub-national rank (S-rank) for any other smaller unit (a specific locality) jurisdiction in its range (e.g. Poonch valley). The conservation rank of an element known or assumed to exist within the jurisdiction is designated by a specific number from 0 to 6, preceded by a G (Global), N (National) and S (Sub-national or local). The numbers have the following meanings:

0=Extinct 1=Critically Endangered 2=Endangered 3 =Vulnerable to extinction 4=Rare 5= Near threatened 6=Secure

Table 1: Categories 1, 2 and 3 according to the number of genera and species of flowering plants, gymnosperms and pteridophytes in the flora of Poonch

	Category I		Category II		Category III		
	1	2	3	4	5	6	7
Genera	205	48	23	9	1	2	1
Number of genera	253		32		4		
Total no. Of genera	289		289		289		
%age of genera	87.54		11.07		1.39		
Number of species	301		105		24		
Total no. of species	430		430		430		
%age of species	70.00		24.40		5.60		

During present study the prime tools used for rank assignment were field observations and local informants because no earlier reports on the flora of Poonch were available. Therefore this somewhat different from other scale used because of unavailability of earlier reports on the flora of the study area. Extinct and critically endangered categories were not included (Appendix 1).

Conservation Status Scale (C.S.S.) = Total conservations of a species at different localities/Total number of localities visited. Lists of endangered, rare and vulnerable species were prepared with the help of published work of IUCN (1980, 1994).

RESULTS

Details on plant biodiversity were collected and studied for determination. A list of all plants with detail on the family, habit, habitat, collection month, altitude and locality within the valley is presented in table 2.

Plant Diversity

Floristic studies of the area during plant explorations revealed that 5 species of Bryophytes belonging to 5 genera of 5 families, 13 species of Pteridophytes belonging to 10 genera of 8 families, 4 plant species of Gymnosperms belonging to 3 genera of one family and 413 plant species of Angiosperms belonging to 95 families (56 species of Monocots belonging to 48 genera of 10 families and 357 plant species of Dicots belonging to 228 genera of 85 families) were recorded in the study area.

Floristic estimation

Table 1 show 289 genera and 430 species of pteridophytes, gymnosperms and flowering plants in study area with genera classified into three arbitrary categories according to the number of species. Category I consists of genera represented by one to two species, category II by three to four species and category III by five to seven species.

Table 2: A list of all plants with detail on the family, habit, habitat, collection month, altitude and locality within the valley

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
1.	<i>Arisaema tortuosum</i> (Wall.) Schott Araceae	Herb	Open moist places	Jul-Aug 7000-8000	LD, TP
2.	<i>Arisaema flavum</i> (Forssk.) Schott Araceae	Herb	Open dry places	Jul-Aug 5000-7000	Pdk, Sr and Bs
3.	<i>Arundo donax</i> Linn. Arundnaceae	Shrub	Dry open places	Jul-Sep 4500-5500	Md, Dth and Hj
4.	<i>Commelina benghalensis</i> Linn. Commelinaceae	Herb	Moist fertile soil	Jul-Aug 4000-5000	Md, Gh, Kh
5.	<i>Carex pseudocyperus</i> Linn Cyperaceae	Herb	Wet places	May-Aug 3000-04000	Hj, Ph, Dth, Pl, Gh
6.	<i>Carex spp.</i> Cyperaceae	Herb	Steep places	May-Aug 3500-6000	Hj, Ph, Dth, Pl, Sr
7.	<i>Scirpus lacustris</i> (Royle) Eng. & Irm Cyperaceae	Herb	Moist habitat	Jul-Aug 5000-6000	BG, Bj, Dth
8.	<i>Scirpus sylveticus</i> (C.C.Gmel)Cyperaceae	Herb	Moist shady places	Jul-Aug 3500-6000	Md, Hj, Trk, Pl
9.	<i>Cyperus compressus</i> Linn.Cyperaceae	Herb	Dry open places	May-June 4000-5000	Gh, Kh, Dth, Ph Pl
10.	<i>Cyperus longus</i> Linn. Cyperaceae	Herb	Marshy places.	Jul-Aug 4000-5000	Low land
11.	<i>Dioscorea deltoidea</i> Wall. ex Kunth Dioscoreaceae	Herb	Moist shady places	Jul-Aug 4000-5000	TP, Gh, Kh, Hj, Trk
12.	<i>Lilium polyphyllum</i> D.Don. Bul Liliaceae	Herb	Moist shady places	Apr-May 6000-7000	N.PI
13.	<i>Paris polyphylla</i> H.B. & K Liliaceae	Herb	Moist shady places	Jul-Aug 6000-8000	Bs, TP, LD, MG
14.	<i>Allium humile</i> Kunth Liliaceae	Herb	Moist temperate forest	Jun.-Aug. 7000-8000	TP, LD, MG
15.	<i>Smilacina purpurea</i> (DC) Liliaceae	Herb	Moist shady places	Jul-Aug 5000-7500	Bj, Jd
16.	<i>Smilax aspera</i> Liliaceae	Herb	Moist shady places	Jul-Aug 5000-8000	MG, Pdk,Bs
17.	<i>Theopogon pallidus</i> BI Liliaceae	Herb	Moist shady places	Jun-Jul 6500-7500	PCh, HM, MG, LD
18.	<i>Tulipa stellata</i> Sibth Liliaceae	Herb	Moist open places	Feb-Mar 3500-4500	Md, Hj, Gh, Dth, Pl
19.	<i>Gagea elegans</i> Wall.ex Royle Liliaceae	Herb	Moist shady places	Jul.-Aug 6000-8000	ShG, Bk, Jd, Bj, MG
20.	<i>Asparagus filicinus</i> Ham Liliaceae	Herb	Shrub Moist shady places	Sep-Oct 4000-5000	Hj, Ph, Sr, Kh, PCh.
21.	<i>Cryptochilus luteus</i> Orchidaceae	Herb	Moist sub alpine forest	Jul-Aug 6000-7000	LD MG, Bj, ShG
22.	<i>Epipectis royleana</i> Lindl Orchidaceae	Herb	Moist damp soil	Jun-Jul 6000-7000	Bj, B
23.	<i>Habenaria pectinata</i> D. Don Orchidaceae	Herb	Moist subalpine forests	Jul-Aug 7000-8000	TP, LD, MG
24.	<i>Herminium monorchis</i> (Linn.) R. BrOrchidaceae	Herb	Damp soil	May-Jun 6000-7000	AS, SG
25.	<i>Malaxis muscifera</i> (Thunb.) Sw Orchidaceae	Herb	Moist grassy field	Jul-Sep 3500-8000	MG, Dth, LD, ShG
26.	<i>Brachypodium sylvaticum</i> P. Beauv Poaceae	Herb	Moist shady places	Jun-Aug 4000-7000	Whole valley
27.	<i>Bromus pectinatus</i> Linn. Poaceae	Herb	Moist places	mar-Apr 3500-5000	Ph, Gh, Pl, Md, Hj
28.	<i>Bromus catharticus</i> Vahl Poaceae	Herb	Moist open places	Mar-Apr 3500-5000	Ph, Trk, Gh, Pl, Md
29.	<i>Apluda aristata</i> Linn. Poaceae	Herb	Dry open places	Jul.-Aug 5000-6000	Dth, Trk, Hj, Kt Pl
30.	<i>Aristida adscensionis</i> Linn. Poaceae	Herb	Dry rocky soil	Jul.-Aug 3000-5000,	Dth, Trk, Hj, Kt, Pl
31.	<i>Cenchrus pennisetiformis</i> Hochst. Steud Poaceae	Herb	Dry open places	Jul.-Aug 3500-5000	Ph, Hj, Pl, Md, Gh
32.	<i>Chrysopogon aucheri</i> (Boiss) Staft Poaceae	Herb	Dry open places	May-Aug 3500-4500	Kh, Gh, Pl, AP, T, Hj

continued...

Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
33.	<i>Eragrostis pilosa</i> (Linn.) P. Beauv Poaceae	Herb	Moist open places	Jun-Jul 3500-5000	Kh, Gh, Dth, Md, Hj
34.	<i>Festuca juncifolia</i> Poaceae	Herb	Moist damp places	Apr-Aug 6000-8000	MG, LD, ShG
35.	<i>Festuca longifolia</i> Poaceae	Herb	Dry rocky soil	Apr-May 4000-5000	Trk, T
36.	<i>Dactylis glomerata</i> Linn. Poaceae	Herb	Moist shady places	May-Jun 5000-6000	N.PI, G
37.	<i>Dichanthium annulatum</i> (Forssk) Stapf. Poaceae	Herb	Open grassy field	Jul-Aug 3500-4500	Gh, Md, Hj, Dth
38.	<i>Digitaria ciliaris</i> (Retz.)Koel Poaceae	Herb	Open dry places	Mar.-Apr. 4000-5000	Throughout the valley
39.	<i>Lolium multiflorum</i> Poaceae	Herb	Moist places	Mar-Jun. 3500-6000	Lower areas of valley
40.	<i>Oplismenus burmannii</i> (Thunb.) Kze Poaceae	Herb	Moist shady places	Apr-may 3500-6500	Ph, Dth, Gh, PI
41.	<i>Paspalidium flavidum</i> Smith Poaceae	Herb	Ditches and wet places	Mar-May 3500-5500	Bj, Dth, Gh, Md, Hj
42.	<i>Pennisetum lanatum</i> (Retz.) A.Comus Poaceae	Herb	Dry rocky soil	Jun-Jul 3500-5000	Trk, PI
43.	<i>Phalaris minor</i> Ham Poaceae	Herb	Moist fertile soil	Mar-Apr 3500-5000	Gh, Md, Dth, H, Ph
44.	<i>Phleum pratense</i> Retz. Poaceae	Herb	Moist shady places	Mar-Apr 3500-5000	Gh, Md, Hj, Dth, Kt
45.	<i>Phragmites karka Falcex</i> Bth Poaceae	Herb	Wet places	Jul-Aug 3500-4500	Gh, Md, Hj, Kt
46.	<i>Poa infirma</i> Poaceae	Herb	Moist open places	Jun-Sep 3500-6000	lower areas of valley
47.	<i>Poa palustris</i> H.B.K. Poaceae	Herb	Moist places	Jun-Sep 6000-8000	MG, TP
48.	<i>Polypogon monspeliensis</i> R.Br. Poaceae	Herb	Wet places	Mar-Apr 3500-6000	Kh, Trk, Gh, PI, Hj
49.	<i>Sorghum halepense</i> (Linn.) Hill Poaceae	Herb	Moist open places	Jul-Aug 3500-5500	Ph, Trk, Hj, Gh, Md
50.	<i>Echinochloa crus-galli</i> (Linn.) P. Beauv Poaceae	Herb	Marshy places	Jul-Sep 4000-6000	Md, Dth, Hj, PI
51.	<i>Cymbopogon schoenanthus</i> Spreng Poaceae	Herb	Dry open places	Jul-Aug 4000-5000	low land of the area
52.	<i>Cymbopogon flexusus</i> Poaceae	Herb	Dry open places	Jul-Aug 4000-5000	Lower areas of valley
53.	<i>Cynodon dactylon</i> (Linn.) Pers. Poaceae	Herb	Moist open places	Whole year 3500-6500	Whole valley
54.	<i>Potamogeton nodosus</i> Linn. Potamogetonaceae	Herb	Pond and lakes	May-Jun 6000-7000	Bj, Hj
55.	<i>Curcuma aromatica</i> Linn Zingiberaceae	Herb	Moist damp soil	Jul-Aug 4000-5000	Gh, K, Bs, Ph
56.	<i>Adhatoda vesica</i> Nees Acanthaceae	Shrub	Dry open places	Mar-Apr 4000-5000	Hj, Kh, AP, Gh, Ph
57.	<i>Barleria cristata</i> Linn. Acanthaceae,	Herb	Open grassy field	Jul-Aug 4000-5000	Md, Kt, AP, Gh, Ph
58.	<i>Dicliptera roxburghiana</i> Nees Acanthaceae	Herb	Moist shady places	Whole year 3500-4500	Whole valley
59.	<i>Justicia peploides</i> (Nees in Wall) T.Anders Acanthaceae	Herb	Dry rocky soil	Jun-Jul 3500-4500	Md, Kh, AP, Gh, Ph
60.	<i>Strobilanthes dalhousieanus</i> Edgew. Acanthaceae	Herb	Moist shady places	Mar-Apr 3500-5000	Md, PI, Kh, AP, Hj
61.	<i>Strobilanthes attenuatus</i> (Nees) Clarke Acanthaceae	Herb	Moist shady places	Jun-Jul 4500-8000	MG, TP, LD, ChH
62.	<i>Acer acuminatum</i> Wall Aceraceae	Tree	Moist rocky Places	Mar-Apr 6000-7000	PI, Pdk, Gh,Sr
63.	<i>Acer caesium</i> Wall ex Brandis Aceraceae	Tree	Moist rocky places	Mar-May 6000-7000	PI, Gh, Sr
64.	<i>Achyranthes aspera</i> Linn. Humid Amaranthaceae	Herb	Shady places	Jul-Oct 4000-8000	Everywhere

continued...

Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
65.	<i>Alternanthera sessilis</i> (Linn.) DC Amaranthaceae	Herb	Damp soil	Jun-Jul 3000-4000	Hj, Kh, Gh, Pl
66.	<i>Celosia argentea</i> Linn. Amaranthaceae	Herb	Moist fertile soil	Jul-Aug 3500-5000	Ph, Md, Gh
67.	<i>Digera muricata</i> (Linn.) Mart Amaranthaceae	Herb	Moist open places	Apr-May 4000-5000	Gh, Kh, Kt.
68.	<i>Pistacia integerrima</i> A.B.Jackson Anacardiaceae	Tree	Dry Places	Apr-May 3500-5500	Md, Hu, Hj, Dth, Pl
69.	<i>Rhus cotinus</i> Anacardiaceae	Shrub	Sunny hillsides	Apr-May 4000-5000	Ph, Kt, Gh
70.	<i>Nerium indicum</i> Apocynaceae	Shrub	Moist places	May-Aug 3500-5500	Kl, Md, Pl.
71.	<i>Trachelospermum lucidum</i> H. & T.O.E.S. Apocynaceae	Woody climber	Moist shady places	Apr-May 3500-5500	Ph, Kh, Kt a Gh
72.	<i>Carissa caranta</i> Linn. Apocynaceae	Shrub	Low land dry places	Apr-May 3500-5000	Md, Ph, Kh, Pl AP
73.	<i>Ilex dipyrena</i> Wall Aquifoliaceae	Tree	Moist soil	May-Jun 6000-7000	MG, ShG, Bs
74.	<i>Hedra nepalensis</i> K. Koch Araliaceae	Woody climber	Moist shady places	Apr-May 4000-8000	Gh, MG, Bj, Sr
75.	<i>Aristolochia griffithii</i> Aristolochiaceae	climber	Dry shady places	May-Jun 6500-7500	Md, Kh, Gh, Dth, Pl
76.	<i>Ceropegia pubescens</i> Asclepiadaceae	Climber	Dry scrub forest	Apr-May 3500-4500	Md, Ph
77.	<i>Cryptostegia grandiflora</i> R.Br Asclepiadaceae	Herb	Rocky soil	Apr-May 3500-4000	Kh, Gh, P, Hj
78.	<i>Cynanchum vincetoxicum</i> (Linn.) Pers. Asclepiadaceae	Herb	Dry open places	Jun-Jul 4000-5000	Kh, T.Gh, T
79.	<i>Tylophora hirsuta</i> Hk.f. Asclepiadaceae	Woody climber	Dry open places	Jun-Jul 3500-5500	Kh, Dth, Gh, AP
80.	<i>Achillea millefolium</i> Linn. Asteraceae	Herb	Moist temperate forest	Jun-Aug 4000-8000.	MG, TP, LD, ShG
81.	<i>Anaphalis nepalensis</i> (Spreng.) Hand Asteraceae	Herb	Damp soil	Jul-Aug 6000-7000	MG ShG, Dth, Bs, Bj
82.	<i>Anaphalis margaritacea</i> Bth. Hk.f Asteraceae	Herb	Moist temperate forest	Aug-Nov 6000-7000	MG, LD, ShG
83.	<i>Anthemis nobilis</i> Linn. Asteraceae	Herb	Moist shady places	Jun-Jul 4000-6000	HM, B, Dt
84.	<i>Artemisia dubia</i> Wall Asteraceae	Herb	Moist shady places	Jun-Aug 4000-5500	Hj, Md
85.	<i>Artemisia amygdalma</i> Dcne Asteraceae	Herb	Moist temperate forest	Jun-Aug 6000-7000	PCh, TP, Sr, Pdk
86.	<i>Artemisia gmelinii</i> Web.ex Stech Asteraceae	Herb	Moist temperate forest	Jul-Aug 6500-7500	LD, TP
87.	<i>Artemisia roxburghiana</i> Wall.ex Besser Asteraceae	Herb	Moist temperate forest	Aug-Sep 6000-7800	MG, LD
88.	<i>Aster falconeri</i> (Chlarke) Hutch Asteraceae	Herb	Moist shady places	Mar-May 7000-8000	MG, TP, LD
89.	<i>Aster himalicus</i> Asteraceae	Herb	Moist places	Mar-May 6000-7000	HM, Br, Dth
90.	<i>Aster macrophyllus</i> Asteraceae	Herb	Open moist places	Mar-May 4000-5000	Hd, Ph, Gh, Kh
91.	<i>Centaurea iberica</i> Trev.ex Spreng Asteraceae	Herb	Dry rocky soil	Jun-Jul 5000-7000	GM, KhG
92.	<i>Cicerbita macrantha</i> Asteraceae	Herb	Dry open places	Jul-Sep 4000-5000	Pl, Gh
93.	<i>Cichorium intybus</i> Linn. Asteraceae,	Herb	Moist grassy field	Jul-Aug 3500-5000	Kh, Ph, Dth, Pl, Gh
94.	<i>Conyza bonariensis</i> (Linn.) Cronquist Asteraceae	Herb	Dry open places	Jul-Aug 4500-6000	Md, Ph, Hj, Pl, Gh
95.	<i>Echinops echinatus</i> Roxb Asteraceae	Herb	Dry open places	Apr-May 6000-7000	GM, Dth, KhG
96.	<i>Eclipta alba</i> (Linn.) Hasskl. Asteraceae	Herb	Wet places	Jun-Jul 4000-6000	Hj, Pl, GM
97.	<i>Erigeron multicaulis</i> Wall. ex DC Asteraceae	Herb	Sub alpine forest	Jun-Jul 6000-7000	MG, LD
98.	<i>Erigeron multiradiatus</i> Bth. Gen. Asteraceae	Herb	Moist damp soil	Jun-Aug 7000-8000	LD, HM, Pdk, B

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
99.	<i>Gerbera gossypina</i> (Royle) Beauv Asteraceae	Herb	Dry open places	Apr-May 4000-5000	Gh, Kh, Bs, Md, Kt
100.	<i>Gnaphalium affine</i> D. Don Asteraceae	Herb	Moist fertile soil	Jul-Aug 6000-7800	LD, TP, MG
101.	<i>Gnaphalium luteo-album</i> Linn. Asteraceae	Herb	Moist forest	Jul-Aug 7000-8000	MG, LD
102.	<i>Inula cappa</i> (Ham.) DC Asteraceae	Shrub	Moist soil	Jul-Aug 5000-6000	Dth, Pl, G
103.	<i>Inula racemosa</i> Hb. F Asteraceae	Herb	Moist soil	Jul-Aug 6000-7000	GM, ShG
104.	<i>Myrlactis nepalensis</i> Linn. Asteraceae	Herb	Moist shady places	Jul-Aug 4000-7000	MG, Dth, AS, Bj
105.	<i>Origanum vulgare</i> (Retz.) P.Beaur Asteraceae	Herb	Moist grassy field	Jun-Aug 3500-6000	Md, Hj, Pl, Dth
106.	<i>Prenanthes brunoniana</i> Wall ex Lehn Asteraceae	Herb	Moist shady places	May-Jun 5000-6000	MG, Dth, Sr, Trk
107.	<i>Saussurea atkinsonii</i> (Don.) Muell Asteraceae	Herb	Alpine meadows	Jul-Aug 7000-8000	MG, LD
108.	<i>Saussurea gnaphalodes</i> Clarke Asteraceae	Herb	Moist shady places	Jul-Aug 5000-6000	T. Gh, Pl, GhP
109.	<i>Saussurea heteromalla</i> (Royle) Sch.Bip. Asteraceae	Herb	Moist places	Jun-Jul 5000-6000	T. Gh, Pl, GhP
110.	<i>Saussurea roylei</i> (D.Don.) Hand.Viazz Asteraceae	Herb	Alpine meadows	Jul-Aug 6000-8000	TP, GM, Bs
111.	<i>Senecio analogus</i> (Linn.) Pers. Asteraceae	Herb	Moist open places	Jun-Jul 5000-6000	ChH, GhP
112.	<i>Senecio chrysanthemoides</i> DC Asteraceae	Herb	Moist shady places	Jun-Jul 5000-6000	DG, Pl
113.	<i>Senecio kraschenninikovii</i> DC Asteraceae	Herb	Moist open places	Jul-Aug 6000-8000	MG, TP, LD
114.	<i>Senecio graciliflorus</i> Schischkin Asteraceae	Herb	Moist open places	Jul-Aug 5000-8000	Dth, Jd, Bj
115.	<i>Solidago virgaurea</i> Lour Asteraceae	Herb	Moist shady places	Jun-Jul 5000-6500	ShG, GM, Bj
116.	<i>Sonchus asper</i> Linn Asteraceae	Herb	Moist open places	Mar-Apr 3500-5500	Kh, Ph, Dth, Pl, Gh
117.	<i>Taraxacum officinale</i> (G.Don) B.L.Burt Asteraceae	Herb	Moist open places	Mar-Apr 3500-7000	Bj, Ph, Pl, ChH.
118.	<i>Tegetes minuta</i> Asteraceae	Herb	Dry open places	Mar-May 3500-4500	Md, Hj, Dth, Pl, Bj
119.	<i>Tragopogon dubius</i> (D.Don) Schum Asteraceae	Herb	Moist shady places	Jul-Aug 5000-6500	Ph, Pl, Gh
120.	<i>Youngia japonica</i> Linn Asteraceae	Herb	Moist open places	Mar-Apr 3500-5000	Ph, Md, Hd
121.	<i>Impatiens balsamina</i> Linn. Balsaminaceae	Herb	Moist shady	places-----4000- 5000	Ph, Gh
122.	<i>Impatiens edgeworthii</i> Hk. f. Balsaminaceae	Herb	Moist shady places	Jun-Aug 6000-7000	MG, Trk, LD
123.	<i>Berberis aristata</i> DC Berberidaceae	Shrub	Open scrub forest	Apr-Jun 5000-8000	throughout the valley
124.	<i>Berberis lyceum</i> Royle Berberidaceae	Shrub	Lowland forest	Apr-Jun 4000-6000	Kh, Ph, Kt, Md, Gh
125.	<i>Betula utilis</i> D.Don Betulaceae	Tree	Sub alpine forest	Apr-May 4000-5000	Gh, Sr, Pl, Hj
126.	<i>Cynoglossum glochidiatum</i> Wall ex Benth Boraginaceae	Herb	Open moist places	Jun-Aug 5000-8000	LD, Bs, MG
127.	<i>Cynoglossum lanceolatum</i> Forssk Boraginaceae	Herb	Dry open places	Jun-Aug 3500-5000	Md, Pl, Gh, Dth
128.	<i>Cynoglossum zelanicum</i> (Vahl.) Thunb ex Lehn Boraginaceae	Herb	Moist shady places	Jul-Aug 7000-8000	LD,TP.
129.	<i>Lithospermum arvanse</i> Linn. Boraginaceae	Herb	Dry open places	May-Jun 4000-5000	Gh, BG, Kh, Nr
130.	<i>Trichodesma indicum</i> Scop Boraginaceae	Herb	Dry open places	Apr-May 3500-4500	Ph, Kh, Md Pl

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
131.	<i>Nasturtium officinale</i> Wall. ex Roxb Brassicaceae	Herb	Aquatic	Mar-May 3500-4000	Hj, Md
132.	<i>Senebiera didyma</i> (Linn) Alston Brassicaceae	Herb	Moist open places	Mar-Apr 3500-5000	Md, Hj, Dth,Pl
133.	<i>Thlaspi andersonii</i> Brassicaceae	Herb	Moist shady places	Jun-Jul 5000-65000	ChH, ShG, LD, Bj
134.	<i>Capsella-bursa-pastoris</i> (Linn.) Medic Brassicaceae	Herb	Moist open places	Mar-Apr 3500-5000	Md, Pl, Gh, Hj, Kh
135.	<i>Sisymbrium altissimum</i> (Linn.) Pers. Brassicaceae	Herb	Moist open places	Mar-Apr 7000-8000	TP, LD
136.	<i>Sisymbrium irio</i> Linn. Brassicaceae	Herb	Moist open places	Mar-Apr 3500-5000	Md, Kh, Pl
137.	<i>Buxus papilosa</i> C.K. Buxaceae Small	Tree	Moist sub alpine forest	Apr-Jun 5000-8000	TP, ShG, Trk
138.	<i>Sarcococca saligna</i> Wall ex Sweet Buxaceae	Shrub	Moist shady places	Jun-Jul 6000-8000	MG, LD, Jd, Bj, ShG
139.	<i>Bauhinia variegata</i> Linn. Caesalpiniaceae Small	Tree	Sub alpine forest	Mar-Apr 4000-5000	Gh, Dth, Md, Pl
140.	<i>Campanula benthamii</i> Wall Campanulaceae	Herb	Moist open places	Jun-Jul 6000-7000	MG, LD, TP
141.	<i>Lonicera quinquelocularis</i> Lanok Caprifoliaceae	Shrub	Moist shady places	Mar-May 3500-7500	Gh, MG, Hj, ShG
142.	<i>Viburnum cotinifolium</i> Desf.ex Poir Caprifoliaceae	Shrub	Moist shady places	May-Jun 5500-8000	MG, ChH, LD, TP
143.	<i>Viburnum cylindricum</i> D.Don Caprifoliaceae	Shrub	Moist shady places	Apr-May 5500-6000	Bj, Kh, Jd
144.	<i>Viburnum foetens</i> Ham.ex D.Don Caprifoliaceae	Shrub	Moist open places	Apr-May 5500-7000	Jd, Bs, Bj
145.	<i>Cerastium cerastioides</i> (Linn.) Britt Caryophyllaceae	Herb	Moist forest	Jun-Aug 6000-700	ChH
146.	<i>Cerastium fontanum</i> Baug Caryophyllaceae	Herb	Moist sub alpine forests	Jun-Aug 5000-7000	T.Gh, Ckt
147.	<i>Vaccaria pyramiolata</i> Linn Caryophyllaceae	Herb	Moist open places	Mar-Apr 3500-5000	Hj, Kh, Trkl, Pl
148.	<i>Silene conoidea</i> Linn Caryophyllaceae	Herb	Moist open places	Mar-Apr 3500-4500	Md, Pl, Gh, Hj
149.	<i>Silene vulgaris</i> Linn Caryophyllaceae	Herb	Moist open places	Mar-Apr 4500-5000	ChH, GhP
150.	<i>Silene viscosa</i> (Moench.) Garche Caryophyllaceae	Herb	Moist shady places	Mar-Apr 7000-8000	MG, TP, LD
151.	<i>Stellaria decumbens</i> (Linn.) Pers. Caryophyllaceae	Herb	Dry rocky soil	Mar-Apr 5000-8000	Sr, Pdk, TP, LD, MG
152.	<i>Euonymus echinatus</i> Celastraceae Small	Tree	Moist damp soil	Jun-Jul 6000-7000	ShG, Trk, Jd
153.	<i>Chenopodium album</i> Linn. Chenopodiaceae	Herb	Moist open places	Mar-Apr 3500-5000	Md,Pl, Gh, AP, Kh
154.	<i>Ipomoea purpurea</i> (Linn.) Roth Convolvulaceae	Climber	Moist Damp soil	Aug-Sep 4000-5000	GM, Md, Hj, KhG
155.	<i>Ipomoea cairica</i> (Linn.) Sweet Convolvulaceae	Herb	Moist fertile soil	Jul-Aug, 4000-8000	Pl, Trk, Md, Hj
156.	<i>Convolvulus arvensis</i> Linn. Convolvulaceae	Herb	Moist fertile soil	Jun-Jul 3500-4500	Md, Kh, Gh, AP
157.	<i>Cornus macrophylla</i> Wall Cornaceae	Tree	Mixed lowland forest	Apr-May 4000-6000	Kt, Dth, MG, Gh ChH
158.	<i>Sedum ewersii</i> Dunn Crassulaceae	Herb	Moist open places	Jul-Aug 6000-8000	MG, TP, Bj
159.	<i>Sedum adenotrichum</i> Ledeb. Crassulaceae	Herb	Moist rocks	Jul-Sep 7000-8000	MG, TP, BS LD
160.	<i>Corallocarpus epigaeus</i> Clarke Cucurbitaceae	Herb	Moist forest	Apr-May 3500-4500	Hd, Ph, Kh, Kt, Md Gh

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
161.	<i>Momordica dioica</i> Cucurbitaceae	Climber	Moist shady places	Jun-Jul 4000-6000	HM, B
162.	<i>Solena heterophylla</i> Cucurbitaceae	Herb	Moist shady places	May-Jun 3500-5000	Dth, Dt, Pdk, Ckt
163.	<i>Datisca cannabina</i> Linn. Datiscaceae	Shrub	Wet places	Apr-May 4000-6000	Gh, Dth
164.	<i>Dipsacus inermis</i> Wall Dipsacaceae	Herb	Moist damp soil	Jul-Aug 7000-8000	LD,TP
165.	<i>Diospyros lotus</i> Linn. Ebenaceae	Small tree	Open moist places	Aug-Nov 4000-6000	BG, Dth, Trk, G Pl
166.	<i>Elaeagnus parvifolia</i> Wall Elaeagnaceae	Shrub	Moist shady places	Apr-Jun 4000-7000	Hj, Dth, Pl, Kt
167.	<i>Rhododendron arboreum</i> Wall ex Roxb Ericaceae	Small tree	Moist places	Mar-May 6000-7800	MG
168.	<i>Rhododendron hodgsonii</i> Smith Ericaceae	Small tree	Moist places	Apr-May 5500-7800	BG, ShG, MG
169.	<i>Euphorbia cognata</i> Boiss Euphorbiaceae	Shrub	Moist shady places	May-Jun 6000-7800	LD TP
170.	<i>Euphorbia helioscopia</i> Linn. Euphorbiaceae	Herb	Moist open places	Mar-Apr 3500-5000	Md, Hj, Dth, Pl
171.	<i>Euphorbia hirta</i> Linn. Euphorbiaceae	Herb	Moist open places	Jun-Jul 3500-5000	Md, Hj, Dth, Kt, Pl
172.	<i>Euphorbia wallichii</i> Hk. F Euphorbiaceae	Herb	Moist damp soil	Jun-Jul 7000-8000	LD, TP
173.	<i>Mallotus philippensis</i> (Lindl) O.Ktze Euphorbiaceae	Smalltree	Dry rocky soil	May-Nov 3500-5000	Hj, Md, Ph, Kh, Pl
174.	<i>Phyllanthus niruri</i> (Retz.) Euphorbiaceae	Herb	Moist open places	Mar-May 3500-5000	Ph, Kt, Gh
175.	<i>Phyllanthus parvifolius</i> Linn. Euphorbiaceae	Herb	Moist shady places	Mar-May 5000-6000	Sr, Bj, MG, Dth
176.	<i>Andrachne cordifolia</i> (Dene.) Muell Euphorbiaceae	Shrub	Moist shady places	Jul-Aug 3500-7000	Throughout the valley
177.	<i>Croton plicatum</i> Roxb Euphorbiaceae	Small tree	Dry rocky soil	Jun-Jul 4000-4500	Hj, Kh, Kt, S.Pl
178.	<i>Ricinus communis</i> Euphorbiaceae	Shrub	Moist open places	Mar-Apr 3500-5500	Kh, Dth, Pl, Kt
179.	<i>Quercus baloot</i> Ham.ex D.Don Fagaceae	Tree	Moist places	Apr-Aug 5000-6000	Jd, AS, Bs
180.	<i>Quercus dilatata</i> Griffith Fagaceae	Tree	Dry places	Apr-Aug 6000-7000	Chk
181.	<i>Quercus floribunda</i> Lindl ex Royle Fagaceae	Tree	Moist places	Apr-Aug 6000-7000	HC, Sg
182.	<i>Quercus incana</i> Fagaceae	Tree	Dry places	Apr-Aug 3500-5500	BG, Ph, Gh
183.	<i>Fumaria indica</i> (Hausskn) H.N. Pugsley Fumariaceae	Moist fertile soil	Moist fertile soil	Mar-Apr 3500-5000	Hj, Md, Rkt, T, Gh
184.	<i>Gentiana kurroo</i> Royle Gentianaceae	Herb	Moist soil	Jul-Oct 6000-7000	GM, Kh, Gh, Jd, Bj
185.	<i>Gentiana ornata</i> Gentianaceae	Herb	Moist open places	Jul-Aug 6000-7000	TP, GM, Bj, ShG, LD
186.	<i>Swertia chirayita</i> Nees Gentianaceae	Herb	Moist open places	Jul-Aug 4500-6000	Ph, Gh, Sr, Dth, Pl
187.	<i>Swertia paniculata</i> (Roxb.) ex Fleming Karst Gentianaceae	Herb	Moist open places	Jun-Jul 5000-7000	Ph, Gh, Pl
188.	<i>Swertia cordata</i> Wall Gentianaceae	Herb	Moist open places	Jun-Aug 4500-6000	Bs, Jd, Bj, Dth
189.	<i>Swertia ciliata</i> (G.Don.) Clarke Gentianaceae	Herb	Dry open places	Jul-Aug 7000-8000	MG, LD, Bj
190.	<i>Geranium lucidum</i> Linn. Geraniaceae	Herb	Moist shady places	Jul-Sep 4000-5000	Hj, Kt, Hd, Pl
191.	<i>Geranium nepalense</i> Sweet Geraniaceae	Herb	Moist damp places	Jul-Aug 5000-7000	Bj, ChH, Trk
192.	<i>Geranium wallichianum</i> D.Don ex Sweet Geraniaceae	Herb	Moist damp places x	Aug-Sep 6000-8000	MG, Bs,TP

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
193.	<i>Aesculus indica</i> Wall.ex Camb Hippocastanaceae	Tree	Moist deciduous forest	Apr-Jun 6000-7800	ShG, TP, MG
194.	<i>Deutzia staminea</i> R.Br. ex Wall Hydrangeaceae	Shrub	Steep slopes	Apr-May 3500-5000	Ph, Kt
195.	<i>Hypericum oblongifolium</i> Choisy Hypericaceae	Shrub	Dry rocky soil	Mar-Apr 4000-6000	Dth, G, Pl
196.	<i>Hypericum perforatum</i> Linn. Hypericaceae	Herb	Moist open places	Apr-May 6000-7000	Bj, ShG, Tp
197.	<i>Ajuga bracteosa</i> Wall.ex Bth. Lamiaceae	Herb,	Moist open places	Mar-Apr 4000-4500	Hd, Ph, Kh, Gh
198.	<i>Anisomeles indica</i> (Linn.) O. Ktze Lamiaceae	Herb	Dry rocky soil	Apr-May 5000-6000	Kh, Sr
199.	<i>Calamintha repens</i> (Don.) Bth. Lamiaceae	Herb	Moist open places	Jul-Aug 6000-7800	MG, TP, LD
200.	<i>Calamintha umbrosa</i> (M.Bieb) Fisch & Mey Lamiaceae	Herb	Moist shady places	May-Jun 5000-6000	GK
201.	<i>Calamintha Vulgaris</i> (Linn.) Druce Lamiaceae	Herb	Dry open places	Jun-Jul 6000-7000	AS, ShG
202.	<i>Colebrookea oppositifolia</i> Sm. Lamiaceae	Shrub	Dry rocky soil	Apr-May 4000-5000	Hj, Pl, Kt
203.	<i>Elsholtzia ciliata</i> (Thunb.) Hylander Lamiaceae	Shrub	Moist slopy places	Mar-Apr 5000-7000	Pl, AP, T
204.	<i>Elsholtzia fruticosa</i> Lamiaceae	Shrub	Moist subalpine forest	Jun-Aug 7000-8000	GM
205.	<i>Lamium album</i> Linn. Lamiaceae	Herb	Moist shady places	Apr-May 3500-4500	Ph, Pl, Kh
206.	<i>Lamium amplexicaule</i> Linn. Lamiaceae	Herb	Shady places	Apr-May 4000-7000	Bj, ChH
207.	<i>Leucas capitata</i> Desf Lamiaceae	Herb	Dry open places	May-Jun 3500-5000	Ph, Nr, Hd, Pl
208.	<i>Ligularia amplexicaulis</i> DC Lamiaceae	Herb	Moist shady places	May-Jun 5000-6000	GP
209.	<i>Mentha longifolia</i> Wall ex Walper Lamiaceae	Herb	Wet places	Apr-May 3500-5000	Md, Hj
210.	<i>Mentha spicata</i> (Linn) Huds Lamiaceae	Herb	Wet places	Mar-Apr 4000-6000	Ph, Kh, Md, Hj
211.	<i>Mentha arvensis</i> Linn. Lamiaceae	Herb	Wet places	Apr-May 4000-7000	MG, Bj, Dth
212.	<i>Micromeria hydaspidis</i> Linn. Lamiaceae	Herb	Dry open places	May-Jun 5000-6000	GK
213.	<i>Micromeria biflora</i> Falc. ex Bth Lamiaceae	Herb	Open shady places	Whole year 3500-5000	Hj, Pl, Md, Dth
214.	<i>Nepeta erecta</i> R.Br Lamiaceae	Herb	Moist places	Jul-Aug 6500-7000	MG
215.	<i>Nepeta govaniiana</i> Bth. Lamiaceae	Herb	Dry open places	Aug-Sep 5500-6000	Gh, BG
216.	<i>Nepeta levigata</i> Bth Lamiaceae	Herb	Dry open places	Jul-Aug 5000-7000	MG, Sr
217.	<i>Nepeta podostachys</i> (D.Don) Hand-Mazz Lamiaceae	Herb	Dry stony areas	Jul-Sep 6000-7000	MG
218.	<i>Nepeta bracteata</i> Bth. Lamiaceae	Herb	Moist places	Jul-Aug 6000-8000	AS, Dth, Bj
219.	<i>Otostegia limbata</i> Linn. Lamiaceae	Shrub	Dry rocky soil	May-Jul 4000-6000	Ph, Pl, Gh
220.	<i>Phlomis bracteosa</i> Royl ex Bth. Lamiaceae	Herb	Moist shady places	Jul-Aug 6000-8000	LD
221.	<i>Phlomis spectabilis</i> Linn. Lamiaceae	Herb	Dry rocky soil	Jul-Aug 4000-6000	P A A K, Pdk.
222.	<i>Plectranthus coetsa</i> Linn. Lamiaceae	Herb	Moist shady places	Jul-Aug 5000-6000	Trk, Dth, Hj
223.	<i>Plectranthus rugosus</i> Ham. ex D.Don Lamiaceae	Herb	Moist open places	Jul-Aug 6000-7000	MG, Bs
224.	<i>Plectranthus striatus</i> Wall ex Bth Lamiaceae	Herb	Moist shady places	Jul-Aug 5000-6000	Ph, MG, Gh, Kh
225.	<i>Roylea calycina</i> Mchx Lamiaceae	Shrub	Moist open places	Mar-Apr 5000-7000	MG, TP, Bs
226.	<i>Rabdosia rugosa</i> (Roxb) Briq Lamiaceae	Shrub	Dry open places	May-Sep 5000-7000	MG, Bs

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Table 2: continue

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
227.	<i>Prunella vulgaris</i> Lamiaceae	Herb	Moist open places	Apr-May 7000-8000	GM, MG, TP, LD
228.	<i>Salvia lanata</i> N.J.Anderss Lamiaceae	Herb	Dry open places	Mar-Apr 4000-5500	GhP, Kh
229.	<i>Salvia plebia</i> Roxb Lamiaceae	Herb	Drying pools	Mar-Apr 4000-5000	Md, Gh, Hj
230.	<i>Salvia hians</i> R.Br. Lamiaceae	Herb	Drying pools	Mar-Apr 5000-7000	MG, TP, Bj, Bs
231.	<i>Salvia nubicola</i> Royle ex Bth Lamiaceae	Herb	Moist places	Mar-Apr 4500-7000	Dth, Bj, Jd
232.	<i>Scutellaria discolor</i> Linn Lamiaceae	Herb	Moist shady places	Apr-May 6000-8000	Sr, Pl, Gh
233.	<i>Scutellaria prostrata</i> Lamiaceae	Herb	Dry sandy soil	Apr-May 5500-6000	Sr, Pl, BG
234.	<i>Scutellaria teucrifolia</i> Jack. ex Bth. Lamiaceae	Herb	Moist fertile soil	Apr-May 6000-8000	TP, Rkt, Bj
235.	<i>Siegesbeckia orientalis</i> DC Lamiaceae	Herb	Moist open places	Apr-May 4500-6000	Kh, Gh
236.	<i>Persea duthiei</i> Klotzsch Lauraceae	Tree	Moist dense forest	Apr-May 6000-7800	MG, GhP, Bj, Jd
237.	<i>Reinwardtia indica</i> Roxb. Linaceae	Herb	Moist shady places	Mar-Apr 3500-5500	Md, Gh, Dth, Hj, Pl
238.	<i>Buddleja crispa</i> Bth. Loganiaceae	Shrub	Moist steep places	Mar-Apr 4000-5000	KhG, Md, Dth, Pl, Ph
239.	<i>Woodfordia fruticosa</i> Linn Lythraceae	Shrub	Dry open places	May-Jun 3500-5500	Gh, AP, Hj.
240.	<i>Malvestrum coromandelianum</i> (Lam.) Muell Malvaceae,	Herb,	Moist open places	Jun-Jul 3500-5000	Gh, Md, Ph, Dth, Pl
241.	<i>Melia azedarach</i> (Linn) Gruffb Meliaceae	Tree	Moist open places	Mar-Apr 3500-5500	Hj, Kh, Trk, Pl, Dth
242.	<i>Cedrella toona</i> Roxb ex Rottl & Willd Meliaceae	Tree	Dry woodland	Apr-May 3500-5000	Md, Hj, Pl, Gh, Dth
243.	<i>Cissampelos pareira</i> Linn. Menispermaceae	Herb	Dry scrub forest	Apr-May 3500-5000	Kh, Gh, Pl, Br
244.	<i>Acacia modesta</i> Wall Mimosoideae	Small tree	Dry Places	Apr-May 4000-5000	Br, Ph, AP, Pl, Kh Hj
245.	<i>Albizia mollis</i> (Wallich) Ali Mimosoideae	Tree	Moist open places	Apr-May 3500-6000	Br, Ph, AP,Pl, Kh, Hj
246.	<i>Albizia chinensis</i> (Osbeck) Merrill Mimosoideae	Tree	Moist fertile soil	Apr-May 3500-5000	Ph, AP, Pl, Kh, Hj
247.	<i>Mimosa rubicaulis</i> (Ham.) Bth. Mimosoideae	Shrub	Moist shady places	Apr-May 3500-5000	Br, Hd, Hj, Ph
248.	<i>Neptunia oleracea</i> Bth Mimosoideae	Herb	Aquatic	Apr-May 3500-5000	Md, Kl
249.	<i>Broussonetia papyrifera</i> (Linn.) Vent Moraceae	Small tree	Moist fertile soil	Mar-Apr 3500-5000	Everywhere
250.	<i>Ficus auriculata</i> Lour Moraceae Small	tree	Moist shady places	Apr-May 4000-5000	Kt
251.	<i>Ficus foveolata</i> Wall. ex Mig. Moraceae	Shrub	Climbs on trees and cliff	Apr-May 3500-6000	Hj, Kt
252.	<i>Ficus nerifolia</i> (Wall. ex Mig) Corner Mss Moraceae	Small tree	Moist shady places	Apr-May 3500-4500	Kt
253.	<i>Ficus palmata</i> Forssk Moraceae	Small tree	Moist open places	Apr-May 3500-6000	Md, Gh, Dth, Pl, Hj
254.	<i>Ficus virgata</i> Roxb Moraceae	Shrub	Dry steep places	Apr-May 3500-5000	Hj, Hd, Pl, Kt
255.	<i>Ficus glomerata</i> Linn. Moraceae	Small Tree	Moist soil	May-Jun 3500-5000	Md, Pl, Trk, Hj
256.	<i>Morus alba</i> Roxb.ex Willd Moraceae	Small tree	Moist fertile soil	Apr-May 3500-5000	Hd, Ph, Pl
257.	<i>Acanthocalyx nepalensis</i> Morinaceae	Herb	Dry hilly areas	Jul-Aug 5000-7000	GK, Rkt, Dth, Kh, B
258.	<i>Myrsine semiserrata</i> Linn. Myrsinaceae	Herb	Dry steep places	Jul-Aug 5000-6500	Hj, Md
259.	<i>Eucalyptus prostrata</i> Myrtaceae	Tree	Moist soil	May-Jun 3500-4500	Hd, Kl

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
260.	<i>Jasminum humile</i> Linn. Oleaceae	Shrub	Dry open places	Jul-Aug 6000-7000	Bj, PCh, B
261.	<i>Jasminum officinale</i> Linn. Oleaceae	Shrub	Moist open places	Jul-Aug 6000-7500	ChG, GM, ShG
262.	<i>Olea ferruginea</i> Roth Oleaceae	Small tree	Dry places	Apr-May 3500-5500	Kh, Ph, Pl.
263.	<i>Epilobium hirsutum</i> Linn. Onagraceae	Herb	Wet places	Jul-Aug 3500-5500	Md, PCh.
264.	<i>Oenothera rosea</i> Mill Onagraceae	Herb	Moist open places	whole year 5000-7000	Ph, MGi, Md, Hj
265.	<i>Oenothera tetragina</i> Sol and Onagraceae	Herb	Marshy places	Jul-Sep 3500-5000	Ph, Hd.
266.	<i>Oxalis latifolia</i> (B.lb.) Boiss Oxalidaceae	Herb	Moist shady places	Mar-Apr 3500-5500	Hj, Gh, Ph, Md, Pl
267.	<i>Cordalis rutifolia</i> Papavaraceae	Herb	Moist shady places	Jun-Jul 6000-7000	Bk, ShG, MG
268.	<i>Lathyrus aphaca</i> Linn. Papilionaceae	Herb	Moist open	places Mar-Apr 3500-4500	Pl, Dth, Md, Hj, Kt
269.	<i>Lespedeza gerardiana</i> Grah ex Maxim Papilionaceae	Herb	Dry open places	Jun-Aug 6000-7000	Jd
270.	<i>Medicago polymorpha</i> Linn. Papilionaceae	Herb	Moist open places	Mar-May 4000-7000	Gh, Md, Pl, Hj
271.	<i>Medicago minima</i> Linn. Papilionaceae	Herb	Moist open places	Mar-Apr 4000-5000	MG, Bj
272.	<i>Trifolium repens</i> Linn Papilionaceae	Herb	Moist shady places	Apr-May 5000-7000	DG, Sr, Jd, Dth, Gh
273.	<i>Trifolium dubium</i> Linn. Papilionaceae	Herb	Moist shady places	May-Jun 6000-8000	MG, LD
274.	<i>Dalbergia latifolia</i> Roxb Papilionaceae	Small tree	Moist deciduous forest	May-Jun 5500-8000	MG, ShG
275.	<i>Dalbergia sissoo</i> Roxb Papilionaceae	Small tree	Dry mixed forest	Mar-Aug 4000-6000	Md, AP, T
276.	<i>Apios carnea</i> Papilionaceae	Herb	Moist shady places	Jul-Aug 3500-5000	Hj, Md, Kt, Kh, Gh
277.	<i>Argyrolobium roseum</i> (Camb.) Jaub. & Spach Papilionaceae	Herb	Open dry places	Apr-May 4000-5000	Ph, Md
278.	<i>Astragalus candolleanus</i> Royle ex Bth Papilionaceae	Herb	Dry open places	Mar-Apr 4000-5000	Ph, Hd, Kh, Gh, AP, Pl
279.	<i>Hedysarum cachemirianum</i> Bth.ex Baker Papilionaceae	Herb	Moist rocky soil	Jun-Aug 7000-8000	MG, LD, TP
280.	<i>Campylotropis meeboldii</i> Schindl Papilionaceae	Herb	Open dry places	Apr-May 4000-6000	Md, Br, Jd
281.	<i>Rhynchosia pseudo-cajan</i> Linn. Papilionaceae	Shrub	Dry rocky soil	Apr-Jul 3500-4500	Br, Hj, Hd.
282.	<i>Trifolium pratense</i> (Linn) R.B.Cooke Papilionaceae	Herb	Moist open places	Mar-Apr 3500-5500	Ph, Kh, Gh, Dth, Pl
283.	<i>Vicia hirsuta</i> Dene Papilionaceae	Herb	Moist open places	Mar-Apr 3500-4500	Ph, Kt, Hj
284.	<i>Vicia sativa</i> (Linn) S.F.Grey Papilionaceae	Herb	Moist open places	Mar-Apr 3500-5500	Md, Dth
285.	<i>Desmodium podocarpum</i> DC Papilionaceae	Herb	Moist shady places	Jun-Aug 4000-8000	Md, AS, Hj
286.	<i>Desmodium tiliaefolium</i> (D.Don) D.Don. Papilionaceae	Shrub	Moist fertile soil	Jul-Aug 5000-7000	MG, Kh, Pl
287.	<i>Desmodium triflorum</i> (Linn.) DC Papilionaceae	Shrub	Moist temperate forest	Jul-Aug 5000-7000	Bj, Kh
288.	<i>Indigofera hebeptala</i> Bth. Ex Baker Papilionaceae	Shrub	Moist shady places	Aug-Sep 4000-5000	Hj, Pl, Hd, Kt
289.	<i>Indigofera heterantha</i> Wall ex Brand. Papilionaceae	Shrub	Moist soil	Jul-Aug 6000-7000	HM
290.	<i>Plantago amplexicaulis</i> J.L.Stewart ex Brandis Plantaginaceae	Herb	Moist shady places	Apr-May 3500-5500	Ph, Gh, Kh, Hd

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
291.	<i>Plantago ciliata</i> Car. Plantaginaceae	Herb	Hard dry area	Apr-May 3500-5500	Kh, Kt
292.	<i>Plantago lanceolata</i> Desf Plantaginaceae	Herb	Moist open places	Apr-May 4000-6000	Dth, Pl
293.	<i>Acantholimon diapensoides</i> Boiss Plumbaginaceae	Herb	Alpine meadows	Jul-Aug 7000-8000	LD, MG, TP
294.	<i>Plumbago zeylanica</i> (DC) Clarke Plumbaginaceae	Shrub	Moist open places	Mar-Apr 3500-5500	Dth, Pl, Md, Hj
295.	<i>Plumbago rolyeana</i> Plumbaginaceae	Shrub	Moist open places	Mar-May 3500-5000	Ph, Md, Hd, Kh
296.	<i>Podopyllum emodi</i> Linn. Podophylaceae	Herb	Thin forest	Jul-Sep 3500-6000	Dth, PCh, Hj
297.	<i>Polygala abyssinica</i> Wall ex Royle Polygalaceae	Herb	Dry open places	Jul-Aug 3500-5000	Ph, Kh, Hd
298.	<i>Fagopyrum esculentum</i> Moench Meth Polygonaceae	Herb	Moist damp soil	Jul-Aug 6000-7000	TP, ShG, Trk
299.	<i>Polygonatum multiflorum</i> R.Br ex Fresen Polygonaceae	Herb	Moist shady places	May-Jun 4000-8000	MG, Bj, LD, TP
300.	<i>Polygonum affine</i> (Linn.) Polygonaceae	Herb	All Rocky ridges	Jul-Aug 5000-6000	AS, Bj, Dth
301.	<i>Persicaria capitata</i> Polygonaceae	Herb	Moist or wet places	Jun-Jul 5000-6500	ShG, LD, Bj
302.	<i>Polygonum alpinum</i> D.Don Polygonaceae	Herb	Wet places	Jul-Aug 6000-8000	MG, TP
303.	<i>Polygonum molle</i> Polygonaceae	Herb	All Wet places	Jul-Sep 3500-4500	Hj, Gh, Ph, Kt, Md, Pl
304.	<i>Polygonum amplexicaule</i> Polygonaceae	Herb	Moist shady places	Jul-Aug 6000-8000	MG, LD, Bj, Bs
305.	<i>Polygonum nepalense</i> D.Don Polygonaceae	Herb	Moist shady places	Jul-Aug 5000-6000	Bj, ShG
306.	<i>Polygonum plebejum</i> Meissn Polygonaceae	Herb	Wet places	Jul-Aug 5000-6000	AS, Dth, Jd
307.	<i>Rumex dentatus</i> Kunth & Bouche Polygonaceae	Herb	Moist places	Apr-Jun 5500-6500	Bj, Dth, Pl
308.	<i>Rumex hastatus</i> Linn. Polygonaceae	Herb	Dry rocky soil	Apr-Jun 3500-5500	Gh, AP, Dth
309.	<i>Rumex nepalensis</i> D.Don Polygonaceae	Herb	Moist places	Apr-Jun 3500-5000	Ph, Hj
310.	<i>Androsace primuloides</i> Hardw Primulaceae	Herb	Moist open places	May-Jun 6500-8000	LD, MG, ChH
311.	<i>Primula glomerata</i> Wall ex DC. Primulaceae	Herb	Moist wet places	May-Jul 7000-8000	LD
312.	<i>Primula denticulata</i> Linn Primulaceae	Herb	Moist wet places	May-Jul 6500-7500	MG, LD, TP
313.	<i>Punica granatum</i> Franchet Punicaceae	Shrub	Dry open places	Apr-May 3500-6500	Md, Hj, Kh, Dth, Pl
314.	<i>Aconitum heterophyllum</i> Wall ex Royle Ranunculaceae	Herb	Alpine forest	Jul-Aug 5000-7000	ShG, MG, Dth, Jd
315.	<i>Aconitum melifolia</i> Royle Ranunculaceae	Herb	Moist temperate forest	Jul-Aug 6000-8000	ShG, Bk, AS, MG GPL
316.	<i>Anemone tetrapseala</i> Royle Ranunculaceae	Herb	Moist shady places	Jun-Jul 6000-7000	ShG, MG, LD.
317.	<i>Anemone vitifolia</i> Ham Ranunculaceae	Herb	Moist shady places	Jun-Jul 6000-7500	ShG, AS, Bk, MG GPL
318.	<i>Anemone polyanthes</i> D.Don Ranunculaceae	Herb	Moist open places	May-Jun 7000-8000	ShG, MG, ChH.
319.	<i>Aquilegia pubiflora</i> Wall ex Royle Ranunculaceae	Herb	Moist places	May-Jun 6000-8000	MG, LD.
320.	<i>Clematis barbellata</i> Edgew Ranunculaceae	Herb	Moist sub alpine forest	Jul-Aug 6000-7000	Gh, Md, Br.
321.	<i>Clematis connata</i> DC Ranunculaceae	Herb	Low land and deciduous forest	Jul-Aug 5000-6000	MG, TP.
322.	<i>Clematis gouriana</i> Roxb ex DC Ranunculaceae	Herb	Low land deciduous forest	Jul-Aug 4000-5000	Gh, Md, Kt, Kh, AP

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
323.	<i>Clematis grata</i> Wall Ranunculaceae	Herb	Moist mountain forest	Jul-Aug 6000-7800	Bj, Jd, ChH
324.	<i>Clematis graveolens</i> Lindl Ranunculaceae	Herb	Moist low land forest	Jul-Aug 3500-5000	Tp, B
325.	<i>Clematis montana</i> Buch. Ham Ranunculaceae	Herb	Moist sub alpine forest	Jul-Aug 6000-8000	TGh, Pl
326.	<i>Clematis paniculata</i> Ranunculaceae	Herb	Moist sub alpine forest	Jul-Aug 6000-7500	Bj, TP, LD, MG
327.	<i>Ranunculus arvensis</i> (Roxb) Bth & Hk.f Ranunculaceae	Herb	Moist shady places	Mar-Apr 3500-6000	Md, Hj, Pl
328.	<i>Ranunculus hirtellus</i> Linn. Ranunculaceae	Herb	Moist open places	Mar-Apr 5000-8000	Md, Hj
329.	<i>Ranunculus muricatus</i> Royle Ranunculaceae	Herb	Wet places	Mar-Apr 3500-5500	Gh, Hd, Kh, AP, Br
330.	<i>Ranunculus scleratus</i> Linn. Ranunculaceae	Herb	Marshes and wet places	Mar-Apr 3500-5000	Gh, ShG, Dth, MG
331.	<i>Thalictrum alpinum</i> Ranunculaceae	Herb	Moist open places	Jun-Aug 5500-8000	MG, Bj, ShG, ChH, Jd
332.	<i>Thalictrum cultratum</i> Linn Ranunculaceae	Herb	Moist shady places	Jun-Aug 3500-5000	Pdk, Kt, Ak, Jd, Pl
333.	<i>Thalictrum virgatum</i> Wall Ranunculaceae	Herb	Moist shady places	Jun-Jul 4500-6000	Ph, Dth, DG, Pl, Trk
334.	<i>Helinus lanceolatus</i> Wall ex Brandis Rhamnaceae	Shrub	Moist shady places	Apr-May 5000-6000	Nr, Kh, Gh
335.	<i>Ziziphus mauritiana</i> Roxb Rhamnaceae	Shrub	Dry open places	Jun-Aug 4000-6000	Kh, TGh, Gh
336.	<i>Ziziphus oxyphylla</i> Lamb Rhamnaceae	Shrub	Dry open places	Jul-Aug 3500-5500	Dth, AP, Hj
337.	<i>Ziziphus nummularia</i> Edgew Rhamnaceae	Small tree	Dry rocky soil	Jun-Aug 4000-6000	Gh, Pl
338.	<i>Rhamnus purpurea</i> Linn. Rhamnaceae	Small tree	Mesophytic forest	Apr-May 4500-7500	MG, Gh, Pl
339.	<i>Rhamnus triquetra</i> Edgew Rhamnaceae	Shrub	Moist open places	Apr-May 3500-6500	Bs, Dth
340.	<i>Agrimonia pilosa</i> Hk.f. non Ledeb Rosaceae	Herb	Moist open places	Jul-Aug 6000-7000	LD, Bj
341.	<i>Fragaria nubicola</i> Lindl. Ex Lacaita Rosaceae	Herb	Moist shady places	Mar-Aug 4000-5000	throughout the valley
342.	<i>Geum alatum</i> G.Don Rosaceae	Herb	Moist open places	Aug-Sep 7000-8000	LD, MG
343.	<i>Geum urbanum</i> Rosaceae	Herb	Moist temperate forest	Jul-Sep 7000-8000	LD, MG
344.	<i>Prinsepia utilis</i> Linn. Rosaceae	Shrub	Moist open places	Jul-Aug 5000-7000	MG, Gh.
345.	<i>Prunus cornuta</i> Linn. Rosaceae	Shrub	Moist damp places	Apr-May 6500-8000	MG, Trk, PAK.
346.	<i>Prunus maackii</i> (Wall ex Royle) Steud Rosaceae	Shrub	Moist open places	Apr-May 6500-8000	MG.
347.	<i>Prunus serrula</i> Rupredit Rosaceae	Tree	Moist shady places	Apr-May 6000-7000	Nr, Trk
348.	<i>Rosa brunonii</i> Linn. Rosaceae	Woody	climber Moist rocky soil	Mar-Apr 3500-5500	Br, Sr, Dth
349.	<i>Rosa laevigata</i> Lindl Rosaceae	Woody	climber Moist shady places	May-Jun 5500-8000	MG, LD, Pdk
350.	<i>Rosa webbiana</i> Wall ex Royle Rosaceae	Shrub	Moist open places	Jul-Aug 5500-7000	HCh, MG, Trk, Rwk
351.	<i>Pyrus pashia</i> Linn. Rosaceae Small	tree	Moist mixed forest	Mar-Apr 3500-6000	Ph, Gh, Pl
352.	<i>Rubus ellipticus</i> Linn. Rosaceae	Shrub	Moist places	Mar-Apr 3500-5000	Ph, Hd, Md, Gh, Pl
353.	<i>Rubus fruticosus</i> Smith Rosaceae	Woody	climber Moist places	Mar-Apr 3500-6000	Ph, Gh, Pl

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
354.	<i>Rubus hoffmeisterianus</i> Hk.f. non linn. Rosaceae	Woody	climber Dry open places	Mar-Apr 4000-6000	Bj, Dth
355.	<i>Potentilla eriocarpa</i> Poir Rosaceae	Herb	Cliffs	Jul-Aug 6000-8000	GM, LD
356.	<i>Galium asperifolium</i> Wall Rubiaceae	Herb	Moist soil	Jul-Aug 6000-7000	Bj, MG, TP
357.	<i>Galium elegans</i> Wall Rubiaceae	Herb	Moist soil	Jul-Aug 4000-5000	Hj, Md, Gh
358.	<i>Galium hirtiflorum</i> Requier Rubiaceae	Herb	Moist soil	Jul-Aug 5000-6000	DG
359.	<i>Rubia cardifolia</i> Linn. Rubiaceae	Herb	Moist shady places	Aug-Sep 3500-5500	Ph, Pl, Gh
360.	<i>Randia tetrasperma</i> Dumort Rubiaceae	Shrub	Dry open places	May-Jun 3500-5500	Gh, TGh, Kt
361.	<i>Skimmia laureola</i> Linn. Rutaceae	Shrub	Moist shady places	May-Jun 5500-7500	MG, Jd, ShG, Bj
362.	<i>Zanthoxylum alatum</i> (Linn) DC Rutaceae	Shrub	Dry open places	Mar-Apr 3500-5000	Ph, Kh, Pl
363.	<i>Meliosma pungens</i> Linn. Sabiaceae	Tree	Moist open places	Mar-Apr 3500-4500	Hj, Ph, Kt
364.	<i>Populus ciliata</i> (Kault) Pres Salicaceae	Tree	Mesophytic forest	Mar-May 4500-7000	MG, TP, ShG
365.	<i>Populus nigra</i> Wall. ex Royle Salicaceae	Tree	Moist soil	Apr-May 3500-5000	Hj, Gh, Md, Kh, Pl
366.	<i>Salix Alba</i> Wall ex Clarke Salicaceae	Tree	Moist or wet places	Mar-Apr 3500-5800	Ph, Md, Hj, Gh
367.	<i>Salix denticulata</i> Linn. Salicaceae Small	tree	Moist steep places	Apr-May 6000-8000	MG, ShG
368.	<i>Dodonaea viscosa</i> (Linn.) Jacq Sapindaceae	Shrub	Dry rocky soil	Apr-May 3500-5000	Md, Kh, AP, T
369.	<i>Cardiospermum halicacabum</i> Linn. Sapindaceae	Herb	Climber Moist forest	Apr-May 4000-5000	Pl, Kh, Hj
370.	<i>Saxifraga androsacea</i> DC Sch Saxifragaceae	Herb	Moist open places	Jun-Aug 6000-8000	MG, TP, Bs
371.	<i>Saxifraga jacquemontiana</i> Linn. Dry Saxifragaceae	Herb	Places	Jun-Aug 6000-8000	MG, TP, ChG
372.	<i>Saxifraga mucronulata</i> Done Jacq Saxifragaceae	Herb	Moist open places	Jun-Aug 7000-8000	ChH, LD, Pl, TP
373.	<i>Bergenia ciliata</i> (Haw.) Sternb Saxifragaceae	Herb	Rocky steep places	Mar-Jul 6000-8000	MG, Bj, LD, TP
374.	<i>Verbascum thapsus</i> Jones Scrophulariaceae	Herb	Moist open places	Jul-Aug 3500-5500	Ph, Dth, Gh, Pdk, Pl
375.	<i>Veronica anagallis aquatica</i> Linn Scrophulariaceae	Herb	Moist shady places	Mar-Apr 3500-5500	Ph, Kh, Gh, Kt
376.	<i>Veronica biloba</i> Linn Scrophulariaceae	Herb	Moist shady places	Jun-Aug 3500-5000	Kh, AP, Gh
377.	<i>Veronica didyma</i> Linn Scrophulariaceae	Herb	Fertile soil	Jun-Aug 4000-6000	Gh, Trk, Sr
378.	<i>Veronica melissifolia</i> Temore, Prodr Scrophulariaceae	Herb	Moist shady places	Jun-Aug 4000-7000	MG, LD, Pdk, Bj
379.	<i>Wulfenia amherstiana</i> Linn Scrophulariaceae	Herb	Moist shady places	Jun-Jul 5000-7000	Pdk, AS
380.	<i>Ailanthus excelsa</i> Roxb Seas. Simarubaceae	Tree	Rain forest	Apr- May 3500-5000	Md, Kt, Dth, Trk, Pl
381.	<i>Solanum pseudocapsicum</i> Linn. Solanaceae	Herb	Moist open places	Jul-Aug 3500-5500	Pl, Gh, NmJ, Dth, T
382.	<i>Solanum surattense</i> Linn. Solanaceae	Herb	Dry open places	Jun-Aug 3500-4500	Md, Gh, Kh, Hj, Trk, Pl
383.	<i>Physalis minima</i> Ham Solanaceae	Herb	Moist fertile soil	Jul-Aug 3500-4500	Gh, Hd, Ph, Pl
384.	<i>Daphne papyracea</i> Wall ex Steud Thymeleaceae	Shrub	Sub alpine forest	Nov-Apr 5000-7000	ShG, MG, GM

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Table 2: continued

S. No.	Species Name and Family	Habit	Habitat	Mon. of col., Altitude range (ft),	Location (valley)
385.	<i>Corchorus aestuans</i> Linn. Tiliaceae	Herb	Moist fertile Soil	Jul-Aug 3500-5000	Md, Ph, Kh, Hd, Gh, Kt
386.	<i>Ulmus wallichiana</i> Whit Ulmaceae	Tree	Moist open places	Feb-Mar 3500-5500	Pl, Ph, Kt, Gh, Hd
387.	<i>Ulmus villosa</i> Ulmaceae	Tree	Dry rocky soil	Feb-Mar 4000-7000	Ph, Dth, Gh, Pl
388.	<i>Celtis australis</i> Linn. Ulmaceae	Tree	Warm dry forest	Apr-Jun 3500-6000	Gh, Md, Pl, Ph
389.	<i>Bupleurum candollei</i> Wall ex DC. Umbelliferae	Herb	Moist sub alpine forest	Jun-Aug 5000-7000	Pl, B, ShG
390.	<i>Bupleurum lanceolatum</i> Wall ex DC. Umbelliferae	Herb	Moist sub alpine forest	Jun-Aug 5000-7000	Pl, ShG, B, Trk
391.	<i>Bupleurum subuniflorum</i> Boiss & Heldr Umbelliferae	Herb	Moist open places	Jun-Aug 5000-7000	Pdk
392.	<i>Chaerophyllum villosum</i> Wall.ex DC Umbelliferae	Herb	Moist open places	May-Aug 5000-6000	Dth, HM, B
393.	<i>Selinum tenuifolium</i> Linn. Umbelliferae	Herb	Moist places	Apr-May 5500-7500	MG
394.	<i>Pimpinella acuminata</i> Wedd Umbelliferae	Herb	Moist open places	Jun-Aug 5000-7000	Dth, Bs, Bj, MG
395.	<i>Eryngium bourgatii</i> Gouan Umbelliferae	Herb	Dry rocky soil	Jul-Aug 5000-6000	T Pch
396.	<i>Pleurospermum brunonis</i> Wall ex Bth Umbelliferae	Herb	Moist shady places	Jun-Jul 5000-6000	N.G
397.	<i>Debregeasia longifolia</i> D.Don) Rendle Urticaceae	Shrub	Dry rocky soil	Jul-Sep 3500-5000	Gh, Dth, Trk
398.	<i>Debregeasia salicifolia</i> (D.Don) Rendle Urticaceae	Shrub	Near water courses	Apr-Sep 3500-4500	Hj, Md
399.	<i>Gerardinia palmata</i> (Forssk) Guad. Urticaceae	Herb	Moist sub alpine forest	Jul-Aug 6000-8000	MG, TP
400.	<i>Urtica dioica</i> Brandis ex Gamble Urticaceae	Shrub	Moist shady places	Jun-Jul 6000-8000	MG, TP, LD
401.	<i>Pilea scripta</i> Linn. Urticaceae	Herb	Moist shady places	Jul-Aug 5000-8000	Pdk, MG, Bj
402.	<i>Valeriana pyrolifolia</i> Medik Valerianaceae	Herb	Moist open places	Jun-Jul 6000-7000	Bj, Jd
403.	<i>Valeriana jatamansi</i> Dene Valerianaceae	Herb	Moist open places	Jun-Jul 6000-7000	Ph, Dth, Gh, Pdk, Pl
404.	<i>Verbena officinalis</i> Linn Verbenaceae	Herb	Wet places	Mar-Apr 3500-5500	Ph, Dth, Pl, Gh
405.	<i>Caryopteris odorata</i> (Ham) B.L.Robinson Verbenaceae	Shrub	Open dry places	Mar-Apr 3500-5000	Md, Ph, Kh, Pl
406.	<i>Citharexylum spinosa</i> Verbenaceae	Tree	Moist deciduous forest	May-Jun 4000-5500	N.Gh, BsG
407.	<i>Callicarpa macrophylla</i> Vahl Verbenaceae	Shrub	Dry open places	Mar-May 4000-5000	S.Pl
408.	<i>Lantana camara</i> Linn. Verbenaceae	Shrub	Moist fertile soil	Whole Year 4000-5000	Kh, AP, Nr
409.	<i>Viola biflora</i> Linn Violaceae	Herb	Moist shady places	Mar-Apr 3500-5500	Ph, Hd, Kh, Pl
410.	<i>Vitis trifolia</i> Linn Vitaceae	Woody	climber Moist open places	Apr-May 3500-5500	Hj, Kt, Kh, T Gh, Pl

Key: MG: Mehmood Gali BG: Badri Gali LD: Lus Danna, NGH: Numbal Ghamir Gh: Ghamir, Kh Kharanj, Ph: Phagwati, Md: Mandhole, Br: Brari, Hd: Houd, Bs: Bsari, TP: Toulipir, GM: Ghorimar, KhG: Khaigalla, B: Barian, BsG: Bosa Galla, Jd: Jandali, Bj: Banjosa, Nr: Narian, Sr: Sarari, BCK.: Bunback, Mjd: Mujahidabad, Pl: Palandri, GP: Ghratapar, S. Pl: Seah Palandri, Trk: Trarkhel, DG: Devi Gali, Kt: Kelot, PCh: PothiChaprian, P.A.A.K: Pothi Amir Ali Khan, AP: Azad Patten, AS: Alisoujal, Rwk: Rawalakot, T: Tian, Pdk: Pidrkot, ChH: Chunjal Hill, Dth: Dothan, HM: Huramer, Tp: Topa, TPCh: Tanghi Pacheot, Kl: Kemyal, ChG: Chota Galla, GK: Gallakanut, HCh: Hill Chowk, ChG: Chota Galla Dt: Dattot, NG: Nakar Gorah, Chk: Chidrikot, Sg, Singola.

Table 3: Diversity and its components recorded from Poonch valley

S. No	Total density	Species Richness	Shannon diversity index (H')	McIntosh's diversity index	Dominance	Evenness Index
1	419.81	0.78	3.45	10473.26	0.89	1.38
2	10.97	0.62	2.94	549.21	0.76	2.01
3	20.36	1.08	3.74	738.18	0.82	2.05
4	6.36	0.45	2.18	774.12	0.58	1.71
5	30.90	1.29	4.06	671.02	0.86	2.11
6	21.69	1.56	4.19	429.24	0.86	2.17
7	29.25	1.75	4.47	422.27	0.90	0.96
8	24.37	1.75	4.36	490.07	0.87	0.94
9	10.70	1.35	3.83	357.92	0.85	0.93
10	8.82	1.05	3.99	355.09	0.75	2.52
11	15.02	2.04	4.30	403.93	0.88	0.95
12	10.04	2.59	3.78	285.37	0.90	1.90
13	28.47	2.37	4.45	311.08	0.90	0.93
14	15.45	1.10	3.89	334.55	0.86	0.95
15	12.49	1.20	3.64	277.92	0.85	0.94
16	13.01	0.90	3.11	585.36	0.75	1.92
17	1.50	1.50	3.96	277.04	0.87	2.19
18	10.86	1.42	3.84	309.14	0.85	2.15
19	9.72	1.11	3.57	362.35	0.82	2.13
20	25.06	1.41	4.34	604.25	0.88	2.23
21	25.55	1.12	3.99	578.82	0.86	2.17
22	21.40	1.16	3.99	680.27	0.82	2.04
23	42.39	2.04	4.76	548.26	0.91	0.95
24	14.28	1.02	3.61	475.49	0.82	2.12
25	17.05	1.32	3.82	303.41	0.86	0.94

Among the 289 genera, 253 (87.50%) belong to category I, 33 (11.10%) belong to category II, whereas genera in category III only 4 (1.40%). Category 'I' was dominant in the Poonch valley followed by category 'II' and 'III'.

Many ferns were also recorded, including 13 species from 6 families. At generic level *Clematis* showed the largest number of species (7species), followed by *Polygonum* and *Ficus* (6 species), *Nepeta* (5 species), *Artemisia*, *Euphorbia*, *Quercus*, *Ranunculus*, *Salvia*, *Saussurea*, *Senecio*, *Swertia* and *Veronica* (4 species each), *Aster*, *Anemone*, *Bupleurum*, *Calamintha*, *Cynoglossum*, *Desmodium*, *Gallium*, *Geranium*, *Mentha*, *Plantago*, *Plecteranthus*, *Prunus*, *Rubus*, *Rumex*, *Saxifraga*, *Scutellaria*, *Silene*, *Trifolium*, *Ulmus*, *Viburnum* and *Ziziphus* (3 species each). The family Asteraceae indicated the greatest species richness (42 species), followed by Lamiaceae (39 species), Papilionaceae (22 species), Ranunculaceae (20 species), Rosaceae (16 species), Polygonaceae (12 species), Moraceae and Umbellifereae with 8 species each.

Community structure

25 plant communities were reported from the valley. These communities were located at: Mehmood Gali, Chidrikot, Badri Gali, Tanda Ghamir, Numbal Ghamir,

Jandali, Pidrkot, Basari, Chunjal Hill, Kharanj, Gorah Palandri, Tian, Hill Chowk, Mujahida Bad, Azad Patten, Sarari, Shaheed Gala, Khai Gala, Devi Gali, Lus Danna, Gohri Mar, Toulipir, Hajira, Bunjosa, Barian in the valley. Diversity, Species Richness, Shannon diversity index, McIntosh's diversity index, Dominance and evenness index was presented in table 3.

Diversity

The highest diversity was recorded from *Abies pindrow-Punica granatum- Pilea scripta* community (419.81) at an elevation of 7800 feet. It was followed by *Acacia modesta-Punica granatum-Fumaria indica* community (42.39), *Quercus dilatata-Punica granatum-Mentha arvensis* community (30.90), *Pinus wallichiana-Berberis aristata-Penesitum lanatum* community (29.25), *Betula uitius-Punica granatum-Strobilanthes attenuatus* community (28.47), *Abies pindrow-Aesculis indica – Andrachnae cordifolia* community (25.55), *Abies pindrow-Viburnum cotinifolium-Oplismenus burmannii* community (25.06), *Pinus wallichiana-Ziziphus oxyphylla-Sonchus asper* community (24.37) and *Abies pindrow-Buxus papilosa -Oplismenus burmannii* community (21.40). Lowest diversity was reported for *Pinus roxburghii-Punica granatum-Bupleurum candollei* community (6.36) at an elevation of 5000 feet (table 3).

Table 4: List of endangered, vulnerable and rare species of the Poonch Valley

S. No	Name of Species	Con. status	S. No	Name of Species	Con. status
1	<i>Acacia modesta</i>	VU	74	<i>Inula racemosa</i>	VU
2	<i>Acer acuminatum</i>	EN	75	<i>Ipomoea cairica</i>	VU
3	<i>Acer caesium</i>	VU	76	<i>Jasminum humile</i>	R
4	<i>Aconitum heterophyllum</i>	R	77	<i>Jasminum officinale</i>	R
5	<i>Aesculus indica</i>	VU	78	<i>Lamium album</i>	EN
6	<i>Ajuga bracteosa</i>	EN	79	<i>Lespedeza gerardiana</i>	R
7	<i>Albizia mollis</i>	EN	80	<i>Ligularia amplexicaulis</i>	R
8	<i>Allium humile</i>	EN	81	<i>Lolium multiflorum</i>	VU
9	<i>Anemone tetrasepala</i>	R	82	<i>Mallotus philippensis</i>	VU
10	<i>Anemone vitifolia</i>	VU	83	<i>Marsilea minuta</i>	R
11	<i>Anthemis nobilis</i>	VU	84	<i>Medicago polymorpha</i>	VU
12	<i>Apios carnea</i>	EN	85	<i>Melia azedarach</i>	EN
13	<i>Aquilegia pubiflora</i>	VU	86	<i>Meliosma pungens</i>	VU
14	<i>Arisaema flavum</i>	VU	87	<i>Mentha arvensis</i>	R
15	<i>Arisaema tortuosum</i>	VU	88	<i>Mimosa rubicaulis</i>	R
16	<i>Aristida adscensionis</i>	VU	89	<i>Myrsine africana</i>	EN
17	<i>Artemisia amygdalma</i>	R	90	<i>Myrsine semiserrata</i>	R
18	<i>Artemisia dubia</i>	EN	91	<i>Nepeta podostachys</i>	VU
19	<i>Arundo donax</i>	EN	92	<i>Olea ferruginea</i>	R
20	<i>Asparagus filicinus</i>	VU	93	<i>Origanum vulgare</i>	R
21	<i>Astragalus candolleanus</i>	R	94	<i>Otostegia limbata</i>	VU
22	<i>Barleria cristata</i>	EN	95	<i>Paris polyphylla</i>	R
23	<i>Berberis lycium</i>	VU	96	<i>Paspalidium flavidum</i>	VU
24	<i>Bergenia ciliata</i>	EN	97	<i>Pennisetum lanatum</i>	VU
25	<i>Bupleurum lanceolatum</i>	EN	98	<i>Phlomis bractiosa</i>	R
26	<i>Calamintha umbrosa</i>	EN	99	<i>Phragmites karka</i>	VU
27	<i>Campylotropis meeboldii</i>	EN	100	<i>Pimpinella acuminata</i>	EN
28	<i>Capsella-bursa-pastoris</i>	VU	101	<i>Pistacia integerrima</i>	R
29	<i>Cardiospermum halicacabum</i>	R	102	<i>Plantago ciliata</i>	VU
30	<i>Carex pseudocyperus</i>	VU	103	<i>Poa palustris</i>	R
31	<i>Caryopteris odorata</i>	R	104	<i>Podophyllum emodi</i>	EN
32	<i>Cedrus deodara</i>	R	105	<i>Polygala abyssinica</i>	R
33	<i>Cerastium cerastioides</i>	VU	106	<i>Polygonum plebejum</i>	VU
34	<i>Ceropegia pubescens</i>	EN	107	<i>Polypogon monspeliensis</i>	VU
35	<i>Ceterach dalhousiae</i>	VU	108	<i>Potamogeton nodosus</i>	VU
36	<i>Chaerophyllum villosum</i>	EN	109	<i>Primula denticulata</i>	EN
37	<i>Chenopodium album</i>	R	110	<i>Prinsepia utilis</i>	EN
38	<i>Cicerbita macrantha</i>	VU	111	<i>Quercus baloot</i>	R
39	<i>Citharexylum spinosa</i>	R	112	<i>Rhamnus purpurea</i>	VU
40	<i>Clematis grata</i>	R	113	<i>Rhamnus triquetra</i>	R
41	<i>Clerodendron phlomoides</i>	EN	114	<i>Rhus cotinus</i>	EN
42	<i>Convolvulus arvensis</i>	R	115	<i>Rhynchosia pseudo-cajan</i>	VU
43	<i>Conyza bonariensis</i>	VU	116	<i>Rubus fruticosus</i>	VU
44	<i>Cynodon dactylon</i>	VU	117	<i>Rumex hastatus</i>	R
45	<i>Cynoglossum glochidiatum</i>	R	118	<i>Salvia hians</i>	VU

continued...

Table 4: continued

S. No	Name of Species	Con. status	S. No	Name of Species	Con. status
46	<i>Daphne papyracea</i>	R	119	<i>Saussurea atkinsonii</i>	VU
47	<i>Desmodium tiliaefolium</i>	VU	120	<i>Saxifraga mucronulata</i>	R
48	<i>Deutzia staminea</i>	VU	121	<i>Scirpus sylveticus</i>	EN
49	<i>Dichanthium annulatum</i>	VU	122	<i>Sedum ewersii</i>	VU
50	<i>Dicliptera roxburghiana</i>	VU	123	<i>Senecio analogus</i>	VU
51	<i>Dioscoria deltoidea</i>	EN	124	<i>Senecio graciliflorus</i>	VU
52	<i>Eclipta alba</i>	VU	125	<i>Senecio kraschennikovii</i>	R
53	<i>Elsholtzia ciliata</i>	EN	126	<i>Silene conoidea</i>	R
54	<i>Elsholtzia fruticosa</i>	VU	127	<i>Smilacina purpuria</i>	VU
55	<i>Epilobium hirsutum</i>	R	128	<i>Sorghum halepense</i>	VU
56	<i>Erigeron multicaulis</i>	R	129	<i>Stellaria decumbens</i>	VU
57	<i>Erigeron multiradiatus</i>	VU	130	<i>Strobilanthes attenuatus</i>	R
58	<i>Eryngium bourgatii</i>	EN	131	<i>Swertia paniculata</i>	VU
59	<i>Euphorbia cognata</i>	VU	132	<i>Tegetes minuta</i>	EN
60	<i>Euphorbia wallichii</i>	VU	133	<i>Trachelospermum lucidum</i>	VU
61	<i>Fagopyrum esculentum</i>	R	134	<i>Tragopogon dubius</i>	VU
62	<i>Gentiana kurroo</i>	R	135	<i>Tulipa stellata</i>	VU
63	<i>Geranium wallichianum</i>	R	136	<i>Valeriana jatamansi</i>	R
64	<i>Gerbera gossypina</i>	VU	137	<i>Verbena officinalis</i>	VU
65	<i>Geum alatum</i>	VU	138	<i>Veronica didyma</i>	R
66	<i>Gnaphalium affine</i>	VU	139	<i>Veronica melissifolia</i>	VU
67	<i>Habenaria pectinata</i>	VU	140	<i>Vitis trifolia</i>	R
68	<i>Hedysarum cachemirianum</i>	R	141	<i>Woodfordia fruticosa</i>	EN
69	<i>Helinus lanceolatus</i>	EN	142	<i>Wulfenia amherstiana</i>	VU
70	<i>Hypericum perforatum</i>	VU	143	<i>Ziziphus mauritiana</i>	R
71	<i>Ilex dipyrrena</i>	VU	144	<i>Ziziphus nummularia</i>	VU
72	<i>Indigofera heterantha</i>	R	145	<i>Ziziphus oxyphylla</i>	
73	<i>Inula cappa</i>	R			

Appendix -1

Conservation Status Scale

Name of species *Elsholtzia fruticosa*

Field observation = Rare

Information from local people = Used for curing chest diseases (exploited vigorously)

Report from earlier collectors = Nil

CSS of species at different localities= 0 + 4 + 0 + 0 + 4 + 0 + 0 + 0 + 4 + 3 + 0 + 0 +

0 + 0 + 5 + 4 + 0 + 4 + 0 + 0 + 3 + 0 + 0 + 0 + 0 = 31

Total number of localities visited = 25

$$C.S.S = S = \frac{\text{Total conservation of a species at different localities}}{\text{Total number of localities visited}}$$

$$C.S.S = 31/25 = 1.24$$

The C.S.S. value for *Elsholtzia fruticosa* falls in the range 1 to 2.

Species Richness

Range of species richness varied from 9.27-0.44. The highest species richness was reported for *Aesculus indica-Viburnum foetens-Commelina bengalensis* community (9.27). It was followed by *Betula utilis-Punica granatum-Strobilanthes attenuatus* community (2.36) and *Pinus wallichiana-Viburnum foetens-Strobilanthes dalhousieanus* community (2.04) and *Acacia modesta-Punica granatum-Fumaria indica* community (2.03). Lowest species richness was recorded for *Pinus roxburghii-Punica granatum-Bupleurum candollei* community (0.44) (table 3).

Index of Dominance

The maximum dominance value was recorded for *Acacia modesta-Punica granatum-Fumaria indica* and *Pinus wallichiana-Berberis aristata-Penisetum lanatum*, *Pinus roxburghii-Berberis aristata-Digitaria ciliata* which are followed by *Abies pindrow-Punica granatum-Pilea scripta*, *Aesculus indica-Viburnum foetens-Commelina bengalensis* and *Pinus wallichiana-Viburnum foetens-Strobilanthes dalhousieanus* community (table 3).

Shannon Diversity Index

The highest Shannon diversity index was recorded for *Acacia modesta*, *Punica granatum*, *Fumaria indica* community. It was followed by *Pinus wallichiana*, *Berberis aristata*, *Pennisetum lanatum* community whereas lowest Shannon diversity index was recorded for *Pinus roxburghii*, *Punica granatum*, *Bupleurum* community (table 3).

McIntosh Diversity Index

The maximum McIntosh diversity index was recorded for *Aesculus indica*, *Indigofera hebeptala*, *Oplismenus burmannii* community which was followed by *Abies pindrow*, *Punica granatum* *Pilea scripta* community. Minimum McIntosh diversity index was recorded for *Aesculus indica*, *Persea duthiei*, *Cynodon dactylon* community while remaining communities were intermediate in the valley (table 3).

Index of Evenness

The maximum evenness value was recorded for *Pinus roxburghii-Viburnum foetens-Strobilanthes dalhousieanus* and *Pinus wallichiana-Lonicera quinquelocularis-Oplismenus burmannii* which is followed by *Abies pindrow-Punica granatum-Pilea scripta* community, *Pinus roxburghii-Punica granatum-Persicaria capitata* community and *Pinus wallichiana-Punica granatum-Onoclea vecunifolium* community. Minimum evenness value was recorded for *Abies pindrow-Viburnum cotinifolium-Oplismenus burmannii* community while remaining communities were intermediate in these communities (table 3).

Conservation of Biodiversity

Poonch valley has 430 known species of Pteridophytes, Gymnosperms and flowering plants. Of these, 145 (33.72 %) threatened plants species were assigned one of the IUCN threaten categories. Out of which 30 plant species were endangered, 68 vulnerable, 47 species were rare in the area. The endangered plant species comprises 6.97%, vulnerable 15.81% and 10.93% were rare (table 4).

DISCUSSION

The flora of Poonch valley is under biotic pressure resulting from the loss and degradation of habitats, over-exploitation of plant, agricultural intensification and climate change. Anthropogenic disturbance is the major factor responsible for fragmentation of forest vegetation into small patches. In the last 10 years uncertain rainfall and snowfall had caused adverse effects on the vegetation and environment of the region. Dry season prevailed for two years with uncertain sporadic rainfall. The forest resources are illegally used for economic benefits without giving a single thought to the adverse future perspectives of such actions and their impact on the flora of the region.

Wilson (1992) stated that the worst thing that can happen during the 1980s that will take millions of years to correct the loss of genetic and species diversity by the destruction of natural habitats. Under present circumstances, it is estimated that about 50,000 higher plant species that is one fifth of the existing total, will be either extinct or severely genetically eroded by the year 2050 AD and this is the folly that our descendants are at least likely to forgive us. Two such studies suggest that Pakistan's woody biomass is declining at a rate of 4-6% per year (GOP 1992, Hosier 1993). Consumption (primarily for house hold firewood) exceeds production in all the provinces except in the relatively sparsely populated Northern Areas; consumption is expected to increase in line with population growth at about 3% per year. Both studies concluded that Pakistan's woody biomass could be totally consumed within the next 10 to 15 years.

In my view, awareness campaigns in local communities, good will and sincere efforts and effective policies on the part of government NGO's and local people can help in saving the diminishing forests in the future. Extensive cultivation in the eroded forests and then care and protection can be the best solution of the problem.

Floristic Diversity aspects of the area

Pakistan has a rich flora of over 6000 flowering plants species. A large number of them are found in north and north western parts comprising the Himalayas and Kashmir. The flora of Poonch valley is unique because this area is located at the foothills of Himalayan range. Vegetation of an area may be described as an expression of phytogeography and climate of the area. Both these factors contribute substantially in determining the vegetational distribution in the area (Sharma and Shringi 1986). Northern and Southern elements in the area come equal and it is self supporting, to depict the floristic diversity aspect of the area. North facing slopes are rich in vegetation than the south facing slopes. It is easy to understand about the presence of arid zone species on the south facing slopes, *Ziziphus oxyphylla*, *Ziziphus mauritiana*, *Acacia modesta* and *Olea ferruginea* along with some typical species of low land area e.g., *Quercus incana*, *Pyrus pashia* and *Punica granatum*.

The vegetation of Poonch Valley was divided into three categories on the basis of elevation and ecological characters. The vegetation below 5000 feet was called "Lowland vegetation and consisted of seasonal rainforests. The vegetation above 5000 feet was called "mountain vegetation" and was further subdivided into Lower Mountain and upper mountain forests. The lowland vegetation consisted of plant species mainly belonging to the sub-tropical lowland components (e.g., Anacardiaceae, Lythraceae, Meliaceae, Moraceae and Verbenaceae) whereas the upper mountain vegetation was

dominated by plant species belonging to the temperate families (e.g., Pinaceae, Ericaceae, Aceraceae, Hipocastinaceae, Fagaceae, Gentianaceae, Ranunculaceae and Rosaceae).

Ahmad and Sarajuddin (1996) classified the District Swat into seven types of forests. The studies included 1541 species from 135 families reported from the area. Similar study was reported by Kim (1996) entitled "plant diversity in the cool temperate forests of Northeast Asia, with emphasis on Korea." The study showed a very rich taxonomic composition, comprising 2,166 species of vascular plants in 484 genera and 119 families, representing more than 30% of all higher plants in Northeast Asia.

Plant communities in Poonch valley

25 plant communities were reported from lowland below 5000 feet sub-tropical vegetation and upland mountain area above 5000 of temperate vegetation. *Pinus wallichiana* dominated in 8 plant communities while in 4 communities *Aesculus indica*, *Berberis aristata*, *Punica granatum* and *Oplismenus burmannii* were dominant. The dominance of *Pinus wallichiana* indicates that this species is protected in the investigated area. The co-dominance i.e., *Sarcococca saligna*, *Onoclea sensibilis*, *Strobilanthes attenuatus* and *Pilea scripta* favor moist conditions and are unpalatable species. Some plants such as *Oxalis corriculata*, *Viola iflora*, *Adiantum venustum*, *Impatiens balsamina* and *Strobilanthes attenuatus* are moist loving plants and flourish under high saturation and shady areas. *Quercus incana*, *Aesculus ndica*, *Viburnum cotinifolium*, *Sarcococca saligna* and *Polygonum amplexicaulis* were the indicators of moist temperate zone. *Sarcococca saligna*, *Viburnum foetens* and *Berberis lycium* are unpalatable species and multiplying under grazing pressure. *Pinus wallichiana*, *Ulmus wallichiana*, and *Croton plicatum*, *Populus ciliata*, *Punica granatum*, *Quercus floribunda* were present with low importance value index. The reason might be due to the zonation of the area. The young forms of these plants are the indicator of remnant zone.

The number of species and number of individuals per species as well as their distribution in a site is a reflection of biodiversity. Species richness and other indices of biodiversity were used to compare status between and among communities analysed in the area. In the investigated area the communities located at the high altitude indicated high diversity whereas it was low for the communities situated in the low altitude. Similar finding was also reported by Malik and Ahmad (1990).

The most diversity was recorded for *Abies pindrow-Punica granatum-Pilea scripta* community at an elevation of 7800 feet indicating that diversity is high in top vegetation category, lowest diversity was recorded for

Pinus roxburghii-Punica granatum-Bupleurum candollei community located at an elevation of 5500 feet suggested that diversity was low at the middle zone. The significant co-efficient of association was recorded among the communities analysed. This is due to similar abiotic features of climate such as temperature and degree of seasonality.

Biodiversity conservation process

Poonch is located adjacent to Pirpunjal Mountain of the Himalayan ranges and is home to unique and diverse flora (Ali and Qaiser 1986). Biodiversity and its conservation is the most important area to study the maintenance of indigenous forests because forests prevent erosion, maintain the atmosphere, producing large amount of water vapors, oxygen and taking carbon dioxide.

Endangered Flora of Poonch Valley

Poonch Valley is one of the most exploited areas in Azad Kashmir; people utilize plant resources not only for their own requirements but also for economic reasons. They seem to be unaware of exploitation of valuable plant resources; as a result most of the economic plants are threatened in the area and many become story of the past if existing conditions prevented for a longer period. During the present study, efforts (lectures and awareness programs) were made to pinpoint ways and means for sustainable use of plant resources and to reduce pressure on the flora of this important Himalayan region.

The most effective way to conserve plants in their own environment and ensure sustainable use of plant resources it is vital to educate the people about sustainability concept and provide the opportunities for better living standards. In this way the exploitation of the local vegetation will be reduced.

The conservation status of some places of Poonch Valley's flora at present stage is intact in its diversity despite continuous human disturbances over the years. This is possibly due to inaccessibility of unexploited forests. On the other hand situation for Poonch Valley's alpine forest, however, stands in sharp contrast. Its conservation status is far more serious, due to the high degree of exploitation only a small number of potential stands are remaining in the region. These stands are mostly small covering 5 to 50 hectares and are highly fragmented and scattered and are easy prey to logging. The major threats to the biodiversity of Poonch come from the activities such as slashed of subsistence, farming by local inhabitants and logging. The degree of damage caused through large scale extraction of logs for commercial purpose has been a continuous issue in the last 10 years or so. 1950's onward, due to increased population and urbanization trends, the indigenous flora of the area is under continuous pressure. Some of the reasons for decreasing forest cover in the area are:

deforestation, forest fires, lack of awareness, over grazing and browsing, army installations, medicinal plant collection, and exploitation of forest resources and smuggling of timber wood. Similar finding was reported Hamayun 2003 from Utror and Gabral Valleys of district Swat Pakistan. He discussed the conservation status of certain species with respect to endangered taxa of the area.

Khan, 2003 reported that Pakistan is blessed with a variety of plants that are being used for multiple purposes and stated that due to population explosion, poverty and ignorance, richer cover of the herbaceous flora has vanished from about 60% of their natural habitats.

However, some pockets especially in the inaccessible areas still have majority of the representatives of medicinal and aromatic plants. These plants need to be preserved before they disappear because of excessive commercial harvesting and local uses. Schippmann (2001) stated that gathering of medicinal plants can provide an important source of income for local people, but if it is not appropriately managed, wild harvesting may jeopardize the long term viability of plant populations and habitats.

Such concerns call for adherence to and observation of cultural and intellectual property rights have been addressed and enshrined in the Chiang-Mai and Kari-Oca declarations. The first countries to seriously tackle these issues are China and India. Indeed, programmes dealing with medicinal plant conservation, cultivation, community involvement and sustainable development being initiated elsewhere, could benefit immensely from the Chinese and Indian experiences (World Bank, 1997).

Awareness with out incentive will not be succeeded. Because due to poverty local people are forced to exploit natural resources ruthlessly even if they are aware to protect the forest and vegetation of the area. It is suggested that an industrial base research facility unit may be established in Poonch valley. In this perspective demand for medicinal plants will lead to cultivation programmes in this area. The people of the area will get job opportunity and as a result they will care and promote cultivation of medicinal plants.

An ex-situ conservation effort was carried out by cultivating 13 threatened and medicinally important plant species. Only seven plant species survived in the new habitat. These were *Primula denticulata*, *Valeriana jatamansii*, *Podophyllum emodi*, *Geranium wallichianum*, *Daphne papyracea*, and *Aconitum heterophyllum*. Similar ex-Situ conservation effort was carried out by Ahmad (2003) he reported that 31 medicinal and aromatic plant species were cultivated in Sawat at three different sites. Preliminary results indicated that eleven plant species can be grown successfully as minor crops on marginal fields.

Genetic biodiversity of traditional medicinal plants is continuously under the threat of extinction as a result of growth exploitation, loss of growth habitats and unmonitored trade of medicinal plants. Medicinal herbs possessing anti-cancer principles are the focus of smuggling to import markets in Germany, France, Switzerland, Japan, U.K. and the U.S.A. The best known example, in recent times, is that of tetu lakda (*Nothadytes foetida*). Commonly encountered in southern India and Sri Lanka, the herb is a source of anti-cancer drugs is exploited by the developed countries. On the other hand, *Adonis vernalis*, extinct in Italy, and Netherland, is an endangered species in Germany, Slovakia, Swedan and Switzerland. Fortunately, to safeguard against such practices and losses, guidelines and licensing concerning the use of such plants are provided for, in the convention on International Trade of Endangered Species of wild flora and fauna (CITES) (Hoerau and Dasilva, 1999).

Conclusion and recommendations

The present study provides information on the plant diversity and IUCN conservation status of vascular plants of the Poonch Valley. The highest diversity was recorded for communities located at high altitude and lowest diversity was observed for the middle zone. This is due to similar abiotic features of climate such as temperature and degree of seasonality.

This study revealed that the conservation status of some places of Poonch's flora at present stage is intact in its diversity despite of high degree of exploitation. On the other hand situation for Poonch Valley's alpine forest, however, only a small number of potential stands are remaining. The major threats to biodiversity of Poonch came from the activities such as construction of settlement and army installation in the forest area. The degree of damaged caused through large scale extinction of logs for commercial purpose has been a continuous issue in the last ten years or so. Therefore, there is an urgent need for practical application of existing knowledge to stop the spread of exploitation of forest and to revegetate denuded regions for conserving biodiversity of the area.

The following recommendations were proposed for further research in the area:

1. Local people must be provided information and awareness on biodiversity conservation.
2. An effective strategy is required for the transition to sustainable reforestation.
3. Natural habitat should not be disturbed by human activities.
4. The system of protected areas should be established in the study area.
5. Afforestation projects should be launched on suitable waste lands. These projects will not only conserve the

local flora but also improve the socio-economic conditions of the area.

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REFERENCES

- Ahmad H and Sirajuddin (1996). Ethnobotanical Profile of Swat. Proc. First Train. Workshop Ethnob. *Appl. Conser PARC Islamabad* : 202-211
- Ahmad H (2003). Capacity bui lding for cultivation and sustainable harvesting of medicinal and aromatic plants. Proceed, of Intern. *Workshop Conservation and sustainable uses of medicinal and aromatic plants of Pakistan*, **3**: 1-36.
- Ali SI and Qaiser M (1986). A phytogeographical Analysis of the phanerogams of Pakistan and Kashmir. In: proceedings of Royal Society of Edinbergh, **898**: 89-101.
- Azad Kashmir Statistical Book (1998). Planning and Development Department Azad Government of the State Jammu and Kashmir, pp.1-210.
- Azad Jammu and Kashmir I.T. Board (2005). Kashmir "Jannat Nazeer". Net Magazine of Information Technology and Kashmir, **8**(4): 31-39. www.netmag.com.pk
- Brower JE and Zar JH (1977). Field and Laboratory Methods for General Ecology (3rd ed.) Dubuque. Iowa; Brown, pp.24-51.
- Curtis JT and McIntosh RP (1950). The interrelations of certain analytic and synthetic phytosociological characters. *Ecology*, **31**: 434-455.
- Davis G and Recharadson D (1995). Mediterranean Type Ecosystems: The Function of Biodiversity. Springer, Berlin, Germany, p.366.
- Gilbertson DD, Kent M and Pyatt FB (1985). Practical Ecology for Geography and Biology. Hutchinson/Unwin-Hyman, London.
- GOP (1992). Forestry Sector Master Plan. Government of Pakistan.
- Hoareau L and Da silva EJ (1999). Medicinal plants: A re-emerging health aid. *Elect. J. Biotech.*, **2**: 2 ISSN 0717-3458. .
- Hosier R (1993). Forest energy in Pakistan: The evidence for sustainability. Pakistan household Energy Strategy Study (HESS). Islamabad: GOP, Energy Wing, Energy sector Management Assistance Programme.
- International Union for Conservation of Nature (1980). world conservation strategy. IUCN-UNEP-WWF, Gland Switzerland.
- International Union for Conservation of Nature (1994). Red List categories. IUCN Publication, Switzerland.
- Khan A. A (2003). Role of conservation of medicinal and aromatic plants in the socio-economic development of rural poors. International workshop on conservation and sustainable uses of medicinal and aromatic plants of Pakistan. Joint venture by WWFF, MINFAL and Qarshi Industries Pvt. Ltd.
- Kim JW (1996). Floristic characterization of the temperate oak forests in the Korean Peninsula using high rank taxa. *J. Pl. Biol.*, **39**: 149-159.
- Magurran A (1988). Ecological Diversity and Its Measurement. Croom Helm, London.
- Malik ZH, Hussain F and Ahmad S (1990). Contribution to the plant communities around Bhimber Hills, Azad Kashmir. *J. Sc. Tech. University of Peshawar*, **17**: 103-107.
- McIntosh RP (1967a). An index of diversity and the relation of certain concepts of diversity. *Ecology*, **48**: 392-404.
- Mishra BP, Tripathi RS, Tripathi OP and Pandey HN (2003). Effect of disturbance on fur dominant and economically important woody species in a broad-leaved subtropical humid forest of Meghalaya, northeast India. *Cur Sci.*, **84**:1449-1453.
- Muller-Dombois and Ellenberg DH (1974). Aims and Methods of vegetation Ecology. John Willey & Sons. New York.
- Nasir E and Ali SI (eds) (1971-95). Flora of Pakistan. Islamabad and Karachi: National Herbarium, PARC and Department of Botany, University of Karachi.
- PNK Bamzai Kashmir and central Asia (1995). Book Trades Main Chambers, 3-Temple Road Post Box No. 1854, Lahore, Pakistan, pp.45-57.
- Ramakrishnan PS, Saxena KG and Chandrashekara UN (1998). Conserving the Sacred for Biodiversity Management. Oxford and IBH Publication Co. Pvt. Ltd., Newdelhi, India.
- Ravindranath NH, Gadgil M, Subhash Chandran MD and Dancils RJR (1992). Study of vegetation. Dynamics in regenerating forest and Grass Lands. Paper prepared for ford foundation programme network on Forestry.
- Schippmann U (2001). Medicinal plants significant trade. CITES Project S-109, Plants committee document PC9: 9.1.3. (rev.) BFN Skripten-39, Bundesamt fur Naturschutz, Bonn.
- Sharma and Shringi (1986). Botany of Jhalawar District- III Phytogeographical aspects. *Biol. Bult.*, **8**(1): 6-12.
- Siddiqui KM and Khan A (1991). Proceeding of workshop on "Promotion of medicinal plants". PFI, Peshawar.
- Simpson EH (1949). Measurement of diversity. *Nature*, **163**: 688.

- Stewart RR (1972). An annotated catalogue of the *vascular* plants of West Pakistan and Kashmir. Karachi: Fakhri Printing Press.
- UNEP (1995). Global Biodiversity Assessment. Cambridge University Press.
- Williams G (1987). Techniques and Fieldwork in Ecology. Collins Educational, London.
- Wilson EO (1992). The diversity of life. Belknap press of Harvard University press, Cambridge, UK.
- Wilson EO (ed) (1998). Biodiversity, National academy Press, Washington Dc, USA.
- World Bank (1997). Medicinal Plants: Rescuing a Global Heritage, eds. Lambert J, Srivastava J. and Veitmeyer. N., Technical Paper. 355: 61.