



# Variation of Floristic Diversity along Altitudinal Gradient in Pir Panjal Forests of North Western Himalaya, India

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

The present study is an attempt to make a floristic inventory in Raithan Range of Pir Panjal Forest Division of, Jammu and Kashmir India. For this purpose, a preliminary study was carried with the aim to know the diversity of flora at different altitudes ranging from 1800-2800m amsl. For study purpose the area was divided into 3 different altitudes viz - 1800m, 2300m and 2800m amsl. The reported results revealed that, a total of 136 species from 58 different families and 113 genera were recorded. Out of 136 species there are 29 tree species (belonging to 16 families), 9 shrub species

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(6 families), 92 herb species (33 families), 4 climber species (4 families) and 2 fern species (belonging to 2 different families). The Asteraceae and Rosaceae family were dominant in the research area, according to the data. Among different sites in the study area, site 1 (altitudinal range of 1800-2300m) showed maximum diversity of flora represented by 85 species, followed by site 2 (2300-2800m) represented by 71 species and least at site 3 (> 2800m) represented by 49 species. The study is a preliminary one and can be used for management of the species having less population for conservation and sustainable utilization.

*Keywords: Diversity; Himalaya; altitude; flora; tree; conservation.*

## 1. INTRODUCTION

Floristic diversity is referred to as the variety of plants present in a specific region at a particular period of time. Often, it refers to the variety of naturally occurring native or indigenous plants. Since the beginning of human society's existence on this planet earth, the plant kingdom has been essential to its survival [1,2]. Our basic food crops, construction materials and pharmaceuticals, oils, lubricants, rubber, other latexes, resins, waxes, fragrances, dyes and fibres are all produced by plants [3]. India is a nation with a great deal of biological diversity, as well as physical, cultural, social and linguistic diversity. India has 17,000 different types of flowering plants, making it one of the world's 12 mega-biodiversity countries. With only 2.4 % of the world's total land area, it represents 8% of the biodiversity [4,5].

Floristic diversity is concerned with the enumeration of plant species growing in a specific region at a specific time. Its evaluations are regarded as the basic requirement to understand the current status of plant diversity. The most ecological characteristics of a particular ecosystem are its structure, composition, and vegetation functions, which vary in response to both natural and anthropogenic factors [6]. Loss of habitat, fragmentation, overexploitation, pollution, alien species invasions, and global climate change are the main challenges to ecosystems and biodiversity [7].

The study of floristic diversity gives the required information about the various plant species regarding their nomenclature, distribution, uses and ecology. These investigations also aid in understanding the basic aspects of biology such as speciation, isolation, endemism and evolution. Because the information gathered from these investigations is extremely valuable for ecological, biogeographic, taxonomic and evolutionary studies, floristic diversity is of the utmost importance to fundamental research. A

variety of practical research domains, such as land management, forestry, conservation biology, ecology, and range science, make use of the knowledge produced by these investigations. It forms the basis for systematic monographs and regional floras. Though, several investigations have been conducted in different parts of the India as well as in abroad [8-22].

The floristic diversity has been documented throughout the globe including India and in India all the Himalayan states like Uttarakhand, Himachal Pradesh, J&K have been covered [23-27]. In J&K number of studies on floristic diversity has been conducted by different workers [28-31] but the site Raithan range of Pir Panjal Forest Division, J &K, India was yet to be explored for floristic diversity and ecological study, therefore keeping in mind the importance of this study for conservation of plant ecology and sustainable utilization, this study has been conducted to assess the floristic diversity and community characteristics at different altitudes of Raithan range of Pir Panjal Forest Division, J &K, India .

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The present study was conducted in Raithan range of Pir Panjal forest division of Jammu and Kashmir UT. Raithan Range with its headquarter at Raithan (covering an area of 14511.4 hectares with 6329.4 hectares forest area). This forest range is only 10-15 kms away from forest control room of the Pir Panjal Forest Division. The forest spreading over 41 km<sup>2</sup> lies within the jurisdiction of Pir Panjal Forest Division in Budgam district and is about 42 km from state summer capital and 22 km from district headquarter Budgam. The region, an alpine valley, receives 660 mm of precipitation in the form of rain and snow on an average annual basis, or roughly 70 rainy days. The average minimum and maximum temperature ranges from -11 to 33 degrees Celsius. The winter season begins in the middle of October and severe winter conditions

continues till the middle of February or March. The range is rich in indigenous plants. There are many different plant species in the range. This range's native vegetation is varied and includes everything from coniferous forests on the steep slopes to beautiful green grasslands. Due to the extreme variability of ecological and climatic conditions, there is a considerable diversity in the flora. Coniferous trees such as *Pinus wallichiana* (Kail), *Abies pindrow* (Silver Fir), *Picea smithiana* (Spruce) and *Taxus wallichiana* (Yew) are frequently found in the forests of this range. The range also includes broad-leaved tree species such as Horse chestnut, Maple, Hazelnut, Bird cherry, Poplar, Willow, Birch and walnut. The crop type is greatly influenced by altitude and aspect. The crop varies depending on the height and slope where the gentle sloppy areas have a good crop and reaches have scanty crop due to the impact of unfavourable ecological factors.

## 2.2 Methodology

The study was carried out in Raithan range of Pir Panjal Forest Division in UT of J & K, India, at three different altitudes ranging from 1800-2800m amsl. For the course of investigation the study sites were repeatedly surveyed during the course of investigation. Throughout the course of these studies, plants were collected from a variety of habitats at different altitudes (1800-2300m, 2300-2800m & >2800m amsl) of Raithan range. During collections, extensive field observations were made. Using pertinent floras, other taxonomic literature, including Hooker (1872-897), Stewart (1972), and Sharma and Kachroo (1981-1982) [32,33,34] and online resources, like e-floras, International Plant Name Index (IPNI), Catalogue of Life, Plant Net, The Plant List and GRIN, the collected plant species were properly processed according to standard herbarium techniques [35]. By comparing the specimens with the pre-selected relevant specimens from the region deposited in Kashmir University Herbarium (KASH), authentication of identification was accomplished. The arrangement of genera into families mostly follows Mabberley's system (2008) [36]. To determine the currently accepted scientific names, the recent nomenclatural changes (if any) have been taken into account [www.theplantlist.org]. despite being time-consuming, this effort has brought clarity to the confusing maze of synonyms that frequently arbitrarily increased the number of species. The order of plant species in the inventory is alphabetical for convenience.

## 3. RESULTS

The study revealed that Raithan range of Pir Panjal Forest Division represents a rich vegetation diversity. The study recorded a total number of 136 species including 128 Angiosperms (114 species are Dicotyledons and 14 species are monocotyledons), 6 Gymnosperms and 2 Species of Pteridophytes. which are taxonomically grouped among 113 genera in 58 different families (Table 1), following an extensive examination of the area. Out of 136 species, there are 29 tree species which belongs to 16 different families, 9 shrub species belongs to 6 different families, 92 herb species of 33 different families, 4 climber species of 4 different families and 2 fern species which belongs to 2 different families. Trees, shrubs, herbs and woody climbers are represented by 29, 9, 94 and 4 species, respectively, in terms of growth form. The family Asteraceae and Rosaceae had the highest representation of 16 species each (11.8%) followed by Poaceae 11 species (8.1%), Fabaceae, Apiaceae, Polygonaceae and Lamiaceae 5 species each (3.7%), Pinaceae, Salicaceae, Boraginaceae and Plantaginaceae 4 species each (2.9%), Ranunculaceae and Brassicaceae 3 species each (2.2%), Solanaceae, Caryophyllaceae, Moraceae, Amaranthaceae, Cannabaceae, Rubiaceae, Geraniaceae, Balsaminaceae, Orobanchaceae, Adoxaceae, Berberidaceae and Ulmaceae 2 species each (1.5%) and others with one species each including Caprifoliaceae, Malvaceae, Verbenaceae, Violaceae, Aceraceae, Sapindaceae, Cupressaceae, Betulaceae, Taxaceae, Juglandaceae, Simaroubaceae, Celastraceae, Euphorbiaceae, Primulaceae, Onagraceae, Hypericaceae, Iridaceae, Pteridaceae, Dryopteridaceae, Melanthiaceae, Vitaceae, Convolvulaceae, Dioscoreaceae, Urticaceae, Phyllanthaceae, Lythraceae and Scrophulariaceae.

The analysis of species composition that existed in 3 altitudinal ranges of vegetation is presented in Table 1. It is clear from the table that the First altitudinal zone (1800-2300m MSL) was found to be richest in composition (85 species) followed by 2nd altitudinal range (2300-2800m MSL) representing 71 species and least (49 species) by 3rd altitudinal range (> 2800m MSL) as against an overall composition of 136 species in the study area. *Achilea millefolium*, *Mentha arvensis*, *Rosa macrophylla*, *Aesculus indica*, *Cedrus deodara*, *Cirsium wallichii*, *Cupressus sempervirens*, *Pinus wallichiana* and *Populus*

*ciliata* were some of the species which are coming in all the altitudinal ranges of the study area.

The analysis of family composition that existed in 3 altitudinal zones of vegetation is presented in Table 1. it is clear from the table that the first altitudinal zone (1800-2300m MSL) is found to be richest family composition (36 families) followed by 2nd altitudinal zone (2300-2800m MSL) representing 34 Families and least with 3rd

altitudinal range (> 2800m MSL) with 30 families and as against an overall family composition of 58 families in the study area (Fig. 1) Apiaceae, Asteraceae, Berberidaceae, Boraginaceae, Brassicaceae, Cannabaceae, Caryophyllaceae, Cupressaceae, Fabaceae, Lamiaceae, Moraceae, Pinaceae, Plantaginaceae, Poaceae, Polygonaceae, Rosaceae, Rubiaceae, Salicaceae, Sapindaceae, aresome of the families which are common in all the altitudinal ranges of the study area.

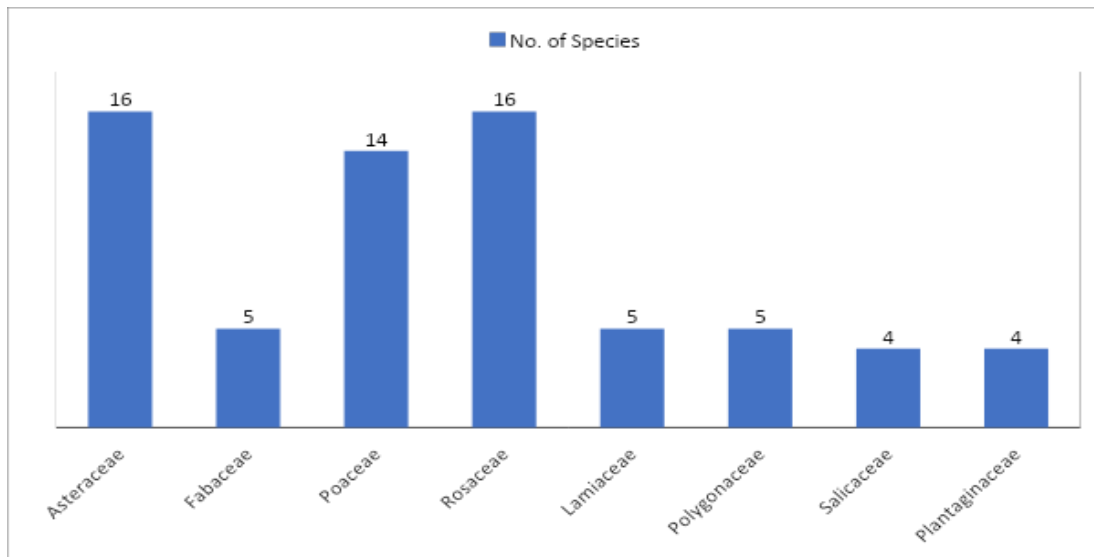


Fig. 1. Species contribution of dominant families

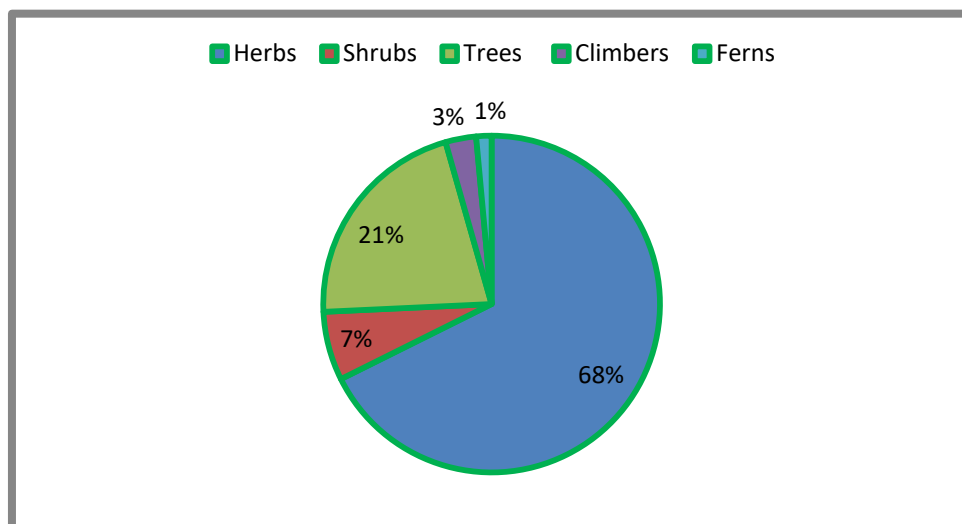


Fig. 2. Life habit of plant species

**Table 1. List of Plant species of the study area**

S.No.	Botanical Name	Local Name	Family	Growth form	Sites		
					Site 1	Site 2	Site 3
1	<i>Abies pindrow</i> (Royle ex D. Don) Royle	Budul	Pinaceae	T	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	<i>Acer caesium</i> Wall. Ex Brandis	Maple	Sapindaceae	T	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	<i>Achilea millefolium</i> L.	Pahel gassih	Asteraceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	<i>Aconitum heterophyllum</i> Wall. Ex Royle	Atis/Patris	Ranunculaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5	<i>Adiantum capillus-veneris</i> L.	Geutheer	Pteridaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
6	<i>Aesculus indica</i> (Wall. Ex Cambess.) Hook.	Handoon	Sapindaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	<i>Ailanthus altissima</i> (Mill.) Swingle	Alamthar	Simaroubaceae	T	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	<i>Ajuga bracteosa</i> Wall. Ex Benth.	Jan-e-adam	Lamiaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9	<i>Alchemilla vulgaris</i> L.	Jangal pun	Rosaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10	<i>Amaranthus</i> spp	Lissih	Amaranthaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	<i>Anagallis arvensis</i> L.	Chari sabun	Primulaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	<i>Angelica glauca</i> Edgew.	Chohore	Apiaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
13	<i>Anthemis cotula</i> L.	Fackigassih	Asteraceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14	<i>Anthriscus sylvestris</i> L.	N/A	Apiaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
15	<i>Arctium lappa</i> L.	Hapath koath	Asteraceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16	<i>Arnebia benthamii</i> Wall. Ex G. Don	Kahzaban	Boraginaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
17	<i>Artemisia</i> spp	N/A	Asteraceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18	<i>Artemisia absinthium</i> L.	Tethwan	Asteraceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
19	<i>Artemisia annua</i> L.	Tethwan	Asteraceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20	<i>Atropa acuminata</i> Royle ex Lindl.	Meithkafal/Jalkafal	Solanaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
21	<i>Berberis lycium</i> Royle.	Kawdach	Berberidaceae	S	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
22	<i>Bromus japonicus</i> Thunb.	Shoal gassih	Poaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
23	<i>Bromus</i> spp	N/A	Poaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
24	<i>Caltha alba</i> L.	Wan gulab	Ranunculaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
25	<i>Cannabis sativa</i> L.	Bhang	Cannabaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26	<i>Capsella bursa-pastoris</i> (L.) Medik.	Kralmund	Brassicaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
27	<i>Cedrus deodara</i> (Roxb.) G. Don	Divdhor	Pinaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
28	<i>Celtis australis</i> L.	Brimij	Cannabaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

S.No.	Botanical Name	Local Name	Family	Growth form	Sites		
					Site 1	Site 2	Site 3
29	<i>Cerastium cerastoides</i> (L.) Britton	N/A	Caryophyllaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
30	<i>Chenopodium urbicum</i> L.	Zewa dawda kual	Amaranthaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
31	<i>Cirsium wallichii</i> DC.	Kund posh	Asteraceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
32	<i>Clinopodium vulgare</i> L.	N/A	Lamiaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
33	<i>Convolvulus arvensis</i> L.	Harangi/Thuræ posh	Convolvulaceae	C	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34	<i>Conyza bonariensis</i> L.	Shashedra	Asteraceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35	<i>Conyza canadensis</i> L.	Paleet	Asteraceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36	<i>Corylus avellana</i> L.	Thangi/ Thankoli/Wiri	Betulaceae	T	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
37	<i>Cupressus sempervirens</i> L.	Sarva kul	Cupressaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
38	<i>Cydonia oblonga</i> Mill.	Bumm tcoxoonth	Rosaceae	T	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39	<i>Cynodon dactylon</i> (L.) Pers.	Dramun	Poaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
40	<i>Cynoglossum glochidiatum</i> Wall.	Cherun	Poaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41	<i>Cynoglossum lanceolatum</i> Forssk.	Landi	Poaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42	<i>Descurainia Sophia</i> (L.) Webb ex Prantl	Zarkash	Poaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43	<i>Dioscorea deltoidea</i> Wall. Ex Griseb.	Kreach/Krees	Dioscoreaceae	C	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
44	<i>Dryopteris</i> spp	Daid	Dryopteridaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
45	<i>Echinochloa colona</i> (L.) Link	Hama	Poaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46	<i>Epilobium hirsutum</i> L.	N/A	Onagraceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
47	<i>Euonymus hamiltonianus</i> Wall.	Himalayan Spindle Tree	Rosaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
48	<i>Euphorbia peplus</i> L.	Gur sotchal	Euphorbiaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49	<i>Ficus carica</i> L.	Anjeer kul	Moraceae	T	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50	<i>Filipendula vestita</i> Wall. Ex G. Don	Chitpava	Rosaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
51	<i>Foeniculum vulgare</i> Mill	Badiyan	Apiaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
52	<i>Fragaria nubicola</i> Lindl. Ex Lacaita	Rangresh/Ishtabur	Rosaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
53	<i>Galinsoga parviflora</i> Cav.	Marczwangun ghassih	Asteraceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54	<i>Galium aparine</i> L.	N/A	Rubiaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
55	<i>Geranium pretense</i> L.	Ratan joug	Geraniaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
56	<i>Geranium sibiricum</i> L.	N/A	Geraniaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

S.No.	Botanical Name	Local Name	Family	Growth form	Sites		
					Site 1	Site 2	Site 3
57	<i>Hypericum perforatum</i> L.	Chai kul	Hypericaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
58	<i>Impatiens brachycentra</i> Kar. & Kir.	Buntil	Balsaminaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
59	<i>Impatiens glandulifera</i> Royle	Buntil/Hillu	Balsaminaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
60	<i>Indigofara heterantha</i> Wall.	Zand/Keiche	Phyllanthaceae	S	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
61	<i>Iris hookeriana</i> Foster	Mazar mund	Iridaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
62	<i>Juglans regia</i> L.	Doon kul	Juglandaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
63	<i>Jurinea macrocephala</i> (DC. Ex Royle) C.B. Clarke.	Dhoop	Asteraceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
64	<i>Lactuca dissecta</i> D. Don	N/A	Asteraceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
65	<i>Lespedeza elegans</i> Cambess.	N/A	Fabaceae	S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
66	<i>Lolium perenne</i> L.	Voltviski	Poaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
67	<i>Malus domestica</i> L. Borkh	Tcxoonth	Rosaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
68	<i>Malva neglacta</i> Wallr.	Sotchal	Malvaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
69	<i>Medicago sativa</i> L.	Lasun ghassih	Fabaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
70	<i>Mentha arvensis</i> L.	Pudnih	Lamiaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
71	<i>Mentha longifolia</i> (L.) Huds.	Yen pudnih/Chala pudina	Lamiaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
72	<i>Morus alba</i> L.	Tuel kul	Moraceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
73	<i>Myosotis sylvatica</i> Ehrh.	N/A	Boraginaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
74	<i>Pedicularis punctata</i> Decne.	N/A	Orobanchaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
75	<i>Phleum pratense</i> L.	N/A	Poaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
76	<i>Picea smithiana</i> (Wall.) Boiss.	Kachul/Rayal	Pinaceae	T	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
77	<i>Picrorhiza kurroa</i> Royle ex Benth.	Khor/Kutki	Plantaginaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
78	<i>Pinus wallichiana</i> A. B. Jacks.	Kaayur/Yaari kul	Pinaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
79	<i>Plantago lanceolata</i> L.	Chamch-e-pater	Plantaginaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
80	<i>Plantago major</i> L.	Gula	Plantaginaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
81	<i>Plantanus orientalis</i> L.	Booen	Platanaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
82	<i>Poa annua</i> L.	N/A	Poaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
83	<i>Poa palustris</i> L.	N/A	Poaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
84	<i>Poa pratensis</i> L.	N/A	Poaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

S.No.	Botanical Name	Local Name	Family	Growth form	Sites		
					Site 1	Site 2	Site 3
85	<i>Podophyllum hexandrum</i> Royle	Wanwangun	Berberidaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	✓
86	<i>Polygonum amplexicaule</i> (D.Don) Ronse Decr.	Maachran chai	Polygonaceae	H	<input type="checkbox"/>	✓	✓
87	<i>Polygonum aviculare</i> L.	Druab/Dudijj	Polygonaceae	H	✓	<input type="checkbox"/>	<input type="checkbox"/>
88	<i>Polygonum hydropiper</i> (L.) Delabre	Merchedi	Polygonaceae	H	✓	✓	<input type="checkbox"/>
89	<i>Populus ciliata</i> Wall. Ex Royle	Jungli Fras	Salicaceae	T	✓	✓	✓
90	<i>Populus deltoides</i> W. Bartram ex Marshall	Russi Fras	Salicaceae	T	✓	✓	<input type="checkbox"/>
91	<i>Potentilla indica</i> (Andrews) Th. Wolf	Yangraesh	Rosaceae	H	<input type="checkbox"/>	✓	✓
92	<i>Potentilla nepalensis</i> Hooker	Ratan jot	Rosaceae	H	<input type="checkbox"/>	✓	✓
93	<i>Prunella vulgaris</i> L.	Kalveuth	Lamiaceae	H	✓	✓	<input type="checkbox"/>
94	<i>Prunus armeniaca</i> L.	Chhhear kul	Rosaceae	T	✓	<input type="checkbox"/>	<input type="checkbox"/>
95	<i>Prunus avium</i> L.	Gilaas kul	Rosaceae	T	✓	<input type="checkbox"/>	<input type="checkbox"/>
96	<i>Prunus domestica</i> L.	Aer kul	Rosaceae	T	✓	<input type="checkbox"/>	<input type="checkbox"/>
97	<i>Punica granatum</i> L.	Daen	Lythraceae	S	✓	<input type="checkbox"/>	<input type="checkbox"/>
98	<i>Pyrus communis</i> L.	Tang kul	Rosaceae	T	✓	✓	<input type="checkbox"/>
99	<i>Ranunculus laetus</i> Wall.	N/A	Ranunculaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	✓
100	<i>Rheum webbianum</i> Royle	Pamb hakh	Polygonaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	✓
101	<i>Rhinanthus minor</i> L.	N/A	Orobanchaceae	H	<input type="checkbox"/>	✓	<input type="checkbox"/>
102	<i>Robinia pseudoacacia</i> L.	Kikar kul	Fabaceae	T	✓	✓	<input type="checkbox"/>
103	<i>Rosa chinensis</i> Jacq.	Gulab	Rosaceae	S	✓	<input type="checkbox"/>	<input type="checkbox"/>
104	<i>Rosa macrophylla</i> Lindl.	Wani gulab/Jungli Gulab	Rosaceae	S	✓	✓	✓
105	<i>Rosa webbiana</i> Wall. Ex Royle	Poshzand/Jungli poash	Rosaceae	S	✓	✓	<input type="checkbox"/>
106	<i>Rubia cardifolia</i> L.	Majaith	Rubiaceae	C	✓	<input type="checkbox"/>	<input type="checkbox"/>
107	<i>Rubus fruticosus</i> L.	Chaanch	Rosaceae	S	✓	<input type="checkbox"/>	<input type="checkbox"/>
108	<i>Rumex napalensis</i> Spreng.	Abuj	Polygonaceae	H	✓	✓	<input type="checkbox"/>
109	<i>Salix alba</i> L.	But veer	Salicaceae	T	✓	✓	<input type="checkbox"/>
110	<i>Salix matsudana</i> Koidzumi.	Volveer/Ringh Veer	Salicaceae	T	✓	<input type="checkbox"/>	<input type="checkbox"/>
111	<i>Sambucus wightiana</i> Wall. Ex Wight & Arn.	Gandula/Faqual	Adoxaceae	H	<input type="checkbox"/>	✓	✓



S.No.	Botanical Name	Local Name	Family	Growth form	Sites		
					Site 1	Site 2	Site 3
112	<i>Saussurea lappa</i> C.B. Clarke	Koth	Asteraceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
113	<i>Scandix pecten-veneris</i> L.	Kachkagin	Apiaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
114	<i>Senecio chrysanthemoides</i> DC.	Chahl/Jarjam/Bagghu	Asteraceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
115	<i>Setaria viridis</i> (L.) P.Beauv.	N/A	Poaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
116	<i>Sisymbrium loeselii</i> L.	Dandh Haakh	Brassicaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
117	<i>Solanum nigrum</i> L.	Kachmach	Solanaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
118	<i>Sorghum halepense</i> (L.) Pers.	Braham	Poaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
119	<i>Stellaria media</i> (L.) Vill.	Naremneur	Caryophyllaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
120	<i>Taraxacum officinale</i> (L.) Weber ex F.H. Wigg.	Handh	Asteraceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
121	<i>Taxus wallichiana</i> Zucc.	Birmi/Posthul	Taxaceae	T	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
122	<i>Torilis japonica</i> (Houtt.) DC.	N/A	Apiaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
123	<i>Trifolium pratense</i> L.	Batakneur	Fabaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
124	<i>Trifolium repens</i> L.	Batakpanj	Fabaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
125	<i>Trillium govanianum</i> Wall. Ex D. Don	Tripatter	Melanthiaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
126	<i>Ulmus villosa</i> Brandis ex Gamble	Brenn	Ulmaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
127	<i>Ulmus wallichiana</i> Planch.	Brenn	Ulmaceae	T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
128	<i>Urtica dioica</i> L.	Soi	Urticaceae	H	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
129	<i>Valeriana wallichii</i> L.	Mushkbala	Caprifoliaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
130	<i>Verbascum Thapsus</i> L.	Wantamook/Gadi kan	Scrophulariaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
131	<i>Verbena officinalis</i> L.	Vervain	Verbenaceae	H	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
132	<i>Veronica</i> spp	Kreer	Plantaginaceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
133	<i>Viburnum grandiflorum</i> Wall. Ex DC.	Kilmunch/Kulmunj	Adoxaceae	S	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
134	<i>Viola odorata</i> L.	Numposh/Banafsha	Violaceae	H	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
135	<i>Vitis vinifera</i> L.	Dach	Vitaceae	C	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
136	<i>Xanthium Strumarium</i> L.	Cond gasse	Asteraceae	H	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

#### 4. DISCUSSION

Various studies [29,30,37-39,40,41] have been reported on the altitudinal variation of flora in Indian Himalayas. They have reported a species variation of 100 to 320. In our study we have reported a total number of 136 species, belonging to 113 genera and 58 different families. The results of our study are based on data collected during the survey of study area. A baseline floristic survey of study area (field and literature based) documented a total of 932 plant taxa belonging to 371 genera in 76 families [42]. These results are also in conformity with the study of floristic diversity and distribution pattern communities along altitudinal gradient conducted in Sangla Valley, Northwest Himalaya [37] in which a total of 320 plant species in their study belongs to 199 genera and 75 families. Among the various recorded families, Asteraceae, Rosaceae, Apiaceae, and Ranunculaceae were the most dominant families. Similar findings have been reported in studies on floristic study at Kanayannur, Kannur district, Kerala in which total of 111 vascular plants under 24 orders and 49 families were recorded and out of them 110 were angiosperms and 1 gymnosperm. Among the angiosperms 87 members were dicots and 21 were monocots and only 2 magnolids were documented in their study [38].

Hence in comparison with previous studies, similar results were recorded in one of the study on "Floristic diversity along altitudinal gradient in Shopian Forest Range of J&K, India", researchers reported the presence of 6 trees, 7 shrubs and 28 herb species in the lower altitude (1800-2100m). The mid altitude (2100-2400m) had 7 tree species, 6 shrub and 25 herb species and 6 tree species, 5 shrub and 29 herb species were recorded at the highest altitude (2400-2700m) [29]. Similar trend was observed in floristic diversity study at Eastern Himalayan forests, where species diversity decreased with increasing altitude. There are ample examples of similar documentation in other parts of Himalayas [30,40,41,43].

Despite being in its early stages, the present investigation of floristic diversity in Raithan range of Pir Panjal Forest Division sheds light on the rich plant life of this region. To recognize the vegetation dynamics, climate change, and other ecological aspects of the area, which will help in management and conservation methods for long-term sustainability, subsequent study is required. The knowledge of the vegetation structure of an

area is the major requirement for any ecological and biodiversity conservation strategies [43]. Floristic information is a crucial component for any biodiversity conservation management programmes [44,45,46]. Many floristic studies that highlight the significance of taxonomic data for the biodiversity conservation has been reported by the various researchers [47,48,13]. In the light of above findings, it is recommended that a long term comprehensive study should be undertaken to document the ecological status of complete flora of the study area.

#### 5. CONCLUSIONS

The flora of Raithan range of Pir Panjal Forest Division is extremely diverse and abundant and consists of plants of economic importance. It is crucial to know the importance of the plant diversity so that the multiplication and conservation of such plants become quite imperative, particularly in the case of plants that are close to extinction. The documentation of floral diversity is extremely important as it is crucial that native and indigenous species of plants are conserved. In keeping with this, the current publication offers the first annotated taxonomic inventory of the flora of Raithan range of Pir Panjal Forest Division, J &K, India. For use by the researchers, decision-makers, land managers, and common people who are interested in documentation, conservation, and sustainable use of plant varieties of this region will be able to use this checklist as baseline data. In this area, there are several arboreal species that are used as sources of food, fodder, fuel wood, timber, dye, essential oils, and medicines.

The current study revealed that this area is rich in diversity of wild plants as well as cultivated plants. In present work a total of 136 species belongs to 113 genera and 58 different families have been recorded with majority formed by herbs and trees. The Asteraceae and Rosaceae families are represented as the most dominant families with 16 species each followed by Poaceae family with 14 plants species. The distribution of species also vary at different altitudes. The present study reports a decreasing trend in terms of species diversity from lower altitude to higher altitude in all three life forms. The maximum number (85) of species were found at altitudinal range of 1800-2300m followed by 2300-2800m with 71 species and only 49 species were present at altitude of above 2800m. Some endangered species like *Aconitum heterophyllum*, *Saussurea costus*, *Picrorrhiza*

*kurroa*, *Taxus wallichiana*, *Podophyllum hexandrum* and *Trillium govanianum* were also reported from the study area. For the local and regional authorities interested in conserving this priceless diversity for greater use in the welfare of future generations and sustainable development of the area, such a study could play a significant role.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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