

Floristic Diversity in Alpine Pasture of Thachi, District Mandi, Himachal Pradesh

Akshay Kumar, R. K. Verma

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ABSTRACT

Study of floristic diversity provide basis for devising suitable strategies for conservation of the plant resources. Accordingly, a study was conducted to understand the floristic diversity of alpine pasture of Thachi, District Mandi, Himachal Pradesh during the year, 2017. The location of the pasture lies at 31°38' 14.94' N latitude, 77°15'23.52' E longitude and 2900–3100 m elevation. A total of 86 plant species belonging to 30 families and 72 genera were recorded from the study area. Dominant families were Asteraceae, Lamiaceae, Rosaceae, Poaceae and Ranunculaceae. On the basis of IVI, *Geum elatum* recorded the highest value (10.93) followed *Trifolium repens* (10.42) and *Poa alpina* (10.36). The lowest value of IVI was observed by *Potentilla leschenaultiana* and *Thalictrum foliolosum* (0.79). The ratio of A/F indicates the distribution pattern of all the species was contiguous. Out of 66 medicinal plant species recorded from the pasture, two species viz., *Roscoea alpina* and *Selinum vaginatum* fall in the category of threatened plants.

Keywords Alpine pasture, Dominant, Threatened plant, Distribution pattern, Conservation.

INTRODUCTION

The alpine pastures are an important constituent of the Himalayan ecosystem. The Himalayas constitute one of the richest and most unusual ecosystems on Earth (Salick et al. 2009). Alpine flora was probably first evolved in the Central Asian highlands during the periods of mountain building in late Myocene and early Pliocene (Billings 1974). The term alpine is derived from the Latin word *albus* which means white (or snow-covered) originally referring to the peaks of Alps (Love 1970). Himalayan alpine vegetation communities retain high ecological significance, because they control the soil stability of their catchment areas, play a major role in ecosystem functioning and are vital in cultural, ethical and aesthetic aspects (Stirling and Wilsey 2001). Alpine refers to those lands lying above climatic limit of upright trees. It is a region of open vegetation, above the timberline where general environment and the vegetation are significantly different from that of lowland. These regions are characterized by relatively low atmospheric pressure, low temperature, intense insolation, rapid and high ultraviolet radiation along with other related effects as chain reactions (Santvan 1993). The alpine pasture, locally known as *Dhar* in Himachal Pradesh. These pasture are rich in variety of grasses and medicinal herbs which grow naturally. The pastures in the alpine zone occupy about 1.52% of the total land area of the country and are mainly concentrated in the Himalayan states of Arunachal Pradesh, Sikkim, Uttarakhand, Himachal Pradesh and Jammu and Kashmir. In Himachal Pradesh alpine pastures cover

Akshay Kumar*, R. K. Verma
Himalayan Forest Research Institute, Conifer Campus, Panthaghati, Shimla 171013, India
email: prasharakshay258@gmail.com
*Corresponding author

around 10,052 sq km which otherwise constitute 17% of the total geographical area of the state (Verma and Kapoor 2014). The phytosociological studies are also useful for comparing different communities. Due to lack of proper management practices, a large number of pastures lands have been converted or are in the process of conversion to degraded lands. Very little scientific attention has been given to the vegetation of the alpine regions. The present study was carried out to know the floristic diversity of alpine pasture, which in turn could be helpful in devising strategies for conservation of the plant resources.

MATERIALS AND METHODS

Study was conducted in alpine pasture of Thachi, District Mandi, Himachal Pradesh during the year 2017 in rainy season. The site lies at 31°38'14.94" N latitude, 77°15'23.52" E longitude between 2900–3100 m elevation range. Phytosociological studies was carried out by laying out the quadrats of size 1 m × 1 m randomly in the alpine pasture. The vegetation data were analyzed for density, frequency and abundance as per Curtis and McIntosh (1950). The relative values of density, frequency and dominance were summed to get importance value index (IVI) of individual species. The abundance to frequency ratio (A/F) of different species was determined for eliciting the distribution pattern of the floral elements. This ratio indicates regular (< 0.025), random (0.025 to 0.050) and continuous (> 0.050) distribution (Curtis and Cottam 1956). The plant species diversity was calculated following Shannon–Wiener Diversity Index (H) (Shannon–Wiener 1963) :

$$H = - \sum_{i=1}^S (N_i / N) \ln (N_i / N)$$

Where, N_i = Number of individuals of species i and N = Total number of individuals of all the species.

Dominance Index (C) was measured by Simpson's Index (Simpson 1949) :

$$C = \sum_{i=1}^S (N_i / N)^2$$

Where, N_i = Importance value of species i and N

= Total importance value of all the species. Richness Index was estimated as per Margalef (1958) i.e. :

$$R = S - 1 / \ln N$$

Evenness Index was calculated as per Hill (1973) i. e. :

$$E = H / \ln S$$

Where, S = Total number of species, N = Total number of individuals of all the species, H = Index of diversity.

RESULTS AND DISCUSSION

Total number of herb species was 86 in the alpine pasture of Thachi. Table 1 *Lotus corniculatus* species having highest value for abundance (5.50) followed by *Geum elatum* (4.67). In terms of density, *Trifolium repens* having highest value (0.67) followed by *Poa alpina* and *Thymus linearis* (0.63). In case of frequency, *Trifolium repens* recorded the highest value (30.00%) followed by *Poa alpina* and *Thymus linearis* (23.33%) and *Inula orientalis* (20.00%). On the basis of IVI, *Geum elatum* was the dominant species (10.93) followed *Trifolium repens* (10.42) and *Poa alpina* (10.36). The lowest value of IVI was observed by *Potentilla leschenaultiana* and *Thalictrum foliolosum* (0.79).

The ratio of A/F indicates the distribution pattern of all the species was contiguous (Table 1). The contiguous distribution is the commonest pattern which is usually observed in nature. The general preponderance of contiguous distribution in vegetation has been reported by several workers (Shameem et al. 2010, Verma and Kapoor 2010, Verma 2014). The value of Dominance Index (C), Diversity Index (H), Richness Index (R) and Evenness Index (E) for herbs was 0.017, 4.200, 12.310 and 0.943 respectively. The higher the value of dominance index, greater is the homogenous nature of the community and vice-versa (Kohli et al. 2004). The lower value of dominance show that dominance of plant is shared by many species. The higher values of index of diversity indicate the variability in the type of species and heterogeneity in the communities, whereas, the lesser value indicate the homogeneity in the community. The higher value of richness index indicates higher diversity of the

Table 1. Phytosociological attributes of herb species in alpine pasture of Thachi.

Sl. No.	Herbs species	Density (m ⁻²)	Frequ-ency	Abun-dance	A/F	IVI
1	<i>Achillea millefolium</i> L.	0.13	5.00	2.67	0.533	2.54
2	<i>Adiantum edgeworthii</i> Hook.	0.07	5.00	1.33	0.267	1.49
3	<i>Agrostis munroana</i> Aitch. & Hemsl.	0.13	8.33	1.60	0.192	2.45
4	<i>Agrostis pilosula</i> Trin.	0.12	6.67	1.75	0.263	2.15
5	<i>Ainsliaea latifolia</i> (D. Don) Sch. Bip.	0.07	5.00	1.33	0.267	1.42
6	<i>Anaphalis contorta</i> (D. Don) Hook. f.	0.05	5.00	1.00	0.200	1.31
7	<i>Anaphalis triplinervis</i> (Sims) Sims ex C. B. Clarke	0.13	5.00	2.67	0.533	2.36
8	<i>Androsace lanuginosa</i> Wall.	0.37	8.33	4.40	0.528	6.14
9	<i>Anemone obtusiloba</i> D. Don	0.30	6.67	4.50	0.675	3.90
10	<i>Arenaria festucoides</i> Benth.	0.03	3.33	1.00	0.300	0.92
11	<i>Arisaema jacquemontii</i> Blume	0.10	3.33	3.00	0.900	1.99
12	<i>Arisaema propinquum</i> Schott	0.05	3.33	1.50	0.450	1.74
13	<i>Aster himalaicus</i> C. B. Clarke	0.05	5.00	1.00	0.200	1.26
14	<i>Bergenia ciliata</i> (Haw.) Sternb.	0.13	5.00	2.67	0.533	2.36
15	<i>Bupleurum longicaule</i> Wall. ex DC.	0.27	6.67	4.00	0.600	3.33
16	<i>Campanula pallida</i> Wall.	0.20	6.67	3.00	0.450	2.95
17	<i>Carex nivalis</i> Boott	0.05	5.00	1.00	0.200	1.31
18	<i>Cirsium falconeri</i> (Hook. f.) Petr.	0.07	5.00	1.33	0.267	2.73
19	<i>Cirsium wallichii</i> DC	0.10	3.33	3.00	0.900	2.53
20	<i>Clinopodium umbrosum</i> (M. Bieb.) Kuntze	0.20	6.67	3.00	0.450	4.31
21	<i>Corydalis goviana</i> Wall	0.05	3.33	1.50	0.450	1.05
22	<i>Cynoglossum microglochin</i> Benth.	0.10	5.00	2.00	0.400	3.00
23	<i>Cynoglossum wallichii</i> G. Don	0.13	6.67	2.00	0.300	3.72
24	<i>Cynoglossum zeylanicum</i> (Vahl) Brand	0.10	8.33	1.20	0.144	3.52
25	<i>Cyperus squarrosus</i> L.	0.30	6.67	4.50	0.675	4.59
26	<i>Delphinium vestitum</i> Wall. ex Royle	0.30	6.67	4.50	0.675	3.90
27	<i>Elsholtzia strobilifera</i> (Benth.) Benth.	0.10	5.00	2.00	0.400	2.10
28	<i>Epilobium royleanum</i> Hausskn.	0.10	6.67	1.50	0.225	2.22
29	<i>Erigeron multiradiatus</i> (Lindl. ex DC.) Benth. & Hook. f.	0.20	8.33	2.40	0.288	3.21
30	<i>Fragaria vesca</i> L.	0.47	13.33	3.50	0.263	6.10
31	<i>Galium aparine</i> L.	0.20	6.67	3.00	0.450	3.16
32	<i>Geranium polyanthes</i> Edgew. & Hook. f.	0.05	3.33	1.50	0.450	1.11
33	<i>Geranium wallichianum</i> D. Don ex Sweet	0.17	10.00	1.67	0.167	3.00
34	<i>Geum elatum</i> Wall. ex G. Don	0.47	10.00	4.67	0.467	10.93
35	<i>Gypsophila cerastoides</i> D. Don	0.20	11.67	1.71	0.147	3.94
36	<i>Hackelia uncinata</i> (Benth.) C. E. C. Fisch.	0.05	3.33	1.50	0.450	1.00
37	<i>Halenia elliptica</i> D. Don	0.20	6.67	3.00	0.450	2.76
38	<i>Inula orientalis</i> Lam.	0.37	20.00	1.83	0.092	7.46
39	<i>Lactuca macrorhiza</i> (Royle) Hook. f.	0.07	5.00	1.33	0.267	1.42
40	<i>Lotus corniculatus</i> L.	0.37	6.67	5.50	0.825	4.54
41	<i>Malva neglecta</i> Wallr.	0.47	13.33	3.50	0.263	7.60
42	<i>Mazus surculosus</i> D. Don	0.10	3.33	3.00	0.900	1.47
43	<i>Mentha spicata</i> L.	0.30	13.33	2.25	0.169	6.49
44	<i>Microula sikkimensis</i> (C. B. Clarke) Hemsl.	0.20	8.33	2.40	0.288	4.93
45	<i>Myriactis nepalensis</i> Less.	0.17	5.00	3.33	0.667	3.50
46	<i>Nepeta elliptica</i> Royle ex Benth.	0.10	5.00	2.00	0.400	1.73
47	<i>Origanum vulgare</i> L.	0.30	6.67	4.50	0.675	5.45
48	<i>Parnassia nubicola</i> Wall. ex Royle	0.20	6.67	3.00	0.450	3.41
49	<i>Parochetus communis</i> D. Don	0.40	15.00	2.67	0.178	5.78
50	<i>Pedicularis gracilis</i> Wall. ex Benth.	0.13	5.00	2.67	0.533	2.05
51	<i>Persicaria amplexicaulis</i> (D. Don) Ronse Decr.	0.23	6.67	3.50	0.525	3.52
52	<i>Phleum alpinum</i> L.	0.10	3.33	3.00	0.900	1.47
53	<i>Phlomis bracteosa</i> Royle ex Benth.	0.23	6.67	3.50	0.525	3.80

Table 1. Continued.

Sl. No.	Herbs species	Density (m ⁻²)	Frequ-ency	Abun-dance	A/F	IVI
54	<i>Plantago depressa</i> Willd.	0.13	5.00	2.67	0.533	2.20
55	<i>Platanthera edgeworthii</i> (Hook. f. ex Collett) R. K. Gupta	0.07	3.33	2.00	0.600	1.16
56	<i>Poa alpina</i> L.	0.63	23.33	2.71	0.116	10.36
57	<i>Poa annua</i> L.	0.40	16.67	2.40	0.144	7.33
58	<i>Polygonum aviculare</i> L.	0.40	11.67	3.43	0.294	7.70
59	<i>Potentilla argyrophylla</i> Wall. ex Lehm.	0.10	5.00	2.00	0.400	2.10
60	<i>Potentilla atrosanguinea</i> G. Lodd. ex D. Don	0.07	3.33	2.00	0.600	1.31
61	<i>Potentilla leschenaultiana</i> Ser.	0.05	1.67	3.00	1.800	0.79
62	<i>Potentilla lineata</i> Trevir.	0.10	3.33	3.00	0.900	1.47
63	<i>Potentilla polyphylla</i> Wall. ex Lehm.	0.23	8.33	2.80	0.336	3.78
64	<i>Primula denticulata</i> Sm.	0.07	5.00	1.33	0.267	1.42
65	<i>Prunella vulgaris</i> L.	0.13	5.00	2.67	0.533	1.93
66	<i>Ranunculus diffusus</i> DC.	0.17	5.00	3.33	0.667	2.55
67	<i>Ranunculus hirtellus</i> Royle	0.07	3.33	2.00	0.600	1.31
68	<i>Roscoeia alpina</i> Royle	0.37	13.33	2.75	0.206	5.97
69	<i>Rosularia rosulata</i> (Edgew.) H. Ohba	0.17	10.00	1.67	0.167	5.62
70	<i>Rumex acetosa</i> L.	0.13	6.67	2.00	0.300	4.61
71	<i>Rumex nepalensis</i> Spreng.	0.47	16.67	2.80	0.168	7.55
72	<i>Saxifraga parnassifolia</i> D. Don	0.13	5.00	2.67	0.533	2.36
73	<i>Selinum vaginatum</i> C. B. Clarke	0.12	5.00	2.33	0.467	2.16
74	<i>Senecio laetus</i> Edgew.	0.13	3.33	4.00	1.200	1.94
75	<i>Sibbaldia cuneata</i> Schouw ex Kunze	0.40	10.00	4.00	0.400	5.81
76	<i>Silene indica</i> (Roxb.) Roxb. ex Otth	0.07	3.33	2.00	0.600	1.40
77	<i>Swertia ciliata</i> (D. Don ex G. Don) B. L. Burtt	0.08	3.33	2.50	0.750	1.75
78	<i>Swertia cordata</i> (Wall. ex G. Don) C. B. Clarke	0.13	5.00	2.67	0.533	2.96
79	<i>Tanacetum dolichophyllum</i> (Kitam.) Kitam.	0.17	6.67	2.50	0.375	2.63
80	<i>Taraxacum officinale</i> (L.) Weber ex F. H. Wigg.	0.10	5.00	2.00	0.400	1.73
81	<i>Thalictrum foliolosum</i> DC.	0.05	1.67	3.00	1.800	0.79
82	<i>Thymus linearis</i> Benth.	0.63	23.33	2.71	0.116	9.09
83	<i>Trifolium repens</i> L.	0.67	30.00	2.22	0.074	10.42
84	<i>Verbascum thapsus</i> L.	0.05	5.00	1.00	0.200	2.38
85	<i>Veronica persica</i> Poir.	0.37	13.33	2.75	0.206	7.47
86	<i>Viola biflora</i> L.	0.23	13.33	1.75	0.131	4.84

species. The area having high evenness index indicate that species are evenly distributed in the area. The lower value of dominance index and higher value of diversity index was observed by Verma (2015) while studied Floristic Diversity in Khajjiar beat of Kalatop Khajjiar wild life sanctuary of district Chamba, Himachal Pradesh.

Medicinal plants

The important plants of medicinal value found in alpine pasture of Thachi were compiled following Chopra et al. (1956), Kirtikar and Basu (1987), Kala (2002), Verma et al. (2006), Paulsamy et al. (2007),

Samant et al. (2007), Bhat et al. (2012), Kumari et al. (2018). These include ; *Achillea millefolium*, *Ainsliaea latifolia*, *Anaphalis contorta*, *Anemone obtusiloba*, *Arisaema jacquemontii*, *Arisaema propinquum*, *Bergenia ciliata*, *Bupleurum longicaule*, *Campanula pallida*, *Carex nivalis*, *Cirsium wallichii*, *Clinopodium umbrosum*, *Corydalis govaniana*, *Cynoglossum wallichii*, *Cynoglossum zeylanicum*, *Delphinium vestitum*, *Elsholtzia strobilifera*, *Epilobium royleanum*, *Erigeron multiradiatus*, *Fragaria vesca*, *Galium aparine*, *Geranium wallichianum*, *Geum elatum*, *Gypsophila cerastoides*, *Hackelia uncinata*, *Inula orientalis*, *Lactuca macrorhiza*, *Lotus corniculatus*, *Malva neglecta*, *Mazus surculosus*, *Mentha*

spicata, *Nepeta elliptica*, *Origanum vulgare*, *Par-nassia nubicola*, *Parochetus communis*, *Persicaria amplexicaulis*, *Phlomis bracteosa*, *Plantago depressa*, *Platanthera edgeworthii*, *Polygonum aviculare*, *Potentilla argyrophylla*, *Potentilla atrosanguinea*, *Primula denticulata*, *Prunella vulgaris*, *Ranunculus hirtellus*, *Roscoea alpina*, *Rosularia rosulata*, *Rumex acetosa*, *Rumex nepalensis*, *Saxifraga parnassifolia*, *Selinum vaginatum*, *Senecio laetus*, *Senecio laetus*, *Sibbaldia cuneata*, *Silene indica*, *Swertia ciliata*, *Swertia cordata*, *Tanacetum dolichophyllum*, *Taraxacum officinale*, *Thalictrum foliolosum*, *Thymus linearis*, *Trifolium repens*, *Verbascum thapsus*, *Veronica persica*, *Viola biflora*.

Threatened plants

Out of total plant species recorded from the alpine pasture, two species viz., *Roscoea alpina* and *Selinum vaginatum* are fall in the category of threatened species (Goraya et al. 2013). The habitat of most of the plant species has shrunk due to expansion of human population and environmental degradation primarily due to heavy livestock grazing, uncontrolled and unscientific harvest of species, unregulated tourism and construction of roads. The better conservation of natural resources can be done by inclusion of a section on the plant conservation especially of rare and endangered medicinal plants in the wildlife protection act, promotion of community - based conservation, *in situ* conservation, *ex situ* conservation through tissue culture, developing cultivation technologies and nurseries of medicinal plants and conducting of regular training on the procedure of medicinal plants.

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