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Status of Plant Diversity in Alpine Pasture of Chansel of District Shimla, Himachal Pradesh

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ABSTRACT

A study to evaluate the floristic diversity and growth forms in alpine pasture of Chansel of district Shimla, Himachal Pradesh was conducted during August, 2019. Phyto- sociological studies was carried out by laying out quadrates randomly in the selected alpine pasture. The data collected were analyzed for density, frequency, abundance, importantance value index, dominance index, diversity index, distribution pattern, life forms etc., for drawing the logical conclusion. Total numbers of plant species were 100 belonging to 80 genera and 36 families. The plant species comprised of 5 grasses, 1 sedge, 2 leguminous forbs and 74 non leguminous forbs. On the basis of IVI, *Anaphalis contorta* recorded the highest value (10.14) followed by *Trifolium repens* (9.55) and *Taraxacum officinale* (8.44). The distribution pattern of most of the species was contiguous. The value of dominance index, diversity index, richness index and evenness index was 0.021, 4.17, 10.203 and 0.946, respectively. The contribution of tall forbs, short forbs and cushioned and spreading forbs in the alpine pasture was 41.46%, 52.44% and 6.10%, respectively. Out of 53 medicinal plants species recorded from the studied site, 6 species viz., *Aconitum heterophyllum, Bergenia stracheyi, Jurinea dolomiaea, Meconopsis aculeata, Roscoea alpina* and *Selinum tenuifolium* fall in the category of threatened plant species.

Key words : *Diversity index, Dominance, Distribution, Medicinal plants, Threatened plant*

Introduction

The pastures in the alpine zone occupy about 1.52 per cent of the total land area in the country and are mainly concentrated in the Himalayan states of India (Kumar and Verma, 2018). Total geographical area of Himalayan land in India is 61.5 million ha, out of which, 17.8 million ha is covered by alpine pastures usually found at an altitude above 2800 m and where climate is not helpful for growth of any trees (Verma and Kapoor, 2014). The alpine pastures are supposed to be the only true grasslands in India and where the grazing density is too high. Due to high level of this degradation, the present level of grass production of the Himalayan grasslands is about 25 percent - even less than that of their possible potential. In Himachal Pradesh, alpine pastures cover around 10,052 Sq km which otherwise constitute 17 percent of the total geographical area of the state (Verma and Harish, 2022).

The floristic composition, diversity of the species and phytosociological studies are useful elements of the ecosystems (Dansereau, 1961). The phystosociological studies are useful for comparing different communities (Oosting, 1959) and hence, suggested importance of phytosociological value for problem in sociological studies. The large number of pastures lands have been converted or are in the process of conversion to degraded areas due to lack of management practices and very less attention has been given to the alpine pasture for their scientific management. Although the different authors (Laiolo

et al., 2004; Nautiyal and Kaechole, 2006; Verma *et al*., 2006; Verma *et al*., 2008; Shaheen *et al*., 2011; Verma and Kapoor, 2012; Verma and Kapoor, 2014; Arya and Samant, 2017; Pittarello *et al*., 2018; Rahman *et al*., 2020; Qin *et al*., 2021; Wani *et al*., 2022) have worked on plant diversity of alpine pasture but there is less database available on the plant diversity of alpine pastures.

The present study was carried out to know the status of plant species diversity of alpine pasture which could be useful in devising strategies for their better management. The plants in alpine region are in harmony with environment because they form the integral part of very processes that shaped their own environment. These plants are recognized by certain super- imposed morphological and taxonomic peculiarities, which form part of their adaptation to alpine environment.

Materials and Methods

The study was conducted in alpine pasture of Chansel area of district Shimla, Himachal Pradesh during August, 2019 between 3550 to 4200 m elevation range (Fig. 1). The site lies at 31°12′51.4′′ to 31°13′09.11′′ N latitude and 77°58′25.0′′to 77°62′35.41′′ E longitude. Phytosociological studies was carried out by laying out the quadrats of size 1m X 1m randomly in the alpine pasture. The vegetation data was analyzed for density, frequency and abundance as per Curtis and McIntosh (1950). The relative values of density, frequency and dominance was 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 contiguous (>0.050) distribution (Curtis and Cottam, 1956). The plant species diversity was calculated following Shannon-Wiener diversity Index(H) (Eq. 1) (Shannon-Wiener, 1963).

$$H = -\sum_{i=1}^{S} (Ni/N)\, ln\, (Ni/N) \quad \text{(Eq. 1)}$$

Dominance Index (C) was measured by Simpson's Index (Eq. 2)(Simpson, 1949).

$$C = \sum_{i=1}^{S} (Ni/N)^2 \quad \text{(Eq. 2)}$$

Where Ni = Importance value of species i and N= Total importance value of all the species.

Richness Index was estimated as per (Eq. 3) Margalef (1958) *i.e.*,

$$R = S\text{-}1/ln \quad \text{(Eq. 3)}$$

Evenness Index was calculated as per (Eq. 4) Hill (1973) *i.e.*,

$$E = H/ln\, S \quad \text{(Eq. 4)}$$

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

The different plant categories viz., grasses, sedges, leguminous and non-leguminous forbs were recognized and then species were assigned to various growth forms following Santvan (1993). The growth forms indicates tall forbs (>30 cm height), short forbs (<30 cm height) and cushion and spreading forbs. The plants of medicinal values along with threatened category were also documented from the studied site.

Results

Total number of plant species was 100 belonging to 80 genera and 36 families (Table 1). The dominant families were Apiaceae, Asteraceae, Balsaminaceae, Fabaceae, Lamiaceae and Poaceae. *Anaphalis contorta* was the dominant species having maximum value for density (7.80 m^{-2}), abundance (15.42) and frequency (91.67%). This was followed by *Trifolium repens* (6.20 m^{-2}) in term of density. On the basis of IVI, *Anaphalis contorta* recorded the highest value (10.14) followed by *Trifolium repens* (9.55) and *Taraxacum officinale* (8.44). The community identified was *Anaphalis contorta–Trifolium repens*. The distribution pattern of the species was random and contiguous. The values of dominance index (C), diversity index (H), richness index (R) and evenness index (E) was 0.013, 4.460, 11.550 and 0.968, respectively.

The plant species, comprised of 6 grasses, 2 sedges, 2 legumes forbs and 90 non-leguminous forbs was recorded. The grasses comprised of *Agrostis pilosula, Agrostis munroana, Cynodon dactylon, Eragrostis viscosa, Poaannua* and *Poa alpina.* The sedges consisted of *Carex nivalis* and *Cypress squarrosus, Trifolium pretense, Trifolium repens. Bergenia stracheyi, Sibbaldia cuneata, Geranium wallichianum, Plantago lanceolata, Jurinea dolomiaea, Ranunculus hirtellus, Pleurospermum brunoni, Thymus linearis* and *Tanacetum dolichophyllum.* Tall forbs, short forbs, cushion and spreading forbs was 33.65%, 57.69% and 8.65% respectively to the total flora. The pattern of life forms comprised of

chamaephytes (48.08%), hemicryptophytes (25.96%), therophytes (18.27%) and cryptophytes (7.69%).

Total 32 unpalatable plant species have been recorded from the studied alpine pasture. Some of these are *Achillea millefolium, Aconitum violaceum, Adiantum edgeworthi, Anaphalis contorta, Anaphalis triplinervis, Anemone obtusiloba, Anemone tetrasepala, Aquilegia pubiflora, Aquilegia nivalis, Chaerophyllum reflexum, Cirsium falconeri, Crawfurdia speciosa, Cynoglossum micranthum, Delphinium cashmerianum, Erigeron multiradiatus, Impatiens sulcata, Iris kemaonensis, Ligularia amplexicaulis, Meconopsis aculeata, Morina longiflora, Pedicularis hoffmeisteri, Pedicularis longiflora, Pedicularis oederi, Primula denticulata, Primula glomerata, Rumex acetosa, Rumex nepalensis, Sedum ewrsii, Selinum tenuifolium, Senecio graciliflorus, Swertia purpurascens* and *Tanacetum dolichophyllum* (Table 1).

Medicinal and Threatened Plants

The number of medicinal plants at Chansel site were 57. These were *Achillea millefolium, Aconitum violaceum, Ainsliaea latifolia, Allium humile, Anaphalis contorta, Anaphalis triplinervis, Anemone obtusiloba, Anemone tetrasepala, Aquilegia pubiflora, Artemisia parviflora, Aster multiraditus, Bergenia stracheyi,*

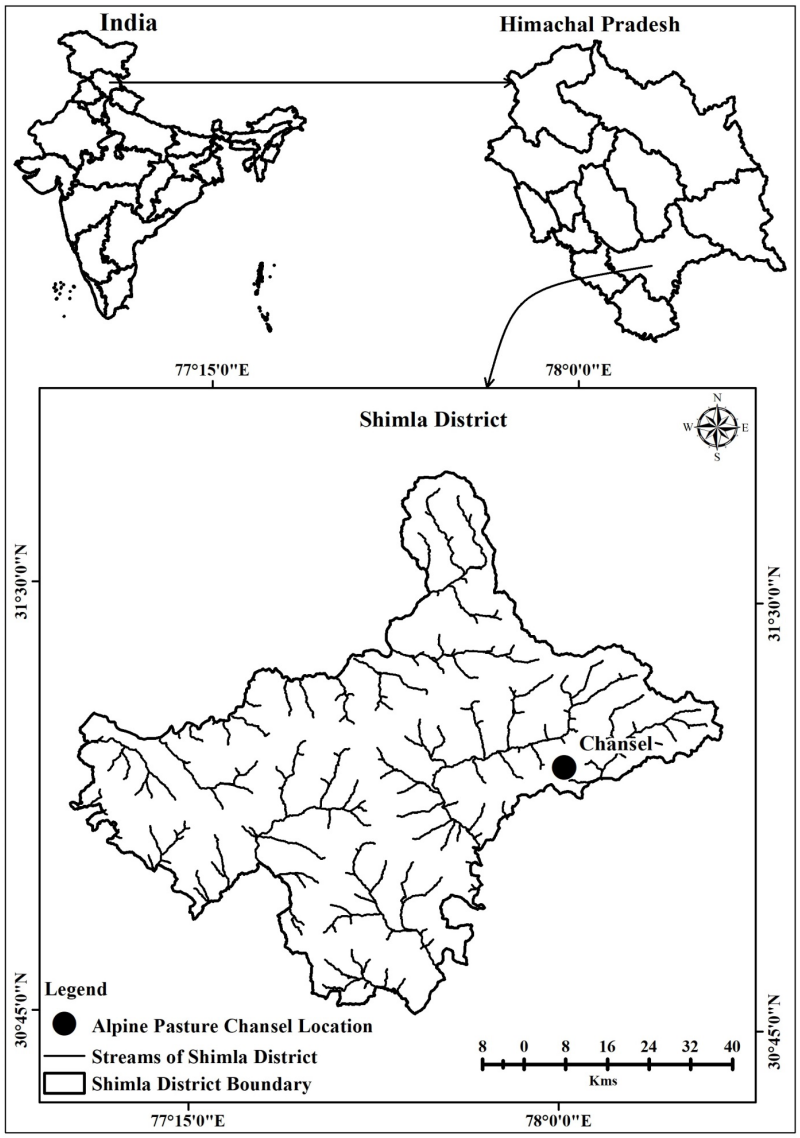

Fig. 1. Map of alpine pasture Chansel of district Shimla, Himachal Predesh

Table 1. Phytosciological attributes of the herb species at Chansel alpine pasture

Plant Species	Density (m^{-2})	Frequency (%)	Abundance	A/F	IVI	Growth Form	Palatable/ Unpalat-able Species
GRASSES							
Agrostis munoroana Aitch. & Hemsl.	2.88	60.00	4.81	0.080	3.13	TF	PA
Agrostis pilosula Trin.	3.00	56.67	5.29	0.093	3.02	TF	PA
Cynodon dactylon (L.) Pers.	5.00	83.33	6.00	0.072	4.80	CS	PA
Eragrostis viscosa (Retz.) Trin.	2.97	88.33	3.36	0.038	3.43	SF	PA
Poa alpina L.	5.12	51.67	12.00	0.232	4.51	SF	PA
Poa annua L.	5.20	88.33	5.89	0.067	4.55	SF	PA
SEDGES							
Carex nivalis Boott	4.20	80.00	5.25	0.066	4.24	SF	PA
Cyperus squarrosus L.	1.40	40.00	3.50	0.088	1.63	SF	PA
LEGUMES							
Trifolium pretense L.	5.40	63.33	8.53	0.135	4.66	CS	PA
Trifolium repens L.	6.20	60.00	8.53	0.142	9.55	CS	PA
NON LEGUMES							PA
Achillea millefolium L.	2.48	80.00	3.10	0.039	5.65	SF	UP
Aconitum violaceum Jacquem. ex Stapf	1.80	48.33	3.72	0.077	2.55	SF	UP
Adiantum edgeworthii Hook.	2.20	36.67	6.00	0.164	2.53	SF	UP
Allium humile Kunth	1.03	48.33	2.14	0.044	2.35	SF	PA
Anaphalis contorta (D.Don) Hook.f.	7.80	91.67	15.42	0.112	10.14	SF	UP
Anaphalis triplinervis (Sims.) sims ex C. B. Clarke	4.88	31.67	9.36	0.487	6.73	SF	UP
Anemone obtusiloba D.Don	4.40	51.67	8.52	0.165	4.90	SF	UP
Anemone tetrasepala Royle	4.20	63.33	6.63	0.105	6.51	SF	UP
Ainsliaea latifolia (D.Don) Sch.Bip.	1.40	36.67	3.82	0.104	2.60	SF	PA
Aquilegia pubiflora Wall. ex Royle	1.60	63.33	2.53	0.040	2.58	TF	UP
Aquilegia nivalis (Baker) Falc. ex B. D. Jacks.	1.00	43.33	2.31	0.053	1.69	SF	UP
Arenaria festucoides Benth.	1.20	48.33	2.48	0.051	2.27	CS	UP
Artemisia parviflora Roxb. ex D.Don	1.83	36.67	5.00	0.136	2.46	TF	UP
Aster multiraditus (Aiton) Kuntze	3.00	40.00	7.50	0.188	3.43	SF	PA
Bergenia stracheyi (Hook.f. & Thomson) Engl.	0.72	31.67	2.26	0.071	1.59	SF	PA
Caltha palustris L.	1.77	48.33	3.66	0.076	3.85	TF	UP
*Cassiope fastigiata*** (Wall.) D. Don	1.80	28.33	6.35	0.224	1.77	SF	UP
Chaerophyllum reflexum Aitch.	0.40	20.00	2.00	0.100	0.90	TF	UP
Cicerbita macrorhiza (Royle) Beauverd	2.20	83.33	2.64	0.032	3.05	SF	PA
Cirsium wallichii DC.	1.00	36.67	2.73	0.074	2.36	TF	UP
Cirsium falconeri (Hook. f.) Petr.	1.40	51.67	2.71	0.052	3.17	TF	UP
Chenopodium album L.	0.48	20.00	2.42	0.121	1.35	TF	PA
Corydalis govaniana Wall.	0.72	36.67	1.95	0.053	1.28	SF	PA
Crawfurdia speciosa Wall.	1.03	43.33	2.38	0.055	1.52	SF	UP
Cremanthodium reniforme (DC.) Benth.	0.48	20.00	2.42	0.121	1.19	TF	PA
Cyananthus lobatus Wall. ex Benth.	1.40	36.67	3.82	0.104	1.67	CS	PA
Cynoglossum micranthum Desf.	1.40	48.33	2.90	0.060	3.40	TF	UP
Delphinium cashmerianum Royle	1.80	60.00	3.00	0.050	3.15	TF	UP
Diplazium esculentum (Retz.) Sw.	1.92	80.00	2.40	0.030	4.72	TF	PA
Epilobium laxum Royle	2.20	88.33	2.49	0.028	3.70	TF	PA
Erigeron multiradiatus (Lindl. ex DC.) Benth. ex C.B.Clarke	2.20	76.67	2.87	0.037	3.33	SF	UP
Fragaria nubicola (Lindl. ex Hook.f.) Lacaita	2.40	48.33	4.97	0.103	2.39	CS	PA

Table 1. *Continued ...*

Plant Species	Density (m^{-2})	Frequency (%)	Abundance	A/F	IVI	Growth Form	Palatable/ Unpalat-able Species
Galium aparine L.	1.80	23.33	7.71	0.331	1.48	CS	PA
Galium asperifolium Wall.	1.32	60.00	2.19	0.037	1.98	SF	PA
Gentiana deperssa D.Don	3.92	60.00	6.53	0.109	3.29	SF	PA
Geranium wallichianum D. Don. ex. Sweet.	1.52	60.00	2.53	0.042	2.05	SF	PA
Geum elatum Wall. ex G. Don	1.57	51.67	3.03	0.059	2.02	CS	PA
Gypsophila cerastoides D.Don	1.77	60.00	2.94	0.049	2.14	SF	PA
Hypericum elodeoides Choisy	0.48	8.33	5.80	0.696	0.49	TF	PA
Impatiens edgeworthii Hook.f.	1.03	48.33	2.14	0.044	1.81	TF	UP
Impatiens sulcata Wall.	0.72	28.33	2.53	0.089	1.15	TF	UP
Iris kemaonensis Wall. ex D.Don	3.52	60.00	5.86	0.098	4.29	TF	UP
Jurinea dolomiaea Boiss.	1.43	31.67	4.53	0.143	3.63	CS	UP
Lactuca lessertiana (Wall. ex DC.) Wall. ex C.B. Clarke	2.52	51.67	4.87	0.094	2.72	SF	PA
Leontopodium jacotianum Beauverd	1.97	60.00	3.28	0.055	2.81	SF	UP
Ligularia amplexicaulis DC.	1.12	20.00	5.58	0.279	3.02	TF	UP
Lychnis nutans Benth.	1.03	23.33	4.43	0.190	1.02	SF	PA
Meconopsis aculeata Royle	2.08	60.00	3.47	0.058	3.31	TF	UP
Morina longifolia Wall. ex DC.	1.12	48.33	2.31	0.048	2.97	TF	UP
Morina polyphylla Wall. ex DC.	0.88	40.00	2.21	0.055	2.29	TF	UP
Nepeta laevigata (D.Don) Hand-Mazz.	2.32	88.33	2.62	0.030	5.31	SF	PA
Nepeta podostachys Benth.	0.97	40.00	2.42	0.060	2.28	SF	PA
Oxyria digyna (L.) Hill	1.80	48.33	3.72	0.077	3.54	SF	PA
Oxytropis lapponica (Wahlenb.) Gay	1.40	28.33	4.94	0.174	1.98	SF	UP
Parnassia cabulica Planch. ex C. B. Clarke	2.63	88.33	2.98	0.034	4.43	SF	PA
Parochetus communis D.Don	3.08	76.67	4.02	0.052	3.59	SF	PA
Pedicularis hoffmeisteri Klotzsch	0.88	40.00	2.21	0.055	1.52	SF	UP
Pedicularis longiflora Rudolph	0.48	23.33	2.07	0.089	0.88	SF	UP
Pedicularis oederi Vahl.	0.60	28.33	2.12	0.075	1.01	SF	UP
Phlomis bracteosa Royle ex Benth.	2.20	80.00	2.75	0.034	6.76	TF	PA
Plantago depressa Wild.	2.20	40.00	5.50	0.138	2.60	SF	PA
Pleurospermum brunonsis Benth. ex C. B. Clarke	2.60	80.00	3.25	0.041	4.05	SF	PA
Pleurospermum candollei Benth. ex C.B. Clarke	1.20	48.33	2.48	0.051	2.02	SF	PA
Polygonum capitatum Buch.-Ham. ex D. Don	1.00	31.67	3.16	0.100	1.51	TF	PA
Polygonum polystachyum Wall. ex Meisn.	1.12	36.67	3.05	0.083	2.23	TF	UP
Potentilla atrosanguinea G.Lodd. ex D.Don	1.83	63.33	2.89	0.046	4.07	SF	PA
Primula denticulata Sm.	1.52	71.67	2.12	0.030	2.86	SF	UP
Primula glomerata Pax	1.40	48.33	2.90	0.060	2.38	SF	UP
Ranunculus hirtellus Royle	3.00	80.00	3.75	0.047	3.38	SF	PA
Rhodiola wallichiana (Hook.) S.H. Fu	1.83	48.33	3.79	0.078	2.12	SF	UP
Roscoea alpina Royle	0.80	36.67	2.18	0.060	1.27	SF	PA
Rumex acetosa L.	1.40	40.00	3.50	0.088	2.22	TF	UP
Rumex nepalensis Spreng.	2.60	88.33	2.94	0.033	4.59	TF	UP
Saussurea graminifolia Wall. ex DC.	2.32	43.33	5.35	0.123	4.89	SF	PA
Saxifraga parnassifolia D.Don	1.97	48.33	4.07	0.084	3.10	SF	PA
Saxifraga sibirica L.	1.40	40.00	3.50	0.088	1.74	SF	PA

Table 1. *Continued ...*

Plant Species	Density (m^{-2})	Frequency (%)	Abundance	A/F	IVI	Growth Form	Palatable/ Unpalat-able Species
Sedum ewersii Ledeb.	0.63	20.00	3.17	0.158	0.82	SF	UP
Selinum tenuifolium Salisb.	0.88	23.33	3.79	0.162	1.30	TF	UP
Senecio graciliflorus (Wall.) DC.	0.72	20.00	3.58	0.179	1.36	TF	UP
Sibbaldia cuneata Schouw ex Kunze	5.40	51.67	10.45	0.202	4.06	SF	PA
Sibbaldia purpurea Royle	5.20	43.33	12.00	0.277	3.88	SF	PA
Silene edgeworthii Bocquet	1.00	48.33	2.07	0.043	1.98	SF	PA
Silene viscosa (L.)Pers.	0.72	31.67	2.26	0.071	1.22	SF	PA
Swertia purpurascens Boiss.	1.00	31.67	3.16	0.100	1.72	TF	UP
Tanacetum dolichophyllum (Kitam.) Kitam.	3.97	63.33	6.26	0.099	2.77	SF	UP
Taraxacum officinale (Kitam.) Kitam.	4.48	56.67	7.91	0.140	8.44	SF	PA
Thalictrum foliolosum DC.	1.60	76.67	2.09	0.027	2.84	SF	PA
Thymus linearis Benth.	3.60	60.00	6.00	0.100	3.61	SF	PA
Urtica dioica L.	0.48	28.33	1.71	0.060	1.58	TF	PA
Viola biflora L.	1.12	20.00	5.58	0.279	1.25	SF	PA

Note: TF= Tall Forbs (> 30cm), SF= Short Forbs (<30cm), CS= Cushion and Spreading Forbs

Bistorta amplexicaulis, Caltha palustris, Cassiope fastigiata, Chaerophyllum reflexum, Chenopodium album, Corydalis govaniana, Cynodon dactylon, Cynoglossum micranthum, Delphinium vestitum, Erigeron multiradiatus, Fragaria nubicola, Galium aparine, Galium asperifolium, Geranium wallichianum, Geum elatum, Hypericum elodeoides, Iris kemaonensis, Jurinea dolomiaea, Lactuca lessertiana, Lychnis nutans, Meconopsis aculeata, Morina longifolia, Nepeta podostachys, Oxyria digyna, Oxytropis lapponica, Phlomis bracteosa, Plantago depressa, Pleurospermum brunonis, Pleurospermum candollei, Polygonum capitatum, Polygonum polystachyum, Potentilla atrosanguinea, Primula denticulata, Ranunculus diffusus, Roscoea alpine, Rumex acetosa, Rumex nepalensis, Selinum tenuifolium, Senecio graciliflorus, Swertia purpurascens, Tanacetum dolichophyllum, Taraxacum officinale, Thalictrum foliolosum, Thymus linearis, Trifolium pretense, Trifolium repens, Urtica dioica, and *Viola biflora.* Out of which 6 species viz., *Aconotum violaceum, Bergenia stracheyi, Jurinea dolomiaea, Meconopsis aculeata, Roscoea alpina* and *Selinum tenuifolium* fall in the category of threatened plant species

Discussion

The species present in alpine pasture were analysed for different growth form classes and the contribution. The plant communities are never static but are always in a changing state and their studies are of great significance for management of grassland providing valuable information on the diversity and dominance of constituent species of the communities (Satvan, 1993; Billing, 1978) while studying the alpine vegetation found it most susceptible to human and animal damage through trampling, camp sites, proliferation of trails which result in exposing soil and in irreversible ecosystem changes and extinction of certain species. The A/F ratio indicates that the distribution pattern of most of the species was contiguous. However, some species showed random distribution. The general preponderance of contiguous distribution in vegetation has been reported by several workers (Kershaw, 1973; Singh and Yadava, 1974 and Kunhikannan *et al*., 1998) while working in different ecosystem.

The results are in conformity with the earlier studies made by Singh (1967), Santvan (1993) and Verma *et al.* (2022). Similar findings were reported by different workers while conducted the study in alpine pasture. Santvan (1993) for the alpine pasture near Rahla, reported 22.5% tall forbs, 45.0% short forbs and 32.5% cushion and spreading forbs.Verma *et al.* (2022) recorded 29.33% tall forbs, 54.66% short forbs and 16.0% cushion and spreading forbs for alpine pasture of Talra, Himachal Pradesh. The short forbs usually have hairy leaves which protect them against frost. The cushion and spreading forbs are characterized by various adaptive features such as leaf rosettes, dense cushion, hairy growth etc. which provide relative protection against the harsh condi-

tions of alpine environment. The annuals form a major component in the alpine and high sub alpine environment. It is difficult for most species to complete the entire life cycle in a single cold growing season (Bliss, 1971; Santvan, 1993 and Verma *et al*., 2008).

The plants of medicinal values found in the alpine pasture were documented (Chopra *et al*., 1956; Kirtikar and Basu, 1987; Kala, 2002). The plants of medicinal values and threatened category found in the different alpine pastures of district Shimla were documented.

The unplatable plant species compiled by Kaur *et al.* (2010) and Singh *et al.* (2017). The unplatable plant species are mainly characteristic species of the camping sites or around the areas of the graziers where the organic matter was found accumulated due to excretory wastes of the animals (Verma *et al.,* 2006; Nautiyal and Kaechole, 2006; Verma *et al*., 2008; Kaur *et al*., 2010; Arya and Samant, 2017). The unpalatable plant species occurred throughout the alpine pastures, however, their occurrence was more around the areas of the graziers.

The lower value of dominance index and higher value of diversity index was observed by Santvan (1993) in the alpine vegetation near Rahla in Kullu, Himachal Pradesh. Similar finding were also reported by Verma *et al*. (2008), Verma and Kapoor (2012) and Verma and Kapoor (2014) while studied alpine pastures of Himachal Pradesh. The higher the value of concentration of dominance, the greater is the homogenous nature of the community and viceversa (Kohli *et al.,* 2004). The lower value of dominance shows that dominance of plants is shared by many species. The species diversity is regulated by long term factors like community stability and evolutionary time as heterogeneity of both macro and micro environment affects the diversification among different communities. The higher values of index of diversity indicate the variability in the type of species and heterogeneity in the communities, whereas, the lesser values point to the homogeneity in the community. The higher value of evenness indices indicate that species are evenly distributed in this region. The nature of plant community at a place is determined by the species that grow and develop in such environment (Bliss, 1962).

In the present study besides leguminous forbs and fewgrasses, non-leguminous forbs *viz*., *Anaphalis contorta, Anemone obtusiloba, Anemone tetrasepala, Iris kemaonensis, Primula denticulata, Primula glomerata,Thymus linearis* etc, were mostly dominant in thepasture. It may be due to heavy grazing pressure. The dominant non leguminous forbs are not preferred by the animals for eating. The results are in conformity with the earlier studies made by Singh (1967), Santvan (1993) and Verma *et al.* (2008). The overgrazing results inchanges in botanical composition which however, varies with the type of vegetation cover, its palatability, forage productivity, the way it is utilized and sequence of climate events (Shankaranarayan, 1977) which necessitate suitable strategies for management by regulating the grazing. If suitable steps are not taken well in times, there could be further decline in the density of preferred species of leguminous and non leguminous forbs. The ecological studies of all alpine pastures of Himalayan states should be carried out to know the present status of these pastures and thereby devising suitable strategies for their scientific management.

Out of 57 medicinal plant species found in all the studied alpine pasture, 6 species fall in the category of threatened plant species, when compared with the available literature like Red Data Book and CAMP Reports (Ved *et al*., 2003). The rarity in these medicinal plants is due to habitat alteration, narrow range of distribution along with other factors. A major threat is for the species those are uprooted and their underground parts such as rhizomes, tubers, bulbs and roots are used in medicine. The habitat of most of the plant species have shrunk due to expansion of human population and environmental degradation primarily due to heavy live-stock grazing, uncontrolled and unscientific harvest of species, unregulated tourism and construction of road etc. 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 wild life protection act, promotion of community based conservation, *ex-situ* conservation through tissue culture, developing cultivation technologies and nurseries of medicinal plants and conduction of regular training on the procedure of medicinal plants collection, processing among the local people, traders and real stake holders.

Conclusion

In Chansel alpine pasture besides leguminous forbs and few grasses, non leguminous forbs were mostly dominant. The dominant non leguminous forbs are

not preferred by the animals for eating. The contribution of short forbs were more than tall and cushion & spreading forbs. There is a need to take some steps to stop further decline in the density of preferred plant species and suitable strategies should be develop for management of alpine pasture by regulating thegrazing.

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