JOURNAL OF SCIENTIFIC RESEARCH IN ALLIED SCIENCES
ISSN NO. 2455-5800
Contents available at: www.jusres.com

POPULATION STATUS OF WILD EDIBLE PLANT SPECIES IN MOIST TEMPERATE FORESTS OF DISTRICT KINNAUR, HIMACHAL PRADESH, INDIA

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ARTICLE INFO **ABSTRACT** **ORIGINAL RESEARCH ARTICLE**

Article History
Received: April 2018
Accepted: May 2018
Keywords:
Density, Plant resource, Conservation, Edibility

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The population status of wild edible plants species studied in the moist temperate forest areas of the district Kinnaur, Himachal Pradesh, India by quadrat method is presented in this paper. The study revealed that the local inhabitants utilize 53 plants out of 96 plants recorded from the moist temperate forest areas for various edible purposes. Among the 53 edible plants recorded, seven were trees, 21 shrubs and the remaining 25 were herbs. A total of 96 plant species (53 edible and 43 non edible) which included 11 trees, 30 shrubs and 55 herb species were recorded from the habitat. The population study showed that the tree species used for various edible purposes had low density (21.56 trees/ha) and basal area (0.93 m^2/ha) as compared to non-edible tree species, which had density of 303.92 trees/ ha and basal area of 22.16 m^2 /ha. The higher density of non-edible tree species in this forests is mainly due to the dominance of *Cedrus deodara*, which had density of 228.43 trees/ha, basal area of 18.66 m2/ha and IVI of 207.63. Similarly wild edible shrub total density (0.94 bushes/9m^2) was also less as compared to non-edible shrubs (1.69 bushes/9m^2). Density of wild edible shrubs ranged between 0.01 to 0.17 bushes/9m^2. Herb species used for edible purposes by the local inhabitants also had low density (13.10 individuals/m^2) when compared herbs which are non-edible (17.48 individuals/m^2). Though many species are mentioned wild edible, but most of the species are rarely used by local people now-a-days. It was also observed that knowledge about edibility of plant species is decreasing drastically among young generation. There is dire need to start awareness as well as conservation programmes for the wild edible plant species.

Introduction

Kinnaur district of Himachal Pradesh in the Western Himalaya harbors rich plants diversity, which is being utilized by the local inhabitants in a variety of ways. It harbors a wide array of vegetation ranging from sub-tropical upper Himalayan pine forest to alpine pasture and the distribution of vegetation follows an altitudinal zonation similar to that in the outer Himalayas. The important forest types in the district as per Champion and Seth (1968) included, sub-

tropical upper Himalayan pine forest (9/C1b), Himalayan moist temperate forests (12 /C1c, 12/C1d, 12/C1e and 12/C2c), neoza pine forest (13/C2a), dry deodar forest (13 C2b), moist alpine scrubs (15/C_1 and 15/C_2/E_1) and dry alpine scrub (16/C_1). The inhabitants of the area are known as '*Kinnauras'* and they are primarily agro–pastoral and their main occupation revolves around agriculture and horticulture. They have traditional rights to collect a variety of forest products including edibles and medicinal plants from the forests and its adjoining areas (Balokhra, 1998). The local inhabitants utilize a variety of plants for various uses including food, fodder and medicine etc., such traditional knowledge on plants have been documented by various authors from this area (Negi and Subramani, 2002; Negi, 2004; Singh, 2004; Meenakshi, 2006). The inhabitants of the district use a variety of plant parts such as leaves, roots, tubers, stems, buds, flowers, fruits and seeds for edible purposes.

The wild edible plant diversity in Neoza or Chilgoza pine (*Pinus gerardiana*) forest which is a major forest subtype (Dogra, 1964; Chib, 1978) found in the district has been reported by Singh *et al.* (2016). However, information on wild edible plants and their population status is unavailable from Himalayan moist temperate forests which occurs between chirpine forest and sub-alpine formation. Both the coniferous as well as broad leaved crops are found and in mixed stand coniferous species predominate. Moreover, it has been observed recently that the traditional culture of tribes including their knowledge about the use of wild edible plants is rapidly changing due to westernization. Further, increase in human population coupled with increasing demand for economically important plants has led to over exploitation and habitat degradation of many economically important biodiversity elements. Also due to grazing, deforestation, developmental activities and establishment of hydroelectric projects etc., population of most of the wild edible plants is getting depleted in the forests. Though a large number of studies are carried out on the population status of different places in Himalayan region (Saxena and Singh, 1982; Kalakoti *et al*., 1986; Dhar *et al*., 1997; Singh and Rawat, 1999; Negi, 2002; Sharma, 2004; Pant and Samant, 2007; Dutt *et al*., 2007; Verma and Kapoor, 2010), studies on population structure of wild edible plant species are scanty in Himalayan region (Sundriyal and Sunderiyal, 2004) and lacking in Kinnaur District of Himachal Pradesh (Negi, 2004). Therefore, present study was undertaken to assess the diversity of wild edible plants in moist temperate forests of Kinnaur District.

Materials and Methods

Study area: This study was carried out in moist temperate forests areas of the Kinnaur District, Himachal Pradesh, which mainly occupy Nichar and some parts of Sangla region of the district. The District lies between 77° 45' 00" to 79° 00' 35" East Longitudes and 31°55'50" to 32°05'15" North Latitudes and it is surrounded by the Tibet to the east, Uttarkashi District of Uttarakhand on the south and south eastern sides, Shimla District on the western side and Lahaul and Spiti on the north and north-west. It is divided into three administrative blocks viz. Pooh, Nichar and Kalpa. The entire District is spread over the Himalayan mountainous terrain, covering an area of 6,679 km^2 area with altitudes ranging from 1500 to more than 6770 meters above mean sea level. Most of region enjoys a temperate climate, with long winters from October to May and short summers from June to September, April to May is spring and September to October is autumn. The average annual rainfall in the District is 816 mm.

Documentation of wild edible plants: To document the traditional

knowledge of local inhabitants on wild edible plants frequent field visits were carried during July, 2009 to October, 2012. Informants/households were first identified through informant referral by other informants as knowledgeable. For documenting wild edible plants, the first step consisted of semi-structured interviews using free-lists technique to elicit the cognitive domain of wild plants by visiting informants at their homes or fields (Weller and Romney 1988; Puri and Vogl 2005; Victoria *et al*., 2005). Plants were considered edible as per information collected through semi-structured interviews and literature review. In order to verify the identity of plant species mentioned by the respondents, field visits were undertaken with the respondent and in his or her inability other person of his or her family and village. The plant specimens were collected and verified from the respondents who had mentioned the species as wild edible. The specimens of wild edible plants were collected and identified with the help of various floras (Collett, 1921; Nair, 1977; Chowdhery and Wadhwa, 1984; Polunin and Stainton, 1984; Dhaliwal and Sharma, 1999).

Population status of wild edible plants: Population status of all plant species in the habitat was assessed by quadrat method in three sites which represents all the possible landscape heterogeneity in the study region using random sampling during monsoon season of year 2011, when all plant species were in active growth stage. At each site, to enumerate trees 50 quadrats (10 x 10m size) were laid and in each 10 x 10m quadrat two sampling quadrats (3 x 3m) were laid to enumerate the shrub species. Besides, two quadrats of 1 x 1m size were laid in each 3 x 3m quadrat to enumerate the herbs. Thus, a total of 150 quadrats for trees, 300 for shrubs and 600 for herbs were laid in the three sampling sites. Woody plant with more than 31.5cm Girth at Breast Height (GBH) was counted as trees, while tree species between 10.5 and 31.5cm GBH were counted as shrubs/saplings and species with less than 10.5cm were considered as herbaceous plants (Knight, 1963; Sundryial, 1999). For tree species data on GBH (in cm) and number of tree species were noted. The number of bushes was recorded for shrubs species. In case of herb species, numbers of individuals were noted. All the plant species which are used for various edible purposes by the local people of the district were considered as edible plants.

The vegetation data were quantitatively analyzed for frequency, density, abundance, total basal area (for trees) and Importance Value Index (IVI) following Curtis and Mc Intosh (1950) and Misra (1968). The relative values of parameters viz. Relative Frequency (RF), Relative Density (RD) and Relative Basal Area (RBA) were determined following Phillips (1959). In case of trees, density and basal area was calculated per hectare basis and in case of shrubs, density was calculated as number of bushes /9 m^2 and for herbs, density was represented as number of individuals/m^2. All the plant species encountered in the quadrats were enumerated.

Results and Discussion

A total of 96 plant species which comprised of 11 trees 30 shrubs and 55 herb species were recorded through quadrat survey from the habitat. Out of the total species recorded, 53 plants (7 trees, 21 shrubs and 25 herbs) are used for various edible purposes by the local inhabitants of the area. Of the eleven-tree species recorded in the habitat, the wild edible trees (7 species) had low density (21.56 trees/ha) and basal area (0.93 m^2/ha) as compared to non-edible (4 species), which had density of 303.92 trees/ ha and basal area of 22.16 m^2 /ha. The higher density of non-edible tree species in this forest is mainly due to the dominance of *Cedrus deodara* with the

density of 228.43 trees/ha, basal area of 18.66 m^2/ha and IVI of 207.63 (Table 1). *Cedrus deodara* had very high share in terms of density (70.42%), basal area (80.83%) and IVI (69.21%) to the total tree species recorded from this forest. Similarly, *C. deodara* had high frequency of occurrence (92.16%). Besides, *C. deodara*, the other conifer tree species recorded in the forest included *Abies pindrow*, *Picea smithiana* and *Pinus wallichiana* (Table 1). Among the wild edible tree species, *Prunus persica* and *Pyrus pashia* had density of 6.86 trees/ha each and IVI of 7.22 and 6.87, respectively. The frequency of occurrence of wild edible tree species varied from 0.98% to 6.86%. The density of other edible tree species was less.

Table 1: Population status of wild edible and non-edible tree species along with their uses recorded from moist temperate forests in study area.

Sl. No.	Species	Uses	Abundance	Density (trees/ ha)	Frequency (%)	Total Basal Area (m^2/ha)	IVI
	Edible Species						
1	*Aesculus indica* (Wall ex Jeqem) Hook.f.	Nuts are used for making flour	1.00	1.96	1.96	0.43	3.65
2	*Celtis australis* Linn.	Seed flour	1.00	1.96	1.96	0.05	2.03
3	*Ficus palmata* Forsskal	Fruits are edible	1.00	1.96	1.96	0.05	2.04
4	*Juglans regia* Linn.	Nuts are edible	1.00	0.98	0.98	0.04	1.06
5	*Morus serrata* Roxb.	Fruits are edible	1.00	0.98	0.98	0.02	1.01
6	*Prunus persica* (Linn.) Batsch.	Fruits are edible	1.00	6.86	6.86	0.21	7.22
7	*Pyrus pashia* Buch-Ham. ex D. Don.	Fruits are edible	1.00	6.86	6.86	0.13	6.87
	Sub total			**21.56**		**0.93**	
	Non-edible species						
8	*Abies pindrow* Royle	Timber	1.17	6.86	5.88	0.20	6.57
9	*Cedrus deodara* (Roxb.) Louden	Timber	2.48	228.43	92.16	18.66	207.63
10	*Picea smithiana* (Wall.) Boiss	Timber	1.40	20.59	14.71	1.33	21.14
11	*Pinus wallichiana* A.B. Jacks.	Timber	1.69	48.04	28.43	1.97	40.78
	Sub total			**303.92**		**22.16**	
	Grand Total			**325.48**		**23.09**	

The local inhabitants also use 21 shrub species for various edible purposes, out of thirty shrubs recorded in the forest. Most of the edible species recorded are eaten by people rarely. The density of wild edible plants was 0.94 bushes/9m^2 while density of non-edible shrubs was 1.69 bushes/9m^2. Density of wild edibles ranged between 0.01 to 0.17 bushes/9m^2 with very low frequency of occurrence. Among all edible shrubs, *Berberis lycium* was most dominant and abundant species with density of 0.17 bushes/9m^2, frequency of 14.63% and IVI value of 16.14. *Prinsepia utilis* was co-dominant species with density at 0.15 bushes/ 9m^2, 10.73% frequency of occurrence and 12.97 value of IVI (Table 2).

Table 2: Population status of wild edible and non-edible shrubs species along with their uses recorded from moist temperate forests in study area

Sl. No.	Species	Uses	Abundance	Density (Bushes/ 9m^2)	Frequency (%)	IVI
	Edible species					
1	*Arundinaria falcata* Nees	Seed flour used during scarcity	14.00	0.07	0.49	2.95
2	*Berberis aristata* DC.	Ripe fruits are eaten	1.00	0.01	0.49	0.51
3	*Berberis chitria* Lindl.	Ripe fruits are eaten	1.00	0.03	2.93	3.08
4	*Berberis lycium* Royle	Ripe fruits are eaten	1.13	0.17	14.63	16.14
5	*Celtis australis* Linn.*	Seed Flour	1.00	0.01	0.49	0.51
6	*Cotoneaster microphyllus* Wall ex Lindl.	Ripe fruits are eaten	4.00	0.02	0.49	1.08
7	*Debregeasia salicifolia* (Don) Rendle.	Ripe fruits are eaten	7.00	0.03	0.49	1.64
8	*Elaeagnus umbellata* Thunb.	Ripe fruits are eaten	1.00	0.01	0.49	0.51
9	*Ficus palmata* Forsskal*	Ripe fruits are eaten	1.00	0.01	0.49	0.51
10	*Indigofera gerardiana* Wall.	Floral buds used for vegetable	6.00	0.03	0.49	1.45
11	*Lonicera angustifolia* Wallich ex DC	Ripe fruits are eaten	2.00	0.02	0.98	1.40
12	*Oxyria wightiana* Wall ex Wight.	Leaves used to make edible paste	4.00	0.02	0.49	1.08
13	*Prinsepia utilis* Royle	Edible seed oil	1.41	0.15	10.73	12.97
14	*Prunus persica* (Linn.) Batsch. *	Ripe fruits are eaten	1.00	0.01	0.49	0.51
15	*Pyrus pashia* Buch.-Ham. ex D. Don *	Ripe fruits are eaten	1.00	0.01	0.49	0.51
16	*Rosa moschata* Miller	Ripe fruits are eaten	1.00	0.03	2.93	3.08
17	*Rosa sericea* Lindl.	Ripe fruits are eaten	2.75	0.05	1.95	3.36
18	*Rubus ellipticus* Smith	Ripe fruits are eaten	3.25	0.06	1.95	3.74
19	*Rubus niveus* Wallich.	Ripe fruits are eaten	1.41	0.12	8.29	10.03
20	*Viburnum cotinifolium* Don	Ripe fruits are eaten	1.00	0.06	5.85	6.16
21	*Zanthoxyllum alatum* Roxb.	Leaves used as spices	1.33	0.02	1.46	1.73
	Sub total			**0.94**		
22	**Non-edible species** *Abies pindrow* Royle*	Timber	2.00	0.02	0.98	1.40
23	*Budleija asiatica* Lour.	Fodder	1.00	0.03	2.93	3.08
24	*Cedrus deodara* (Roxb.) Louden*	Timber	2.46	0.44	18.05	29.09
25	*Desmodium tiliaefolium* G. Don	Fodder, fire-wood	1.25	0.12	9.76	11.20
26	*Indigofera heterantha* Wall. ex Brandis	Floral buds used as fodder	1.64	0.29	17.56	22.78
27	*Picea smithiana* (Wall.) Boiss*	Timber	2.25	0.04	1.95	2.99
28	*Pinus wallichiana* A.B. Jacks.*	Timber	2.73	0.20	7.32	12.56
29	*Rabdosia rugosa* (Wll. ex Benth.) Hara	--	1.69	0.51	30.24	39.86
30	*Rhamnus virgatus* Roxb.	--	1.00	0.04	3.90	4.10
	Sub total			**1.69**		
	Grand total			**2.63**		

*Saplings

Other important wild edible shrubs included *B. aristata*, *Elaeagnus umbellata*, *Rubus niveus* and *Viburnum cotinifolium* and these species had very low density of

0.01, 0.01, 0.12 and 0.06 bushes/9m^2, respectively. The habitat also supported few other wild edible shrubs viz. *Cotoneaster microphyllus, Lonicera angustifolia, Rosa moschata, R. sericea, Zanthoxylum alatum*, etc. Tree saplings of edible species such as *Celtis australis, Ficus palmata, Prunus persica* and *Pyrus pashia* together contributed 2.20% to the total density and 2.81% to the total IVI value of edible shrub species.

Altogether non-edible shrubs contributed 65.13% for density (1.69 bushes/9m^2) and 63.53% for IVI of all shrub species recorded from the habitat. Among all edible and non- edible shrubs *Rabdosia rugosa* was the most dominant species with the highest density (0.51 bushes/9m^2), frequency (30.24%) and IVI value (39.86). Four tree saplings viz. *Abies pindrow, Cedrus deodara, Picea smithiana* and *Pinus wallichiana* were fairly present in the habitat and these together contributed 41.70% and 36.24% to the total density and IVI of non-edibles. Among these, *C. deodara* had the highest density of 0.44 saplings/9m^2, 18.05% frequency of occurrence and 29.09 values of IVI. The other non-edible shrubs such as *Budleija asiatica, Indigofera heterantha, Desmodium tiliaefolium* and *Rhamnus virgatus* were also recorded from this habitat.

The local inhabitants also utilize 25 species of the herbaceous plants for various edible purposes, which is 45.45% of the total herbaceous plants recorded from the habitat. Similar to trees and shrubs, the density of edible herbs is also low (13.10 individuals/m^2) when compared to non-edible herbs (17.48 individuals/m^2). Among edible herbs, *Oxalis corniculata* which is rarely consumed by people for its sour tasting leaves had the highest density of 4.00 individuals/9m^2 followed by *Fragaria vesca* with 3.68 individuals/m^2 and *Viola serpens* (3.58 individuals/m^2). *Sparassis crispa* an edible fungi was also encountered, but had very low density (0.001/m^2). Besides, *Diplazium esculentum* a pteridophyte which grows near moist places and highly valued for vegetables had also very low density (0.02 individuals /m^2). Other wild edible herbs had density less than one individual per square meter. Seedlings of *B. chitria* and *B. lycium* were also recorded with low density at 0.17 and 0.01 individuals/ m^2, respectively (Table 3). Total density of non-edibles was 17.48 individuals /m^2, which contributed 57.13% to the total density of all the herbs recorded from the habitat. Seedlings of *C. deodara* and *P. wallichiana* were also recorded with 0.11 and 0.04 seedlings /m^2, respectively.

Table 3: Population status of wild edible and non-edible herb species along with their uses recorded from moist temperate forests in study area.

Sl. No.	Species	Uses	Abundance	Density (indls/ m^2)	Frequency (%)	IVI
	Edible species					
1.	*Allium wallichii* Kunth	Leaves and bulbs used for making vegetables	4.00	0.03	0.74	0.31
2.	*Berberis chitria* Lindl. *	Ripe fruits are eaten	8.75	0.17	1.96	1.13
3.	*Berberis lycium* Royle*	Ripe fruits are eaten	1.33	0.01	0.74	0.24
4.	*Bergenia ciliata* (Haw.) Sternb.	Leaves are used for making snacks	3.00	0.01	0.25	0.10
5.	Bistorta affinis Greene	Seed flour used during famine period	8.33	0.06	0.74	0.41
6.	*Brassica juncea* (Linn.) Hook f. **	Leaves are used for making vegetables	2.60	0.03	1.23	0.46

7.	*Cannabis sativa* Linn.	Seeds are relished	5.92	0.57	9.56	4.61
8.	*Chenopodium album* Linn.	Leaves are used for making snacks	2.00	0.02	0.74	0.26
9.	*Dioscorea deltoidea* Wall.	Roasted tubers eatable	1.67	0.01	0.74	0.25
10.	*Diplazium esculentum* (Retz.) Sw.	Leaves are used for making snacks	3.00	0.02	0.74	0.28
11.	*Fragaria indica* Andr.	Ripe fruits are eaten	5.70	0.36	64.46	30.63
12.	*Fragaria vesca* Linn.	Ripe fruits are eaten	7.40	3.68	4.90	2.60
13.	*Phytolacca acinosa* Roxb.	Tender leaves used for vegetables	2.33	0.02	0.74	0.27
14.	*Oxalis corniculata* Linn.	Leaves used for making edible paste	13.59	4.00	29.41	21.58
15.	*Polygonum affine* D.Don	Seed flour used during famine period as bread	7.40	0.09	1.23	0.65
16.	*Ramaria botrytis* (Pers. Fr.) Ricken	Fruiting bodies are used for vegetables	1.00	0.001	0.25	0.08
17.	*Rumex nepalensis* Sprengel.	Tender leaves are used for vegetable	3.00	0.17	5.64	2.18
18.	*Rumex hastatus* D.Don	Leaves used for *chutney*	12.00	0.03	0.25	0.17
19.	*Solanum nigrum* Linn.	Ripe fruits are eaten	2.00	0.01	0.49	0.17
20.	*Sparassis crispa* Fr.	Fruiting bodies are used for vegetables	1.00	0.001	0.25	0.08
21.	*Stellaria media* Linn.	Tender leaves are used for vegetable	6.75	0.07	0.98	0.50
22.	*Taraxacum officinale* Wigg.	Tender leaves are used for vegetable	2.75	0.03	0.98	0.37
23.	*Thymus serpyllum* Linn.	Leaves used in tea	2.20	0.03	1.23	0.44
24.	*Urtica dioica* Linn.	Tender leaves are used for vegetable	8.00	0.10	1.23	0.68
25.	*Viola serpens* Wall. ex Roxb.	Flowers are eaten	9.20	3.58	38.97	22.98
	Sub total			**13.10**		
	Non-edible species					
26.	*Achyranthes bidentata* Blume.	Medicinal	4.09	0.23	5.64	2.38
27.	*Adiantum lunulatum* Burm.	--	8.78	0.69	7.84	4.52
28.	*Ainsliaea aptera* DC.	--	7.75	1.27	16.42	8.90
29.	*Andropogon munroi* C.B. Clarke	Fodder	9.40	0.46	4.90	2.92
30.	*Artemisia brevifolia* Linn.	Medicinal	1.33	0.01	0.74	0.24
31.	*Artemisia maritima* Linn.	Medicinal	4.32	0.30	6.86	2.95
32.	*Bistorta emodii* (Meisn.) Hara	--	5.21	0.42	8.09	3.71
33.	*Cedrus deodara* (Roxb.) Louden*	Timber	2.50	0.11	4.41	1.63
34.	*Chrysopogon gryllus* (L.) Trin.	Fodder	7.43	0.55	7.35	3.91
35.	*Cynoglossum wallichii* G.Don	--	2.20	0.03	1.23	0.44
36.	*Euphorbia emodi* Hook. f.	--	2.00	0.01	0.25	0.09
37.	*Geranium nepalense* Sweet	--	9.92	1.58	15.93	9.77
38.	*Geranium pratense* Linn	--	4.88	0.10	1.96	0.88
39.	*Impatiens glandulifera* Royle	--	1.50	0.02	0.98	0.33

40.	*Nepeta erecta* Royle ex Benth.	--	1.75	0.02	0.98	0.34
41.	*Pedicularis mollis* Wall	--	3.00	0.01	0.25	0.10
42.	*Pinus wallichiana* A.B. Jacks*	Timber	2.00	0.04	1.96	0.69
43.	*Plantago lanceolata* Linn.	Medicinal	15.67	0.12	0.74	0.59
44.	*Plantago major* Linn.	Medicinal	13.19	2.17	16.42	11.84
45.	*Polygonum glabrum* Willd.	--	5.00	0.05	0.98	0.44
46.	*Potentilla nepalensis* Hook	--	2.00	0.02	0.74	0.26
47.	*Pteris cretica* Linn.	--	7.00	0.07	0.98	0.51
48.	*Salvia nubicola* Sw.	--	6.00	0.34	5.64	2.73
49.	*Swertia angustifolia* Buch-Ham. ex D. Don	Medicinal	2.75	0.03	0.98	0.37
50.	*Tagetes minuta* Linn.	Aromatic oil	5.60	0.07	1.23	0.58
51.	*Thalictrum foliolosum* DC.	Medicinal	3.00	0.05	1.72	0.66
52.	*Themeda triandra* Forsk.	Fodder	8.17	0.24	2.94	1.64
53.	*Trifolium repens* Linn.		15.64	6.94	44.36	35.53
54.	*Valeriana jatamansi* Jones	Medicinal	9.98	1.52	15.20	9.35
55.	*Verbascum thapsus* Linn	Medicinal	1.67	0.01	0.74	0.25
	Sub total			**17.48**		
	Grand total			**30.58**		

*Regeneration; ** cultivated and also grows in fringe forest and community land

The values of vegetation parameters recorded during the present study fall within a comparable range of values reported for moist temperate forests of Kumaun Himalaya (Ralhan *et al.*, 1982; Saxena and Singh, 1982) and Western Himalaya (Kala and Uniyal, 1999). The value of species richness for trees, shrubs and herbs were 1.72, 7.80 and 5.62, respectively (Table 4). Saxena and Singh (1982) recorded high species richness (4 to 22) and diversity (0.74 to 3.10) for the shrub layer in the Kumaun Himalaya, which is comparable to the present study. The values of dominance concentration (cd) were similar to those reported by Whittaker (1965) and Risser and Rice (1971) for temperate vegetation (0.01 to 0.99). Saxena and Singh (1982) and Tiwari and Singh (1985) reported the values of 0.11 to 1.00 for different forests in the Kumaun Himalaya. Species diversity was also comparable with values generally reported for temperate forests (Monk 1967, Singh and Singh, 1987; Risser and Rice, 1971). The differences in terms of species composition suggest a high degree of variation in physical settings of the landscape and disturbance regimes. It is also reported that the regional patterns of species richness are consequences of many interacting factors such as plant productivity, competition, geographical area, historical or evolutionary development, regional species dynamics, regional species pool, environmental variables and human activity (Woodward, 1988; Eriksson, 1996; Zobel, 1997; Criddle *et al.*, 2003).

Table 4: Different indices values of wild edible and non-edible plant species recorded from moist temperate forests in study area

Habitat / Form	Diversity index (H')	Concentration of dominance (C)	Richness index (R)	Evenness index (E)
Trees	1.08	0.50	1.72	0.45
Shrubs	1.99	0.10	7.80	0.51
Herbs	2.37	0.09	5.62	0.59

The present study revealed that the local inhabitants of the area use the plant species available in their surrounding environment for a variety of purposes and most of the species recorded from habitat have minor uses and only few are more useful. However, number of useful species will vary from culture to culture and region to region, more the area covered and more the informants interviewed more likely to get higher number of species. Some wild edible plants have medicinal values and are used by people for their health benefits. Such multipurpose uses of wild edible plants are common in rural areas (Shreshta and Dhillion, 2006).

The people in older age groups were of the opinion that those species which were used in the past for edible purposes have lost their importance as edibles due to easy availability of cultivated and commercial vegetables and fruit species. The knowledge about wild edible plants is suffering profound erosion, especially among young. Many plant species are mentioned as edible by elderly people but are not utilized for edible purposes now-a-days. The transmission of wild edible plant knowledge is diminishing with age and knowledge on this natural resource is more vulnerable to loss. Singh (2013) reported that the knowledge about the edible plants is more common with older people (>50 years) as compared to young adults (<30 years) in the district. The decline in wild food gathering could also be due to scarcity of time, modernization, urbanization etc which may gradually lead to the erosion of indigenous knowledge associated with these plants. Local people especially young need to be sensitized about the importance of wild edible plants so that health benefits of consuming these plants are known to future generation and also to meet the food demand for the increasing population.

During the study it was also observed that the wild plant wealth is facing pressure in its natural habitats from various anthropogenic activities such as grazing, habitat degradation, expansion of horticultural and agricultural areas, fuel wood collection, construction of roads, etc. Further, many of these wild edible plants may not be available in the future due to overexploitation, habitat destruction and invasive alien species. Therefore, documentation and population assessment of wild edible plants and their importance will not only provide recognition to this knowledge but will also help in its conservation for the betterment of human society and to the future generation. Efforts can also be made to identify some promising and potential wild edible plants for domestication. Considering the importance of this natural resource, there is a need to conserve the forest resource at both macro and molecular level for human use and sustainable development of environment. Though wild edible plants annually contribute significantly to rural income and livelihood, the management of most of the Non-Timber Forest Products including wild edibles are often neglected (Champers *et al.*, 1989). Further, information about the actual availability and status of edible plants and impact of extraction on forest structure and composition are required for effective management and conservation of these valuable natural resources. Hence long term monitoring on the population status of these wild edible plants in the district needs to be taken up.

Conclusion

The study reveals that density of wild edible plants in moist temperate forests is very less. Out of 96 plant species, parts of 53 plant species were reported as edible, however, most of these species are rarely used by local people now-a-days. Besides, knowledge about edibility of plant species among people especially young generation is decreasing. Natural plant wealth including wild edible plant species are under

tremendous pressure due to various anthropogenic pressures. The results of this study will serve as baseline for researchers and will also contribute in devising conservation strategies of wild edible plant species.

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