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RESEARCH ARTICLE

Survey of Major Ethnomedicinal Plants of District Kinnaur, Himachal Pradesh

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This paper highlights the medicinal plant wealth and its gradual depletion in Kinnaur district of Himachal Pradesh, India. In most cases, the entire plant is dug out for their rhizomes or roots thereby reducing the chances of regeneration. Out of the forty one plants species in the study areas, 83% belong to herbs, 7% to shrubs and 10% to trees. Apiaceae and Asteraceae being the predominant families represented by 7 species each. Maximum utilisation (56%) of roots and rhizomes was observed followed by whole plant (12.2%), seeds (10%), leaf and flower (7.3%), fruits (5%), barks and leaf (2.4%), and bark, stem and flower (2.4%). Out of 41 plants recorded in the present study, 10 were reported to cure stomachache followed by rheumatism and fever (09), and 4 by anaemia and skin disease. Thirty-three plants species have been reported to have more than one therapeutic uses, whereas 17 species are reported to be used for single ailment.

Key Words: Central Himalaya, Cold desert; Depletion; Medicinal Plants; Traditional uses

Introduction

The Himalayan ranges is one of the most important gene rich centers in India holding a large number of useful plant species including 8000 angiosperms, 44 gymnosperms, 600 pteridophytes and 1159 lichens (Ambasta *et al*., 1992; Barthlott *et al*., 2005; Joshi, *et al*., 2016). Of the total phytodiversity, the Indian Himalayan region contains at least 1748 (23.2%) plant species of known medicinal value (Samant *et al*., 1998). Among the various eco-climatic zones in the region, the alpine flora has shown a particular interest for the phytogeographers and plant taxonomists (Kala and Rawat, 2004). These plant species, having slow growth rate, low population density and narrow geographic ranges (Kala 1998; Dhyani and Kala 2005; Kandari *et al*., 2012). Economic potential of medicinal plants growing in the Himalayan region is a vital area for contribution towards novel biomolecules for medicinal purposes which are already well documented (Dhawan, 1997; Kandari *et al*., 2012; Bisht *et al*., 2013). It is estimated that there are already more than 1000 species of diverse plants occurring between 3300 to 3600 m asl (Rau, 1975). Most existing high altitudinal medicinal plants of the region are habitat specific and their endemic nature makes them more prone to biotic and abiotic stress including climate change.

Sudden rise in global demand of herbal products has restricted in exploitation of plants from the wild. Further, the development of herbal based pharmaceutical companies in developing as well as developed countries has increased the demand of raw materials. As a result, the traders have started exploiting the resources indiscriminately thereby about 90% of raw material from the wild (Tandon, 1996; Ved *et al*., 2003). Declining number of the important medicinal plants in the wild due to over-exploitation has raised concern among various scientists, ecologists and conservationists (Dhar *et al*., 2000). Loss of species and habitat destruction worldwide has increased the risk of extinction of medicinal plants in India (Heywood and Iriondo, 2003; Hamilton, 2008)

Presently, India ranks at 6th place for having the largest number of threatened plant species in the wild (Badola and Pal, 2003). Among them, medicinal plant species are facing a drastic decline in their number, hence placed in Appendix I and II of CITES (Negi and Chauhan, 2009). Recognizing and the need for exploring the need for scientific data gathering and documentation

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in order to ensure appropriate conservation planning and action, the Government of Himachal Pradesh has initiated a project, entitled "Establishment of Forestry Herbarium Plan-7 (http://www.yspuniversity.ac.in).

It was aimed to preserve the genetic resource of forest and other MAPs of Himachal Pradesh. Under this project, various explorations were carried out to estimate the present status of available medicinal plant resources in Kinnaur district, which is a part of Himalayan cold desert. The activity also involved networking and liaising with the local forest administration as well as with several inhabitants of the region. (http://www.yspuniversity.ac.in/fp/fp-rese.htm). The present study largely, focuses on ethnobotany of threatened and endangered flora of the Kinnaur district at different altitudinal variations which can later serve as a base document for initiating restoration steps and suitable measures by various government organizations.

Methodology

Study area

The present study was conducted in Kinnaur district of Himachal Pradesh in Western Himalaya, India. The area lies between 31º 05′ 20′′ to 32º 05′ 15′′ N latitude and 77º 45′ 00′′to 79º 00′ 35′′ E longitudes (Fig. 1). It is bounded by Lahaul & Spiti in the north, Kullu in the northwest, Shimla in the southwest and Uttarakhand state in the south. It also shares an International border with China (Tibet) in the east having the three high mountains ranges i.e. Zanskar, Greater Himalaya and Dhauladhar, enclosing rivers of Sutlej, Spiti, Baspa and their tributaries.

Details of the collection site were attached to the specimens for record. Field characters were noted and later transferred to the field book and herbarium labels. For description of specimens, macroscopic characters of the gathered specimens and field observations were used. Nomenclature has been made up to date with the help of recent taxonomic literature (Collect, 1921; Polunin and Stainton, 1985; Nayar, 1996; Ved *et al*., 2003) and specimens were finally identified in Dr. YSP University of Horticulture and Forestry, Solan, H.P.

Ethnobotanical Survey

Help of the local populace of the district Kinnaur was taken for a detailed ethnobotanical survey which included collection of plants and their ethno medicinal (local) usage. A questionnaire approach was adopted for conducting the survey. Group participation in their local rituals and festivals (including fuliach-festival of flowers) was also carried out to identify and establish their deep association with plants.

Results and Discussion

Socio-economic setup

The people of district Kinnaur called "Kinnaura" belong to scheduled tribes and possess physical resemblance

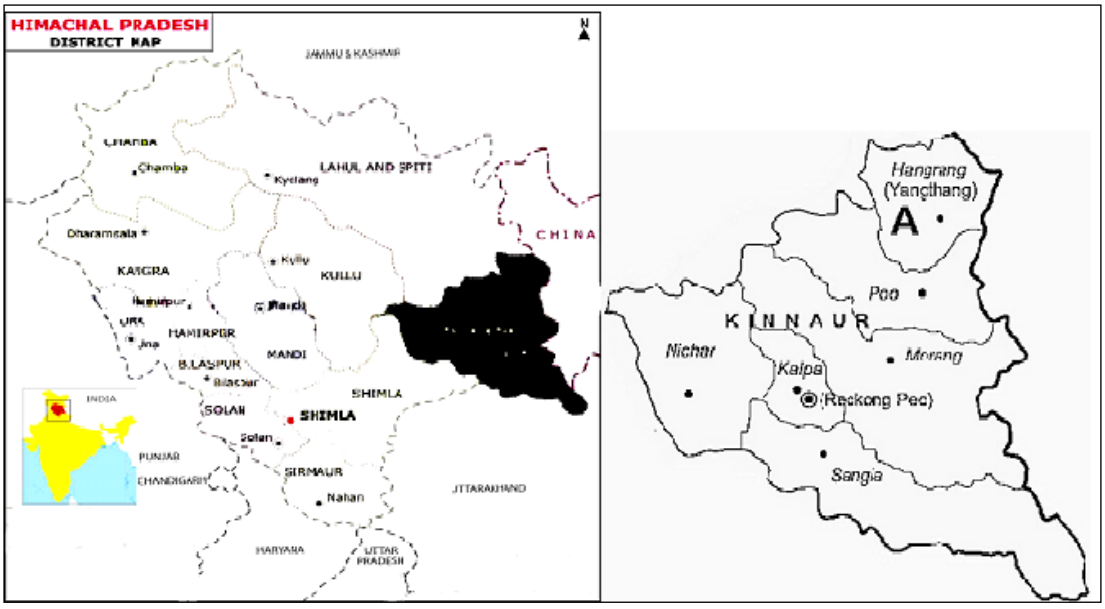

Fig. 1. Map of the study site

with the Mongoloid races (Chandel, 2015). They usually live in dwelling settlements which could be found even up to an elevation of 4300 m asl called "Kanda" area (Alpine zone) during summers. With the onset of winters, they return to their original houses in the lower reaches. Horticulture (cultivation of apple, pear and apricot) and animal husbandry remains most important activities followed by, dairy which are essentially needed. Due to long distance from district headquarters the inhabitants have developed their own system of healing and maintain a strong belief in this regard for immediate ailment relief. These people use locally available plants for traditional household remedies complemented by Vaids and Amchis (folk medicine practitioners) for the cure of minor to major diseases. These traditional medicinal practices adopted by them have been conserved for over decades which can serve as an effective basis for the discovery and development of many drugs. The study areas can be broadly divided into three major sub-divisions based on prevalent climatic conditions viz. upper Kinnaur; mid Kinnaur and lower Kinnaur. The distribution pattern of plant species under the study have been broadly shown by their presence in representative areas of sub divisions indicated in Table 1. Maximum numbers of plants (26) were found growing in Sangla (1500-2000 m asl) valley followed by Kalpa (23) and Morang (16) where conditions are ideal for their development. Lowest numbers of plants (9) were found growing in Yangthang, which is at a higher elevation (beyond 3000 m) and offered tough conditions for plant growth. The plant *Aconitum deinorrhizum* used for cold, fever and cough was found growing all over the Kinnaur area except Yangthang and widely used by locals.

Ethnobotanical study

A total of 41 plant species identified in the area were studied (Table 2). All the plant species belongs to high and medium conservation priority, which are included in some or the other form of near depletion status (Table 3). These species represent 20 families; among which the families' Apiaceae and Asteraceae are the predominant ones represented by seven genus each. The prominent angiosperm families are Asteraceae, Rosaceae, Poaceae, while many families are monotypic (Fig. 2a). Of the total plant species studied, herbs contributed to 83% followed by trees (10%) and only 7% by shrubs (Fig. 2b). However, 56% of the plants have their roots and rhizomes being extensively used followed by whole plant (12.2%), seeds (10%), leaf and flower (7.3%), fruits (5%), bark and leaf (2.4%), bark, stem and flower (2.4%) each (Fig. 3). The type of ailments that were treated by the traditional healers indicates that most of them are of common and simple ones. However, when a traditional healer finds that a particular patient is not responding to his treatment, he is always referred to modern system of medicine for further diagnosis and check-up.

Out of 41 plants recorded in the present study, 10 were reported to cure stomachache. Nine plants cure rheumatism and fever, and 4 could take care of anaemia and skin disease (Fig. 4). Area under commercial medicinal plants ie., *Arnebia benthamii, Dactylorhiza hatagirea, Polygonatum verticillatum* which are known for taking care of problems like baldness, sexual dysfunction and kidney trouble, need to be expanded for bringing in more income to the farmers. Many negative list of export plant species under the EXIM policy since March 1996 like. *Aconitum heterophyllum, A. violaceum, Podophyllum hexandrum, Dactylorhiza hatagirea, Picrorhiza kurroa* and *Jurinea dolomiaea* which are banned from extraction from Himachal Pradesh, are reported to be illegally extracted in abundance from the study area. *Dactylorhiza hatagirea* locally called hathpanja was reported to flourish well in Kalpa Kanda (alpine zone) and was even suggested to be declared as protected area for this particular species (Bhardwaj *et al*., 2013).

Traditional and Social Beliefs

The plant *Saussurea obvallata* called 'dongar' in Kinnaur is used during religious occasions during Fuliach festival (festival of flowers) in Sangla, Ropa and Kalpa Kanda along with the village priest. The study revealed that, priest is the only authorized person to pluck the flowers of this particular species for offering it to local deity and removal of even a small twig by any other person is a taboo. This social restriction was studied thoroughly and was found to be very successful in conservation of this endemic and endangered species in the region (Bhardwaj et al., 2011). *Betula utilis* locally called Bhuj was found in abundance in Chitkul area of Sangla valley, although most of the houses of that area were observed to be thatched using the bark of Bhuj. *Taxus baccata* was also reported to be flourishing well in Chitkul area abounding with *Abies pindrow* (Fir) forest. In Sangla region of the study area, local people have started cultivation of *Saussurea costus* (Kuth) in the alpine

Table 1. Species distribution in different parts of study area

S.No.	Species	Nichar	Morang	Kalpa	Sangla	**Poo**	**Yangthang**
1.	*Aconitum deinorrhizum* Stapf	+	-	-	-	-	-
2.	*Aconitum heterophyllum* Wall. Ex Royle	+	+	+	+	+	-
3.	*Aconitum violaceum* Jacq. ex Stapf.	+	+	+	+	-	-
4.	*Allium stracheyi* Baker Baker	-	+	-	-	+	+
5.	*Angelica glauca* Edgew.	-	-	+	+	-	-
6.	*Arnebia benthamii* (Wall. Ex G. Don)	-	+	-	+	+	+
7.	*Artemisia maritima* L.	-	+	+	-	+	+
8.	*Atropa belladonna* Linn	-	-	+	-	-	-
9.	*Bergenia stracheyi* (J.D. Hooker & Thomson) Engl.	+	-	+	+	+	_
10.	*Betula utilis* D. Don.	-	-	-	+	-	-
11.	*Bunium persicum* Jones Fedtsch	-	_	+	+	-	-
12.	*Carum carvi* Linn.	+	-	+	+	-	-
13.	*Chaerophyllum villosum* Wall. ex DC	+	-	+	+	-	-
14.	*Dactylorhiza hatagirea* (D. Don) Soo	+	+	+	-	-	-
15.	*Dioscorea deltoidea* (D. Don) S	+	+	+	+	_	_
16.	*Ephedra gerardiana* Wall. Ex Stapf.	-	+	-	-	+	+
17.	*Eremurus himalaicus*	-	-	-	-	+	+
18.	*Ferula jaeschkeana* Vatke	-	-	-	-	+	+
19.	*Fritillaria roylei* Hook.	+	-	-	-	-	-
20.	*Heracleum lanatum* Michx.	+	-	+	+	-	-
21.	*Hippophae rhamnoides* Linn.	-	-	+	+	-	-
22.	*Hyssopus heterodonta*	-	+	-	-	+	+
23.	*Hyoscyamus niger L.*	-	+	-	-	+	+
24.	*Inula racemosa* Hook. F	-	-	-	+	-	-
25.	*Jurinea dolomiaea* Boiss	-	+	-	-	+	+
26.	*Jurinea macrocephala* DC	-	+	-	-	+	-
27.	*Nardostachys grandiflora* DC.	-	-	+	+	-	-
28.	*Picrorhiza kurroa* Royle Ex Benth.	-	-	-	+	+	-
29.	*Pleurospermum brunonis* Benth. ex C.B. Clarke	+	-	+	+	-	-
30.	*Podophyllum hexandrum* Royle	-	+	+	+	-	-
31.	*Polygonatum verticillatum* L.	+	-	-	+	-	-
32.	*Rheum australe* D. Don	-	-	+	+	-	-
33.	*Rheum moorcroftianum* Royle	-	+	+	+	-	-
34.	*Rhododendron anthopogon* D. Don	+	-	-	+	-	
45.	*Rhododendron campanulaceae* D. Don	+	-	-	+	-	-
36.	*Rhododendron lepidotum* Wall. ex. D. Don	-	+	+	-	-	-
37.	*Saussurea costus* (Falc) Lipsch.	-	-	-	+	-	-
38.	*Saussurea gossypiphora* D. Don	-	-	+	+	-	-
39.	*Saussurea obvallata* (DC.) Edgew	-		+	+	+	-
40.	*Taxus baccata* Zucc.	-	-	+	+	-	-
41.	*Valeriana jatamansi* Jones	+	+	+		-	-

+ = Present - = Absent

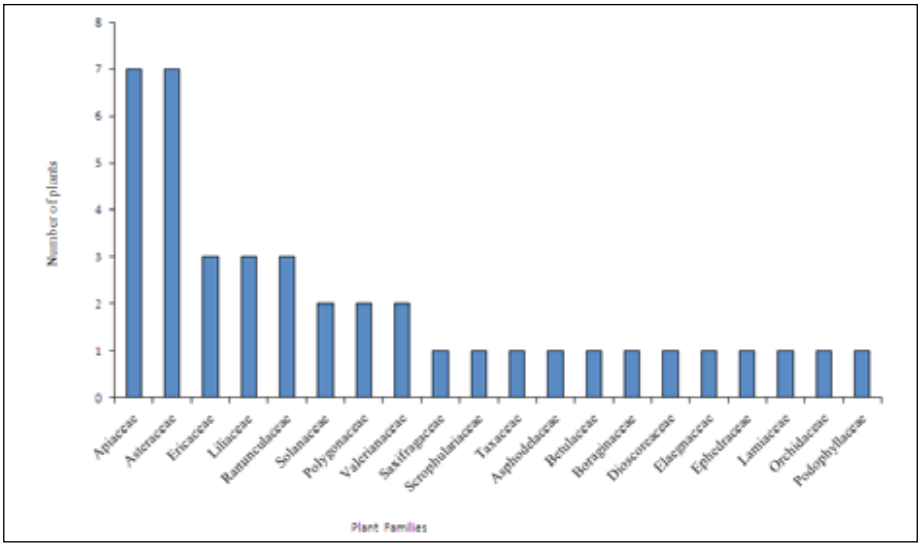

Fig. 2(a). Medicinal plants belongs to different families

pastures (Kanda areas) thereby improvement presently in the plant status. Many other crops viz. *Bunium persicum* (Siah zeera) and *Carum carvi* (Kala zeera) were also found to be under cultivation in the study area ie., The herb *Humulus lupulus* (Hops) was found cultivated in Batsei and Chitkul villages of the study area. A very aromatic herb *Hyssopus heterodonta* (Luffa), was noticed in completely arid region while moving towards Kanda area (alpine zone) which could cause giddiness due to its strong fragrance in oxygen deficit areas. The herb *Ephedra gerardiana* was also found in good number in arid Kinnaur. An important plant *Dioscorea deltoidea* called ratalu is heavily exploited in the study area not only for medicinal purpose but also for its saponin content, which is utilized for washing of woolen clothes by the inhabitants.

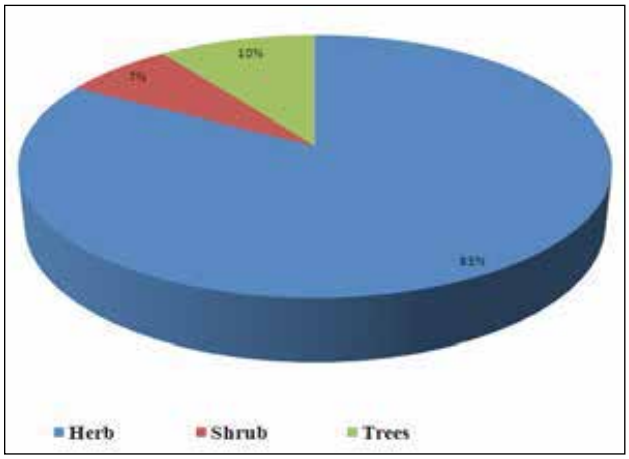

Fig. 2(b). Representation percentage of different life forms

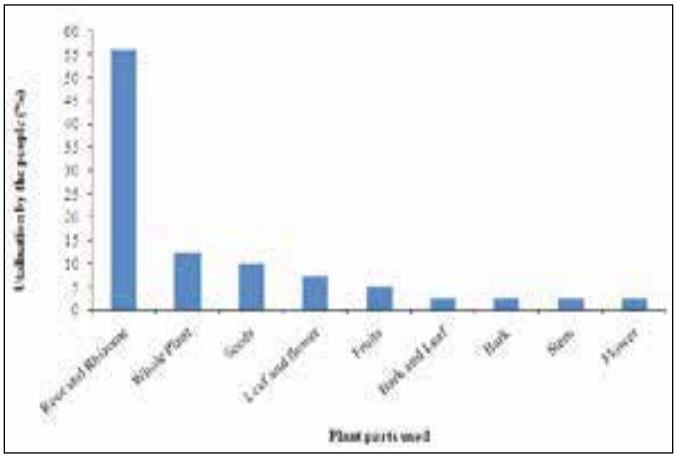

Fig. 3. Plants parts used by traditional communities

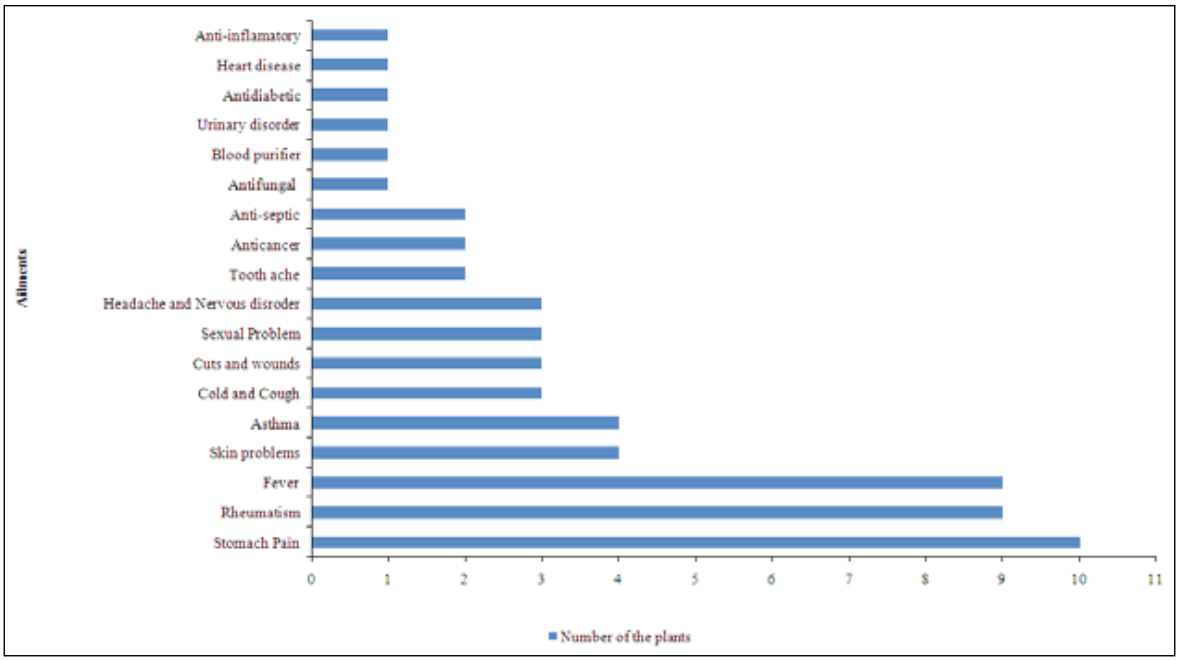

Fig. 4. Number of the plants having different pharamacological actions

This study further highlights the localized, patchy and habitat-specific distribution of the studied plants. Restricted distribution and heavy pressure in the form of grazing by sheep and goat have degraded their habitats further at many places. The habitat has also overlapped with the grazing sites due to easy availability to both livestock and human beings. Therefore, grazing has already been established to be one of the reasons for erosion of biodiversity (Pfister and Gardner, 1999). It was observed that, the species with high market demand

and prohibition for export are declining more rapidly (Table 4). According to an all-India trade survey of prioritized MAPs, demands for some of these species have increased by 50%, whereas availability has declined by 26% (Anonymous, 1976). It was also observed that, people used to collect these plant material for shorter

Table 2. Medicinal Plants resources Selected for population estimation from the wild in Kinnaur area

S. No.	Species	Local name	Field Book No.	Altitude (m asl)	Habitat	Ethnobotanical uses
1	*Aconitum deinorrhizum* Stapf	Mohra bish	10067	2800-3200	SH, AS	Neuralgia, paralysis and muscular rheumatism.
2	*Aconitum heterophyllum* Wall ex Royle	Atees	9817	2400–4000	F, SH, Ogs	Fever Cold, Cough
3	*Aconitum violaceum* Jacq. ex Stapf.	Mitha patish	10081	3200-4500	AS	Rheumatism
4	*Allium stracheyi* Baker	Jimbu	3969	3000–3500	RS, Ogs	Jaundice, cold, cough
5	*Angelica glauca* Edgew	Chora	9678	2200-3200	F	Stomach disorders, diarrhea, bronchitis
6	*Arnebia benthamii.* (Wall ex. G. Don)Johns	Khomae, Ratanjot	10002	3000–4300	OS, SH	Baldness
7	*Artemisia maritima* L.	Nurcha, Seinski	3987	2300-2700	OS	Stomach disorder, fever, jaundice
8	*Atropa belladonna* Linn	Sag-angur	3959	2100-2700	Mr	Spasmolytic
9	*Bergenia stracheyi* (J.D. Hooker & Thomson) Engl.	Ghee-pati	3928	2900–3400	AS	Stomach disorder, fever, Jaundice
10	*Betula utilis* D. Don	Shak-pang, Bhojpatr, Bhooj	9996	2900-3400	F	Rheumatism
11	*Bunium persicum* Jones Fedtsch	Siah jeera	3911	270-3200	Cul	Anti-oxidant
12	*Carum carvi* Linn	Jira	1073	2800-3200	Cul, Mr	Stomach problems, and sexual dysfunction
13	*Chaerophyllum villosum* Wall. ex DC	Ganjari	3913	2100-3600	SH, F	Antimicrobial, antioxidant, stimulant and expectorant.
14	*Dactylorhiza hatagirea* (D. Don) Soo	Hathpanja	10341	2500-4000	OS, Mr	Sexual dysfunction
15	*Dioscorea deltoidea* (D. Don) S	Ratalu	3957	2100-2400	F	Steroid, used I birth control pills cure gastric problems and bloody dysentery
16	*Ephedra gerardiana* Wall. ex stapf	Somlata, Khanta, Phok	3930	2500-4000	RS	Headache and rheumatism
17	*Eremurus himalaicus* Baker	Desert candle	10571	2400-3100	RS	Leaves as remedy for anemia
18	*Ferula jaeschkeana* Vatke	Jungli-hing, Kaith, Kaidmo	10096	2500-3500	RS	Treatment of tumors, chronic wounds and ulcers in man as well as in animals
19	*Fritillaria roylei* Hook	Kakoli	9870	2500-3500	As	Health tonic, member of ashtavarga group (a combination of eight rejuvenating drugs)
20	*Heracleum lanatum* Michx.	Poral ,Patrala	9758	3000-3600	F	Cures leukoderma and psoriasis
21	*Hippophae rhamnoides* L.	Charma, Seabuckthorn, Dhurchuk	3909	2000-3500	RS	Antioxidant, antiulcerogenic, radio protective effects
22	*Hyssopus heterodonta*	Luffa		3200-3800	RS	Stimulant, Carminative and cures digestive uterine and urinary disorders.
23	*Hyoscyamus niger* L.	Khurasani ajwain, Henbane	3929	2800-3900	RS	Analgesic
24	*Inula racemosaa* Hook. F	Pushkarmool	9963	2800-3200	F	Cardiotonic, anti-inflamatory, digestive and febrifuge
25	*Jurinea dolomiaea* Boiss	Dhoop	10001	2800-4000	Os	Antiseptic and for curing fever
26	*Jurinea macrocephala* DC	Dhup, Jari dhoop	9968	3000-4300	Os	Stimulant and applied to skin eruptions
27	*Nardostachys grandiflora* DC.	Bhutkesi	9453	3600-4800	RS	Antispasmodic and stimulant hence used in treatment of fits and heart palpitations
28	*Picrorhiza kurrooa* Royle ex Bent	Kutki	9818	3300-4300	RS	Stomach disorders
29	*Pleurospermum brunonis* C.B. Clarke	Nesar, Chicha	1006	3200-3900	F	Powdered flowering shoots used against fever.
30	*Podophyllum hexandrum* Royle	Bankakri	10016	2400-4500	F, Os	Antifungal also treat warts and timorous growth on the skin.
31	*Polygonatum verticillatum* (L.) All	Macheti	9690	1500-3200	SH	Kidney troubles
32	*Rheum australe* D. Don	Aarcha,Chikri, Revandchini	10006	3000–4200	RS	Antidiabetic, anti-inflammatory, antimicrobial, anticancer and hepatoprotective.
33	*Rheum moorcroftianum* Royle	chikri	11003	3100-3400	Os	Internal injury, cold and cough
34	*Rhododendron anthopogon* D. Don	Talashang, Morua	10026	3000-3400	AS	Leucorrhoea, gonorrhea and post delivery complications
35	*Rhododendron campanulacae* D. Don	Burans, Cherailu	10005	2900-3600	AS	Chronic fever and rheumatism
36	*Rhododendron lepidotum* Wall. ex. D. Don	Cherailu	9869	3100-3700	AS	The tea made from bark is purgative
37	*Saussurea costus* Falc.	Kuth	9834	2700-3100	Cul	Toothache, stomach disorder, asthma
38	*Saussurea gossypiphora* D. Don	Khasbal	10029	3400-3700	RS	Check bleeding from Cuts and wounds

Contd.

S. No.	Species	Local name	Field Book No.	Altitude (m asl)	Habitat	Ethnobotanical uses
39	*Saussurea obvallata* (DC.) Edgew	Dongar, Brahmkamal	9796	4400-4900	RS	Cuts and wounds, Rheumatism
40	*Taxus baccata* Zucc.	Yamdhal	10501	2400-3100	AS	Headache, rheumatism, Anticancerous
41	*Valeriana jatamansii* Jones	Mushkbala	10540	1900-2300	F	Sedative, antispasmodic, Stomachic, stimulant and cure nervous disorders

OS= Open Slopes; **SH**= Shrub Beries; **AS**= Alpine Slopes; **RS**= Rocky Slopes; **F**= Forest; **OGS**= Open grassy slopes; Mr= Marshland; **Cul**=cultivated

Table 3. Assessment of status/depletion level for selected species (based on different guidelines) from the study area with suggested conservation

Species	RDB	PN	CITES Anonymous, 2001	CAMP	IUCN (NW Himalaya)	Mode of propagation	Conservation priority
Aconitum deinorrhizum	-	-	-	CR	-	Seeds and vegetative	High
Aconitum heterophyllum	-	-ve	-	CR	CR, EN	Seeds and Tuber division	High
Aconitum violaceum	-	-	-	CR	CR, EN	Seeds	High
Allium strachei	-	-	-	VU		Seeds	Medium
Angelica glauca	-	-	-	CR		Seeds	High
Arnebia benthamii	-	–ve	-	CR	CR, EN	Seeds, Root cuttings	High
Artemisia maritime	-	-	-	VU	EN	Seeds	Medium
Atropa belladonna			-	CR		Seeds	High
Bergenia stracheyi	-	-	-	VU	VU	Seeds, Rhizome cuttings	Medium
Betula utilis	-	-		EN	EN	Seeds, Vegetatively through layering, grafting , budding	High
Bunium persicum	-	-	-	EN	NL	Seeds	High
Carum carvi	-	-	-	VU	-	Seeds	Medium
Chaerophyllum villosum	-	-	-	VU	-	Seeds	Medium
Dactylorrhiza hatagirea	-	-ve	-	CR	CR, EN	Seeds, Tuber division	High
Dioscorea deltoidea	-	-	CR* Appx. II	CR	-	Tubers	High
Ephedra gerardiana	-	-	-	EN	VU	Seeds	Medium
Eremus himalaicus	-	-	-	Vu	-	Seeds	Medium
Ferula jaeschkeana	-		-	VU	VU	Seeds	Medium
Fritillaria roylei	-	-	-	CR	CR, EN	Seeds	High
Heracleum lanatum	-	-	-	VU	-	Seeds	Medium
Hippaphae rhamnoides	-	-	-	VU	LR-ND	Seeds, Cuttings	Medium
Hyoscyamus niger	-	-	-	VU	LR-ND	Seeds	Medium
Hyossopus heterodonta	-	-	-	VU	NL	Seeds, Division of stem arising from rootstock.	Medium
Inula racemosa	-	-	-	CR	CR	Seeds, Root -stock	Medium
Jurinea dolomiaea	-	-	-	LR NT	NL	Seeds and divisions of rootstock at collar level.	Medium
Jurinea macrocephala	-	-ve	-	EN	-	Seeds	Medium
Nardostachys grandiflora	-	-ve	CR* Appx. II	CR	-	Seeds, Ramets	High
Picrorhiza kurroa	-	-ve	CR* Appx. II	EN	-	Root stolons	High
Pleurospermum brunonis	-	-	-	VU	-	Seeds	Medium
Podophyllum hexandrum	-	-ve	CR* Appx. II	CR	EN	Seeds, Rhizome splits	High
Polygonatum verticillatum	-	-	-	EN	VU	Seeds, Rhizome cuttings	Medium
Rheum austral	-	-ve	-	VU	-	Rhizome splits	Medium
Rheum moorcroftianum	-	-ve	-	VU	-	Rhizome splits	Medium
Rhododendron anthopogon	-	-	-	VU	-	Seeds	Medium
Rhododendron campanulaceae	-	-	-	VU	VU	Seeds	Medium
Rhododendron lepidotum	-	-	-	VU		Seeds	Medium
Saussurea costus	-	-	CR* Appx. I	CR	CR, EN	Seeds, Root cuttings	High
Saussurea gossypiphora	-	-	-	CR	EN	Seeds	High
Saussurea obvallata	-	-	-	EN	VU	Seeds	Medium
Taxus baccata	-	-	CR* Appx. II	CR	LR	Seeds, Shoot cuttings	High
Valeriana jatamansii	-	-	-	CR	-	Seeds	High

RDB= Red Data Book; **PN**= Public notice regarding negative list of export issued by Department of Commerce **CITES**=Convention on International Trade of Endangered Species of Fauna and Flora; **CAMP**= Conservation Assessment and Management Plan; **IUCN** International Union for Conservation of nature and natural resources;**CR**-Critically endangered, **EN**-Endangered, **VU**-Vulnerable, **LR-**Lower Risk**, E**-Endangered; **NL**-Not listed; **LR-NT**-low risk-near depletion.

period of two months (August-September) in earlier days which now has extended to five months (May–September) resulting in a negative effect on regeneration potential of these plants thereby contributing to the present status of these valuable resources. Among the studied species *Berberis aristata*, *Podophyllum hexandrum, Saussurea obvallata, Saussurea costus* and *Taxus baccata* are native to the Himalayan region and prefer to grow in this particular area only. This endemism and habitat specificity can also be considered as one of the major reason for their depletion. The rate and extent of human-mediated extinctions are debated, but there is a general agreement that extinction rates have soared over the past few years, largely because of accelerated habitat destruction. The species with high habitat specificity and/or low, population densities are more prone to extinction. Many policies governing the conservation of these plants have also been issued from time to time including both at National and International level including Convention of Biological Diversity (CBD), Trade-Related Aspects of Intellectual Property Rights (TRIPs) agreement, Biodiversity Act, 2002 and The Protection of Plant Variety and Farmers Right (PPV & FRA) Act, 2001 (Srivastava *et al*., 2011).

Table 4. Export Prohibited Medicinal Plants due to depletion

S. No	Botanical Names	Family
1	*Saussurea Species*	Asteraceae
2	*Podophyllum species*	Berberidaceae
3	*Dioscorea deltoidea*	Dioscoreaceae
4	*Taxus baccata*	Taxaceaee
5	*Aconitum species*	Ranunculaceae
6	*Picrorhiza kurroa*	Scrophulariaceae
7	*Gentiana kurroo*	Gentianaceae

Conclusion

The study analysed the medicinal and aromatic plants are uprooting for the uses of rhizomes or roots from the wild for their regeneration for the next coming growing year. It was found that certain locations, viz. Sangla Kanda, Kalpa Kanda, Ropa, Namgia, Batseri harbour a vast diversity of MAPs. Therefore, these places could be marked as control sites for future monitoring, to provide trends of population status and help in assessing the near future.

It was observed that the species with high market rates are declining more rapidly in their natural habitat and over exploiting. In the study area, few villagers have already started cultivation of important species such as *Saussurea costus*, *Bunium persicum* and *Carum carvi* due to their high economic return and spiritual or sacred values.

Few species *viz., Bupleurum falcatum, Pleurospermum candollei, Pinus gerardiana, Quercus baloot*, *Skimmia anquetilia* which are not considered threatened have been found to be in very small populations in the survey area thereby indicated the necessity of adopting immediate conservation measures for these species. Biotic interference in terms of increase and regular human interventions and unstopped grazing appears to be one of the major causes of declining population of these species in the region which needs to be curbed through village education.

Recommendations

- Protective measures for conservation of key species should be encouraged for conservation. It is suggested that, proper strategy and policy dealing with conservation management for prioritized communities and habitats should be formulated so that effective management of forests could be undertaken.
- Cultivation and conservation of medicinal plants should be promoted through village representatives and priests.
- Local people should be made aware of both *in-situ* and *ex-situ* conservation measures, which are essential to maintain the desired population status of this valuable gene pool.
- Curbing unwanted human intervention in the area.
- Bringing neglected uncultivated wasteland and dry land areas under cultivation of popular commercial medicinal plants.
- Opening up of state-level pharmacy within the district for capacity building and collection of plant material for elementary processing before being sent out of district for sale.
- Creation of plant nurseries facing depletion by forest department for sale/distribution people for planting in their vacant farm areas.

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References

Ambasta SP, KR Chandran, K Kashyappa and R Chand (1992) The Useful Plants of India. Publications and Information Directorate, CSIR, New Delhi.

Anil MN, VK Kumari and SR Wate (2014) Loss of Biodiversity and Conservation Strategies: An Outlook of Indian Scenario. *Asian. J. Conserv. Biol.* **3(2)**: 105–114.

Anonymous (1976) Wealth of India: Raw Materials, Vol. XI, Publication and Information Directorate, Council of Scientific and Industrial Research, New Delhi, India.

Arora RK and A Pandey (1996) Edible plants of India: diversity, conservation and use. NBPGR, New Delhi

Badola HK and M Pal (2003) Threatened Medicinal Plants and their conservation in Himachal Pradesh. *Indian. For.* **129**: 55-68.

Barthlott W, J Mutke, D Rafiqpoor, G Kier and H Kreft (2005) Global centers of vascular plant diversity. *Nova Acta Leopoldina* **92**: 61–83.

Bhardwaj M, NS Chauhan and LS Kandari (2013) Harnessing alpine Himalaya for *in-situ* conservation of critically endangered Medicinal Plant: *Dactylorhiza hatagirea* (D. Don) Soo. *Indian. For.* **139**: 264-266.

Bhardwaj M, NS Chauhan, RN Pareek and R Chauhan (2011) *Saussurea obvallata* (Sacred species): A contemporary context of Biodiversity conservation. *Indian. For.* **137**: 718-721.

Billings WD. and HA Mooney (1968) The Ecology of arctic and alpine plants. *Biol. Rev.* **43**: 481-529.

Bisht VK, LS Kandari, JS Negi, AK Bhandari and RC Sundriyal (2013) Traditional uses of medicinal plants in district Chamoli, Uttarakhand, India: *J. Med. Plant. Res.* **7**: 918-929.

Chandel B (2015) Impact of modernization, development processes level and pattern of transformation among Jad Tribe of Himachal Pradesh. Thesis submitted to the Himachal Pradesh University,

Collect H (1921) Flora Simlensis. Thacker Spink and Co., Calcutta & Shimla, Reprinted 1971. Bishen Singh Mahender Pal Singh, Dehradun.

Dhar U, RS Rawal and J Upreti (2000) Setting priorities for conservation of medicinal plants: a case study in the Indian Himalaya. *Biol. Cons.* **95**: 57-65.

Dhawan BN (1976) Biodiversity-A valuable resource for new biomolecules. In: Himalayan Biodiversity: Action Plant, Edited by U. Dhar. HIMA VIKAS Pub. Gyan. Prakash, Nanital, pp 111-114.

Heywood VH and JM Iriondo (2003) Plant conservation: old problems, new perspectives. *Biol Conserv.* **113**: 321-335.

Hamilton AC (2004) Medicinal plants in conservation and development: case studies and lessons learned. In: Kala CP, editor. Medicinal plants in conservation and development. Salisbury: Plant life International Publisher; 2008. pp. 1-43.

Kala CP and GS Rawat (2004) Floral diversity and species richness in the Valley of Flowers National Park, Western Himalaya. *J. Econ. Tax. Bot.* **28**: 43-51.

Kandari LS, PC Phondani, KC, Payal KS Rao and RK Maikhuri (2012) Ethnobotanical Study towards conservation of medicinal and aromatic plants in upper catchments of Dhauli Ganga in the Central Himalaya. *J. Mt. Sci.* **9**: 286-296.

Kashyap SR (1932) Liverworts of the Western Himalayas and the Panjab Plains. II. The University of Panjab, Lahore, Pakistan, 47-50.

Nayar MP (1996) Hot Spots of Endemic Plants in India, Nepal and Bhutan. SB Press, Trivandrum, India.

Negi VM and NS Chauhan (2009) Medicinal and aromatic plants wealth of a tribal district Kinnaur in Himachal Himalaya. *Indian. For.* **6**: 838-852.

Pandit MK, SS Navjot, PK Lian, B Arun and WB Barry (2007) Unreported yet massive deforestation driving loss of endemic biodiversity in Indian Himalaya. *Biodivers. Conserv.* **16(1)**: 153-163.

Pfister JA and DR Gardner (1999) Consumption of low larkspur (*Delphinium nuttallianum*) by cattle. *J. Range. Manage.* **52**: 378-383.

Polunin O and A Stainton (1985) Flowers of the Himalayas. Oxford University Press, USA Reprint, edition.

Rau MA (1975) High Altitude flowering plants of Western Himalaya. Calcutta, Botanical Survey of India.

Samant SS, U Dhar and LMS Palni (1998) Medicinal plants of Indian Himalaya, diversity, distribution potential values. G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal Almora, India.

Singh DK and PK Hajra (1996) Floristic diversity. In: Gujral GS *et al.* (Eds.) Changing Perspectives of Biodiversity Status in the Himalaya. British Council, New Delhi. pp 23-38.

Srivastava M, A Rakshit, V Chaudhary, M Bhardwaj and RC Aggarwal (2014) Right to Farmers'im PPV & FR Act 2001: A way to support conservation of Plant genetic Resources. *Indian. J. Plant. Genetic. Resour.* **27(1)**: 42-46.

Tandon V (1996) CAMP workshop-plants under threat new list forged. *Medicinal Plants Conservation Newsletter* **2**: 12-13.

Ved DK, GA Kinhal and K Ravikumar (2003) Conservation Assessment and Management Prioritisation for the medicinal plants of Himachal Pradesh, Jammu & Kashmir and Uttaranchal. Foundation for Revitalisation of Local health Traditions (FRLHT), Bangalore, India.

Verma RK and KS Kapoor (2011) Plant Species Diversity in Ropa-Giavung Valley in Cold Deserts of District Kinnaur, Himachal Pradesh. *Biol. Forum. Int. J.* **3(2)**: 34-43.