



## Diversity of medicinal plants in Arakot-Khadikhal forest area of District Tehri Garhwal, Uttarakhand, India

Asha Dobhal

Received: 15.03.2016

Revised: 21.04.2016

Accepted: 12.05.2016

### Abstract

Status of medicinal plants of an oak forest in Arakot-Khadikhal area of Chamba block of Tehri district were analysed on the bases of the quantitative data collected (during August 2000 to July 2002) from different slope sites. The study area is belonging to mid-montane forest of Garhwal Himalaya rich with a number of medicinal plants. 155 species of medicinal importance were observed as common, 110 rare, 30 frequent, 17 escape from cultivation and 6 endangered. Most of the rare and endangered plant species of the present investigation have been recorded as rare or endangered in the flora of District Garhwal. Over-exploited species of medicinal importance was 18. Endangered or rare medicinal plants must be conserved with the help of *in-situ* and *ex-situ* conservation methods.

*Key words: Medicinal plants, diversity, endangered, ayurveda*

### Introduction

A large number of medicinal plants of the Himalaya received significant attention in the ancient treatise such as Rigveda, Ayurveda, Charak Samhita, Agni Puran, Nighantus, Meghadoota, Shustra, Brikshaveda etc., which sung the glory of Himalayan herbs and drugs. The plants which are highly medicinal and already in use in the indigenous Ayurvedic system and herbal industries grown in different parts of the Garhwal Himalaya, are facing the problem due to over-exploitation and collections by tribal and migratory communities of the region such as Bhotiyas, Gujjars, Marchiyas (shepherds) etc. They collect the medicinal plants from the wild habitat when livestock graze in forests and pastures. Most of the collected medicinal species comes in the queue of rare and endangered flora of that region. As per current estimates more than 10% of the plants fall in the threatened category and due to absence of any serious exploratory work (Gaur, 1999). On a global basis, the International Union for Conservation of Nature and Natural Resources (IUCN) has estimated that about 10% of world's vascular plant species totaling to about 20,000-25,000 species are under varying degrees of threat. Simultaneously, to include information on threatened biological species, the IUCN has started publication of Red

#### Author's Address

Department of Botany Govt. P.G. College, New Tehri, Tehri Garhwal

**E-mail:** drpramodsrt@gmail.com

Data Book (Nayar and Sastry, 1987-1990). In India, out of an estimated 15000-16000 species of flowering plants about 1500 (10%) have already come under various categories of threatened plants (Rao, 1994). According to Nayar and Sastry (1987-90) Extinct (Ex) category is only used for species which are no longer known to exist in the wild after repeated searches of the type localities and other known or likely places, Endangered (E) includes the taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction, Vulnerable (V) category includes the taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with population that have been seriously depleted and whose unlimited security is not yet assumed; and taxa with populations that are still abundant but are under threat from serious adverse factors throughout their range, while Rare (R) are the taxa with small world population that are not at present endangered or vulnerable. Taxa known to be extinct, endangered, vulnerable or rare but where there is not enough information to say which of the four categories comes in Intermediate (I) category. Whereas, taxa formerly included in one of the categories, but which are now considered relatively secure because effective conservation measures have been taken or previous threat to their survival



has been removed are included in Out of Danger Category (O), and taxa that are suspected but not definitely known to belong to any category because of the lack of information are counted in Insufficiently known (K). According to a cumulative estimate, the Garhwal Himalaya has more than 3500 species of flowering plants most of which are in forests or alpine meadows. Increasing pressure on the plant resources due to anthropogenic activities like grazing beyond the carrying capacities, increasing human population, increasing demands of fire-wood and cultivation land, increase in demand of timber and other construction wood, forest fires, exploitation of medicinal plants in addition to the invasion by ubiquitous weeds and other natural causes have tremendously affected the plant diversity of the Garhwal Himalaya (Rawat *et al.*, 2001). Ever increasing human and domestic animal population pressure in the arable land, natural resources and lack of well defined land management strategy are further leading to deforestation with serious environmental, social, economic and biological consequences (Khoshoo, 1992). It has also been noticed that though economic plants receive prime concern on account of their over exploitation, the other species facing difficulties in perpetuation due to ecological and phenological events are usually ignored when the rare or threatened taxa are listed, often leading to the un-noticed loss of taxa of the area (Gaur *et al.*, 1993). The present study attempts to describe the vegetation study area with a view to status of medicinal plant that exist at Arakot-Khadikhal area of Tehri district of the Garhwal Himalaya where no such studies were attempted earlier. The work may be helpful to the explorers, ethno-botanists, scholars, naturalists and planners working for various aspects of the vegetation and landscape study and for planning and management purposes.

### Study Area

The study area includes an oak forest at Arakot-Khadikhal in Chamba block of district Tehri Garhwal lying between geo-coordinates 30° 20' N latitude and 78° 26' E longitude, at an elevation ranging from 1550 to 2100 m. The northern part of the study area is highly disturbed due to interference by Gujjars and local shepherds who cross it with their cattle during early summer and

late rainy season. The unscientific road construction has also affected the vegetation of the study area. The chief constituents of the forest were *Quercus leucotrichophora*, *Myrica esculenta*, *Rhododendron areboreum*, *Benthamia capitata* and *Lyonia ovalifolia*. Maximum precipitation was observed from May to September in both the years, whereas January and February of year 2002 also showed maximum rainfall. Mean monthly temperature ranged from 11.8 to 24.9°C and 9.9 to 27.1°C and the minimum from 2.1 to 16.4°C and 1.6 to 17.0°C for the first and second years respectively. Relative humidity ranged from 52.2 (April) to 94.6% (August) for 2000-2001, and from 24.5 (June) to 96.5% (August) for 2001-2002. The wind velocity was found higher during winter season due to dry and cline environmental condition. In comparison to other months of both years, the highest value of wind speed was found during August to December.

### Material and Methods

The data on phytosociology of medicinal plants belonging to tree, shrub and herb layers of the vegetation were used to measure their population size in terms of density. There are no hard and fast rules for classifying the plants into various categories because reproductive capacity of different species shows variations in different site conditions, habitat locations and pressure gradients and for plants of various layers (trees, shrubs, herbs). In the present study, the density and frequency data were used for categorizing medicinal species into four categories given below. The data were used for the study area only and was also compared with their status given in the floras of the adjacent Himalayan region and the Red Data Book.

- 1. Frequent (F):** These species had highest values of the density and frequency and were found in nearly all the sites consistently. Such species can also be called much common.
- 2. Common (C):** These species were present in most of the sites of the study area and had a relatively higher value of density and frequency.
- 3. Rare (R):** These species had a low density and were present in few stands of the study area.
- 4. Endangered (E):** The species with a very low density and frequency values and whose survival in



the area is in danger were classified as endangered species.

**5. Escape from Cultivation (EC):** These included cultivated species that were of medicinal importance and were found in the study area as an escape from the cultivated condition. These plants represented low frequency values.

## Results and Discussion

Total number of 318 species with 219 genera were recorded as medicinal plants from the study area, out of which 39 species and 30 genera of trees, 63 species with 44 genera, and 6 species with 2 genera of dicots and monocots respectively of shrubs, and 179 species belonging to 118 genera of dicotyledons, and 24 species with 20 genera of monocotyledons of herbs and only 7 species with 5 genera belonging to pteridophytes (Table 1). Results on status of medicinal plants were based on density and frequency values and field observation. Out of 318 species of medicinal importance in the study area, 6 were endangered, 110 rare, 155 common, 30 frequent and 17 escape from cultivation (Table 2). Most of the rare and endangered species of the study area have been observed as rare or endangered in the flora of District Garhwal. Among endangered species of the study area, only *Acer oblongum* (which was noted as non-medicinal tree species) has been listed as endangered in the red data book. Out of 6 endangered species of medicinal importance, 2 belonged to tree category and 4 to herb category. Among 110 rare species which were recorded in the study area, the maximum species were herbs (73) followed by shrubs (27), trees (8) and ferns (2). Most of the medicinal plants were observed as common in the area of present investigation, out of which the highest number belonged to herbaceous layer (107) followed by shrubs (36), trees (8) and ferns (4) (Table 3). Frequent species of medicinal importance were found in almost all the stands of the study sites. The number of species of this category of plants enumerated as 16, 8, 5 and 1 belonged to herbs, trees, shrubs and fern respectively. A total of 17 species of medicinal plants were recorded as escape from cultivation category and most of which belonged to trees (13) followed by herb (3) and shrub (1) layers. Table 50 indicates that the common category of medicinal

plants had highest value of percentage (48.74%) in the study area followed by rare (34.59%), frequent (9.43%), escape from cultivation (5.35%) and endangered (1.89%) (Table 3). The number of over-exploited species was 18 in the study area, in which 11 were herbs and 7 shrubs (Table 4). These species had been exploited maximum for the collection of medicinal plants in large quantities in the recent years. Notable among these species were all four species of *Berberis* followed by *Asparagus*, *Valeriana*, *Swertia* and *Viola* (each with two species) found in the study area.

**Table 1: Vegetational status of medicinal plants of the study area.**

Habit	Genera	Species
<b>Trees</b>	<b>30</b>	<b>39</b>
<b>Shrubs</b>		
Dicots	<b>44</b>	<b>63</b>
Monocots	<b>2</b>	<b>6</b>
<b>Herbs</b>		
Dicots	<b>118</b>	<b>179</b>
Monocots	<b>20</b>	<b>24</b>
<b>Ferns</b>	<b>5</b>	<b>7</b>
<b>Total</b>	<b>219</b>	<b>318</b>

As a result of active field study, 318 medicinal plants were recorded from the study area which were categorized in 5 categories on the basis of frequency and density viz. frequent (F), common (C), rare (R), endangered (E) and escape from cultivation (EC). The frequent species had maximum values of density and frequency and occurred in most of the study sites while, common species had relatively higher values of population density and frequency in comparison to rare, endangered and escape from cultivation categories of medicinal plants. Out of 6 endangered species, 4 belonged to herbs and 2 to trees. Among rare taxa which were recorded from the area of present investigation, the highest percentage number belonged to herbs (66.36%) followed by shrubs (24.55%), trees (7.27%) and ferns (1.82%). A total of 427 species of flowering plants has been listed under various categories in Indian Red Data Book (Nayar and Sastry, 1987-1990), of which 30 species have been found distributed in the Garhwal Himalaya (Table 6), but only *Acer oblongum* was found as endangered species from the present study area which is non-medicinal tree in nature.



**Table 2: Status of medicinal plants in the study area showing their frequency (%) and density ( $\text{ha}^{-1}$ ) values and comparison with Red Data Book (Nayar and Sastry 1987-1990) and in District Garhwal flora (Gaur 1999).**

Name of species	Habit	NW		NE		N		S		SE		SW		Status
		D	F	D	F	D	F	D	F	D	F	D	F	
<i>Achyranthus aspera</i> L.	H	–	–	–	–	1000	10	2500	15	3500	25	2000	10	C
<i>Achyranthus bidentata</i> Blume	H	2000	20	6000	20	1000	10	3000	30	–	–	–	–	C
<i>Adiantum edgeworthii</i> Hook.	TF	–	–	–	–	–	–	3000	20	–	–	3000	10	R
<i>Adiantum incisum</i> Forrk	H	–	–	–	10	–	–	–	20	–	–	–	10	C
<i>Adiantum venustum</i> D.Don	TF	–	–	6000	20	–	–	–	–	–	–	–	–	R
<i>Agrimonia aitchisonii</i> Seh.-Temery	H	–	–	–	–	–	10	–	–	–	–	–	10	C
<i>Agrimonia pilosa</i> Ledebour	H	–	–	2000	20	1000	10	–	–	–	–	–	–	R
<i>Ainsliaea aptera</i> DC.	H	–	–	17000	100	1000	10	–	–	–	–	–	–	C
<i>Ainsliaea latifolia</i> (D.Don) Schultz-Bipontinus	H	30500	75	6000	30	17700	100	3000	80	9000	70	32000	90	F
<i>Ajuga bracteosa</i> Wallich ex Benth.	H	3500	30	8000	40	6500	45	11000	50	5500	35	4000	35	F
<i>Ajuga parviflora</i> Benth	H	–	–	–	–	–	–	2000	10	2000	20	7000	40	C
<i>Albizia julibrissin</i> Durazzini	T	–	–	–	–	–	–	10	10	–	–	–	–	R
<i>Alnus nepalensis</i> D.Don	T	10	10	20	20	10	10	–	–	–	–	10	10	C
<i>Amaranthus tricolor</i> L.	H	–	–	–	–	–	–	–	10	–	–	–	–	EC
<i>Ampelocissus rugosa</i> (Wallich) Planchon	Cl.S	–	–	–	40	–	10	–	10	–	30	–	–	C
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Anagallis arvensis</i> L.	H	–	–	–	–	–	10	–	10	–	–	–	10	C
<i>Anagallis pumila</i> Swartz	H	–	–	–	–	–	–	–	10	–	10	–	10	C
<i>Anaphalis adnata</i> Wallich ex DC.	H	–	–	–	10	–	–	–	10	–	–	–	10	C
<i>Anaphalis busua</i> (Buch.-Ham. ex D.Don) DC.	H	12000	70	5000	40	4000	30	3000	30	2500	20	6000	35	F
<i>Anaphalis margaritacea</i> (L.) Benth.	H	–	–	2000	20	–	–	–	–	–	–	–	–	R
<i>Anaphalis triplinervis</i> (Sims) C.B. Clarke	H	–	10	–	10	–	20	–	–	–	10	–	–	C
<i>Anemone rivularis</i> Buch.-Ham.ex DC.	H	–	10	–	–	–	10	–	–	–	–	–	–	C
<i>Anemone tetrasepata</i> Royle	H	–	–	–	10	–	–	–	–	–	–	–	–	C



Diversity of medicinal plants in Arakot-Khadikal

<i>Anemone vittifolia</i> Buch.-Ham. ex DC.	H	–	–	3000	30	1000	10	4000	40	2000	20	2000	20	C
<i>Arabis amplexicaulis</i> Edgew.	H		–		10		–		10		–		–	C
<i>Argemone mexicana</i> L.	H		–		–		–		–		–		10	R
<i>Arisaema concinnum</i> Schott	H		–		–		–		10		–		–	R
<i>Arisaema flavum</i> (Forsk.) Schott	H		–		–		10		–		–		–	R
<i>Arisaema jacquemontii</i> Blume.	H	–	–	–	–	–	–	–	–	1000	10	–	–	R
<i>Artemisia capillaris</i> Thunb.	H		–		–		–		–		10		–	R
<i>Artemisia japonica</i> Thunb.	H		–		–		–		–		10		20	C
<i>Artemisia nilagirica</i> (C.B. Clarke) Pamp.	H	–	–	–	–	4000	30	–	–	–	–	–	–	R
<i>Artemisia roxburghiana</i> Wallich ex Besser	H	2000	15	3000	25	1000	10	1000	10	3500	20	7000	40	F
<i>Asparagus adscendens</i> Buch.-Ham. ex Roxb.	S	120	20	40	10	80	10	–	–	80	10	–	–	C
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Asparagus curillus</i> Buch.-Ham. apud Roxb.	S	–	–	40	10	–	–	–	–	–	–	280	30	R
<i>Asparagus filicinus</i> Buch.-Ham. apud Roxb.	S	40	10	–	–	–	–	80	20	–	–	40	10	R
<i>Asplenium dalhousiae</i> Hook.	TF	2000	15	1500	10	–	–	–	–	2000	10	3000	10	C
<i>Aster peduncularis</i> Wallich ex Nees	H	–	–	–	–	–	–	3000	20	–	–	–	–	R
<i>Barleria cristata</i> L.	H		–		10		–		40		–		20	C
<i>Begonia picta</i> Smith	H	–	–	2000	20	–	–	–	–	–	–	–	–	R
<i>Benthamedia capitata</i> (Wallich ex Roxb) Hara	T	2300	90	90	60	140	90	40	20	10	10	30	30	F
<i>Berberis aristata</i> DC.	S	960	60	240	40	560	60	280	40	360	40	–	–	C
<i>Berberis asiatica</i> Roxb. ex DC.	S	–	–	–	–	120	20	680	80	680	60	760	70	C
<i>Berberis chitria</i> Edward	S	720	50	1840	90	1080	90	–	–	120	20	800	80	C
** <i>Berberis lycium</i> Royle	S	600	50	440	60	–	–	1120	80	480	70	440	40	C
<i>Bergenia ciliata</i> (Haworth) Sternberg	H	3500	25	4000	25	2500	20	5000	20	2000	10	5000	40	F
<i>Bergenia ligulata</i> (Wallich) Engl.	H		–		10		–		–		–		–	R
<i>Boehmeria macrophylla</i> D. Don	S	–	–	–	–	–	–	–	–	–	–	80	10	R
<i>Boehmeria rugulosa</i> Wedd.	T	–	–	–	–	–	–	–	–	60	10	10	10	R
<i>Boeninghausenia albiflora</i> (Hook.) Reichb. ex Meisn.	H	31000	60	15700	60	61000	65	23500	45	7000	30	21500	50	F



Asha Dobhal

<i>Boerhavia diffusa</i> L.	H		-		-		-		-		10		-	R
<i>Bupleurum hamiltonii</i> Balakrishnan	H	-	-	-	-	-	-	1000	10	1000	10	2000	20	R
<i>Cardamine impatiens</i> L.	H	2000	20	-	-	-	-	-	-	-	-	-	-	R
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Carpesium nepalense</i> Lessing	H	1000	10	-	-	-	-	-	-	-	-	-	-	R
<i>Caryopteris foetida</i> (D.Don) Thellung	S	280	30	800	80	1120	60	200	40	680	60	1040	90	F
<i>Cassia pumila</i> Lam.	H		10		-		-		10		-		-	C
<i>Cedrus deodara</i> (Roxb.exD.Don) G.Don	T		-		-		10		-		-		-	R
<i>Centella asiatica</i> (L.) Urban	H		10		-		30		-		-		10	C
<i>Chaerophyllum reflexum</i> Lindley	H		-		-		-		10		-		-	R
<i>Chenopodium album</i> L.	H	-	-	-	-	1000	10	-	-	-	-	-	-	EC
<i>Cirsium wallichii</i> DC.	H		10		10		20		-		-		10	C
<i>Cissampelos pareira</i> L.	Cl.S		20		-		-		10		10		-	C
** <i>Clematis acuminata</i> DC.	Cl.S		-		-		-		10		-		-	R
<i>Clematis buchananiana</i> DC.	Cl.S		10		-		-		-		-		-	R
<i>Clematis connata</i> DC.	Cl.S		-		-		10		-		-		-	R
<i>Clematis grata</i> Wallich	Cl.S		-		-		-		20		-		10	C
<i>Clinopodium umbrosum</i> (M.Bieb.) C.Koch	H	3000	30	-	-	-	-	6000	20	5000	30	5500	25	C
<i>Clinopodium vulgare</i> L.	H	-	-	-	-	4000	30	-	-	-	-	-	-	R
<i>Colebrookia oppositifolia</i> J.E. Smith	S		-		-		-		10		20		10	C
<i>Conyza canadensis</i> (L.) Cronquist	H	2000	10	-	-	11000	30	3000	25	4500	35	10500	45	C
<i>Conyza stricta</i> Willd.	H		-		-		10		-		10		-	C
<i>Coriaria nepalensis</i> Wallich	S		-		10		-		-		-		-	R
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Cosmos bibinnatus</i> Cav.	H		-		-		-		10		-		-	R
<i>Cotinus coggygia</i> Scopoli	S		10		-		30		-		10		40	C
<i>Cotoneaster bacillaris</i> Wallich	S	-	-	-	-	8000	50	-	-	-	-	-	-	R
<i>Cotoneaster microphyllus</i> Wallich ex Lindley	S	120	30	960	60	40	10	-	-	1000	50	160	30	C



Diversity of medicinal plants in Arakot-Khadikal

<i>Crotalaria alata</i> Buch.-Ham. ex D.Don	H		-		-		10		-		10		-	R
<i>Crotalaria albida</i> Heyne ex Roth.	H		10		40		-		40		-		10	C
<i>Cupressus torulosa</i> D.Don	PT		-		-		-		10		-		10	EC
<i>Cuscuta europaea</i> L.	PCIH		-		-		-		-		60		10	C
<i>Cyathula capitata</i> Maq.	H		-		-		10		-		-		-	R
<i>Cynodon dactylon</i> (L.) Persoon	H		-		10		-		20		10		40	C
<i>Cynoglossum glochdiatum</i> Wallich ex Benth.	H	-	-	-	-	4000	20	4000	20	1000	10	-	-	C
<i>Cynoglossum lanceolatum</i> Forsk.	H	-	-	-	-	2000	20	-	-	-	-	-	-	R
<i>Cynotis cristata</i> (L.) D.Don	H	5500	35	2000	20	6000	30	4000	30	-	-	3000	20	C
<i>Cyperus rotundus</i> L.	H	-	-	-	-	-	-	-	-	25000	80	13000	40	C
<i>Daphne papyracea</i> Wallich ex Steudel	S	400	60	200	40	-	-	-	-	400	40	240	30	C
<i>Datura stramonium</i> L.	H		-		-		-		-		10		-	R
<i>Delphinium roylei</i> Munz.	H		-		10		-		-		-		-	E
<i>Desmodium elegans</i> DC.	S		-		-		20		-		10		-	C
<i>Deutzia staminea</i> R.Br. ex Wallich	T	-	-	-	-	-	-	20	20	-	-	-	-	R
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Dicliptera bupleuroides</i> Nees	H	-	-	6000	10	-	-	4500	25	11000	45	5000	25	C
<i>Dipsacus inermis</i> Wallich	H	2000	20	-	-	-	-	-	-	-	-	3000	10	R
<i>Drosera peltata</i> J.E. Smith ex Willd.	H	-	-	-	-	-	-	-	-	5000	10	4000	10	R
<i>Duchesnea indica</i> (Andrews) Focke	H	4000	20	-	-	16000	30	5000	20	-	-	-	-	C
<i>Echinops niveus</i> Wallich ex Royle	H	-	-	-	-	-	-	-	-	-	-	1000	10	E
<i>Elsholtzia ciliata</i> (Thunb.) Hylander	H		-		-		-		40		-		20	C
<i>Emilia sonchifolia</i> (L.) DC.	H		10		-		10		-		10		-	C
<i>Engelhardtia spicata</i> Lesch. ex Blume	T	-	-	-	-	-	-	20	20	-	-	-	-	R
<i>Epilobium brevifolium</i> D.Don	H		10		30		-		10		-		10	F
<i>Epilobium tetragonum</i> L.	H		10		-		-		-		10		-	C
<i>Epipactis helleborine</i> (L.) Crantz	H	-	-	3000	30	-	-	-	-	-	-	-	-	R
<i>Erigeron annuus</i> Pers.	H		-		-		-		10		10		10	C



Asha Dobhal

<i>Erigeron multiradiatus</i> (Lindley ex DC.) C.B. Clarke	H		-		10		10		-				-	C
<i>Euonymus tingens</i> Wallich	T		-		10		-		-				-	R
<i>Eupatorium glandulosum</i> H.B.K.	H	15300	40	12000	45	11700	55	20300	45	17000	40	21000	55	F
<i>Euphorbia hirta</i> L.	H	-	-	-	-	-	-	-	-	-	-	2000	20	R
<i>Euphorbia pilosa</i> L.	H	-	-	-	-	2000	10	-	-	1000	10	-	-	R
<i>Ficus palmata</i> Forsk.	T		-		-		-		-				10	EC
<i>Flacourtia indica</i> (Burm.f.) Merrill	T		30		10		10		20		10		-	C
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Flemingia fruticulosa</i> Wallich ex Benth.	S		-		10		-		-				10	C
<i>Flemingia procumbens</i> Roxb.	H	-	-	-	-	-	-	-	-	6000	40	-	-	R
<i>Fragaria nubicola</i> Lindley ex Lacaita	H		10		30		10		-		40		10	F
<i>Fumaria indica</i> (Haus.) Pugsley	H		-		-		-		10		30		-	C
<i>Galinsoga parviflora</i> Cav.	H	-	-	-	-	2000	20	-	-	1000	10	2000	20	C
** <i>Galium acutum</i> Edgew.	H		-		-		10		-				-	R
<i>Galium aparine</i> L.	H	14000	60	-	-	-	-	4000	20	6500	25	6000	30	C
<i>Galium asperifolium</i> Wallich	H	11000	35	6000	20	17000	50	14000	55	-	-	10700	35	C
<i>Galium asperuloides</i> Edgew.	H	14000	40	-	-	-	-	-	-	-	-	-	-	R
<i>Galium elegans</i> Wallich	H	12000	60	-	-	-	-	19000	50	9000	50	10500	45	C
<i>Galium vestitum</i> D.Don	H	-	-	10000	50	-	-	9000	50	6000	40	-	-	C
<i>Gamphogyne</i> sp.	H		-		-		10		-				-	R
<i>Gentiana aprica</i> Decne.	H		10		-		30		10				10	C
<i>Gentiana pedicellata</i> (D.Don) Wallich	H		-		-		-		10		20		30	C
<i>Geranium nepalense</i> Sweet	H	7500	35	9000	40	6000	30	4000	30	4000	20	6500	45	F
<i>Geranium ocellatum</i> Cambess	H	-	-	-	-	9000	60	-	-	-	-	-	-	C
<i>Geranium wallichianum</i> D.Don ex Sweet	H	-	-	2000	20	5000	25	3000	20	-	-	-	-	C
<i>Gerbera gossypina</i> (Royle) G.Beauv.	H	10500	45	-	-	5500	30	6000	40	23700	65	10700	50	C
<i>Gerbera maxima</i> (D.Don) G. Beauv.	H	-	-	1000	10	1000	10	-	-	2500	20	1000	10	C



Diversity of medicinal plants in Arakot-Khadikal

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Geum elatum</i> Wallich ex G.Don.	H	-	-	-	-	1000	10	-	-	-	-	-	-	R
<i>Goodyera repens</i> (L.) R.Br.	H		-		10		-		-		-		-	R
<i>Grewia optiva</i> J.R. Drummon ex Burret	PT		-		-		-		-		10		-	EC
<i>Habenaria intermedia</i> D.Don	H	9000	50	4000	20	-	-	-	-	-	-	-	-	C
<i>Habenaria latilabris</i> (Lindley) Hook.f.	H	2000	10	1000	10	3000	20	-	-	-	-	-	-	C
<i>Hartmannia rosea</i> G.Don	H		-		30		-		10		-		10	C
<i>Hedera nepalensis</i> K. Koch.	Cl.H		10		-		40		-		10		-	C
<i>Hedychium spicatum</i> Buch.-Ham.ex J.E. Smith	H	-	-	1000	10	-	-	-	-	-	-	-	-	E
<i>Herninium lanceum</i> (Thunb. ex Swartz) Vuijk	H	4000	30	-	-	-	-	-	-	-	-	-	-	C
<i>Himalrandia tetrasperma</i> (Roxb.) Yamazaki	S	600	60	280	30	360	50	560	60	240	40	560	50	F
<i>Hoya lanceolata</i> Wallich ex D.Don	Cl.S		-		-		10		-		-		-	R
<i>Hypericum choisanum</i> Wallich ex N.	S		-		-		10		-		-		-	R
<i>Hypericum oblongifolium</i> Choisy	S	-	-	40	10	-	-	-	-	-	-	-	-	R
<i>Hypericum perforatum</i> L.	H	-	-	-	-	1000	10	-	-	-	-	2000	10	R
** <i>Hypericum podocarpoides</i> N. Robson	S	840	80	80	10	-	-	-	-	320	50	-	-	C
<i>Hypericum uralum</i> Buch.-Ham. ex D.Don.	S	120	20	-	-	120	20	-	-	-	-	160	30	C
<i>Hypoxis aurea</i> Lour.	H		-		10		-		-		-		-	R
<i>Impatiens bicolor</i> Royle	H		-		-		20		10		-		-	C
<i>Impatiens scabrida</i> DC.	H		10		-		10		-		-		-	C
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Imperata cylindrica</i> (L.) P.Beauv.	H		-		60		-		10		10		-	C
<i>Indigofera cassioides</i> Rottler ex DC.	S	-	-	-	-	160	20	-	-	40	10	-	-	R
<i>Indigofera dosua</i> Buch.-Ham. ex D.Don	H		-		-		-		-		10		10	C
<i>Indigofera heterantha</i> Wallich ex Brandis	S	40	10	40	10	-	-	-	-	-	-	40	10	C
<i>Inula cappa</i> (Buch.-Ham. ex D.Don) DC.	S	-	-	-	-	-	-	440	40	-	-	-	-	R
<i>Inula cuspidata</i> (DC.) C.B. Clarke	S	-	-	-	-	-	-	120	20	360	20	400	50	C



<i>Ipomea nil</i> (L.) Roth.	H	–	–	2000	10	12000	40	–	–	–	–	1000	10	C
<i>Jasminum humile</i> L.	S	720	40	520	50	400	50	–	–	600	50	600	50	C
<i>Jasminum officinale</i> L.	S	–	–	320	30	–	–	–	–	–	–	–	–	R
<i>Julgans regia</i> L.	T	–	–	–	–	10	10	–	–	–	–	–	–	EC
<i>Lantana camara</i> L.	S	–	–	–	–	–	–	–	–	–	–	–	10	R
<i>Leea asiatica</i> (L.) Ridsdale	S	–	–	–	–	–	–	80	10	80	20	–	–	R
<i>Lepidium virginicum</i> L.	H	–	10	–	–	–	20	–	10	–	–	–	30	C
<i>Leptodermis lanceolata</i> Wallich	S	360	50	120	20	760	40	–	–	–	–	–	–	C
<i>Lespedeza gerardiana</i> Graham ex Maxim	H	–	–	–	–	–	–	–	–	6000	30	–	–	R
<i>Lespedeza juncea</i> (L.f.) Persoon	H	–	–	–	–	4000	20	3000	20	–	–	2000	20	C
<i>Leucas lanata</i> Benth.	H	–	–	–	–	–	–	3500	25	5000	25	6000	20	C
<i>Lindenbergia indica</i> (L.) Vatke	H	–	–	–	–	5000	40	–	–	–	–	–	–	R
<i>Liparis nervosa</i> (Thunb.) Lindley	EpH	–	10	–	–	–	–	–	–	–	–	–	–	R
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Lonicera quinquelocularis</i> Hardwicke	S	–	–	240	30	240	30	40	10	360	20	–	–	C
<i>Lyonia ovalifolia</i> (Wallich) Drude	T	30	20	80	70	70	60	70	60	30	30	40	40	F
<i>Malaxis acuminata</i> D.Don	H	–	–	–	–	2000	20	–	–	–	–	–	–	R
<i>Malva verticillata</i> L.	H	–	–	–	–	–	–	–	–	–	10	–	40	C
<i>Malvastrum coromandelianum</i> (L.) Gurcke	H	–	–	–	–	–	–	–	10	–	–	–	10	C
<i>Marsdenia lucida</i> Edgew. ex Madden	Cl.S	–	–	–	10	–	–	–	–	–	–	–	–	R
<i>Mazus pumilus</i> (Burm.f.) van Steenis	H	4000	30	2000	20	5000	30	1000	10	–	–	–	–	C
<i>Melia azedarach</i> L.	T	–	–	–	–	–	–	–	–	–	10	–	–	EC
<i>Micromeria biflora</i> (Buch.-Ham. ex D.Don) Benth.	H	–	–	–	–	–	–	22000	30	48300	65	10300	10	C
<i>Morus alba</i> L.	T	–	–	–	–	–	–	–	–	–	10	–	–	EC
<i>Murraya koenigii</i> (L.) Sprengel	S	–	–	–	–	–	–	240	20	–	–	–	–	R
<i>Murraya paniculata</i> (L.) Jack	S	–	–	–	–	40	10	40	10	–	–	40	10	R
<i>Myriactis nepalensis</i> Lessing	H	–	–	–	–	–	10	–	–	–	–	–	–	R
<i>Myrica esculenta</i> Buch-Ham ex D.Don	T	110	70	140	90	120	70	110	70	50	50	70	60	F



Diversity of medicinal plants in Arakot-Khadikal

<i>Myrsine africana</i> L.	S	37120	100	16160	100	16000	100	10480	100	8000	100	7800	90	F
<i>Nasturtium officinale</i> R. Br.	H		-		-		10		-		-		-	R
<i>Nicandra physalodes</i> (L.) Gaertner	H		-		-		-		-		10		10	C
<i>Ophiopogon intermedius</i> D.Don	H	-	-	-	-	4000	30	7000	60	-	-	-	-	C
<i>Origanum vulgare</i> L.	H	-	-	-	-	-	-	1000	10	7000	30	-	-	R
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Osbeckia stellata</i> Buch.-Ham. ex D.Don	S		-		-		10		-		-		-	R
<i>Oxalis acetosella</i> L.	H		40		10		20		30		10		10	F
<i>Oxalis corniculata</i> L.	H	6000	30	7000	25	8000	25	6700	20	7000	15	5700	40	F
<i>Oxalis dehradunensis</i> Raizada	H		-		20		10		-		-		-	C
<i>Parnassia nubicola</i> Wallich ex Royle	H		-		-		10		-		-		-	R
<i>Parnassia ovata</i> Ledeh.	H		-		-		-		10		-		-	R
<i>Pedicularis bifida</i> (Buch.-Ham. ex D.Don) Pennell	H		-		-		-		10		40		20	C
<i>Pedicularis gracilis</i> Wallich ex Benth.	H		-		-		10		-		-		-	R
<i>Perilla frutescens</i> (L.) Britton	H		-		10		-		30		-		10	C
<i>Persicaria chinensis</i> (L.) H.Gross	S		-		-		-		-		-		10	R
<i>Phyllanthus parvifolius</i> Buch.-Ham. ex D.Don	S		-		-		-		10		30		10	C
<i>Pimpinella acuminata</i> (Edgew.) C.B. Clarke	H	4000	30	-	-	2000	10	-	-	-	-	-	-	R
<i>Pimpinella diversifolia</i> DC.	H	3000	20	-	-	2000	20	4000	30	-	-	-	-	C
<i>Pinus roxburghii</i> Sargent	T	20	20	10	10	-	-	60	40	50	40	30	20	C
<i>Pinus wallichiana</i> A.B.Jackson	T	-	-	-	-	20	20	-	-	10	10	-	-	R
<i>Plantago depressa</i> Willd.	H		-		-		10		-		-		-	R
<i>Plantago lanceolata</i> L.	H		-		20		-		10		-		10	C
<i>Polygala arvensis</i> Willd.	H		40		-		-		30		10		20	C
<i>Polygala crotalaroides</i> Buch.-Ham. ex DC.	H		-		10		-		-		30		20	C
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
* <i>Polygonatum cirrhifolium</i> (Wallich) Royle	H		-		10		-		-		-		-	R



<i>Polygonum plebeium</i> R. Br.	H		-		-		-		10		-		-	EC
<i>Polygonum recumbens</i> Royle ex Babcock	H		-		-		10		10		-		20	C
<i>Polypodium microrhizoma</i> Clarke	H		-		-		10		10		-		40	C
<i>Polystichum squarrosun</i> (D.Don) Fee	TF	7300	25	6300	20	8000	20	7000	20	3500	10	6000	10	F
<i>Potentilla argyrophylla</i> Wallich ex Lehm.	H		-		-		-		10		-		-	R
<i>Potentilla fulgens</i> Wallich ex Hook.	H	10000	40	-	-	5000	25	-	-	2000	20	-	-	C
<i>Potentilla gerardiana</i> Lindley ex Lehmann	H	-	-	3000	10	6000	30	11000	20	7500	35	6500	30	F
<i>Potentilla leschenaultiana</i> Sev.	H	-	-	4000	30	4000	10	-	-	-	-	7000	20	C
<i>Potentilla nepalensis</i> Hook.f.	H	-	-	10000	40	5000	40	-	-	-	-	-	-	C
<i>Primula denticulata</i> Smith	H		-		10		-		-		-		-	R
<i>Primula floribunda</i> Wallich	H	-	-	-	-	1000	10	-	-	-	-	-	-	R
<i>Primula microphylla</i> D.Don	H		-		-		10		-		-		-	R
<i>Prinsepia utilis</i> Royle	S	-	-	-	-	-	-	-	-	-	-	80	10	R
<i>Prunus armeniaca</i> L.	T		-		-		-		10		-		-	EC
<i>Prunus cerasifera</i> Ehrhart	T		-		10		-		-		-		-	EC
<i>Prunus cerasoides</i> D.Don	T	20	20	30	30	30	20	60	50	40	40	30	20	F
<i>Prunus cornuta</i> (Wallich ex Royle) Steudel	T		-		10		10		-		-		-	EC
<i>Prunus persica</i> (L.) Batsch	T		-		-		-		-		-		10	EC
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Pteracanthus alatus</i> (Clarke) Bre.	S		-		-		10		-		60		-	C
<i>Pteracanthus angustifrons</i> (Clarke) Bre.	S		-		10		-		10		-		40	C
<i>Punica granatum</i> L.	T	-	-	-	-	-	-	-	-	-	-	10	10	EC
<i>Pyracantha crenulata</i> (D.Don) M. Roemer	S	280	20	-	-	120	10	-	-	-	-	120	20	C
<i>Pyrus malus</i> L.	PT		-		-		10		-		-		-	EC
<i>Pyrus pashia</i> Buch.-Ham. ex D.Don	T	10	10	20	20	20	20	140	80	80	50	60	50	F
<i>Quercus leucotrichophora</i> A. Camus	T	1190	100	1310	100	1190	100	1300	100	1210	100	1090	100	F
<i>Rabdosia lophanthoides</i> (Buch.-Ham. ex D.Don) Hara	H	3000	30	-	-	5000	30	5000	40	1000	10	3000	20	C



Diversity of medicinal plants in Arakot-Khadikal

<i>Ranunculus hirtellus</i> Royle	H	2000	20	-	-	1000	10	-	-	-	-	-	-	R
<i>Ranunculus laetus</i> Wallich ex D.Don	H		10		-		10		-		-		-	C
<i>Reinwardtia indica</i> Dumortier	H	4500	25	2500	15	2500	20	11300	50	-	-	4000	30	C
<i>Remusatia vivipara</i> (Roxb.) Schott.	H	-	-	-	-	-	-	1000	10	1000	10	-	-	R
<i>Rhamnus purpureus</i> Edgew	S		-		-		-		10		-		10	C
<i>Rhamnus triquetra</i> (Wallich) Lawson	T	-	-	-	-	-	-	-	-	10	10	-	-	R
<i>Rhododendron arboreum</i> Smith	T	160	80	180	90	120	80	70	60	10	20	40	40	F
<i>Rhus javanica</i> L.	T	20	20	10	10	30	20	-	-	20	10	10	10	C
<i>Rhus parviflora</i> Roxb.	S	-	-	-	-	-	-	160	30	160	20	160	30	C
* <i>Rhus punjabensis</i> J.L. Stewart	T	-	-	-	-	-	-	-	-	10	10	-	-	E
<i>Ricinus communis</i> L.	S		-		-		-		-		-		10	EC
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Rosa brunonii</i> Lindley	S	80	10	440	50	360	50	-	-	-	-	-	-	C
<i>Rosa macrophylla</i> Lindley	S	-	-	40	10	200	30	-	-	-	-	-	-	R
* <i>Roscoea alpina</i> Royle	H	8000	50	16000	80	15000	70	4000	30	-	-	3000	20	C
<i>Roscoea purpurea</i> J.E. Smith	H		10		20		-		10		-		-	C
<i>Rotala densiflora</i> (Rolt.) Koehre	H		-		-		-		-		10		-	R
** <i>Rubia manjith</i> Roxb. ex Fleming	H	3000	30	5000	30	2000	20	4000	35	2000	20	4000	20	F
<i>Rubus ellipticus</i> Smith	S	560	70	760	70	640	70	1600	80	1720	80	840	80	F
<i>Rubus foliolosus</i> D.Don	Cl.S		-		-		-		10		-		-	R
<i>Rubus niveus</i> Thunb.	S	760	60	440	50	720	70	360	40	280	50	800	60	F
<i>Rubus paniculatus</i> Smith	S	-	-	920	70	560	50	120	20	-	-	120	20	C
<i>Rumex hastatus</i> D.Don	H		-		10		-		20		-		40	C
<i>Rumex nepalensis</i> Sprengel	H		-		-		50		-		10		-	C
<i>Saccharum spontaneum</i> L.	H		-		-		-		-		40		10	C
<i>Salvia nubicola</i> Wallich ex Sweet	H		-		-		-		40		10		20	C
<i>Salvia lanata</i> Roxb.	H	-	-	-	-	-	-	-	-	3000	20	-	-	R
<i>Sanicula elata</i> Buch.-Ham. ex D.Don	H	-	-	5000	20	-	-	-	-	-	-	-	-	R



Asha Dobhal

<i>Satyrium nepalense</i> D.Don	H	-	-	-	-	-	-	-	-	-	-	1000	10	R
<i>Saussurea heteromalla</i> (D.Don) Hand.-Mazz.	H		-		-				10		40		-	C
<i>Scurrula elata</i> (Edgew.) Danser	PS		20		10				10		-		-	C
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Scutellaria scandens</i> Buch.-Ham. ex D.Don	H	11700 0	60	-	-	-	-	-	-	-	-	-	-	C
<i>Sedum multicaule</i> Wallich ex Lindley	H	-	-	27500	30	25000	70	1000	10	2500	10	4000	15	C
<i>Senecio rufinervis</i> DC.	H		-		10				-		-		-	R
<i>Sida cordata</i> (Burm.f.) Bess.	H		10		-				40		-		20	C
<i>Siegesbeckia orientalis</i> L.	H	3000	30	-	-	4000	30	-	-	-	-	-	-	C
<i>Smilax aspera</i> L.	S	200	30	-	-	160	20	-	-	160	40	-	-	C
<i>Smilax glaucophylla</i> Klotzsch	S	1440	80	1080	60	280	30	-	-	-	-	-	-	C
<i>Smilax menispermoidea</i> A.DC.	S	-	-	80	10	80	10	120	10	-	-	-	-	C
<i>Solanum nigrum</i> L.	H	-	-	-	-	1000	10	-	-	-	-	-	-	R
<i>Solena amplexicaulis</i> (Lam.) Gandhi	H	2000	20	-	-	-	-	-	-	-	-	-	-	R
<i>Sonchus oleraceus</i> L.	H		-		-				10		-		10	C
<i>Spermadictyon sauveolens</i> Roxb.	S	-	-	-	-	-	-	120	20	-	-	-	-	R
<i>Spiraea vacciniifolia</i> D.Don	S		-		10				-		40		-	C
<i>Sporobolus diander</i> (Retz.) P. Beauv	H		-		-				60		-		10	C
<i>Stellaria media</i> (L.) Villars	H	-	-	18000	50	15000	20	-	-	5000	10	2000	10	C
<i>Stephania elegans</i> Hook. f. & Thomson	Cl.H		-		-				20		-		-	R
<i>Swertia alata</i> (Royle) ex D.Don) C.B. Clarke	H	-	-	5000	30	-	-	2000	10	1000	10	-	-	C
<i>Swertia angustifolia</i> Buch.-Ham. ex D.Don	H		-		-		10		40		40		-	C
<i>Swertia chirayita</i> (Roxb. ex Fleming) Karsten	H	1000	10	-	-	-	-	-	-	-	-	-	-	E
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Swertia ciliata</i> (D.Don ex G.Don) Burt.	H	-	-	-	-	-	-	-	-	-	-	2000	20	R
<i>Swertia cordata</i> (G.Don) C.B. Clarke	H		-		-				10		-		-	R
<i>Swida macrophylla</i> (Wallich) Sojak	T		10		-		10		10		-		30	F



Diversity of medicinal plants in Arakot-Khadikal

<i>Swida oblonga</i> (Wallich) Sojak	T	-	-	-	-	-	-	20	10	-	-	-	-	E
<i>Tagetes minula</i> L.	H		-		-		-		-		10		-	R
<i>Taraxacum officinale</i> Weber	H	-	-	-	-	-	-	-	-	15000	10	-	-	R
<i>Tectaria coadunata</i> (Wallich.ex Hook. et. Grev.) C.Chr.	TF	-	-	-	-	11000	20	-	-	-	-	-	-	C
<i>Teucrium quadriforium</i> Buch.-Ham. ex D.Don	H	7000	30	-	-	-	-	3000	20	2000	15	-	-	C
<i>Thalictrum foliolosum</i> DC.	H	-	-	1000	10	-	-	-	-	-	-	-	-	R
<i>Thalictrum javanicum</i> Blume	H	2500	10	2000	20	3500	30	3000	20	-	-	2000	10	C
<i>Thalictrum saniculaeforme</i> DC.	H	3000	20	-	-	-	-	-	-	-	-	-	-	R
<i>Thuja orientalis</i> L.	PT		-		-		-		-		-		10	EC
<i>Tillaea pharnacesides</i> Fischet	H	-	-	-	-	-	-	-	-	2000	10	-	-	R
<i>Toona serrata</i> (Royle) M. Roemer	T	-	-	20	20	-	-	10	10	-	-	10	10	C
<i>Trifolium pratense</i> L.	H		-		10		-		-		-		-	R
<i>Trifolium repens</i> L.	H		10		-		30		-		10		-	C
<i>Urtica ardens</i> Link	H		-		-		-		-		-		10	R
<i>Urtica dioica</i> L.	H		-		-		10		-		20		30	C
<i>Valeriana hardwickii</i> Wallich	H	15000	70	7000	40	23000	70	-	-	-	-	-	-	C
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Valeriana jatamansii</i> Jones	H	-	-	-	-	6000	30	5000	40	1000	10	10000	50	C
<i>Valeriana roylei</i> Kdotz & Greeke	H	7000	40	2000	20	5000	30	-	-	-	-	-	-	C
<i>Valeriana stracheji</i> C.B. Clarke	H	1000	10	18000	60	1000	10	-	-	-	-	-	-	C
<i>Verbascum thapsus</i> L.	H	-	-	-	-	-	-	-	-	1000	10	-	-	R
<i>Vernonia cinerea</i> (L.) Lessing.	H	-	-	17000	70	-	-	1500	10	2000	10	2000	10	C
<i>Veronica persica</i> Poiret	H		10		-		-		-		-		-	R
<i>Viburnum continifolium</i> D.Don	T	40	40	30	20	30	30	-	-	-	-	-	-	C
<i>Viburnum cylindricum</i> Buch.-Ham. ex D.Don	T		10		10		-		10		-		-	C
<i>Viburnum mullaha</i> Buch.-Ham. ex D.Don	T	10	10	30	30	20	20	-	-	-	-	-	-	C
<i>Vigna vexillata</i> (L.) A. Richard	H		-		-		-		10		-		20	C
<i>Viola betonicifolia</i> J. Smith	H	3000	20	36000	90	12000	40	-	-	-	-	14000	50	C



Asha Dobhal

<i>Viola biflora</i> L.	H	–	–	4000	10	8000	40	–	–	11000	40	–	–	C
<i>Viola canescens</i> Wallich	H	15000	70	17000	40	6600	55	9500	50	14000	60	5000	30	F
<i>Viola pilosa</i> Blume	H	8000	30	4700	25	25000	50	9000	65	11300	50	12000	60	F
<i>Viscum nepalense</i> Spreng.	PS		–		10		–		–		20		–	C
<i>Vitex negundo</i> L.	S		–		–		10		–		–		–	R
<i>Woodfordia fruticosa</i> (L.) Kurz.	S	–	–	–	–	–	–	–	–	–	–	120	20	R
<i>Zanthoxylum armatum</i> DC.	S	200	30	160	30	160	30	160	30	–	–	–	–	C

\* Categorised as Endangered in District Garhwal

\*\* Categorised as Rare in District Garhwal

Status: E - Endangered R - Rare C - Common F - Frequent EC - Escape from Cultivation  
 Life forms: H - Herbs S - Shrubs T - Trees CIH - Climbric Herbs CIS - Climbric Shrubs  
 TF - Terrestrial Ferns PCIH - Parasitic Climbric Herb

**Table 3: Number of medicinal plants in various categories in the study area.**

Category	Trees	Shrubs	Herbs	Ferns	Total
Frequent	8	5	16	1	30
Common	8	36	107	4	155
Rare	8	27	73	2	110
Endangered	2	–	4	–	6
Escape from cultivation	13	1	3	–	17

**Table 4: Percentage distribution of medicinal plants in various categories in the study area**

S. No.	Categories of medicinal plants	Percentage in the study area
1.	Frequent	9.43
2.	Common	48.74
3.	Rare	34.59
4.	Endangered	1.89
5.	Escape from cultivation	5.35

**Table 5 : List of over-exploited medicinal species of the study area**

Botanical name	Common name	Family
<i>Ajuga bracteosa</i> Wallich ex Benth.	Neelkanthi	Lamiaceae
<i>Asparagus curillus</i> Buch.Ham. apud Roxb.	Karu	Liliaceae
<i>Asparagus filicinus</i> Buch.Ham. apud Roxb.	Kaunta	Liliaceae
<i>Berberis aristata</i> DC.	Kingor	Berberidaceae
<i>Berberis asiatica</i> Roxb. ex DC.	Kingor	Berberidaceae



Diversity of medicinal plants in Arakot-Khadikal

<i>Berberis chitria</i> Edward	Kingor, Totar	Berberidaceae
<i>Berberis lycium</i> Royle	Kingor	Berberidaceae
<i>Bergenia ciliata</i> (Haworth) Sternberg	Silparu	Saxifragaceae
<i>Habenaria intermedia</i> D.Don	Rhidi-Bidhi	Orchidaceae
<i>Rubia manjith</i> Roxb. ex Fleming	Manjeth	Rubiaceae
<i>Swertia chirayita</i> (Roxb. ex Fleming) Karsten	Chirayte	Gentianaceae
<i>Swertia ciliata</i> (D.Don ex G.Don) Burt	Chiraita	Gentianaceae
<i>Thalictrum foliolosum</i> DC.	Kirmuli	Ranunculaceae
<i>Valeriana hardwickii</i> Wallich	Shammia	Valerianaceae
<i>Valeriana jatamansii</i> Jones	Sumaya	Valerianaceae
<i>Viola biflora</i> L.	Vanfsa, Dundi-Birali	Violaceae
<i>Viola canescens</i> Wallich	Vanfsa	Violaceae
<i>Zanthoxylum armatum</i> DC.	Timru	Rutaceae

Any rare species of medicinal importance was also not included in the present study which had been listed as rare in the Red Data Book. According to new IUCN Red List Criteria in conservation and management assessment plant (AMP) meeting held in Lucknow (U.P.), *Berberis aristata* is an endangered plant of medicinal importance which was common in present study area but reported as endangered by Kala (1998) from the buffer zone of Valley of Flowers National Park, Garhwal Himalaya and as rare by Sharma (1998) from the Western Himalaya. *Hedychium spicatum* which was recorded as endangered in the study area was reported as rare by Sharma (1998) from Western Himalaya. Among the rare species observed in the study area *Climatis acuminata* and *Galium acutum* were medicinal plants also categorised as rare, while *Rhus punjabensis* was classified as endangered in the flora of District Garhwal (Gaur, 1999). Most of the rare or endangered species of medicinal importance recorded in the study area were also reported by Pandey *et al.* (1993) under similar categories for medicinal plants of Kumaon Himalaya. Some species such as *Rubus manjith*, *Berberis lycium*, *Hypericum intermedia*, *Potentilla fulgens*, *Swertia alata* and species of *Valeriana* and

*Viola* categorised as common or frequent in present study area were reported as threatened species from the different parts of the Himalaya (Shah and Kapoor, 1978; Rajwar, 1982, 1984; Goel and Bhattacharya, 1983; Biswas, 1991; Gaur, 1993; Pandey *et al.*, 1993; Sharma, 1998; Kala, 1998; Gaur, 1999 and Nautiyal *et al.*, 2001). The most dominant category of medicinal plants was common (48.72%) in the study area, of which 69.03% belonged to herbs, 23.23% to shrubs, 5.16% to trees and 2.58% to ferns. Most of the species recorded as common in the study area have also been classified in the same category in the flora of District Garhwal. Gaur (1999) reported more than 10% of the plants fall in the threatened category from the District Garhwal (47 species endangered and 164 species as rare out of 2035 species) and concluded that the original vegetation of Himalaya is more prone to the disturbances as compared to any other phyto-geographical region, the actual number of threatened category of plant is much larger. According to Lucas and Synge (1978), a plant is considered vulnerable when it is believed likely to move into endangered category in the near future if the causal factors continue operating, including the taxa of the population which are



decreasing because of over exploitation, extensive destruction of habitat or other environmental disturbances. Most common medicinal plants which were collected legally by the Government authorized co-operative agencies and unauthorized by some local people and contractors from the study area were *Ajuga bracteosa*, *Asparagus curillus*, *Asparagus filicinus*, *Berberis aristata*, *B. asiatica*, *B. chitria*, *B. lycium*, *Bergenia ciliata*, *Habenaria intermedia*, *Rubia manjith*, *Swertia chirayita*, *Swertia ciliata*, *Valeriana jatamansii*, *Viola biflora*, *Viola canescens* and *Zanthoxylum armatum*. Among these *Berberis asiatica* and *Valeriana hardwickii* were reported as over-exploited plants from Garhwal Himalaya by Rajwar (1989), and Rao and Datt (1993), *Berberis aristata*, *Bergenia ciliata* and *Valeriana hardwickii* from Chamoli district of the Garhwal Himalaya by Sharma and Khali (1998). Similar data of over-exploited medicinal plants of the Himalaya have been recorded by Sinha (1982), Uniyal and Malhotra (1982), Shah (1983), Silas and Gaur (1986), Singh (1993), Gaur *et al.* (1993 1994), Gaur and Raiwani (1995), Dangwal *et al.* (1995), Sharma (1998) and Rawat *et al.* (2001).

The over-exploitation of endangered or vulnerable species is an alarming situation in this area because this condition may further reduce their population to negligible number or they may deplete from this area. These species have been exploited to such an extent that their very existence was threatened generally due to over-exploitation besides loss of natural habitat and other biotic pressure such as over-grazing by domestic animals, forest fire, road construction and tourism. For the conservation of medicinal plants, they should be planted in nurseries, botanical gardens, and in natural habitats, or germplasm of endangered and other medicinal plants must be conserved with the help of *in-situ* and *ex-situ* methods. A national policy on medicinal plant conservation and their development can be a mile-stone against the preservation of endangered or threatened plant species. Sharma and Khali (1998) suggested that NGOs can play a very vital role as they work in close co-operation with the local population in such a way that sustainable exploitation of these species could be organised besides activating the communities in protection/checking of the ruthless and unauthorized extraction of these vital resources by the outside agencies.

**Table 6 :Species which are present in Garhwal Himalaya according to Red Data Book (Nayar and Sastry, 1987-1990).**

Name	Family	RDB Status	Altitudinal range (a msl)	Distribution in Himalaya
<i>Acer caesium</i> Wall. ex Brandis	Aceraceae	Vulnerable	1500-2700	J&K, HP, G, K
* <i>A. oblongum</i> Wall. ex DC.	Aceraceae	Endangered	1500-1800	G
<i>A. osmastonii</i> Gamble	Aceraceae	Endangered	800-2400	EH, G
<i>Aconitum falconeri</i> Stapf	Ranunculaceae	Vulnerable	3600-4000	HP, G, B
<i>Allium stracheyi</i> Baker	Liliaceae	Vulnerable	2500-3000	J&K, HP, G, K, N
<i>Aphyllorchis gollani</i> Duthie	Orchidaceae	Endangered or Extinct	2400-3000	G
<i>A. parviflora</i> King & Patling	Orchidaceae	Rare	3400-3600	G, N, S
<i>Archineottia microglottis</i> (Duthie) Chen.	Orchidaceae	Rare	2000-2400	G
<i>Arenaria curvifolia</i> Majumdar	Caryophyllaceae	Endangered	3550-3650	G
<i>Berberis osmastonii</i> Dunn	Berberidaceae	Rare	1700	G
<i>Calanthe mannii</i> Hook. f.	Orchidaceae	Rare	1300-2200	G, K, N, S, B Khasi Hills
<i>C. pachystalix</i> Reichb. f. ex Hook. f.	Orchidaceae	Endangered	2000	HP, G, N
<i>Catamixis baccharoides</i> Thorns.	Asteraceae	Vulnerable	300-800	G, N
<i>Cyananthus integer</i> Wall. ex Benth.	Campanulaceae	Rare	2800-3800	K, G
<i>Cypripedium cordigerum</i> D. Don	Orchidaceae	Rare	2500-3500	J&K, HP, G, K, N, S, B
<i>C. elegans</i> Reichb. f.	Orchidaceae	Rare	2500-4000	G, K, S, N, B
<i>C. himalaicum</i> Rolfe	Orchidaceae	Rare	3100-4000	G, K, S, N, B
<i>Didicea cunninghamii</i> King et	Orchidaceae	Rare	2000-2500	G, S



Prain ex King et Patling <i>Dioscorea deltoidea</i> Wall. ex. Griseb.	Dioscoreaceae	Vulnerable	2000-2500	J&K, HP, G, K, N, S, EH
<i>Eria occidentalis</i> Seidenf.	Orchidaceae	Rare	1200-1500	G, K
<i>Eulophia machinnonii</i> Duthie	Orchidaceae	Rare	300-800	G
<i>Hedysarum microcalyx</i> Baker	Fabaceae	Vulnerable	3000-4500	J&K, HP, G
<i>Microschoenus duthiei</i> Clarke	Cyperaceae	Indeterminate	4572-4876	G
<i>Nardostachys grandiflora</i> DC.	Valerianaceae	Vulnerable	3200-4600	HP, G, K, N, S, B
<i>Picrorhiza kuffooa</i> Royle ex Benth.	Scrophulariaceae	Vulnerable	3000-4500	HP, K, G
<i>Pittosporum eriocarpum</i> Royle	Pittosporaceae	Indeterminate	1200-2400	G, K
<i>Saussurea bracteata</i> Decne.	Asteraceae	Rare	3500-5000	J&K, HP, G, K
<i>S. costus</i> (Falc.) Lipschitz	Asteraceae	Endangered	2500-3500	J&K, HP, G, K
<i>Silene kumaonensis</i> Williams	Caryophyllaceae	Rare	2500-4000	J&K, HP, G, K

B-Bhutan, G-Garhwal, K-Kumaon, J&K-Jammu and Kashmir, HP-Himachal Pradesh, N-Nepal, S-Sikkim, EH-Eastern Himalaya, RDB-Red Data Book.

\* Found in the present study area

## References

- Biswas, Sas 1991. *Rare and endangered flora of Eastern Himalaya and the measures for its conservation*. In : G.S. Rajwar (ed.) *Advances in Himalayan Ecology*. Today and Tomorrow's Printers & Pub., New Delhi, pp.267-273.
- Dangwal, L.R., Rawat, D.S. and R.D. Gaur 1995. Some rare and interesting plants of Fabaceae from Garhwal Himalaya. *Ind. J. For.*, 18 : 225-257.
- Gaur, R.D. 1999. *Flora of the District Garhwal North-West Himalaya (with Ethnobotanical notes)*. TransMedia, Srinagar (Garhwal).
- Gaur, R.D. and Sukriti Raiwani 1995. A preliminary report on the threatened arborescent taxa of Garhwal Himalaya. *J. Indian Bot. Soc.*, 74 : 283-292.
- Gaur, R.D., Dangwal, L.R. and D.S. Rawat 1994. Some rare plants of Fabaceae from Garhwal Himalaya. *Ind. J. For.*, 17(1) : 80-83.
- Gaur, R.D., Rawat, D.S. and L.R. Dangwal 1993. *Status of some vulnerable plant species from Garhwal Himalaya*. In : U. Dhar (ed.), *Himalayan Biodiversity : Conservation Strategies*. G.B. Pant Institute of Himalayan Envir. and Dev., Kosi, Almora.
- Goel, A.K. and U.C. Bhattacharya 1983. Rare flowering plants of Garhwal Himalaya. In : S.K. Jain and R.R. Rao (eds.), *An Assessment of Threatened Plants of India*, B.S.I., Howrah, pp. 13-17.
- Kala, C.P. 1998. *Ethnobotanical Survey and Propagation of Rare Medicinal Herbs from Farmers in the Buffer Zone of Valley of Flowers National Parks, Garhwal Himalaya*. Report Submitted to International Centre for Integrated Mountain Development (ICIMOD), Kathmandu & Wildlife Institute of India, Dehradun.
- Khoshoo, T.N. 1992. *Plant Diversity in the Himalaya : Conservation and Utilization*. G.B. Pant Inst. of Himalayan Environment and Development, Kosi, Almora.
- Lucas, G.Li and S. Synge 1978. *IUCN Plant Red Data Book*. Gland, Switzerland.
- Nautiyal, S., Maikhuri, R.K., Rao, K.S. and K.G. Saxena 2001. Medicinal plant resources in Nanda Devi Biosphere Reserve in the Central Himalayas. *J. Herbs, Spices & Medicinal Plants*, 8(4) : 47-64.
- Nayar, M.P. and A.R.K. Sastry 1987-90. *Red Data Book of Indian Plants*. Vols. I-III. B.S.I., Calcutta.
- Pandey, N.K., Tewari, K.C., Tewari, R.N., Joshi, G.C., Pande, V.N. and G. Pandey 1993. *Medicinal plants of Kumaun Himalaya and strategies for conservation*. In : U.Dhar (ed.), *Himalayan Biodiversity : Conservation Strategies*. G.B. Pant Institute of Himalayan Env. and Dev., Kosi, Almora.
- Rajwar, G.S. 1982. Endangered or rare plants of Garhwal and Kumaun Himalaya. *Himal. J. Sci.*, 2: 38-40.
- Rajwar, G.S. 1984. Exploitation of medicinal plants of Garhwal Himalaya. *Sci. & Environ.*, 6 : 37-41.
- Rajwar, G.S. 1989. *Human impact on the forests of Garhwal Himalayas*. In : Ram Prakash (ed.), *Advances in Forestry Research in India*. International Book Distributors, Dehradun, pp. 229-241.
- Rao, R.R. 1994. *Bio-diversity in India (Floristic Aspect)*. Bishen Singh Mahendra Pal Singh, Dehradun.
- Rao, R.R. and B. Datt 1993. *Distribution and diversity of the family Berberidaceae in the Himalaya*. In : U. Dhar (ed.), *Himalayan Biodiversity : Conservation Strategies*. G.B.



- Pant Institute of Himalayan Envir. and Dev., Kosi, Almora, pp. 267-278.
- Rawat, D.S., Bhandari, B.S. and R.D. Gaur 2001. *Vegetational Wealth*. In : O.P. Kandari and O.P. Gusain (eds.), *Garhwal Himalaya : Nature, Culture & Society*. TransMedia, Srinagar (Garhwal), pp. 125-148.
- Shah, N.C. 1983. *Endangered medicinal and aromatic taxa of Uttar Pradesh Himalaya*. In : S.K. Jain and R.R. Rao (eds.), *An Assessment of Threatened Plants of India*. B.S.I., Howrah, pp. 40-49.
- Shah, N.C. and L.D. Kapoor 1978. Depletive medicinal plants of Kumaon Himalayas. *Jour. Res. Ind. Med. Yoga & Homoeo.*, 13(3) : 38-43.
- Sharma, A. 1998. *Biodiversity of medicinal and aromatic plants of Western Himalaya, their utilization and strategies for conservation*. In : B.D. Sharma and Tej Kumar (eds.), *Himalayan Natural Resources : Eco-Threats and Restoration Study*. Indus Publishing Company, New Delhi, pp. 121-159.
- Sharma, A.K. and R.P. Khali 1998. *Diversity of medicinal flora of Chamoli district of Garhwal Himalaya*. In : B.D. Sharma and Tej Kumar (eds.), *Himalayan Natural Resources : Eco-Threats and Restoration Study*. Indus Publishing Company, New Delhi, pp. 353-376.
- Silas, R.A. and R.D. Gaur 1986. Notes on distribution of rare and little known *Carex ligulata* Nees from North-west Himalaya. *J. Bomb. Nat. Hist. Soc.*, 82 : 467-468.
- Singh, V.K. 1993. *Exploitation and threat to some medicinal plants and folk drugs of Garhwal and Kumaon regions of Uttar Pradesh, India*. In : U. Dhar (ed.), *Himalayan Biodiversity : Conservation Strategies*. G.B. Pant Institute of Himalayan Envir. and Dev., Kosi, Almora.
- Sinha, R.L. 1982. *Industrial potential and planned exploitation of Indian medicinal plants in relation of hill eco-types in U.P.* In : G.S. Paliwal (ed.), *The Vegetation Wealth of the Himalayas*, Puja Publishers, Delhi, pp. 241-245.
- Uniyal, B.P. and C.L. Malhotra 1982. *Economic exploitation of rare North-western Himalayan plants*. In : G.S. Paliwal (ed.), *The Vegetation Wealth of the Himalayas*. Puja Publishers, Delhi, pp. 221-267.

