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Research article

POPULATION STATUS AND CONSERVATION PRIORITIZATION OF SOME THREATENED  
MEDICINAL PLANTS OF KASHMIR HIMALAYAS\*Bilal Ahmad Baig<sup>1</sup>, D. Ramamoorthy<sup>2</sup> and Bilal Ahmad Wani<sup>3</sup>

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**ABSTRACT:** Himalaya is credited all over the world as a treasure of medicinal and aromatic plants, which in turn prove as treasures of bioactive agents. These medicinal plants taking refuge in the sub alpine and alpine zones are facing the brunt of varied threats. Strategies have been proposed by various environmentalists to conserve biodiversity at regional, national and global levels. Assessment of plant populations is one of the basic activities of conservation biology that can be mainly valuable for sustaining species with minor populations. In the present study, threat status of the 6 medicinal plant species (*Arnebia benthamii* Wall. Ex G. Don, *Meconopsis aculeate* Royle, *Rheum webbianum* Royle, *Aconitum heterophyllum* Wallish Ex Royle, *Podophyllum hexandrum* Royle and *Aquilegia fragrans* Benth.) have been assessed in accordance with IUCN Red List Categories and Criteria 2010 version 8.1 following Guidelines for Application of IUCN Red List Criteria at Regional Levels 2003 version 3.0 criteria. Out of 6 species, 2 were categorized as vulnerable, 3 species as endangered and 1 species as critically endangered. The three factors of over exploitation, overgrazing and habitat degradation have been known as main threats to the medicinal plants. Consequently, monitoring of population and habitats, development of conservative protocol and establishment of species in-situ conditions has been proposed.

**Key words:** Himalaya, bioactive agents, medicinal plants, biodiversity, conservation biology

**INTRODUCTION**

The most prominent feature of our planet is the existence of life and most prominent feature of life is diversity. The candle of life is burning on this planet with flames of diverse colours. This variety is endorsed/measured by different estimates and the values varying with different reports and authorities (Heywood, 1995). Biodiversity is one of the main livelihood options; it offers 13 types of ecosystem amenities (Costanza *et al.*, 1997; Singh, 2007). But due to habitat degradation and Over-exploitation, biodiversity is declining with an alarming rate (Samant *et al.*, 1998b). At current, the quick loss of species is assessed to be between 100 and 1000 times higher than predictable natural extinction rate. Main threats to biodiversity and ecosystem are over exploitation, global climate change, habitat loss, fragmentation, pollution and invasion of alien species (IUCN, 2003) and disturbance of community structure (Novasek & Cleland, 2001). The International Union for Conservation of Nature and Natural Resources (IUCN) has projected around 10% of the vascular plants of the world to be under threat (Nayar & Sastry, 1987-1990). The IUCN Red List of threatened species compiled by IUCN categorizes species that have high chances of extinction in the future as Critically Endangered, Endangered, or Vulnerable. Degradation and fragmentation of more than 70 % of the original habitats placed Himalaya in the list of Global Biodiversity Hotspots. The convention on Biological Diversity Summit in June 1992 signaled worldwide recognition of the alarming loss of biodiversity. The growing consciousness of importance and high rates of loss make it imperative to rapidly assess and conserve biodiversity at local, regional and global levels. Since then, various studies have been carried out to search and identify the threatened plants of the world (Singh, 2002).

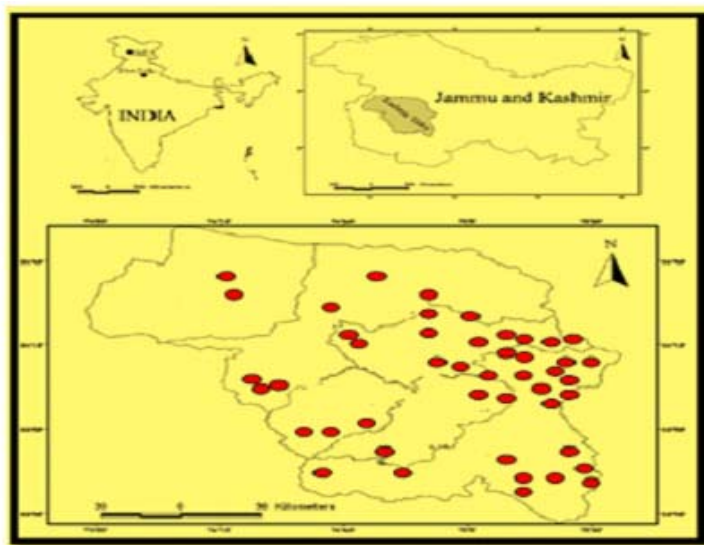
IUCN Red list categories and criteria 1994 and 2001 were planned for the assessment of extinction threat of the species at the global level. Yet, need was felt to assess the population status at local and regional levels because it is the regional scale where the anthropological actions and biodiversity strike (Pimm *et al.*, 2001). The regional or national threat lists play a significant role in enlightening global preservation efforts, particularly when the information that they contain is integrated into the global IUCN Red List (Cuaron, 1993; Rodriguez *et al.*, 2000). It is acknowledged that the Regional Red Lists would provide a more objective assessment of the threats which a taxon is facing at either national or regional scale (Gardenfors, 2001). Furthermore, the national or regional threat lists can also have advantage in determination of different threats levels and the insertion of these threat levels into the National Conservation Planning (Master, 1991; Mace, 1995). It is with this contextual, lots of studies had been carried out all over the world, where in different plant species have been assessed for their conservation status in a particular country or region.

In the past, a large number of studies have been carried out to assess the threat status of various plant species (Soehartono and Newton, 2000; Jenkins, 1997; Garcia *et al.*, 2002; Peng *et al.*, 2008; Haruntyunuan *et al.*, 2010; Hamayun *et al.*, 2006; Ali and Qaisar, 2010a,b; Alam and Aliu, 2010; Ali *et al.*, 2012; Kala, 2005; Nautiyal *et al.*, 2000; Goraya, 2010; Dhar *et al.*, 2002; Kaul, 1997; Dar and Naqshi, 2000 and Malik *et al.*, 2011). However, no actual assessment of these valuable medicinal was done in Kashmir Himalayas. The current study is an attempt to study the population status of six medicinal plants and their categorization into different threat categories as per IUCN guidelines. This determination of threat status will help in finding the main element which is in immediate requirement of conservation of medicinal plant species. Therefore, present attempts have been made: (i) assess species for threat categories; (ii) to suggest conservation management plan.

## MATERIAL AND METHODS

### Study Area

Kashmir valley (33°20' to 34°54' N latitudes and 73°55' to 75°35' longitudes) is located in the Northwest Himalayan biogeographic zone in India, covering an area of 15,948 Km<sup>2</sup>. The valley is asymmetrical surrounded by lofted mountains of the Pir Panjal in the South and southwest and by the Great Himalayan range in the North and East, with 64% of the total area being mountainous. The climate of the area is temperate. The vegetation generally covers temperate, sub-alpine and alpine types. Alpine pastures are dominated by herbaceous medicinal plant species and dispersed patches of alpine scrubs.



**Figure-1: Map of Kashmir Valley showing surveyed areas**

- 1-Handwara; 2-Langate; 3-Bandipora; 4-Gurez; 5-Pattan; 6- Aparwat; 7-Gulmarg;
- 8-Khilanmarg; 9- Dhara; 10-Mansbal; 11-Harmukh; 12-VishenSar; 13-Kangan; 14- Rayil;
- 15-Dugwan; 16- Dachigam; 17-Zailder Dub; 18- Thajwas; 19-Baltal; 20-Pojila Pass; 21-
- Yousmarg; 22-Doodhpathri; 23-Charrieresharief; 24- Nagbaren; 25-Tral;
- 26-Shikargah; 27-Aharbal; 28- Peer Ki Gali; 29- Shopian; 30-Marsar; 31-Tarsar;
- 32-Chumbnai; 33-Nandkan; 34-Poshpathar; 35-Munwarsar; 36-Liderwat; 37-Aru;
- 38-Chandanwari; 39- Pahalgam; 40- Achabal; 41-Gawran; 42-Verinag; 43-Kokernag;
- 44- Ducksum; 45-Jawaher Tunnel; 46-Simthan Top

## METHODS

Surveys were carried out during 2011-2013 throughout the Kashmir valley. The particular medicinal plant species were surveyed in 46 sites in Kashmir valley (Fig. 1). The geographical co-ordinates of these locations were recorded with GPS. The size and range of population of selected medicinal plant species were determined by walking extensively in an area around the population (Ali and Qaiser, 2010a). Detailed field records on habitat and altitudinal ranges were also recorded in the field. Mature individuals were counted in each area (Ali and Qaiser, 2010a). Actual threats to the population of a selected plant species in a given area were recorded by direct observation. The Area of Occupancy (AOO) was calculated by the presence of a taxon in a uniform grid that covers the whole range of a taxon and then tallying the number of occupied grid cells with the area of individual cell (IUCN, 2001). To calculate AOO, a grid size of  $2 \times 2 \text{ Km}^2$  (cell area of  $4 \text{ Km}^2$ ) was selected (IUCN, 2004). The extent of occurrence (EOO) was calculated by  $\alpha$ -hull (IUCN, 2005). The region was recorded as one site when it was observed that a particular threatening event can quickly disturb all the individuals of the taxon present in this zone area (IUCN, 2001). The population decline was calculated by tallying the total number of mature individuals present during the first year to the total number of mature individuals present during the second year (Ali and Qaiser, 2010a). The data collected were assessed in light of IUCN Red List Categories and Criteria 2010 version 8.1 following Guidelines for Application of IUCN Red List Criteria at Regional Levels 2003 version 3.0. Five basic criteria (A, B, C, D and E), formulated by IUCN for assessing the taxa at regional level. Only one of the criteria (A, B, C, D, or E) needs to be met. However, a taxon should be evaluated against as many criteria as available data permit (IUCN, 2003).

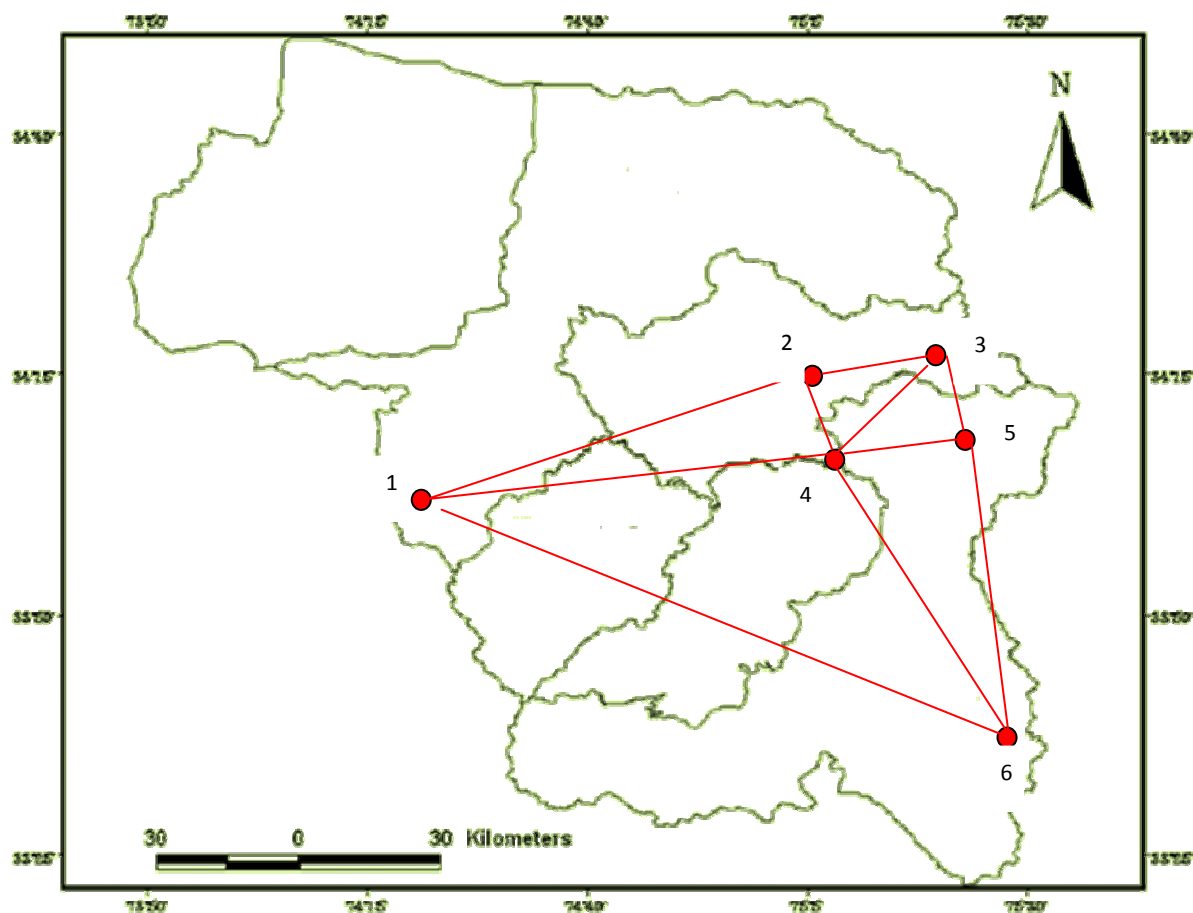


Fig. 2: Map showing EOO of *Arnebia benthamii* in Kashmir valley

1. Aparwat; 2. Rayil; 3. Thajwas; 4. Nagbaren; 5. Munwersar; 6. Ducksum

## RESULTS

During the current study the threat status of six medicinal plant species (*Arnebia benthamii*, *Meconopsis aculeate*, *Rheum webbianum*, *Aconitum heterophyllum*, *Podophyllum hexandrum* and *Aquilegia fragrans*) according to IUCN categories and criteria 2010 version 8.1 following regional guidelines 2003 version 3.0. Habitat degradation, overgrazing, over exploitation, deforestation and excessive tourist flow have been identified as major threats to these medicinal plant species. The medicinal plant species assessed are given below:

### 1) *Arnebia benthamii* Wall. Ex G. Don

#### Local distribution

Six different populations (Aparwat, Rayil, Thajwas, Nagbaren, Munwersar and Ducksum) have been found during the present investigation (Fig. 2)). *Arnebia benthamii* occurs as small populations on moist shady open slopes or among on very steep rocks or in rock crevices at an altitude of 3100 to 4000 m.

#### Taxonomic description

*Arnebia benthamii* belongs to Boraginaceae family and is endemic to North West Himalaya. It is a rhizomatous, perennial alpine herb and attains height up to 30-95cms. The inflorescence is a spike containing more than 220 flowers. Leaves are linear, hairy and lanceolate. The flowers are tubular with a corolla tube and five fused petals and sepals. The sepals are persistent. Fruit is a single seeded.

**Common Name:** Kawazaban

**Ethno medicinal use:** The Goazaban a main component of a commercially available drug is obtained mainly from *Arnebia benthamii*, which has anti-fungal, anti-bacterial and anti-inflammatory activity. It is given against high fevers and mainly the flowers are reported to have soothing effect on patients with heart diseases.

#### Evaluation of threat status:

In order to assess the threat status of the species in accordance with the IUCN guidelines, Area of Occupancy (AOO), Extent of Occurrence (EOO), population size in the form of mature individuals and the different types of threats to the species were recorded. The most common threats are overgrazing, over exploitation for local use and landslides.

The total AOO of *Arnebia benthamii* in Kashmir valley is 24 km<sup>2</sup>, calculated by summation of all sub-populations in the Kashmir valley. The total EOO of *Arnebia benthamii* is 127.12 km<sup>2</sup>, calculated by summing the areas of all triangles. As the EOO and AOO of the species is 127.12 km<sup>2</sup> and 24Km<sup>2</sup> which is less than 5,000 Km<sup>2</sup> and 5, 00 Km<sup>2</sup> respectively and there is the continuing decline in the number of mature individuals. Thus, the plant species meets the criteria for **Endangered (EN)** category under the criteria B1b (v) c(iv), B2b (v) c (iv) and Cc2a (i).

M.K. Kaul (1997) assigned the species as Endangered in Kashmir Himalaya. IUCN (1997) also assigned the species Endangered in Jammu & Kashmir. IUCN (1998) assigned the plant species as Critically Endangered for Northwestern Himalaya and also in 2003, IUCN categorized Endangered threat category to the species for J & K (Kala, 2004c). Conservation and Management Prioritization, (1998) assigned the plant species as Critically Endangered under criteria A1 acd.

### 2) *Meconopsis aculeate* Royle

#### Local distribution

Five different Sub-populations (Gurez, Harmukh, Thajwas, Nagbaren and Munwersar) have been found in the Kashmir valley during the present investigation (Fig. 3). This rare endemic species occurs among rocks or in rock crevices with a steeper slope and few coexisting species.

#### Taxonomic description

*Meconopsis aculeata* is an endemic perennial medicinal herb of papaveraceae family. The plant bears a single, unbranched, erect, hard, and prickly stem. Single raceme bears many flowers. Flower is showy, actinomorphic, hermaphrodite, complete and hypogynous. Flower has a thin, cylindrical, bristly and erect pedicel. Petals are four, obtuse, obovate, delicate, thin, soft and with wavy margins. Fruit is a many seeded capsule.

**Common Name:** Achatsarmum

**Ethno medicinal use:** The whole herb is used as analgesic, chronic, renal pain, tonic, narcotic and febrifuge.

#### Evaluation of threat status

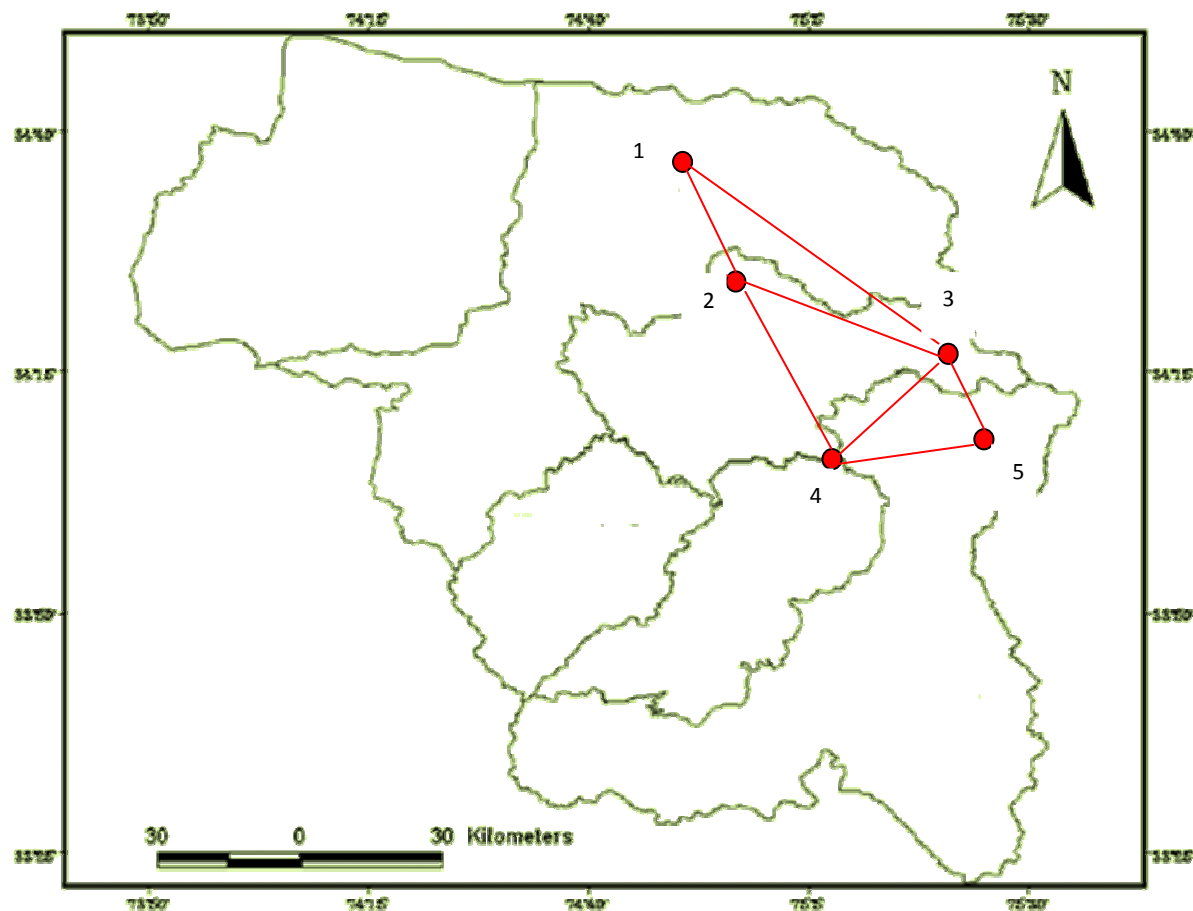


Fig. 3: Map showing EOO of *Meconopsis aculeata* in Kashmir valley

1. Gurez; 2. Harmukh; 3. Thajwas; 4. Nagbaren; 5. Munwersar

The total AOO of *Meconopsis aculeata* in Kashmir valley is 20km<sup>2</sup>, calculated by summation of all sub-populations in the Kashmir valley. The total EOO of *Meconopsis aculeata* is 87.80 km<sup>2</sup>, calculated by summing the areas of all triangles. As the EOO of the species is 87.80km<sup>2</sup> which is less than 100 Km<sup>2</sup> and there is the continuing decline in the number of mature individuals. Thus, the plant species meets the criteria for **Critically Endangered (CR)** category under the criteria B1b (v) c (iv).

IUCN (1998) assigned the species as Critically Endangered for Northwestern Himalaya. Conservation and Management Prioritization, (1998) also assigned the plant species as Critically Endangered under criteria A1 acd; B1, 2c for J&K as well as for the globe. IUCN (2001) assigned the plant species as Critically Endangered for Northwestern Himalaya and Endangered for J & K.

### 3) *Rheum webbianum* Royle

#### Local distribution

During the current study, *Rheum webbianum* has been documented from nine different sites (Gurez, Harmukh, Vishensar, Zailder dub, Aparwat, Munwersar, Aharbal, Peer ki Gali and Simthan top) (Fig. 4). The species grows in alpine zone at an altitude of 3300 to 4000 m asl and is found in shady, humid places or among rocks.

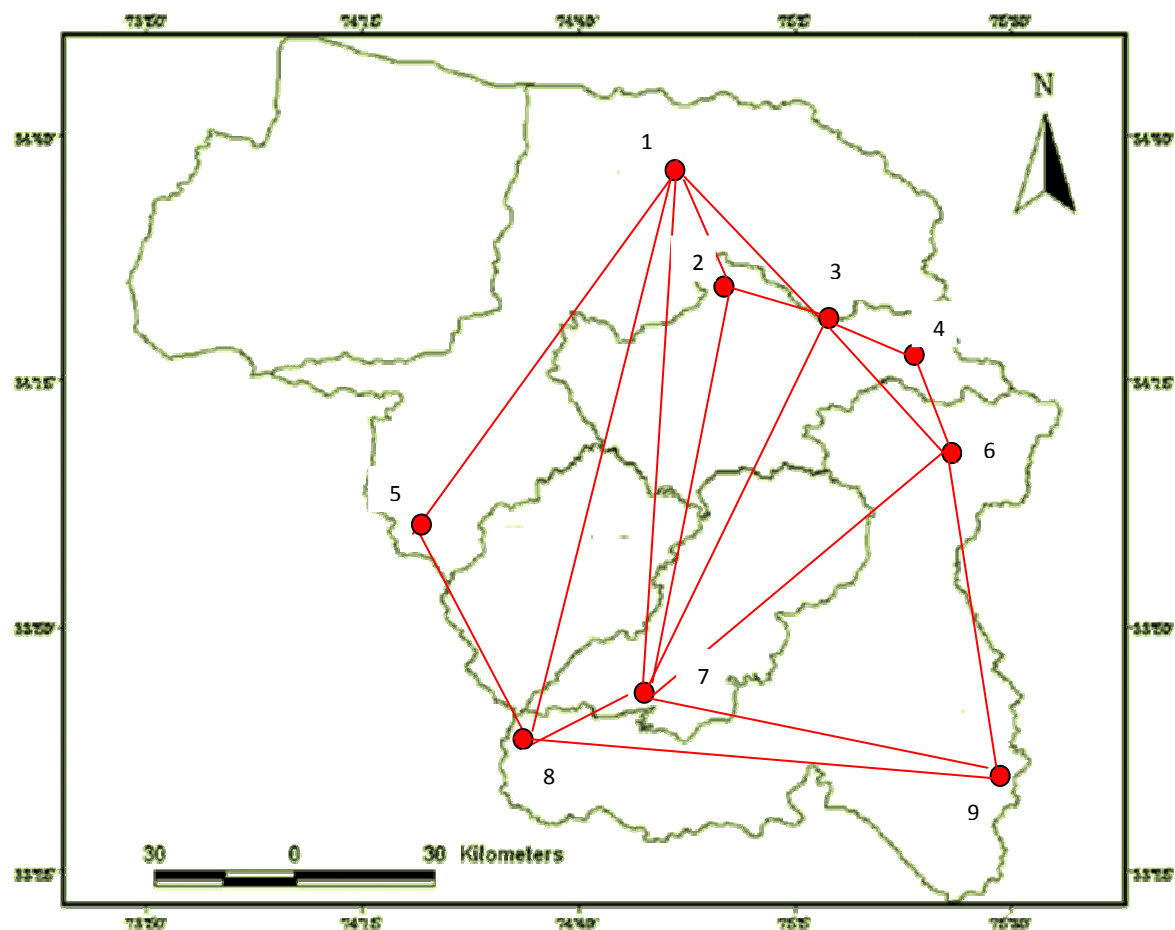
#### Taxonomic description

*Rheum webbianum* is a perennial medicinal herb of polygonaceae family. The plant bears a diffusely branched inflorescence. Leaves are radical having long petiole. Flowers are ebracteate, pedicelate, pale yellowish and filiform. Fruits are broadly oblong, winged and notched on both sides.

**Common name:** Pumbchalan

**Ethno medicinal uses:** The rhizome and roots of the plant species are source of the drug which is used as purgative. The decoction of root is used to cure lung infection and liver. The root powder is sprinkled on ulcers and wounds for rapid curing.

**Assessment of threat status:**



**Fig. 4:** Map showing EOO of *Rheum webbianum* in Kashmir valley

1. Gurez; 2. Harmukh; 3. Vishensar; 4. Zailder dub; 5. Aparwat; 6. Munwerser; 7. Aharbal; 8. Peer ki Gali; 9. Simthan Top

The total AOO of *Rheum webbianum* in Kashmir valley is 44 km<sup>2</sup>, calculated by summation of all sub-populations in the Kashmir valley. The total EOO of *Rheum webbianum* is 587.17 km<sup>2</sup>, calculated by summing the areas of all triangles. As the EOO and AOO of the species is 587.289 km<sup>2</sup> and 44 km<sup>2</sup> which is less than 20,000 km<sup>2</sup> and 2,000 km<sup>2</sup> respectively and the number of sub-populations in the valley are 9 which also falls between 6-10 as standardized in IUCN Categories and Criteria (2010) for Vulnerable category and there is the continuing decline in the number of mature individuals. Thus, the plant species meets the criteria for **Vulnerable (VU)** category under the criteria B1ab (v), B2ab (v) and Cc2a (i). The results obtained during the current study are in confirmatory with the Ved et al. (2003) and CAMP (2003) who also categorized the plant species as vulnerable in J&K state.

#### 4) *Aconitum heterophyllum* Wallish Ex Royle

##### Local distribution

During the current study, *Aconitum heterophyllum* has been documented from six different sites (Gurez, Harmukh, Khilanmarg, Thajwas, Munwarsar, and Poshpathar) (Fig. 5). The species is restricted to alpine meadowlands of Kashmir Himalayas at an altitude of 2680 to 3500 m.

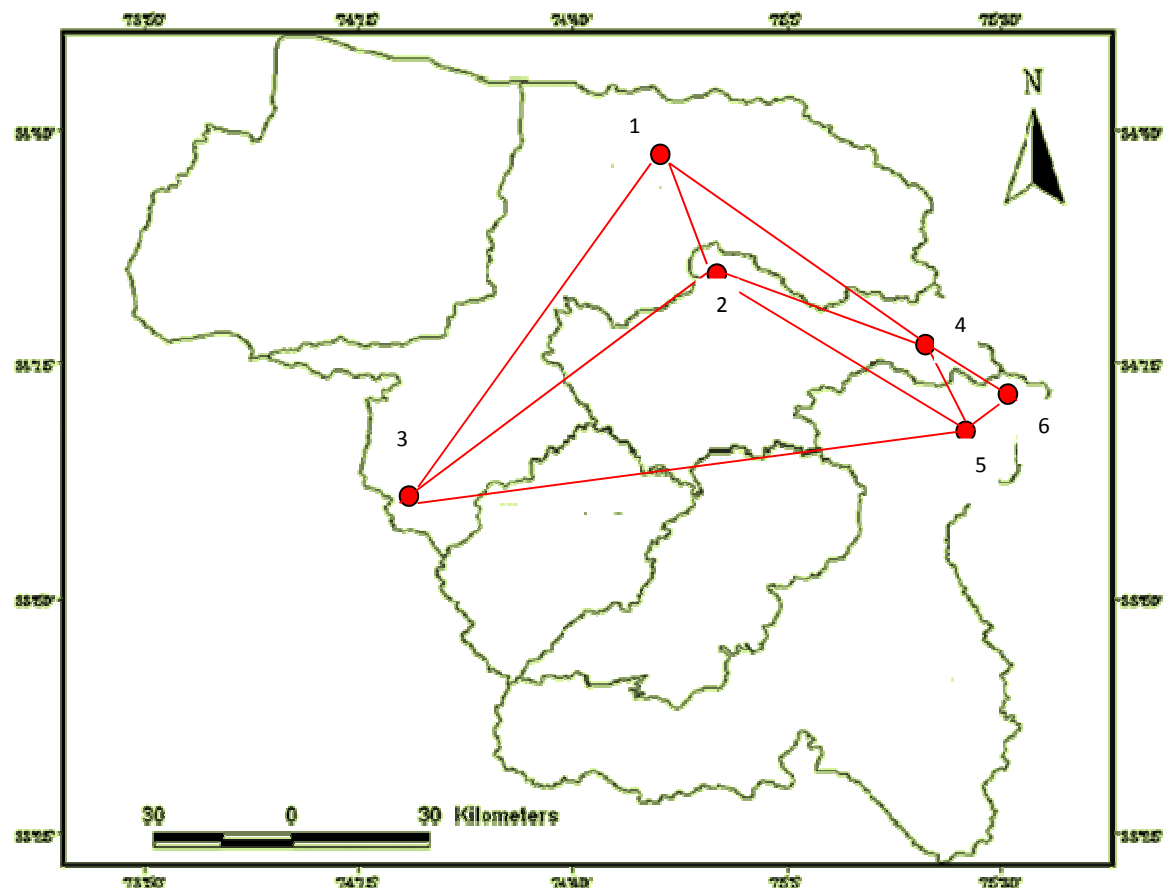
**Taxonomic description**

*Aconitum heterophyllum* is a perennial medicinal herb of Ranunculaceae family. The plant bears a single, unbranched and erect stem. The plant bears tuberous root. Flowers are aggregated in racemes. Flower is hermaphrodite, bracteoles linear, petals five and glabrous.

**Common name:** Patrees

**Ethno medicinal uses:** Ancient aconite drug in India, a valuable febrifuge, a bitter tonic, mainly given after malarial and other fevers. It is recorded to be used against dysentery, diarrhea and chronic enteritis.

**Assessment of threat status:**



**Fig. 5:** Map showing EOO of *Aconitum heterophyllum* in Kashmir valley

1. Gurez; 2. Harmukh; 3. Khilanmarg; 4. Thajwas; 5. Munwersar; 6. Poshpathar

The total AOO of *Aconitum heterophyllum* in Kashmir valley is 24 km<sup>2</sup>, calculated by summation of all sub-populations in the Kashmir valley. The total EOO of *Aconitum heterophyllum* is 260.38 km<sup>2</sup>, calculated by summing the areas of all triangles. As the EOO and AOO of the species is 260.38 km<sup>2</sup> and 24 km<sup>2</sup> which is less than 5,000 km<sup>2</sup> and 5,000 km<sup>2</sup> respectively and there is the continuing decline in the number of mature individuals. As per the data assessed against the IUCN Red List Categories and Criteria (2010), the species qualifies for the threat category of **Endangered (EN)** category under criteria B1b (v) c (iv) and B2b (v) c (iv).

M.K. Kaul (1997) assigned the species as Vulnerable in Kashmir Himalaya. IUCN (1998) assigned the plant species as Critically Endangered for Northwestern Himalaya and also in 2003, IUCN categorized Critically Endangered threat category to the species for J & K (Kala, 2004c).

### 5) *Podophyllum hexandrum* Royle

#### Local distribution

During the current study, *Podophyllum hexandrum* has been documented from 13 different sites (Gurez, Hrmukh, Vishensar, Rayil, Aparwat, Nagbaren, Nandkan, Munwersar, Shikargah, Yousmarg, Aharbal, Peer ki Gali and Ducksum) (Fig. 6). The species is restricted to alpine meadow lands of Kashmir Himalayas at an altitude of 2300- 3700 m.

**Taxonomic description:** *Podophyllum hexandrum* is a valuable medicinal plant, distributed in the Himalayan zone at an altitude ranging from 2300 to 3700 m above MSL. It is an herbaceous and rhizomatous perennial plant. *Podophyllum hexandrum* (Himalayan May apple), is monocarpic perennial herb of Podophyllaceae. *Podophyllum hexandrum* grow from 12 to 18 inches far above the ground with deeply lobed leaves, fleshy stems, which arise vertically from the soil. The plant has attractive leaves that are divided into 3 lobes. The plant bear white or pale pink, 6-petaled flowers are borne at the stout stems; these are followed by fleshy, oval and red berries. The flower has six petals and six stamens, which inspired its species name hexandrum, meaning six stamens. Fruit is a large red or reddish berry, 2.5-5 cm, with many seeds embedded in pulp. It can be propagated by seed or by dividing the rhizome.

**Common name:** Wanwagun

**Ethno medicinal uses:** *Podophyllum* root contain active compounds- Podophyllin and Podophyllotoxin. It is considered a cholagogue, emetic, alterative, purgative and a bitter tonic. Recently it has been used to treat some of the cancers.

**Assessment of threat status:**

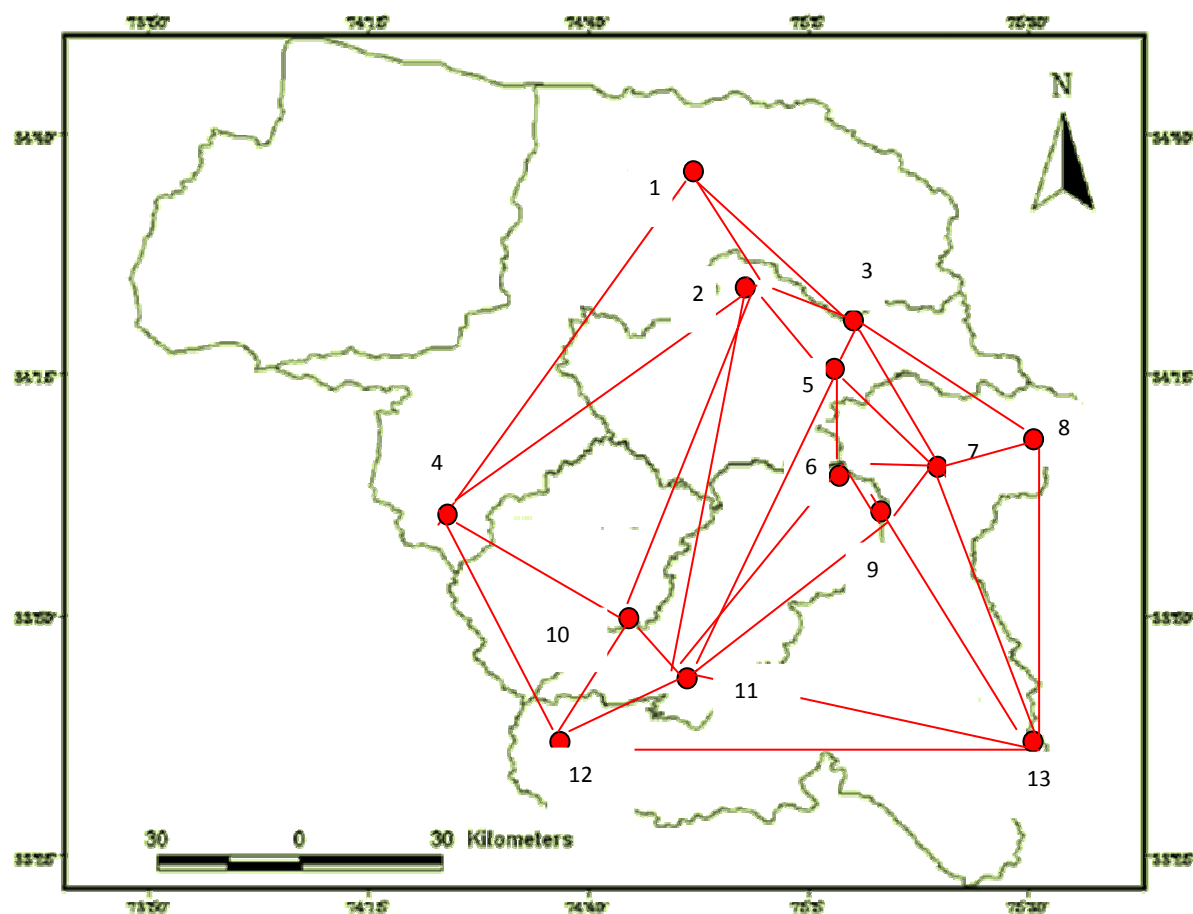


Fig. 6: Map showing EOO of *Podophyllum hexandrum* in Kashmir valley

1. Gurez; 2. Harmukh; 3. Vishensar; 4. Aparwat; 5. Rayil; 6. Nagbaren; 7. Nandkan; 8. Munwersar; 9. Shikargah; 10. Yousmarg; 11. Aharbal; 12. Peer ki Gali; 13. Ducksum



The total AOO of *Podophyllum hexandrum* in Kashmir valley is 64 km<sup>2</sup>, calculated by summation of all sub-populations in the Kashmir valley. The total EOO of *Podophyllum hexandrum* is 633.76 km<sup>2</sup>, calculated by summing the areas of all triangles. As the EOO and AOO of the species is 633.76 km<sup>2</sup> and 64 km<sup>2</sup> which is less than 20,000 km<sup>2</sup> and 2,000 km<sup>2</sup> and there is the continuing decline in the number of mature individuals. Thus, the plant species meets the criteria for **Vulnerable (VU)** category under the criteria B1b (v) and B2b (v). The results obtained during the current study are in confirmatory with the Ved et al. (2003) and CAMP (2003) who also categorized the plant species as vulnerable in J&K state.

## 6) *Aquilegia fragrans* Benth.

### Local distribution

Five different populations (Gurez, Khilanmarg, Vishensar, Nagbaren and Munwersar) have been found during the present investigation (Fig. 7). The plant species occurs in small and patchy populations in wet shady soil or in exposed alpine pastures among rocks or, rocky slopes in marginally hard at an altitude of 3,000-3,800 m.

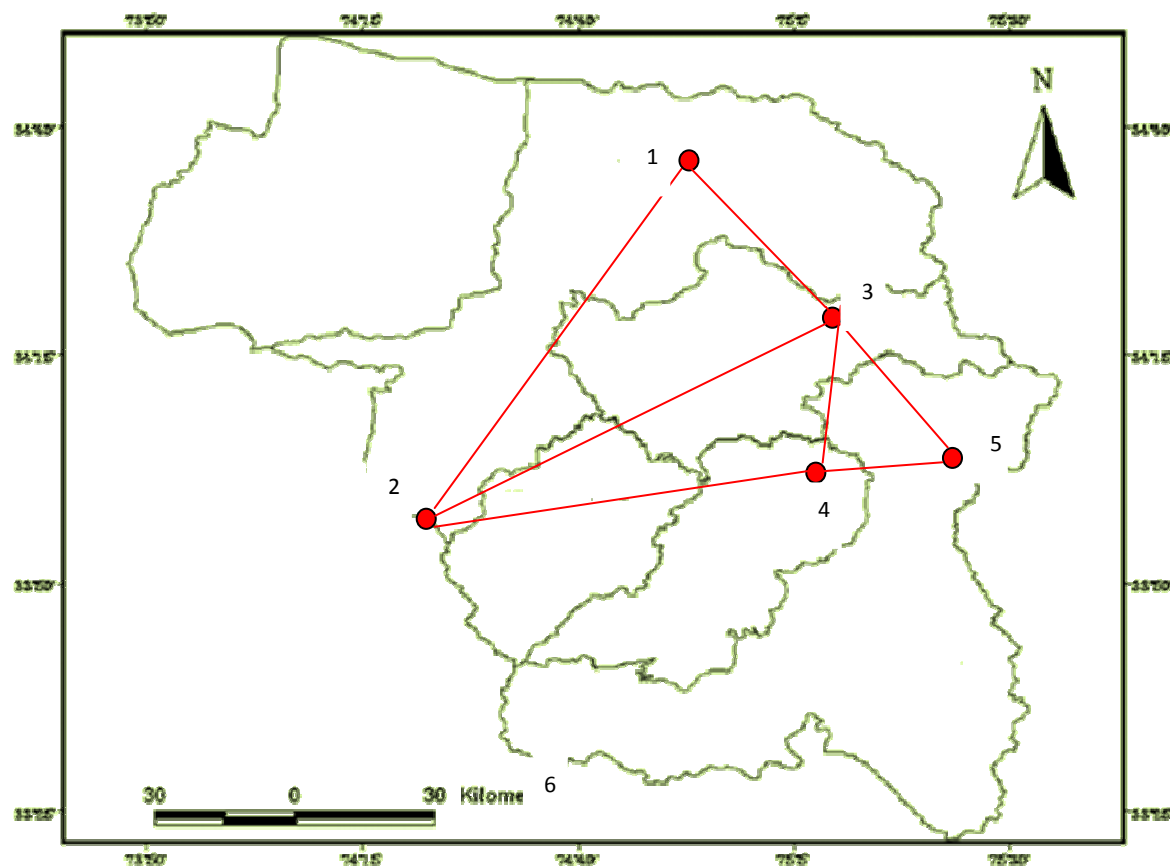
### Taxonomic description

*Aquilegia fragrans* is a perennial medicinal herb that belongs to the family Ranunculaceae. The species bear a solitary stem. Upper spike leaves commonly absent and if present much reduced. Flowers solitary or a few per plant, dark-blue to violet sepals and petals five. Petals linear to obovate. Each petal has a curved conic-obtuse spur. Stamens many and anthers basifixed and stigma with a pinhead-shaped.

**Common Name:** Zaoneel

**Ethno medicinal use:** Root used against wounds and inflammation. Flowers used against cold and cough.

**Evaluation of threat status:**



**Fig. 7:** Map showing EOO of *Aquilegia fragrans* in Kashmir valley  
1. Gurez; 2. Khilanmarg; 3. Vishensar; 4. Nagbaren; 5. Munwersar

The total AOO of *Aquilegia fragrans* in Kashmir valley is 20 km<sup>2</sup>, calculated by summation of all sub-populations in the Kashmir valley. The total EOO of *Aquilegia fragrans* is 242.15 km<sup>2</sup>, calculated by summing the areas of all triangles. As per the data evaluated against the IUCN Red List Categories and criteria (2010), *Aquilegia fragrans* qualifies for the threat category of Endangered (EN) under criteria B1b (v) c (iv) and B2b (v) c (iv).

## DISCUSSION AND CONCLUSION

The specific assessment of the conservation of concerned taxon is considered to be the utmost important step in order to effectively protect the taxon from extinction (Vischi et al., 2004). Such assessment of the degree of threat of extinction of a species further clues us to assign it a standardized threatened category. If immediate site-specific actions were not taken of highly threatened taxon, they will possibly be extinct (Rickettes et al., 2005). As a result, conservation of species is considered to be the main priority in order to decline degrees of global biodiversity loss (Rickettes et al., 2005). Sufficient plant collections with good field investigation records may play a critical role in evaluating conservation status and conservation priorities (Burgman et al., 1995; Funk et al., 1999; Golding, 2001; Schatz, 2002; Ungricht et al., 2005). IUCN Red List Categories and Criteria have been established for this purpose. During the current study the threat status of some threatened medicinal plants of Kashmir valley have been assessed in accordance with IUCN regional guidelines 2003 version following IUCN categories and criteria 2010 version 8.1.

The regional evaluation of these medicinal plant species was carried out by using criterion B, C and D proposed by IUCN. Evaluation under A (population reduction) was not possible due to the lack of quantitative information related to population decline over years. Even though efforts were made in this study to evaluate the population size of each medicinal plant species, yet no historical data were available to quantify the trend. Criterion E (Quantitative analysis) showing the possibility of extinction in the wild was not conducted for any of the medicinal plant species.

During the current study 6 species (*Arnebia benthamii*, *Meconopsis aculeate*, *Rheum webbianum*, *Aconitum heterophyllum*, *Podophyllum hexandrum* and *Aquilegia fragrans*) were evaluated according to IUCN Guidelines. Throughout the investigation, it was observed that habitat degradation, uncontrolled grazing, over exploitation, deforestation and excessive tourist flow has been identified as major threats to these selected medicinal plant species in wild habitat. The habitat of most of these medicinal plant species falls within the widely grazed green alpine pastures and the grazing animals besides eating the leaves of the medicinal plant species and thus limits their population size and distribution. Overutilization of these valuable medicinal plant species for local use has adversely impacted the populations of these species. The native people eliminate the whole plant species, thus rendering them threatened. Cutting down of forests at an unprecedented rate have also extremely diminished the availability of these medicinal plant species in the wild. Deforestation as well as the agricultural activities have resulted in the habitat destruction of the medicinal plant species, thus restrict the availability of these species in the natural habitats. All these threatened factors either separately or in combination operate at different sub-population of these medicinal plant species, which results in the decline in the number of mature individuals of these species. The flora of Kashmir Himalaya has been subjected to tremendous anthropogenic pressures as a result of habit loss, deforestation, excessive grazing, tourist rush, increasing urbanization, etc. The alpine and sub-alpine meadows used as open grazing grounds. This has resulted in a good percentage of plant species to become threatened. There is an urgent need to undertake thorough studies on several aspects of our threatened medicinal plant species, and to work out measures for their conservation. Extensive field investigations in their well-known areas are required to establish their total absence, as some little-known and rare plant species from Kashmir have been recollected after a gap of up to 150 years (Dar and Naqshi, 1984a). Research and scientific data not only determines the importance of biodiversity conservation programmes but also helps in formulating better development intercessions. Controlling deforestation and other anthropogenic activities in sub alpine region is significant because it will ease the pressure on the resources of alpine zone. Considering both the ecological and economic significance of the transhumance and heavy reliance of the indigenous and nomadic population on these ecosystems, ways and means should be implemented to control overgrazing. The medicinal plant species which are found in very less densities and abundance need an immediate attention. These threatened plants can be rehabilitated mainly through *ex-situ* means followed by their consequent re-establishment into their appropriate habitat types and it will help in preserving a complete gene pool of these species. Moreover, awareness and capacity building of traders and nomads about each plant species, its biology, uses, method of harvest and marketing, protection strategies etc. should be initiated immediately for its conservation.

## ACKNOWLEDGEMENT

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**Table 1: Sub-population, population size and Area of occupancy of *Arnebia benthamii***

S. No	Sub-populations	Population size			(AOO) Km <sup>2</sup>
		2011	2012	2013	
1	Aparwat	99	89	80	4
2	Rayil	132	125	107	4
3	Thajwas	141	132	137	4
4	Nagbaren	55	40	37	4
5	Munwarser	189	200	195	4
6	Ducksum	230	242	227	4
<b>Total</b>		<b>846</b>	<b>828</b>	<b>783</b>	<b>24</b>

**Table 2: Sub-population, population size and Area of occupancy of *Meconopsis aculeata***

S. No	Sub-populations	Population size			(AOO) Km <sup>2</sup>
		2011	2012	2013	
1	Gurez	150	145	132	4
2	Harmukh	117	107	96	4
3	Thajwas	100	103	93	4
4	Munwarsar	196	187	170	4
5	Aparwat	56	46	40	4
<b>Total</b>		<b>619</b>	<b>588</b>	<b>531</b>	<b>20</b>

**Table 3: Sub-population, population size and Area of occupancy of *Rheum webbianum***

S. No.	Sub-populations	Population size			(AOO) Km <sup>2</sup>
		2011	2012	2013	
1	Gurez	645	600	650	4,4
2	Harmukh	566	547	540	4
3	Vishen Sar	671	666	652	4
4	Zailder dub	292	297	291	4
5	Aparwat	348	341	334	4
6	Munwarsar	672	685	654	4,4
7	Aharbal	211	217	207	4
8	Peer ki Gali	292	277	277	4
9	Simthantop	311	299	282	4
<b>Total</b>		<b>4008</b>	<b>3929</b>	<b>3887</b>	<b>44</b>

**Table 4: Sub-population, population size and Area of occupancy of *Aconitum heterophyllum***

S. No	Sub-populations	Population size			(AOO) Km <sup>2</sup>
		2011	2012	2013	
1	Gurez	256	240	274	4
2	Harmukh	130	143	120	4
3	Khianmarg	109	99	111	4
4	Thajwas	234	220	205	4
5	Munwarsar	300	285	280	4
6	Poshpathar	291	277	263	4
<b>Total</b>		<b>1320</b>	<b>1264</b>	<b>1253</b>	<b>24</b>

Table 5: Sub-population, population size and Area of occupancy of *Podophyllum hexandrum*

S. No	Sub-populations	Population size			(AOO) Km <sup>2</sup>
		2011	2012	2013	
1	Gurez	2643	2500	2423	4,4
2	Harmukh	899	923	885	4
3	VishenSar	671	666	652	4
4	Aparwat	322	315	307	4
5	Rayil	348	341	334	4
6	Nagbaren	996	856	743	4,4
7	Nandkan	2689	2573	2598	4,4
8	Munwersar	521	543	517	4
9	Shikargah	132	100	89	4
10	Yousmarg	321	285	261	4
11	Aharbal	442	401	373	4
12	Peer kiGali	667	601	542	4
13	Ducksum	672	598	617	4
		<b>11323</b>	<b>10702</b>	<b>10341</b>	<b>64</b>

Table 6: Sub-population, population size and Area of occupancy of *Aquilegia fragrans*

S. No	Sub-populations	Population size			(AOO) Km <sup>2</sup>
		2011	2012	2013	
1	Gurez	265	231	204	4
2	khilanmarg	150	132	121	4
3	Vishen Sar	199	165	187	4
4	Nagbaren	96	83	75	4
5	Munwarsar	167	145	132	4
<b>Total</b>		<b>877</b>	<b>756</b>	<b>719</b>	<b>20</b>

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