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Population structure, ecological features and associated species of *Arnebia euchroma*

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Abstract

Present investigations were carried out on important medicinal and threatened plant of cold desert from Lahaul-Spiti area. Surveys and sampling was done on individual sites to identify the population of *Arnebia euchroma* and its associated species. *Arnebia euchroma* (Royle ex Benth.) Johnston, commonly known as 'Ratanjot' is an important medicinal plant species and is found distributed in the western Himalaya at elevations ranging between 3200 - 4500 m above sea level. Considering its potent medicinal properties, cultural significance, declining population density and critically endangered status of this taxon, the present investigation was carried out for the assessment of its availability in the natural alpine landscapes of the Spiti cold desert of western Himalaya in Himachal Pradesh (India). We focused our study on its ecological features, population dynamics and performance in natural habitats, so as to formulate conservation plans. The present paper provides population structure, ecological features of *A. euchroma* in the Spiti cold desert of Western Himalaya.

Keywords: ecological features, associated species, *Arnebia euchroma*

Introduction

Arnebia euchroma (Royle ex Benth.) is a perennial herb growing 15-40 cm tall. Stems usually one or several, erect, branched above, sheathed with remaining bases of leaves, spreading white or pale yellow hirsute. Many flowered cymes with terminal, rounded clusters of pink-purple flowers which turns blackish-purple. Flowers are hermaphrodite, heterostylous and are pollinated by insects. Calyx lobes linear, 1.2-1.6 cm, to 3 cm in fruit, densely pale yellow hirsute on both sides, apex subacute. Corolla dark purple, sometimes pale yellow and purple-red tinged, tubular-campanulate, glabrous or sparsely short pubescent outside; tube straight, 1-1.4 cm; limb 6-10 mm wide; lobes spreading, ovate. Anthers ca. 2.5 mm. Style apex 2-lobed; stigmas 2, obovate. Nutlets black-brown, broadly ovate, ca. 3.5×3 mm, scabrous reticulate lined, with few tubercles, adaxially almost flat, center line prominent, abaxially convex, apex subacute; attachment scar somewhat triangular. It is in flower from June to August, and the seeds ripen from July to September. Leaves linear, with conspicuous long bristly hairs; stem leaves many, stalkless, mostly 5-8 cm. Rootstock stout upto 2 cm in diameter containing copious purple dye. Suitable for light (sandy) soils, prefers well-drained soil and can grow in nutritionally poor soil. Rocky slopes, gravelly marshes, meadows are preferred by the plant. Suitable pH: acid, neutral and basic (alkaline) soils. It cannot grow in the shade. Himalayan herbs are getting unprecedented attention all over the world as it harbors most fascinating and life rejuvenating drug resources.

Arnebia euchroma (Royle ex Benth.) commonly also known as 'Ratanjot' is an important medicinal plant species growing in western Himalaya at an elevation ranging between 3200-4500 m above sea level. Out of total five species of *Arnebia*, three are found in the Spiti cold desert of trans-Himalaya (Aswal and Mehrotra, 1994)^[1]. The plant is having various medicinal properties due to which ruthless harvesting of plant is continue resulting in decline of its population resulting in critically endangered status of this taxon. Among its various uses root powder is used to cure cough and lung problems. Powder is also given to women suffering from menorrhagea. Root fibre of the plant is mixed with muster or apricot oil to impart red colour for use as hair oil and is useful against controlling of dendruf and falling of hairs. The root extracted in apricot or mustered are applied on skin for treating skin infections. It is also used as a colorants in preparing different types of dishes. Used by local v aids as a blood purifier by mixing it with other drugs. *Arnebia euchroma* is effective against healing wounds, hence the study support the traditional use of *Arnebia euchroma* roots to treat skin disorders including burns (Pirbalouti *et. al*, 2011)^[2]. Shikonin derivatives isolated from the roots of *Arnebia euchroma* have been reported to have antimicrobial, anti-inflammatory and anti-tumor activities and thus to be considered as important compounds for potentially medicinal use.

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(Houghton *et al.* 2005) [3], as per literature market rate of Rupees 55-110 per kg has been reported (Chauhan N.S. 1999) [4]. People also used the plant against bad evils or jadu-tonas. Used as a colourant for dyeing clothes & cup designs. Plant is used to improve fertility of the soil by mixing it with the soil. Studies on its population status and ecological attributes play a vital role to formulate the conservation plans (Uniyal *et al.* 2002) [5] and are required to develop appropriate strategies for its long term monitoring and sustainable use.

Materials and Methods

Surveys were conducted in different parts of Spiti regions to estimate the population density of *Arnebia euchroma* in its natural habitat. The locations from where samples were collected include Lingti, Chubrang, Kaza, Kakti, Tabo top.

Sampling technique and analysis

10 sample plots of size 1x1 m each in 10 sites of its natural occurrence were set. The density (number of individuals/m²) and frequency (%) of the species were calculated.

$$\text{Percent frequency} = \frac{\text{No. of sampling unit in each species occur}}{\text{No. of sampling units studied}} \times 100$$

$$\text{Density (d)} = \frac{\text{Total no. of individuals}}{\text{Total no. of quadrat studied}}$$

Result & Discussion

Present Study was made in five different locations of natural habitats of *Arnebia euchroma* in the Spiti valley. The species generally grows in association with number of species depending upon the microclimatic condition and prevailing environmental conditions in the area. The common associated species found were *Crepis flexuosa*, *Astragalus candolleanus*, *Caragana brevifolia*, *Dracocephalus nutans*, *Cicer macrophylla*, *Gleuchoma niveli*, *Causinea thomsonii*, *Selinum tenuifolium*, *Polygonum plebeium*, *Ephedra gerardiana*, *Rosa webbiana*, *Hiphophae tibetana*, *Arnebia guttata*, *Artemisia maritima*, *Caparis spinosa*, *Heracleum thomsoni*, *Ribes orientalis* etc.

Singh *et al.* (2012) [6] while studying occurrence of *Arnebia euchroma* in Farka, Sangam, Telling, Kibber, Langza and Lapcha Longpa also reported presence of most of the species mentioned above as dominant associates of *Arnebia euchroma*. However no reports of the occurrence of the species like *Astragalus candolleanus* was reported by them which was present predominantly in each site of the study area under present study. Similarly other species of *Arnebia*

i.e. *Arnebia guttata* was not reported by them. However under present study *Arnebia guttata* was also recorded to growing with *Arnebia euchroma* at Tabo and its surrounding areas at higher altitudes.

It has been observed that *Arnebia euchroma* grow in rocks or drier regions of open slopes. In lower field only one species of *Arnebia* is found i.e. *Arnebia guttata* while at high altitude both *Arnebia guttata* and *Arnebia euchroma* were found to grow in association. The plant is well adapted to the climate by protecting itself from grazing owing to its thorny leaves. It was observe that there is lesser number of fruit setting which might be due to self-incompatibility of the species. Majority of seed fall within the vicinity of plant base and germinate nearby the plant making dense population of plant.

The highest average density of *Arnebia euchroma* was recorded in Tabo top (2.60 individual/m²) followed by Lingti (2.20 individual/m²) while lowest density (0.80 individual/m²) was observed in Kakti. A wide range of frequency of occurrence (30 to 100 %) was observed. Maximum frequency (90 %) was observed in Lingti, followed by Chubrang (80 %) while lowest frequency (30 %) was observed in Kakti.

According to Nayar and Shastry (1987-1990) [7] over 113 plant taxa of endangered categories grow in Indian Himalaya, and are under the pressure of over exploitation and the destruction of their natural habitat Ved & Tandan (1998) [8]. *Arnebia euchroma* in Spiti is also facing similar threats. The extraction of roots by digging out whole plants indiscriminately by local inhabitants for various purposes causes low population densities and habitat degradation, which are the major constraints for future regeneration. It is a usual practice in Spiti valley to sell and use its roots as edible dye and medicine Shen *et al.* (2002) [9]. Local doctors (known as Amchis in western Himalaya) use the root extract in different indigenous medicines, prescribed for cough and for blood purification. Moreover, trampling by livestock was also noted as major factor for the depletion of its population in its natural habitats. Kala (2000) [10] reported the over-exploitation and grazing pressure are the disturbances most responsible for the low density and continuous decline of the wild populations of most of rare and endangered medicinal plants in the Indian Himalayan region.

The distribution in fragmented habitats and the wide variation in frequency of occurrence of *Arnebia euchroma* suggested a high potential of the species to grow over large areas, but due to anthropogenic activities, it seemed unable to form large continuous distribution boundaries.

Table 1: Occurrence of *Arnebia euchroma* and some of its associates in different sites

Species	Lingti	Chubrang	Near Kaza circuit house	Kakti	Tabo	Tabo top
<i>Arnebia euchroma</i>	√	√	√	√	X	√
<i>Arnebia guttata</i>	X	X	X	X	√	√
<i>Ephedra gerardiana</i>	√	√	√	√	√	√
<i>Caragana brevifolia</i>	X	X	X	X	X	√
<i>Caparis spinosa</i>	X	X	X	√	√	√
<i>Hiphophae rhamnoides</i>	√	√	√	√	√	X

Table 2: Availability and status of *Arnebia euchroma* in Spiti cold desert

Location	Major community	Micro-habitat(s)	Altitude (m)	Aspect	Latitude & longitude	Density	Frequency	Dominant associates
Lingti	Ae-Eg-Ht	Slightly steep, scree slope,	3557	NE	N 32°08.055" E 078°11.372"	2.20	90	<i>Arnebia euchroma</i> , <i>Ephedra gerardiana</i>
Chubrang	Ac- Cf-Ae	Very Steep scree slope	3636	NW	N 32°51.334" E 078°10.919"	1.0	80	<i>Astragalus candolleanus</i> <i>Crepis flexuosa</i>
Near Kaza	Ac-Ct	Steep scree slope	3682	NW	N 32°13.027"	1.70	60	<i>Astragalus candolleanus</i> ,

circuit house					E 078°04.732"			<i>Causinea thomsonii</i>
Kagti	Ac-Ae	Bouldry slopes	3826	NW	N 32°12.795" E 078°04.998"	0.80	30	<i>Astragalus candolleanus</i> , <i>Arnebia euchroma</i>
Tabo top	Ae-Ag	Bouldry slopes	3700	E	N 32°06.206" E 078°22.543"	2.60	70	<i>Arnebia euchroma</i> , <i>Arnebia guttata</i>

Conclusion

Phytosociological study conducted on *Arnebia euchroma* endangered and threatened medicinal plant of cold desert indicates a speedy decline in its natural habitat. Locally known as Ratanjot or Khamet lesser known medicinal herb has very vast scope for obtaining root tans and dyes which occurs only in colonies in its natural habitat. Considering the ecological features and population status of *A. euchroma*, the present study suggests designing and implementing effective conservation programs for this critically endangered taxon in the Spiti cold desert of trans-Himalaya. It is imperative to study the local harvesting methods, the response of the species to specific harvesting techniques and the quantity harvested. That information is inadequately known for most of medicinal plant species. The development of specific agrotechniques for the species in the Spiti cold desert, to meet the requirements for raw materials for domestic use will help reduce the pressure on the existing populations of *A. euchroma* in its natural habitats.

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