

Article

Threatened medicinal plants of Menwarsar Pahalgam, Kashmir Himalayas: Distribution pattern and current conservation status

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Abstract

It is imperative to understand the distribution and conservation status of medicinal plants in their natural habitats, owing to their increased demand and value. We studied the distribution pattern and current conservation status of six threatened medicinal plants in Pahalgam valley, Kashmir Himalayas, by random quadrat sampling (n=216) in different habitat types. The different uses of medicinal plants were obtained by informal interviews and group discussions with family elders. Recent re-emergence of herbal medicine applicability along with the ever escalating threats to biodiversity and the intensifying Biopiracy controversies have necessitated for an urgent documentation of the traditional use of bioresources. This survey, in addition to the precious ethno medicinal information, recorded the important natural history details. Our results indicate that *Podophyllum hexandrum* Royle is most common and has the highest density. While *Arnebia benthamii* (Wall ex Benth) I.M. Johnston and *Mecanopsis aculeata* Royle are least frequent. Moist rocky slopes (MR) were the most preferred habitat followed by flat tableland (FL) situated above the tree line. While the shady slopes (SSs), flat meadow (FM) and moist meadow (MM) were least preferred. Our findings can help to formulate a conservation strategy for the unknown grass lands and the threatened vital medicinal plants of Pahalgam valley. While the low and localized distribution of all studied species deserves effective conservation strategies, the scope of such measures should be explored in a way to address the reliance of local communities on these plants.

Keywords medicinal plants; Pahalgam valley; Kashmir Himalayas; bioresources; ethno-medicine; conservation strategy.

1 Introduction

The herbal medicine is gaining wide currency and acceptability and the documentation of valuable indigenous knowledge about medicinal plant species is assuming urgent priority (Anim et al., 2012; Budovsky and Fraifeld, 2012), due to the recent controversies of illegal Biopiracy. The precious indigenous knowledge when supplemented and validated by the latest scientific incites can offer new holistic models of sustainable development that are economically viable, environmentally benign and socially acceptable. The Kashmir Himalayas, often referred to as terrestrial paradise on earth, is located at the north-western tip of the Himalayan biodiversity hot spot. The region supports a rich and spectacular biodiversity of great scientific curiosity and promising economic benefits owing to its topographic variations spanning from valley floor

through the terraced table lands (karewas) and dense forests elevating up to the snow capped alpine peaks, since ages through trial and error. People in the Himalayan region have learned and practiced the medicinal usage of plants growing in their vicinity for treating various ailments.

The medicinal use of plants by the nomadic and migratory tribes like Gujjars and Bakerwals in Kashmir has been documented previously (Navchoo and Bhat, 1994; Khan et al., 2004). However a periodic and continuous monitoring of these species in the wild Habitat is largely lacking with the available information being either qualitative (Dhar and Kachroo, 1983) or ethno-botanical (Dar et al., 1984; Ara and Naqshi, 1992). A perusal of literature indicates that the documentation of ethno-botany of Ladakh (Bhattacharyya, 1989; Kaul et al., 1995), Doda (Kaul et al., 1994; Singh, 1995), Bhaderwah hills (Kapur, 1995), Little Tibet (Sharma, 1995), Uri sector (Lone, 2003), Muzaffarabad (Dar, 2003), and Samahni valley (Ishtiaq et al., 2006a, b, 2007) of Kashmir Himalayas has been done. However, southern region of Kashmir in spite of being great repository of medicinal plants (Dhar and Kachroo, 1983) remained unexplored in this regard. Therefore this study was undertaken in one of the alpine grass lands of Pahalgam valley, Kashmir to report on the distribution pattern, indigenous uses and availability of six threatened medicinal plants. i.e. *Podophyllum hexandrum* Royle, *Picrorhiza kurroa* Royle ex Benth, *Aconitum heterophyllum* Wall, *Rheum emodi* wall. ex Meissner, *Arnebia benthamii* (Wallich ex G. Don) I.M. Johnston and *Mecanopsis aculeata* Royle.

2 Material and Methods

2.1 Study site

The study was carried out in plains and alpine grass lands of Menwarsar Pahalgam which is located at a distance of 26 km. from the headquarters of Pahalgam. The area extends between 34°05' north and 75°22' east at an altitude of 12205 ft. from the sea level. The diverse topographic features offer many habitats and microhabitat types for a variety of herbal species to grow in the high altitude alpine forests. With the melting of snow the vegetation starts growing from early April and comes to its full bloom during June to September and starts dying out by the end of November. The area experiences heavy snowfall and remains under snow till March of next year.

2.2 Methods

Field surveys and structured interviews were used to illicit secret knowledge from the traditional communities inhabiting inaccessible habitats of the region. Field surveys were conducted in the various localities during 2010 - 2012. Usually the survey in each locality started with the interview of elderly and experienced members. Often they were accompanied to the field for the identification of plant species and authentication of plant specimens collected from the habitats. Besides the common people of the localities were consulted who have used these plant species for health-care. In addition to our focused study frequency, abundance and IVI was obtained from random quadrates (n=36) of 1m² size (Misra, 1968). Analytical features for population study and distribution pattern like percentage frequency and density (plants per m²) were calculated for each species across all sights. The mean values were taken to calculate Important Value Index (IVI) of individual species (Cottam and Curtis, 1956).

Information and data pertaining to the traditional method of medicinal uses were obtained through a structured questionnaire survey conducted among the family elders of all visiting households (n=40). As all the three ethnic community tribes frequently use these herbs, it helped us to get a comparative account of the utilization of these plant species. In addition we also conducted unstructured informal interviews with the other family members (n=13, 8 males and 5 females) and group discussions (n=20) to further increase the horizons of our understanding on the local time, traditional use, part used, current nature of use (household consumption or commercial and recent trend in species status).

Table 1 Characteristic features of selected medicinal plant species at Menwarsar, Pahalgam.

Scientific name	Local name			Altitude(m)	Part used	Folklore uses	CS(IUCN)	Current use within three communities		
	Gujjar	Chopan	Bakerwal					Gujjar	Chopan	Bakerwal
<i>Podophyllum hexandrum</i>	Kakhri	Wanwangun	Kakhri	2300-3900	Fruit/ roots	Septic wounds, gastric problems	EN	H	Not used	H
<i>Picrorhiza kurroa</i>	Kaurd	Kaurd	Kaurd	3000-4400	Rhizome/roots	Considered to be favourite in Dilious dyspepsia, stomachic and laxative	EN	H	H	H
<i>Aconitium heterophyllum</i>	Patrees	Patrees	Patrees	2900-3800	Roots	Bitter tonic especially given after malarial & other fevers & is	CE	H	CEX	CEX
<i>Rheum emodi</i>	Rahman	Pambchalan	Chutyal	2800-4200	Rhizome/leaves	Root powder is sprinkled on ulcers, wounds for quick healing & is also used as laxative, tonic &	EN	H	H	H
<i>Arnebia benthamii</i>	Kahzaban	Lailoot	Kahzaban	3200-4000	Whole plant	Given against high fevers & flowers are reported to have soothing effect on patients with heart	CE	H	CEX	CEX
<i>Mecanopsis aculeata</i>	Patharmaway	Budhzadh	Budhzadh	2900-3800	Whole plant	Water extract of whole herb used to wash wounds	CE	CEX	Not used	H

Note: CS, conservation status: IUCN, international union for conservation of nature and natural resources: CE, critically endangered; EN, endangered; VU, vulnerable; H, household use; CEX, commercial exploitation.

Table 2 Phytosociological Parameters of the threatened medicinal plants at menwarsar, Pahalgam.

Scientific name	Menwarsar				
	Density (plants/m ²)	Relative density(RD)	Frequency (%)	Relative frequency(RF)	Important value Index (IVI) (%)
<i>P. hexandrum</i>	1.73	0.41	66.66	0.38	0.90
<i>P. kurroa</i>	1.2	0.28	40	0.23	0.59
<i>A. heterophyllum</i>	0.56	0.13	23.33	0.13	0.31
<i>R. emodi</i>	0.36	0.08	20	0.11	0.30
<i>A. benthamii</i>	0.16	0.03	13.33	0.07	0.21
<i>M. aculeata</i>	0.13	0.03	10	0.05	0.14

Note: F, frequency; RF, relative frequency; IVI, Important value Index.

3 Results

3.1 Density and distribution of species

The distribution of species varied significantly among different habitats and none of the species occurred on all the habitats (Fig. 1 (a)-(f)). *P. hexandrum* was found on five different habitats, *A. heterophyllum* occurred on three while *P. kurroa* and *R. emodi* occurred on two habitats. The critically endangered *M. aculeata* recorded on only a single habitat type indicated its narrow distribution (Table 3). Flat table land and moist rocky slope were the preferred habitat types with each growing three species followed by moist meadows with two species while others grew only a single species each. The shady slopes regardless of their aspect also grow only a lone species i.e. *P. hexandrum*.

Observation on the average distribution of the species across all sights revealed *P. hexandrum* to be most frequent (66.66%) followed by *P. kurroa* (40 %) and *A. benthamii* (13.33%) and *M. aculeata* (10%) as least frequent while *A. heterophyllum* (23.33%) and *R. emodi* (20%) were intermediate with moderate distribution (Table 2). While *P. hexandrum* (1.73 ind.m²) and *P. kurroa* (1.2 ind.m²) indicated highest density, the presence of *P. kurroa* in a single habitat type with the highest density emphasized its narrow and squeezed distribution. The least frequent *M. aculeata* had also the lowest density (0.13 ind. m²).

Important value Index (IVI) of each species was calculated to measure their numerical strength and assess their contribution to the total plant community. The highest IVI recorded is (0.90%) and lowest (0.14%) for *P. hexandrum* and *M. aculeata*, respectively.

3.2 Folklore use of Assessed species

The knowledge on the habitat distribution and medicinal use of these plants is maintained well within all the three ethnic tribes. The community elders and women folk have a handsome knowledge of the habitats, life history features, regeneration and uses of medicine plants. The continued belief of these communities on these high altitude easily accessible traditional medicinal plants and absence of alternative modern medicinal facilities for them have greatly affected their source of medicine at this high altitude area. Data collected through the questionnaires highlighted the indigenous uses and reflected the collection, trade and reliance (Table 4) of these ethnic people on these medicinal plants.

Table 3 Distribution, density, frequency and IVI of selected taxa across the different habitat types at Menwarsar, Pahalgam.

Scientific name	Habitat type																				
	SS			OS			MR			FL			FM			DS			MM		
	D	F	IVI	D	F	IVI	D	F	IVI	D	F	IVI	D	F	IVI	D	F	IVI	D	F	IVI
<i>P. hexandrum</i>	2.86	26.3	5.5	0.32	10.01	1.31	1.71	13.2	5.6	-	-	-	-	-	2.90	1.8	4.90	1.30	14.4	3.3	
<i>P. kurroa</i>	-	-	-	-	-	-	1.7	13.6	5.01	10.02	19	6.02	-	-	-	-	-	-	-	-	-
<i>A. heterophyllum</i>	-	-	-	-	-	-	0.42	10.01	2.2	1.02	16.2	2.4	0.38	9.4	1.90	-	-	-	-	-	-
<i>R. emodi</i>	-	-	-	-	-	-	1.5	17	7.1	1.6	20	7.8	-	-	-	-	-	-	-	-	-
<i>A. benthamii</i>	-	-	-	-	-	-	0.92	11.4	2.6	0.82	10.1	2.3	-	-	-	-	-	-	-	-	-
<i>M. aculeata</i>	-	-	-	-	-	-	0.13	10	0.14	-	-	-	-	-	-	-	-	-	-	-	-

Note: SSA, shady slope ; OS, open gentle slope; MR, moist rocky slope; FL, flat table/land above tree line; FM, flat meadow ; DS, dry shady slope; MM, moist meadow; D, density; F, frequency; IVI, Important valve Index; - (absent).

Table 4 Categorization of the assessed taxa in to different groups.

Species name	Rate in Rupees	Consumption			Trade value (existing)	Nature of trade
		Mostly Household	Mostly commercial	Both		
<i>P. hexandrum</i>	300 - 650	+	-	-	Lowest	Illegal
<i>P. kurroa</i>	400 -800	+	-	-	Low	Illegal
<i>A.heterophyllum</i>	4500	-	+	-	High	Illegal
<i>R. emodi</i>	300 - 500	+	-	-	Low	Illegal
<i>A.benthamii</i>	1200 - 1800	-	-	+	High	Illegal
<i>M. aculeata</i>	800 - 1000	+	-	+	Low	Illegal

Note: Denotes the price which people get / kg from the middlemen and thus not reflect the market price.

Table 5 Comparative account of population status (density/m²) of selected plant species at selected localities of Pahalgam.

Name of species	Menwarsar	Chhumnai	Liderwart
<i>P. hexandrum</i>	1.73	1.96	1.30
<i>P. kurroa</i>	1.2	0.96	0.97
<i>A. heterophyllum</i>	0.56	0.4	0.35
<i>R. emodi</i>	0.36	0.46	0.58
<i>A. benthamii</i>	0.16	0.13	-
<i>M. aculeata</i>	0.13	0.1	-

Note: (-) absent

Almost all these plant species are used to cure common ailments like cough, cold, headache, asthma, fever, bronchitis and stomach pain by all the three ethnic tribes (Table 1). Furthermore species like *A. heterophyllum* are also used for some specific cases. A comparison of species indicates that *A. heterophyllum* and *P. kurroa* are the Prioritized medicinal plants for these people in terms of their ethno medicinal properties and uses. These plants have known antibacterial, anti-inflammatory and antipyretic properties, which together with their high market value make them a species of choice among all the three communities. These plants are also used frequently for their ethno veterinary applications by these tribes. Notable in this regard is *R. emodi* and *P. kurroa* which are used by the communities to cure different diseases of their livestock. Specifically the *R. emodi* is used to cure cough, dysentery, eye diseases, skin problems, constipation, hoof diseases, internal injury and broken horn of livestock by these communities while *P. kurroa* is used mostly to cure elementary disorders, in digestion, tonsils and intestinal worms by Bakerwals and Gujjars. Similarly *P. hexandrum* are specifically used for cuts, wounds and bone fracture.



Fig. 1 (a) *P. hexandrum*



Fig. 1 (b) *P. kurroa*



Fig. 1 (c) *A. heterophyllum*



Fig. 1 (d) *R. emodi*



Fig. 1 (e) *A. benthamii*



Fig. 1 (f) *M. aculeata*

4 Discussion

The IVI provides an excellent marker for understanding the status of distribution and availability across varying environmental and biotic conditions (Ram and Arya, 1991; Negi et al., 1992). This paper has described the distribution pattern and the current conservation status of threatened medicinal plants from a hitherto unknown Pahalgam valley, Kashmir. Relative values of the assessed species were tabulated and compared (Table 5) and based on this it was found *P. hexandrum* is widely distributed in different habitat types. The high frequency of *P. hexandrum* stems from its ability to grow in varied habitat types and complete the life cycle. In addition it is relatively lesser use and the part used frequently i.e. fruit also adds to its high frequency and density. However, the other species are highly localized and prone to grazing and trampling besides the part used being rhizomes and tubers. All these factors add to their low density and availability which is well reflected from our results.

Species frequency and density are efficient ways to reveal the distribution and strength of any species in a landscape (Alhamad, 2006). Comparing these features with similar studies outside Pahalgam valley, it is evident that our values on density and distribution are low (Table 5). As no scientific reporting from the area has been done and there are no historical data on the distribution of the species from the upper reaches of the Pahalgam valley which historically have been used for grazing, it appears that the sampled species are the remnants of a previously large population which over the years have narrowed in their distribution due to a multitude of factors, many of which went unnoticed. Not all assessed species are preferred by animals, but because the area is grazed mostly by goats and sheep (personal observations) which are both non-selective in foraging (Chandrasekhar et al., 2007) which adds to the damage. Trampling is the other damaging factor which seems to have affected these species enormously in open areas and squeezed their distribution. In the elsewhere IHR, earlier studies (Nautiyal et al., 1997; Pandey et al., 2000) have also reported grazing, trampling, biotic interference and low seed viability to be responsible for the diminution population of these species. Our results also high lightened the low availability i.e. population size and habitat specificity of these species in the wild (Table 3). This has important conservation applications as the species with specific habitat requirements are at great risk than the species with broad habitat range (Samant et al., 1996); besides a minimum population size is required for the long term viability of rare and endangered species (Cunningham and Saigo, 1999).

The communities include in this study are rural and migrate seasonally to the higher alpine areas for live stock grazing. The people have learnt the medicinal usage of plants that grow in their proximity in their ages (Khuroo et al., 2007). This was also evident from the information we calculated through the questionnaire survey and group discussions held. The wealth of practical knowledge on the various plants, their distribution and the traditional uses further strengthens the argument. However to represent best range of the ethno medicinal use of the various high altitude species, more efforts need to put in conducting a comprehension ethno botanical survey of the whole Pahalgam valley with due attention paid towards studying the conservation status of the important and rear medicinal herbs.

The migratory pattern of the communities differs largely among the three tribes. Bakerwals are truly migratory and nomadic, Gujjars are semi-nomadic, but the Kashmiri Chopans are semi-sedentary. This division was also reflected in the difference in the utility of the plants among the three communities with the Chopans and the young ones using the least number of the assessed species that too in minimum number of ways (Table 1). This adds to our observation that the young generation of the Chopans treat the folklore knowledge's primitive and incompatible with the contemporary societal ideas. Consequently the older generation which harbors this wealth of the knowledge is generating and dying without passing on this invaluable legacy. This subtle change will bear a long term upshot on the maintenance and continuation of the

indigenous Knowledge to subsequent generations which will greatly affect the way. These medicinal plants are used and managed by these communities.

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