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# Prioritization and Conservation of Himalayan Medicinal Plants: *Angelica glauca* Edgew. as a case study

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**Research**

## Abstract

The present study broadly supports the need for conservation initiatives for Himalayan medicinal plants. An approach is set up for prioritization grading of the importance of medicinal plants that is based upon the knowledge of local communities about the species. The study of Himalayan medicinal plants in general and *Angelica glauca* Edgew. in particular reveals that the utilization pattern, traditional knowledge base and trade of medicinal plants show trends that are not ideal for sustainability in the Indian Himalaya. The research attempts to integrate the analysis of several aspects of Himalayan trade in medicinal plants to reveal the threat to the plants and to suggest ways to overcome the problem.

## Introduction

The people of the Himalaya inherit a wide range of traditions, dialects, beliefs and cultures. Indigenous communities living in the region have learned to utilize the resources around them in many ways. One way plant resources are used is for the treatment of diseases. In general medicinal plants are also getting wide attention and recognition throughout global markets. The use of herbal medicine, the dominant form of medical treatment in developing countries, is increasing in developed countries in recent years (British Medical Association 1993). According to the estimates of WHO, over 80% of people in developing countries depend upon traditional medicine for their primary health care. One possible reason for this is the perception of them having lesser side effects (Farnsworth & Soejarto 1991, Kamboj 2000).

Most of the high altitude medicinal plants of Himalaya, of which medicinal extracts are derived, are habitat specific (Dhar *et al*. 2000). These are also subject to high grazing pressure and different kinds of anthropogenic pressures. As a result, their distribution is scattered and restricted to small areas.

During the last few decades, the considerable increase in the human population has put tremendous pressure on medicinal plants all across the Himalaya. This has severely affected the natural habitats of these plants. The increasing demand of herbal drugs in developing as well as developed countries has resulted in the steady increase in the number of pharmaceutical companies. This has in turn increased the demand for raw plant material. As a result traders at various levels have started exploiting the plant resources indiscriminately. Several reports about usage of medicinal plants from the Himalaya region suggest that greater than 90% of raw material for pharmaceutical companies is drawn from natural habitats (Gupta *et al.* 1998, Tandon 1996, Ved *et al*. 1998).

In the context of medicinal plant conservation, documentation of traditional knowledge can be helpful. It has been reported that tribes not only exploit their bio-resources for meeting basic needs, but are also aware of the consequences of ruthless exploitation of their surrounding re-

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sources and have their own means of sustainable exploitation of their resources. However, up scaling demand for plant raw material coupled with handsome incentives associated with increased extraction might motivate them to over exploit the same resources for short-term gain.

In spite of the fact that there are earlier attempts to document the use of medicinal plants in indigenous medicinal systems (Ambasht & Joshi 1996, Chauhan 1999, Dey 1980, Dhar *et al*. 2000, Modden 1969, Nadkarni 1998, Rai & Sharma 1994, Samant *et al*.1998, Shah, 1981, Sivarajan & Bala Chandra 1994, Thakur *et al*. 1989), very few studies in India have described the linkages and relationships of traditional knowledge, use patterns and people's perception of conservation issues with regard to the availability of the species used. In view of these gaps, the present study focuses on two sets of objectives. The first set envisages to:

i) assess traditional knowledge specifically with regard to gender, age and center of occurrence;
ii) identify and prioritize potential medicinal plants of the two centers (states);
iii) study comparative utilization patterns across genders and centers of occurrence, and
iv) assess the trade of medicinal plants in two centers (states).

Also, the study identifies a critically endangered (Anonymous 1997a, Mamgain *et al*. 1998) Himalayan perennial herb, *Angelica glauca* Edgew. (Apiaceae) as an example of the kinds of problems seen with medicinal plants in the region. The plant is a prioritized medicinal plants of western Himalaya and ranks number three in the list of 52 medicinal plants prioritized for consultation and conservation (Sastry & Chatterjee 2000). This plant serves as the focus of the second set of objectives, which attempt to:

i) examine comparative utilization patterns of the species between two major centers of its occurrence;
ii) document the traditional knowledge base across the centers on the basis of gender and age classes;
iii) record peoples perception on its status and trade.

Our understanding was such that the two sets of objectives were intended to either reconfirm or cancel each other thus strengthening the results. *Angelica glauca* was selected in view of its multiple uses (spice, medicine, and other). We considered that in view of its multiple utility, that the response rate across social demographics of age and gender would be higher than if we had focused on a species with only a single use.

## Study Area and Methods

To address the first set of objectives, the study was conducted in two different states, Uttaranchal and Himachal Pradesh, in the Indian Himalaya region. Six villages, each from Uttaranchal (Hudu, Ousara, Dara, Makku, Khati and Vaccham) and Himachal (Pullag, Rumshu, Barsaini, Syansa, Jhulling, Sissu) were identified for detailed study. Information on demographics (age, gender) and ethnobotanical information (medicinal plant species and uses) was gathered from each village with the help of semi-structured, close-ended questionnaires (Appendix 1). Respondents from different villages were selected at random, however, while doing so, age class was taken into consideration so that half the number of respondents selected were greater than 50 years of age and half less than 50 years of age. Assessment of traditional knowledge across gender and age classes was done on the basis of number of medicinal plants known to an individual divided by total number of medicinal plants known to the particular group (male/female and >50 years old/<50 years old).

Identification of plants was done by comparing specimens of taxa identified by the respondents and collected from the field with those in the G.B. Pant Institute Herbarium and Botany Department Kumaon University Herbarium. The voucher specimens were deposited in the herbaria of GBPIHED, Kosi-Katarmal, Almora.

Potential medicinal plants were sorted using a priority index that was assigned based on the percentage of informants in each village having knowledge of the particular species. The species were then classified into four priority categories (A-D) (see Table 1) based upon the percent of people having an awareness of their usage with the most widely known plants receiving the highest preference rank. In this case a high preference rank implies a plant of potentially high conservation concern.

Trade potential of medicinal plants was assessed by interviewing villagers on use patterns (domestic consumption, trade only, and both). Information on use patterns was also computed on percentage basis. The results were then used to compare the two centers. Medicinal plants from different regions of Uttaranchal and Himachal Pradesh were surveyed for their current market value (in Indian rupees) and were compared with the values collected from secondary sources.

To address the second set of objectives a second study was carried out in selected locations in states of Himachal Pradesh and Uttaranchal. The study was conducted in 9 villages, of which 4 (Lata, Khati, Wacham and Bamri) are in Uttaranchal (UA) and 5 (Badeiragra, Kothi, Shansha, Sissu and Jholing) are in Himachal Pradesh (HP). The uneven number of villages selected for study was due to the limited number of sites of occurrences of A. *glauca* in UA.

Data was collected on the number of sites of occurrence near each village, use pattern, distribution of knowledge, people's perceptions on status. The perspectives of individuals who were randomly encounter in the study areas were also determined, particularly focusing on their perspectives on trade. All individuals were questioned using a structured, close-ended questionnaire (Appendix 1). From each village 15 men, 15 women and 10 randomly encountered individuals (who could be either gender, resident or nonresident of the same village) were interviewed individually. Additional aspects of the field methodology are listed as noted below:

**(i) Comparative use patterns**: Four categories of use were used to sort the responses about use: spice, medicine, both spice and medicine, and other uses.

**(ii) Traditional knowledge distribution**: Traditional knowledge was sorted on the basis of (1) average number of sites known and (2) percentage of individuals of a gender/age class using the species for purposes other than spice and medicine.

**(iii) Encounter's perspective**: Individuals randomly encountered were asked if they were involved in trade of the *A. glauca* and responses were recorded as "Yes" or "No".

**(iv) Perception's on status of the *A. glauca***: General perceptions of the status of plants were determined by asking people about their visual observations of changes in plant availability over recent times. The results were categorized as "Increasing", "Decreasing" and "No change".

The entire study took two years to complete from August 2002 until July 2004.

## Results

### *Medicinal Plant Knowledge*

Appendix 2 lists the medicinal plant species recorded from the two states. Figure 1 illustrates the extent of knowledge by gender and age class. Table 1 shows the prioritization of medicinal plants on the basis of percent extent of knowledge base in Uttaranchal and Himachal Pradesh.

### *Conservation and Trade in Medicinal Plants*

Table 2 shows the percent contribution of villagers of Himachal Pradesh (men and women) in collection of medicinal plants for domestic consumption and/or trade. Table 3 shows the variation in the market price (Rs/kg) of medicinal plants within Himachal Pradesh and Uttaranchal.

### *Utilization of Angelica glauca*

Figure 2 shows the utilization patterns of *Angelica glauca* in Uttaranchal and Himachal Pradesh as a spice, medicine, or other uses. Table 4 illustrates the distribution of knowledge about *Angelica glauca* across the populations interviewed.

## Discussion

### *(a) Medicinal Plant Knowledge*

Of the total recorded medicinal plants from both the states (Appendix 2), the higher number was recorded in Uttaranchal. The use of medicinal plants varied between the gender and age groups. In both the states, males knew of more medicinal plants (Figure 1a and b), however, the variation between gender was not significant ($X^2 = 0.035$). Older people (>50) knew of more medicinal plants than younger people (<50), and the difference was significant ($X^2 = 9.23$).

*Neopicrorhiza scrophulariiflora* (syn. *Picrorhiza kurrooa*), occupies the top rank in the prioritization exercise with 70-80% of people (both male and female) recognizing the species in Uttaranchal and Himachal Pradesh. *Dactylorhi-*

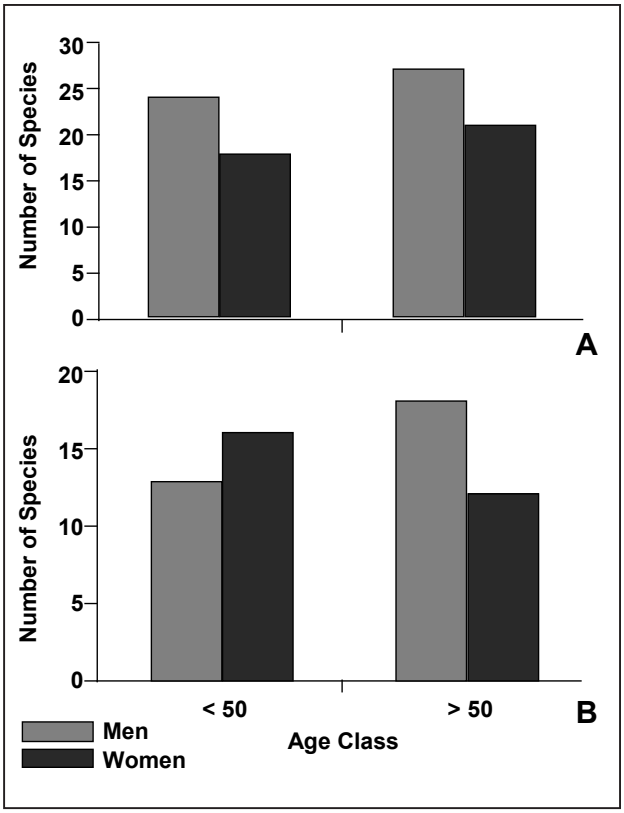


**Figure 1**. Extent of knowledge base by gender and age class. **A**) Uttaranchal; **B**) Himachal Pradesh

**Table 1**. Prioritization of medicinal plants on the basis of extent of knowledge base (%) in Uttaranchal and Himachal Pradesh, India. Conservation Priority: A= highest, B = high, C= moderate, D= least.

| Species | Uttaranchal | | | Himachal Pradesh | | |
|---|---|---|---|---|---|---|
| | Men | Women | Priority | Men | Women | Priority |
| *Aconitum atrox* (Bruhl) Muk. | 24.4 | 22.2 | D | N/A | N/A | N/A |
| *Aconitum heterophyllum* Wall. ex Royle | 91.1 | 74.4 | **A-B** | 92.2 | 72.2 | **A-B** |
| *Ainsliaea aptera* DC. | 10.0 | 12.2 | D | N/A | N/A | N/A |
| *Allium wallichii* Kunth | 20.0 | 13.3 | D | N/A | N/A | N/A |
| *Angelica archangelica* L. | 14.4 | 12.2 | D | N/A | N/A | N/A |
| *Angelica glauca* Edgew. | 47.8 | 31.1 | **C** | 31.1 | 27.8 | **C** |
| *Asparagus gracillis* Royle ex Baker | 24.4 | 20.0 | D | N/A | N/A | N/A |
| *Aster amellus* L. | 13.3 | 10.0 | D | N/A | N/A | N/A |
| *Benincasa hispida* (Thunb.) Cogn. | 17.8 | 15.6 | D | N/A | N/A | N/A |
| *Berberis lycium* Royle | 22.2 | 24.4 | D | N/A | N/A | N/A |
| *Bergenia stracheyi* (J.D. Hooker & Thomson) Engl. | 7.8 | 12.2 | D | N/A | N/A | N/A |
| *Bergenia ciliata* (Haw.) Sternb. | 24.4 | 20.0 | D | N/A | N/A | N/A |
| *Bunium cylindricum* (Boiss. & Hoh.) Freyn | 2.2 | N/A | D | 13.3 | 12.2 | D |
| *Centella asiatica* (L.) Urb. | 14.4 | 11.1 | D | N/A | N/A | N/A |
| *Cirsium verutum* (D.Don) Spreng. | 8.9 | 7.8 | D | N/A | N/A | N/A |
| *Cucumis sativus* L. | 11.1 | 10.0 | D | N/A | N/A | N/A |
| *Cuminum cyminum* L. | 8.9 | 11.1 | D | 10.0 | 12.2 | D |
| *Dactylorhiza hatagirea* (D.Don) Soo | 72.2 | 32.2 | **B-C** | 46.7 | 45.6 | **C** |
| *Delphinium denudatum* Wall. ex Hook.f. & Thomson | N/A | N/A | N/A | 20.0 | 11.1 | D |
| *Dioscorea deltoidiea* Wall. ex Griseb. | 20.4 | 14.4 | D | 17.8 | 13.3 | D |
| *Geranium wallichianum* D.Don ex Sweet | N/A | N/A | N/A | 8.9 | 2.2 | D |
| *Girardinia diversifolia* (Link) Friis | 14.4 | 12.2 | D | 8.9 | 2.2 | D |
| *Heracleum candicans* Wall. ex DC. | N/A | N/A | N/A | 13.3 | 12.2 | D |
| *Inula racemosa* Hook.f. | N/A | N/A | N/A | 27.8 | 14.4 | **C-D** |
| *Jurinea dolomiaea* Boiss. (syn. *J. macrocephala*) | 6.7 | 2.2 | D | 32.2 | 24.4 | **C-D** |
| *Nardostachys grandiflora* DC. (syn. *N. jatamansi*) | 45.6 | 31.1 | **C** | N/A | N/A | N/A |
| *Neopicrorhiza scrophulariiflora* (Pennell) D.Y. Hong (syn. *Picrorhiza kurrooa*) | 100.0 | 100.0 | **A** | 100.0 | 100.0 | **A** |
| *Paeonia emodi* Wall. ex Royle | 2.2 | 1.1 | D | N/A | N/A | N/A |
| *Physochlaina praealta* (Decne.) Miers | N/A | N/A | N/A | 6.7 | 5.6 | D |
| *Podophyllum hexandrum* Royle | 15.6 | 17.8 | D | 22.2 | 20.0 | D |
| *Polygonatum verticillatum* (L.) All. | 7.8 | 8.9 | D | 10.0 | 6.7 | D |
| *Polygonum rumicifolium* Royle | 46.0 | 7.8 | **C-D** | N/A | N/A | N/A |
| *Rheum australe* D.Don (syn. *R. emodi*) | 21.1 | 21.1 | D | N/A | N/A | N/A |
| *Rheum moorcroftianum* Royle | 45.6 | 27.8 | **C** | 14.4 | 8.7 | D |
| *Rhododendron anthopogon* D.Don | 18.9 | 11.1 | D | N/A | N/A | N/A |
| *Rhododendron arboreum* Sm. | 24.4 | 17.8 | D | N/A | N/A | N/A |
| *Rumex hastatus* D.Don | 2.2 | 2.2 | D | N/A | N/A | N/A |
| *Saussurea costus* (Falc.) Lipsch. | N/A | N/A | N/A | 12.2 | 6.7 | D |

| Species | Uttaranchal | | | Himachal Pradesh | | |
|---|---|---|---|---|---|---|
| | Men | Women | Priority | Men | Women | Priority |
| *Saussurea obvallata* (DC.) Edgew. | 24.4 | 22.2 | D | N/A | N/A | N/A |
| *Selinum wallichianum* (DC.) Raizada & Saxena (syn. *S. tenuifolium*) | 22.2 | 20.0 | D | 14.4 | 11.1 | D |
| *Skimmia arborescens* T. Anderson ex Gamble | 10.0 | 8.9 | D | N/A | N/A | N/A |
| *Solanum surattense* Burm.f. | 13.3 | 14.4 | D | N/A | N/A | N/A |
| *Stephania glabra* (Roxb.) Miers | 8.9 | 10.0 | D | N/A | N/A | N/A |
| *Tanacetum dolichophyllum* (Kitam.) Kitam. ex Kitam. & Gould | 6.7 | 5.6 | D | N/A | N/A | N/A |
| *Valeriana hardwickii* Wall. | N/A | N/A | N/A | 13.3 | 20.0 | D |
| *Valeriana jatamansii* Jones | N/A | N/A | N/A | 24.4 | 20.0 | D |
| *Viola pilosa* Bl. (syn. *V. serpens*) | N/A | N/A | N/A | 13.3 | 8.9 | D |
| *Zanthoxylum armatum* DC. | 7.8 | 5.6 | D | N/A | N/A | N/A |

*za hatagirea* and *Aconitum heterophyllum* were the next most commonly identified with indices >50%. *Angelica glauca*, the species identified for detailed study, scored indices of 30-40% in both the centers. Some of the species otherwise considered important, such as *Rheum australis (*syn. *R. emodi*), *Saussurea obvallata* and *Aconitum atrox* exhibited very low (0-10) prioritization indexes in Uttaranchal (Table 1) implying that they are poorly known and therefore less likely to be in demand and threatened by excessive use. Similarly, *Heracleum candicans* and *Podophyllum hexandrum* were poorly known in Himachal Pradesh (Table 1) implying that they are not conservation concerns at least due to local usage.

In spite of the fact that a higher number of medicinal plant species were recorded in Uttaranchal, it does not necessarily imply that the status of traditional knowledge is better in Uttaranchal. The difference could be either due to differences in the status of traditional knowledge or merely variation in the medicinal plant diversity of the two centers. The results also showed that traditional knowledge with regard to medicinal plants works as a function of gender as well as age class. A non-significant difference with regard to traditional knowledge between the two genders showed that the medicinal plants derive similar interest among the people of each study area, irrespective of the gender. A little more knowledge in males could be attributed to their involvement in the marketing chain and trade related activities. However, significantly more knowledge in the elderly age class suggested that, the younger generation is less aware of the potential of medicinal plants. This could be attributed to the fact that the interests of younger respondents are primarily linked with trade and they might know only about the medicinal plants from a market point of view. On the contrary, older folk have assimilated the knowledge about the medicinal plants from the point of view of their traditional health care system and they do practice it in their day to day life.

Changing values (and thus absence of apprentices) threaten persistence of traditional medicinal plant use in many traditional societies (Comerford 1996, Voeks 1996). A few older people who have some knowledge about uses of medicinal plant are unable to perpetuate it in absence of adequate apprentices.

It is believed that an even distribution of knowledge among age classes reduces the risk of knowledge being lost due to natural and socioeconomic changes (Phillips & Gentry 1993). However, in the present context, differences in perceptions and value in the two age classes could indicate possible risk of knowledge loss.

**Table 2**. Percent contribution of villagers of Himachal Pradesh (men and women) in collection of medicinal plants for domestic consumption and / or trade.

| Use category | Gender | | LSD (P<0.05) | F |
|---|---|---|---|---|
| | Men | Women | | |
| Domestic use | 53.3 | 66.7 | 9.8 | 7.5 |
| Domestic use +Trade | 38.9 | 31.1 | 14.0 | 1.2 |
| Trade | 7.8 | 2.2 | 8.1 | 1.9 |

**Table 3**. Variation in the market price (Rs/kg) of medicinal plants in Himachal Pradesh (HP), Uttaranchal (UA), and India. (* Conservation Priority as determined in Table 1.) (**1 market price as collected during the present study. 2, 3, 4 and 5 are Indian market prices as quoted by Gupta *et al*. 1998.)

| Species | Priority* | 1** | | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| | | HP | UA | India | | | |
| *Inula racemosa* | C-D | 1000 | | | | | |
| *Dactylorhiza hatagirea* | B-C | 500-800 | 1200 | 600-800 | | | 500 |
| *Saussurea costus* | D | 700 | | | | | |
| *Neopicrorhiza scrophulariiflora* | A | 600-650 | 310 | 80-140 | 75 | 60-80 | 10-20 |
| *Aconitum heterophyllum* | A-B | 500-1000 | 2500-2800 | 1000 | 50 | 250-300 | 160-200 |
| *Cumminum cyminum* | D | 350-375 | | | | | |
| *Podophyllum hexandrum* | D | 250-350 | | | | | |
| *Bunium cylindricum* | D | 100-250 | | | | | |
| *Angelica glauca* | C | 50 | 20 | | | | 50-60 |
| *Valerriana jatamansi* | D | 25-75 | 106-115 | 70 | 45 | 85-90 | |
| *Rheum moorcroftianum* | C-D | 35 | | | | | |
| *Dioscorea deltoidiea* | D | 30 | | | | | |
| *Valeriana hardwickii* | D | 60 | | | | | |
| *Heracleum candicans* | D | 30 | | | | | |

***Conservation and Trade of Medicinal Plants***

This study reveals that medicinal plants are largely collected for domestic consumption (Table 2) in Himachal Pradesh. Collection for domestic consumption is slightly greater among women while collection for trade is higher among men.

Market value surveys of the medicinal plants from Uttaranchal and Himachal (Table 3) illustrate that *Angelica glauca*, *Rheum moorcroftianum*, *Dioscorea deltoidea*, *Valerriana jatamansi* and *Heracleum candicans* have been quoted to be sold at substantially lower rates than *Inula racemosa*, *Dactylorhiza hatagirea*, *Aconitum heterophyllum*. Unexpected variations in the rates were observed between the two centers, markets and even within a market. For example, *Dactylorhiza hatagirea* is sold for 800-850 Rs./kg in Himachal, however, the same species is sold for 1200 Rs./kg in Uttaranchal. Some medicinal plants showed several fold increases in the prices when compared with earlier recorded prices in India. The highest rate increases were observed for *Aconitum heterophyllum* and *Neopicrorhiza scrophulariiflora*.

*Neopicrorhiza scrophulariiflora* finds wide appreciation in both traditional and modern Indian systems of medicines as antiperiodic, stomachic and cathartic hepatoprotective (Jain 1968). The species is one of the major component of

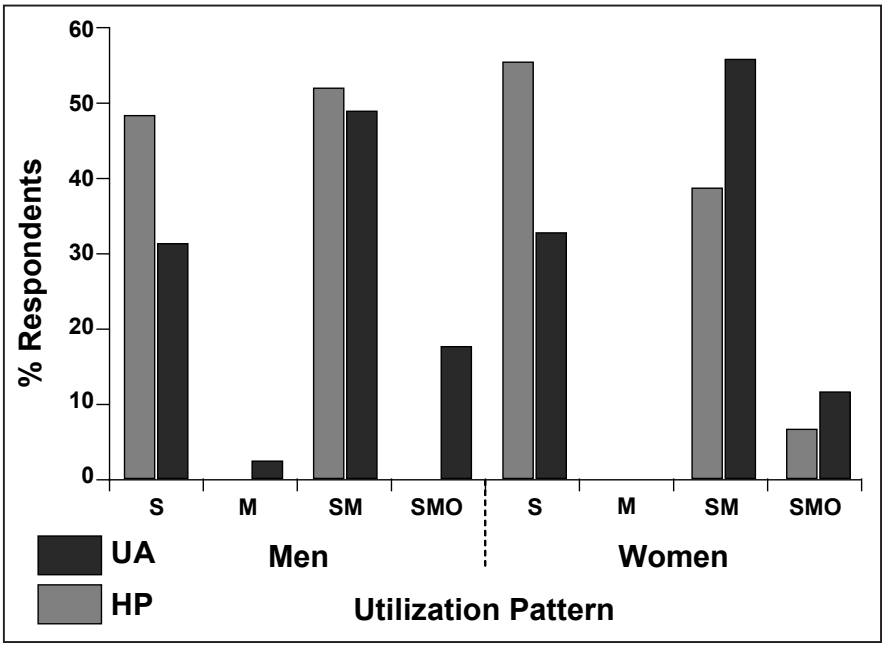


**Figure 2**. Utilization pattern of Angelica glauca in Uttaranchal (**UA**) and Himachal Pradesh (**HP**). S: Spice, M: Medicine, O: Other uses.

**Arogyavurdhini**, an ayurvedic formulation used to treat liver ailments (Anonymous 1997b, Kapahi *et al*. 1993). The above indications and its demand in pharmaceutical and Ayurvedic formulations are responsible for making the species popular among respondents. Indiscriminate collection of *Picrorhiza kurrooa* from wild habitats and lack of attention to cultivation practices has already resulted in its depletion from natural habitats (Samant *et al*. 2001). This perspective is supported by the finding of our study, which assigns it at the highest rank in prioritization index.

Of the prioritized species in this study, 18 (5- Endangered; 6- Critically Endangered; 6-Vulnerable and 1- Low Risk Near Threatened) are listed by IUCN (IUCN status in 1998 for northwest Himalaya and state wise IUCN status in 2003) and 6 fall under Red Data Book plants of India (1- Endangered and 5-Vulnerable) (Nayar & Sastry 1987, 1988, 1990). Several other species, in spite of being very important in indigenous systems of medicine, e.g., *Rheum emodi*, *Saussurea obvallata*, and *Podophyllum hexandrum*, did not score a high prioritization index, which suggests these species are either not in active trade or are traded at lower market rates. As evident from Table 3, the prioritization index of most of the species corresponds well with market prices with those having higher prices also having higher scores This further indicates that awareness among the indigenous communities about medicinal plants is influenced largely by market demands rather than indigenous applications. It would therefore imply that the strategy for conservation prioritization needs to be based on market value and demand of species. Since most of the species in the two Himalaya states fall into similar categories we anticipate similar priority ratings of these species in rest of the Himalaya region.

Variation between market value of species in the two states and between the markets within states can be attributed to the absence of proper marketing channels and active involvement of middlemen in marketing of medicinal plants. Therefore, the market value of medicinal plants ought to increase or decrease on the basis of availability of the species in natural habitats. Additionally, demand for particular medicinal plants in the pharmaceutical industries is directly proportional to market value. Such variation in market value of medicinal plants throughout the Himalayan region have been observed earlier (Gupta *et al*. 1998).

Trade related use in Uttaranchal was negligible. This is due to the engagement of people in tourism related activities. The seasons of collection of medicinal plants and that of tourism are simultaneous. The people recognize tourism related activities as being more promising in terms of monitory gains. The poor awareness about the economic potential of medicinal plants leads the indigenous communities to opt for tourism activities for quicker returns and a lesser degree of risk. Moreover, extraction of medicinal plants in large quantities is prohibited in the Hima-

**Table 4**. Traditional knowledge base of *Angelica glauca* in 13 villages in Uttaranchal (**UA**) and Himachal Pradesh (**HP**), India.

| S.N. | Villages | Average number of sites of occurrences | | Species known for various purposes other than spice and medicine (%) | | | |
|---|---|---|---|---|---|---|---|
| | | Men | Women | Men | | Women | |
| | | | | >50 | <50 | >50 | <50 |
| **UA** | | | | | | | |
| 1 | Khati | 3 | 5 | 0 | 0 | 0 | 0 |
| 2 | Lata | 4 | 5 | 0 | 0 | 0 | 0 |
| 3 | Wacham | 4 | 5 | 0 | 0 | 0 | 0 |
| 4 | Bamri | 7 | 12 | 60 | 40 | 50 | 50 |
| **HP** | | | | | | | |
| 1 | Fojal | 6 | 6 | 0 | 0 | 0 | 0 |
| 2 | Badeiragra | 16 | 6 | 67 | 33 | 50 | 50 |
| 3 | Oonch | 8 | 3 | 0 | 0 | 67 | 33 |
| 4 | Kothi | 7 | 4 | 100 | 0 | 100 | 0 |
| 5 | Jholing | 9 | 5 | 0 | 0 | 0 | 0 |
| 6 | Shansha | 10 | 4 | 100 | 0 | 0 | 0 |
| 7 | Sissu | 5 | 3 | 0 | 0 | 0 | 0 |
| 8 | Barseini | 10 | 8 | 50 | 50 | 0 | 0 |
| 9 | Pullag | 10 | 8 | 67 | 33 | 71 | 29 |

layan states and therefore a risk of prosecution restricts people from engaging themselves in this venture. On the contrary a majority of the people in Himachal Pradesh are engaged in agriculture and horticulture activities. They are more commercial in their mind-set. A few instances of getting handsome incentives from medicinal plant trade in the state may have previously encouraged people to carry on with trade of medicinal plants.

***(b) Angelica glauca***

***Utilization of Angelica glauca***

The male and female respondents of both the states confirmed the use of *Angelica glauca* for various purposes (Figure 2). The use patterns of *A. glauca* were similar in the majority of aspects in UA and HP. In UA more people use the species as a spice and almost half recognize it as both a spice and a medicine. However, only a small percent of the population recognized the species for other purposes. None of the respondents reported use of species strictly as medicine. In HP a majority of people use the species as spice as well as medicine, whereas less than a third use it only as a spice (Figure 2). Nearly 15% of people use it for other purposes and very few people (1.1%) use the species as a medicine only.

Some interesting anecdotal information was reported in the course of survey. For example, *A. glauca* was reported to be used as a snake repellent, insect repellent, and remedy for colds, for improving lactation in cattle and as an ingredient of incense (**Dhoop**). Most of the respondents identify *A. glauca* as a remedy for stomach troubles, bilious complaints, bronchitis.

***Distribution of Traditional Knowledge***

The term traditional knowledge implies the knowledge about a species identification, uses and possible habitats. People of HP reported more information about *A. glauca*. This may be related to the result that they also had greater availability of the resource with regard to mean number of sites of occurrence (Table 5).

Men knew more sites of occurrence but only slightly more uses. (Different sites of occurrences were reported by the respondents were confirmed during field visits by the authors.) This likely is an indicator that men are the primary collectors but both genders use the plants. Older people know much more than younger people although in some communities the young and the old were similar in their knowledge levels. More knowledge about the species among men in HP can be attributed to their contacts with outsiders while a lower accumulation of traditional knowledge in men of UA can be attributed to changes in their mode of earning a living.

***Perspectives of Randomly Encountered Interviewees***

Randomly encountered interviewees presented a clear picture of trade in the two centers. About half of those encountered in HP and only 10% in UA believed that trade of *A. glauca* was in practice in their respective regions. However, out of 52.2% randomly encountered individuals of HP, 100% belonged to the region of Kullu and Parvati valley and out of 10% encounters of UA 100% belonged to Bamri and adjacent villages of Badrinath.

Since the randomly encountered individuals were not asked directly whether they harvested *A. glauca*, their perspective on the status of the species can be considered unbiased and honest. However, from their point of view trade is in practice in Kullu and Parvati valley of HP and Badrinath region of UA. This suggests that immediate regulatory mechanisms should be enforced for collection of medicinal plants from the wild.

***People's perception on status of the species***

This study revealed that a majority of people in HP (74.07%) and UA (76.67%) believed that *A. glauca* is diminishing from its natural populations. A majority of the people, 63.33% in UA and 61.48% in HP agreed that the species was being harvested indiscriminately without consideration of its regeneration.

## Conclusions

*Angelica glauca* has been identified as one of the important medicinal plants used in traditional health care in the area studied. Local perceptions and knowledge regarding particular species such as *A. glauca*, suggests that significant attention must be directed to area specific indicators for developing any conservation program of the species (Duffield *et al*. 1998). The sustainable resource management policies must be tailored according to the local conditions, which are sensitive to local knowledge.

The present study shows that investigations of various aspects of people-nature relationships need to be conducted before arriving at conclusions for prioritizing species for conservation. It also reveals the importance of such studies in setting conservation priorities, which need to develop around location specific considerations. Proper education and awareness programs need to be developed to address the issue of conservation of prioritized species. Development of cultivation packages of such species and providing them to the villagers, besides practicing other regulatory measures can reduce the pressure on natural populations.

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**Appendix 1**. Questionnaires used in interviews about medicinal plant conservation in Uttaranchal and Himachal Pradesh, India.

**A. Questionnaire for first set of objectives**.

1. Do you know the medicinal plants which found in your locality –If Yes please give the name?
2. What is the use of these medicinal plants?
3. Which parts of these plants are used for medicinal purposes?
4. In which season do you collect these plants?
5. Why do you collect these medicinal plants (1. domestic consumption 2. domestic consumption and trade and 3. Purely trade).
6. If trade what is the market price of these medicinal plants.

**B. Questionnaire for second set of objectives**.

1. Is this plant found near your village-If yes please give the location of its occurrence
2. How you can use this plants (a- as spice b- medicine c- other)
3. Can you classified this plant according to its nature –if yes please give the details of classification
4. Do you know any other species which is adulterated in place of Angelica glauca- If yes please give the name of that species
5. Do you extract this plant- If yes then what is the purpose of extraction (a- domestic b- contractor c-coperatives)
6. How much quantity is extracted by you in every season (a >25 kg B- 10-25 kg c- >10 kg)

**Appendix 2**. Medicinal plants found to be used in traditional medicine in Uttaranchal (UA) and Himachal Pradesh (HP), India.

| Used in | | Vernacular name | Species | Part used | Indications (Uses) |
|---|---|---|---|---|---|
| HP | UA | | | | |
| - | 1 | **Metha** | *Aconitum atrox* (Bruhl) Muk. | Root | Muscular rheumatism and neuralgia |
| 1 | 2 | **Atis/Patis** | *Aconitum heterophyllum* Wall. ex Royle | Root | Diarrhea and dysentery |
| - | 3 | **Khadjari** | *Ainsliaea aptera* DC. | Root | Painful urination |
| - | 4 | **Pharan** | *Allium wallichii* Kunth | Whole plant | Spice |
| - | 5 | **Chhipi** | *Angelica archangelica* L. | Root | Spice |
| 2 | 6 | **Chora** | *Angelica glauca* Edgew. | Root | Spice, bronchitis and stomach trouble |
| - | 7 | **Jhirni** | *Asparagus gracillis* Royle ex Baker | Root | Headache |
| - | 8 | **Bouj / Babru** | *Aster amellus* L. | Root | Cough |
| - | 9 | **Bhujalu** | *Benincasa hispida* (Thunb.) Cogn. | Seed | Gonorrhea |
| - | 10 | **Kirmor** | *Berberis lycium* Royle | Root | Jaundice. |
| - | 11 | **Silpari** | *Bergenia stracheyi* (J.D. Hooker & Thomson) Engl. | Root | Dysentery |
| - | 12 | **Pashanved** | *Bergenia ciliata* (Haw.) Sternb. | Root | Cuts |
| 3 | - | **Singu** | *Bunium cylindricum* (Boiss. & Hoh.) Freyn | Seed | Spice |
| - | 13 | **Brahmi** | *Centella asiatica* (L.) Urb. | Leaf | Blood purification |
| - | 14 | **Biskandara** | *Cirsium verutum* (D.Don) Spreng. | Root | Cuts |
| - | 15 | **Yalaru** | *Cucumis sativus* L. | Fruit | Pneumonia |
| 4 | 16 | **Zeera** | *Cuminum cyminum* L. | Fruit | Spice |
| 5 | 17 | **Panja** | *Dactylorhiza hatagirea* (D.Don) Soo | Root | Nervine and invigorating tonic |
| 6 | - | **Jadwar** | *Delphinium denudatum* Wall. ex Hook.f. & Thomson | Root | Cut and wounds |
| 7 | 18 | **Singli** | *Dioscorea deltoidiea* Wall. ex Griseb. | Root | Fertility improvement |
| 8 | - | **Ratanjot** | *Geranium wallichianum* D.Don ex Sweet | Root | Dysentery and colds |
| - | 19 | **Dholu kandali** | *Girardinia diversifolia* (Link) Friis | Root | Urinary disease |
| 9 | - | **Padiyara** | *Heracleum candicans* Wall. ex DC. | Root | Digestive problem and stimulant |
| 10 | - | **Manu** | *Inula racemosa* Hook.f. | Root | Substitute for kuth |
| 11 | 20 | **Dhoop** | *Jurinea dolomiaea* Boiss. | Root | Incense |
| - | 21 | **Masi** | *Nardostachys grandiflora* DC. | Root | Incense |
| 13 | 23 | **Kutki** | *Neopicrorhiza scrophulariiflora* (Pennell) D.Y. Hong (syn *Picrorhiza kurrooa*) | Root | Fever |
| - | 22 | **Chandrain** | *Paeonia emodi* Wall. ex Royle | Root | Whooping cough |
| 12 | - | **Langthang** | *Physochlaina praealta* (Decne.) Miers | Leaf | Asthma and whooping cough |
| 14 | 24 | **Bankakri** | *Podophyllum hexandrum* Royle | Root | Cancer |
| 15 | 25 | **Salammisri** | *Polygonatum verticillatum* (L.) All. | Root | Kidney trouble |
| - | 26 | **Kanthala** | *Polygonum rumicifolium* Royle | Root | Gastric problems |

| Used in | | Vernacular name | Species | Part used | Indications (Uses) |
|---|---|---|---|---|---|
| HP | UA | | | | |
| - | 27 | **Dola** | *Rheum australe* D.Don | Root | Cuts and wounds |
| 16 | 28 | **Archa/ Chhuchi** | *Rheum moorcroftianum* Royle | Root | Purgative |
| - | 29 | **Tali** | *Rhododendron anthopogon* D.Don | Root | Cuts and wounds |
| - | 30 | **Burans** | *Rhododendron arboreum* Sm. | Flower | Juice |
| - | 31 | **Almoru** | *Rumex hastatus* D.Don | Leaf | Cuts and wounds |
| 17 | - | **Kuth** | *Saussurea costus* (Falc.) Lipsch. | Root | Skin diseases and asthma |
| - | 32 | **Brahmaka-mal** | *Saussurea obvallata* (DC.) Edgew. | Root | Arthritis, appetite loss, cough & colds, cuts and wounds |
| 18 | 33 | **Bhutkasi** | *Selinum wallichianum* (DC.) Raizada & Saxena | Root | Nervine sedative |
| - | 34 | **Nair** | *Skimmia arborescens* T. Anderson ex Gamble | Root | Incense |
| - | 35 | **Kanthkari** | *Solanum surattense* Burm.f. | Root | Cuts and wounds |
| - | 36 | **Rajpatta** | *Stephania glabra* (Roxb.) Miers | Root | Asthma, dysentery and fever |
| - | 37 | **Guggal** | *Tanacetum dolichophyllum* (Kitam.) Kitam. ex Kitam. & Gould | Root | Insecticide |
| 19 | - | **Nihani** | *Valeriana hardwickii* Wall. | Root | Incense |
| 20 | - | **Mushkbala** | *Valeriana jatamansii* Jones | Root | Incense |
| 21 | - | **Banafsa** | *Viola pilosa* Bl. | Whole plant | Skin and blood diseases |
| - | 38 | **Timru** | *Zanthoxylum armatum* DC. | Young Twig | Tooth brush |