Ethno-botanical studies of some threatened medicinal plants and local perception of its population decline in Kargil, Ladakh UT

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Abstract

Kargil lies in the Trans-Himalayan region between 32°15’- 34°56’N latitude and 75°35’- 76°57’ E longitude covering a geographical area of 14,086 Km² has a vast diversity of aromatic and medicinal plants. The traditional uses of medicinal plants to cure various ailments in the Kargil district have been practiced from ancient times. The present study was conducted to validate the information on ethno-botanical studies of some threatened medicinal plants in the region and local people’s perception of its population decline. Therefore extensive field survey was conducted in a different region of district Kargil of Ladakh UT from May 2015- September 2020 to observe the habitat, altitudinal ranges, flowering, traditional uses of threatened medicinal plants, and the factors which are operating for the depletion of these important taxa from their natural habitat. Interviews were conducted in local languages from more than 1000 informants as the corresponding author is a native of the study area. A total of 22 threatened plant species (21 Angiosperms, 1 gymnosperm) belongings to 17 genera, 14 families were traditionally used tribal peoples of the valley to cure various ailments. Most of the threatened taxa belong to the family Ranunculaceae followed by Asteraceae. From local people’s perception, land-use change, illegal exploitation, and the selling of plant parts in the black market are the worst threat to the depletion of these species.

Significance Statement: The flora of Ladakh is crying for Conservation due to factors such as climate change, bio-piracy, smuggling, pre-maturation harvesting pressure, poverty, unemployment, human interference which leads to their extinction in the near future. Therefore it’s very pertinent to develop conservation strategies and adopt Sustainable utilization practices. For this mass awareness programs on sustainable utilization and conservation of these threatened medicinal plants need to be conducted by involving various stakes-holders, universities, colleges, schools, and other various government and non-governmental organizations.

Keywords: Threatened plants, Kargil ethno-botany local perception conservation approaches.

1. Introduction

World Health Organization estimates that more than 75-80% population of the developing world depends on traditional medicine for primary healthcare [1, 2]. WHO recorded more than 20,000 plant species globally used as medicine [3]. Medicinal plants also become a source of income for millions of people. Ethno-medicine has kept its fame in all regions of the developing world and its use is tremendously increasing in industrialized countries [4]. Ladakh is a newly formed Union Territory (5th August 2019) separated from the state of Jammu & Kashmir. It is considered as the “cold desert of India” due to its unique topographic, physiographic, and climatic conditions. It consists of two districts viz; Leh and Kargil which covers an area of more than 78,000 Km² which lies between 32°15’- 34°38’11 N latitudes and 75°36’73 - 78°22’11 E longitudes at an altitude of 2700- 7560m [5-7]. Kargil lies in the Trans-Himalayan region between 32°15’- 34°56’N latitude and 75°35’- 76°57’ E longitude covering a geographical area of 14,086 Km² possess huge diversity of temperate, alpine, and subalpine flora. Ethnobotanically Ladakh is explored by various authors such as [8-12]. However, they stick to the specific ethnic group. Kargil district is the ethnobotanical least explored region of Ladakh despite being vast socio-cultural and religious diversity. Besides this maximum floristic diversity in Ladakh are occurred in the Kargil district. Therefore in this present work, an attempt has been made with the assistance and collaboration of local peoples, herbalists, old aged peoples and herbal experts of various social and cultural tribes of Kargil.
district to substantiate a clear picture of traditional uses of some threatened medicinal plants and their perception and views on its population decline.

Materials and Methods

**Study area:** Kargil district is located between 32°15'-34°56' N latitude and 75°35'-76°57' E longitude (Garmin etrex 10, 30) covering a geographical area of 14,086 sq. Km and shares its boundaries with Pakistan in the North, Leh district in the East, and Kashmir in the West. Extensive field surveys were conducted in a different region of the Kargil district of Ladakh UT from Zojila-pass to Zanskar. Which include the main valleys such as Drass, Hundurman, Batalik, Gargardo, Darchiks, Darkon, Chiktan, Shargole, Sapi, Soth, Kargil, TSG, Sankoo, Barsoo, Suru, Rangdum, and Zanskar from May 2015-September 2020. A field survey was conducted every year from the commencement of spring to the onset of autumn to gain maximum information about the distribution, habitat, flowering season, traditional uses and causes of population decline and to cross-check the information of informants of former visits. The accuracy and reliability of gathered information were confirmed by visiting and interviewing the informants five to six times. Videos, Photographs, and live specimens were shown to the informants such as herbalists, older peoples, plant experts, “Aabs, Amchis”, to get relevant and authentic information on traditional uses (table 2). One question is asked strictly to every informant I. e., Did you noticed that the population of this particular species is declined day by day?, What is your perception about this? Data on elevation, latitude, longitude were recorded by GPS (Garmin etrex-30) specimen habit, habitat, and flowering season were recorded on the spot by keenly observing the specimen. All specimens were identified on the spot with the help of local floras, databases, standard literature, and with the help of regional taxonomic experts. Voucher specimens were deposited in Kashmir University KASH Herbarium, Department of Botany. The scientific name is checked from the database theplantlist.org.

Result and Discussion

Total 22 threatened plant species (21 Angiosperms, 1 Gymnosperm) belongings to 17 genera, 14 families were traditionally used by tribal peoples of Kargil to cure various ailments (Table 2). Most of the threatened taxa belong to the family Ranunculaceae followed by Asteraceae (Figure 2). Maximum threatened plants were herbs (91%) followed by shrubs (9%) (Figure 1). Roots were the most used parts followed by leaves and whole plants (Figure 3). Most of the threatened species belong to alpine vegetation and luxuriantly grows in mesic to wet habitats (Table 2). Every species is used to cure various types of diseases, but most of them used to cure digestive and respiratory-related diseases (Table 2). According to the informant’s perception, collection of rhizomes of Aconitum species and Dactylorhiza hatagirea, Arnebia euchroma, Bergenia sps, Pierorhiza kurrooa, and selling it in the black market is the main cause for the depletion of these important Texas. To obtain this useful plant parts the smuggler targeted the primary and middle school children’s, and unemployed youths, to collect the roots and other useful parts of these plants. Useful plant parts were sold at different costs which are mentioned in (Table 1). Besides this, another factor that we observed from the informants is the pre-harvesting pressure and introduction of exotic fodder plants. Elderly and uneducated women have great knowledge of the traditional uses of medicinal plants in Ladakh. The knowledge of medicinal plants decreases significantly with the increases in the educational level of the informants. The new generation did not even know the vernacular name of plants growing is in their vicinity.

Conclusions

Kargil has a rich cultural and floristic diversity. Most of the area in kargil district falls under the transitional zone which possesses unique diversity. Most of the threatened plants were used to cure several diseases. The plants of Kargil were facing the tremendous threat of their extinction due to factors such as land use-change, climate change, bio-piracy, smuggling, pre-maturation harvesting pressure, poverty, unemployment, human interference. These plants were in need of. Therefore it’s very pertinent to develop conservation strategies and adopt Sustainable utilization practices. For this mass awareness programs on sustainable utilization and conservation of these threatened medicinal plants need to be conducted by involving various stalk-holders, universities, colleges, schools, and other various government and non-governmental organizations.

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| Scientific Name          | Part sold  | Local Price INR per kg |
|--------------------------|------------|------------------------|
| Aconitum heterophyllum   | Root tubers| Rs. 2500               |
| Aconitum violaceum       | Root tubers| Rs. 1000               |
| Dactylorhiza hatagirea   | Rhizome    | Rs. 800-1000           |
| Hippophae rhamnoides     | Fruits     | Rs. 400                |

Table 1: Price of some threatened plant parts in local market

Fig 1: Pie chart showing habit of plant species in percentage
Table 2: Ethno-medicinal uses of threatened medicinal plants in Kargil district of Ladakh Himalaya to cure various ailments by indigenous tribes.

| Scientific Name | Family     | Local Name     | Life form       | Altitude (meter) asl | Flowering       | Habitat                                                                                                                                   | Part used | Medicinal uses/ and mode of administration                                                                 | IUCN- Status |
|-----------------|------------|----------------|-----------------|----------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Aconitum        | Ranunculaceae | Karpo-Bova/ Bona-Karpo | Biennial or perennial herb | 3200-3600             | Mid-June - July | Moist damp soil, semi-shaded places, under the shade of Salix species, moist abandoned lands in villages.                                    | Root tuber | Powder: Root tubers were ground into a fine powder. A half teaspoon full of this powder was taken orally along with one glass of milk with an empty stomach early in the morning to cure Toothache, gastric disorders, and expulsion of intestinal worms particularly Ascaris lumbricoides. 
Decoction: Root decoction is useful to relieve headache, intestinal complaint, fever, diabetes, vomiting, and diarrhea. A raw root tuber is kept between the teeth to cure toothache. | Endangered  |
| heterophyllum   |            |                |                 |                      |                 |                                                                                                                                            |           |                                                                                                                                                 |              |
| Wall. ex Royle  | Ranunculaceae | Nagpo-Bova/ Boma-nagpo | Biennial herb    | 3200-3800             | Mid-June-August | Moist damp soil along the bank of irrigation canal, bank of streams, springs, semi-shaded damp places. It is strictly distributed along the edges of continuous springs and streams.                           | Root tubers | Powder: 10-15 mg of root powdered is used along with honey or milk to cure cough, asthma, high fever, lung problem, rheumatism, gastric problems. 
Decoction: Paste of root powdered is applied to cure boils and sciatic pains. 
Decoction: Dried root powdered is used to kill intestinal parasites. | Vulnerable   |
| Aconitum        | Ranunculaceae | Ree-Bova/ Ree-boma | Biennial herb    | 3800 – 4440           | Mid-July-August  | Alpine grasslands, bank of alpine streams, stabilized meico to wet habitats.                                                                | Root tubers | Powder: Half tea-spoon root powdered is taken along with warm milk to cure stomach trouble, intestinal worms, abdominal pains, dizziness, indigestion, blood purifier, and cough. | Vulnerable   |
| violaceum       |            |                |                 |                      |                 |                                                                                                                                            |           |                                                                                                                                                 |              |
| Jacq.ex Stapf   | Ranunculaceae | Sgrons/ sbrons/ Perennial herbs |                 | 3550-4840             | Mid-May-August  | Stabilized sandy or gravel slopes, areas, dried meadow, semi-dry areas, where there is water during summer.                                 | Root, leaves | Decoction: Dry root decoction is very effective to cure Lungs problems,                                                                                                                                 | Endangered  |
| Aconitum        | Ranunculaceae |              |                 |                      |                 |                                                                                                                                            |           |                                                                                                                                                 |              |
| rotundifolium   |            |                |                 |                      |                 |                                                                                                                                            |           |                                                                                                                                                 |              |
| Kar. & Kir.     | Ranunculaceae | Sgrons/ sbrons/ Perennial herbs |                 | 3550-4840             | Mid-May-August  | Stabilized sandy or gravel slopes, areas, dried meadow, semi-dry areas, where there is water during summer.                                 | Root, leaves | Decoction: Dry root decoction is very effective to cure Lungs problems,                                                                                                                                 | Endangered  |
| Arnebia         | Boraginaceae | Sgrons/ sbrons/ Perennial herbs |                 | 3550-4840             | Mid-May-August  | Stabilized sandy or gravel slopes, areas, dried meadow, semi-dry areas, where there is water during summer.                                 | Root, leaves | Decoction: Dry root decoction is very effective to cure Lungs problems,                                                                                                                                 | Endangered  |
| Species                                      | Family               | Genus                     | Common Name          | Flower Color | Flowering Period | Plant Part(s)              | Habitat/Environment                                                                 |
|---------------------------------------------|----------------------|---------------------------|----------------------|--------------|------------------|-----------------------------|--------------------------------------------------------------------------------------|
| Gentiana algida                           | Gentianaceae         | Gentiana                  | Algae                | Brownish     | June-August      | Roots, Leaflets, Flower     | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Gentiana stracheyi                        | Gentianaceae         | Gentiana                  | Stracheyi            | Brownish     | June-August      | Roots, Leaflets, Flower     | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Gentiana cashmeriana                      | Gentianaceae         | Gentiana                  | Cashmeriana          | Yellow-luteum | June-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Gentiana brunonianum                      | Gentianaceae         | Gentiana                  | Brunonianum          | Yellow-luteum | June-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Gentiana luteum                           | Gentianaceae         | Gentiana                  | Luteum               | Yellow-luteum | June-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Delphinium brunnianum                     | Ranunculaceae        | Delphinium                | Brunnianum           | Yellow       | June-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Delphinium cashmerianum                   | Ranunculaceae        | Delphinium                | Cashmerianum         | Yellow       | June-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Ephedra gerardiana Wall. ex Stapf           | Ephedraceae          | Ephedra                   | Gerardiana           | Yellow       | August-September| Whole Plant                | Hard stony stabilized places, arid habitat, slopes at lower elevation.             |
| Gentiana alpigena                         | Gentianaceae         | Gentiana                  | Alpigena             | Yellow-blue  | June-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Bergenia saxifragae                       | Saxifragaceae        | Bergenia                  | Saxifragae           | Yellow       | July-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Codonopsis clematidea                     | Campanulaceae        | Codonopsis                | Clematidea           | Yellow       | July-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Corydalis govaniana                       | Papaveraceae         | Corydalis                 | Govaniana            | Yellow       | July-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |
| Dactylorhiza hatagirea (D.Don) Soo         | Orchidaceae          | Dactylorhiza              | Hatagirea            | Yellow       | July-August      | Whole Plant                | Arid to semi-arid habitat. Moist rocky slopes, snow or stream-fed rocks.             |

**Usage and Medicinal Properties:**

- **Root** is claimed to be very beneficial for pulmonary diseases, and purification of blood, nose bleeding.
- **Extract**: Roots were rinsed in mustard oil for a week, and then it is applied to overcome hair loss, strengthening hair, and remove dandruff. Leaf powder is taken orally against dry cough. Root and leaf paste is applied externally to relieve back pains and healing of cuts and wounds.
- **Powder**: Roots are collected in the month of August-September and shade dried. A pinch of dried rhizome powder is then taken orally to dissolve kidney stone, cure lung inflammation, heartburn, monorhagia, and urinary related problems. Leaf paste is applied externally on cuts and wounds. Root paste is beneficial to relieve body pains.
- **Decoction**: A cup of leaf and flower decoction is effective against indigestion and fever.
- **Decoction**: Plants were collected early morning and sun-dried, then the decoction of dries aerial shoots such as leaves, flowers were given to a patient suffering from back pain, joint pains, cold, cough, abdominal pain, gastric problems, constipation and also acts as a blood purifier. Tribal peoples collected them during the summer season and stored them in dried shaded places for usage in winter when getting necessary.
- **Root** is claimed to be highly beneficial to cure Kidney disorders, fever, sedative, dysuria, diarrhea, cuts, wounds, and roundworms.
- **Root** is collected in the month of August-September and shade dried. A pinch of dried rhizome powder is then taken orally to dissolve kidney stone, cure lung inflammation, heartburn, monorhagia, and urinary related problems. Leaf paste is applied externally on cuts and wounds. Root paste is beneficial to relieve body pains.
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| Plant Name                  | Family          | Genus                | Distribution          | Habitat                  | Uses                                                                 |
|----------------------------|-----------------|----------------------|-----------------------|--------------------------|----------------------------------------------------------------------|
| Hippophae rhamnoides L.    | Elaeagnaceae    | Inula racemosa       | Perennial shrubs      | Mesic habitat, mostly cultivated in Kargil and Leh | Leaves, flower, fruits, seeds<br>**Decoction:** leaves and flower decoction are used to cure ailments like lung infection, cardiac disorders. Fruit and seeds are consumed as it is claimed to be rich sources of vitamins such as Va, Vb, Vc, Vk, carotenoids, and minerals. It is believed to have anti-aging, anti-cancerous properties, immune booster. Fruit juice extract has been claimed to be beneficial for diabetic patients, against ulcers, joint pains, blood pressure, and wounds.<br>Rare |
| Inula webbianum            | Asteraceae      | Meconopsis ex Benth  | Manu Perennial herbs   | July to Late August      | Root, Leaves<br>**Powder:** Dried root powdered were taken along with warm water or milk to cure stomach trouble, acidity, chest pain, cold, fever. Root or leaf paste is applied externally to heal the wound.<br>Endangered |
| Meconopsis aculeata Royle  | Papaveraceae    | Picrorhiza kurrooa   | Achay-na numo-mindok   | High Alpine meadows, moist alpine pastures | Whole plant parts<br>**Extract:** whole plant part extract is given to the patient in small doses for a week against gastric related discomforts. Leaf paste is applied externally on swelling portions of legs caused due to long walks.<br>Critically Endangered |
| Podophyllum hexandrum      | Berberidaceae   | Podophyllum          | Kaor Perennial herbs   | Alpine meadows, moist alpine pastures | Root<br>Rhizomes are collected washed and shade dried completely and ground into fine powdered which is then taken orally along with one cup of warm water or milk to kill roundworms and other intestinal parasites, stomachs, and intestinal infection. A decoction of root powdered is considered to be beneficial for diabetic and jaundice patients. It is also used to cure burning urination and kidney disorders.<br>Endangered |
| Rheum spiciforme Royle     | Polygonaceae    | Rheum                | Lhachu Perennial herb  | Mesic alpine stone slopes | Root, Stem<br>Dried as well as raw fruit was consumed directly as it is believed to be helpful for curing gynecological disease like menstrual irregularity, improves lung and blood circulation, helps in parturition, skin diseases, anti-cancerous<br>Vulnerable |
| Rheum webbianum Royle      | Polygonaceae    | Saussurea            | Oma-khol/lachoo       | Alpine stone meics slopes, between boulders. Screes, alpine pastures | Root, Stem<br>The stem is consumed as raw as it has a sour taste. It is used to treat swelling wounds, rheumatism, fever, Internal damages, chronic bronchitis, and piles.<br>Vulnerable |
| Saussurea bracteata Deene   | Asteraceae      | Saussurea            | Spangsi-tawo          | Alpine meadows, moist meics slopes | Leaf, flower buds<br>**Paste:** a paste of flower buds is applied externally to cure boils, cuts, and wounds, applied on the forehead to relieve headache.<br>Vulnerable |
| Saussurea costus (Falc.)    | Asteraceae      | Aconitum             | Rulta Perennial herb   | Mostly cultivated in Leh and Kargil | Root<br>Roots were used to cure various ailments such as cancer, diabetes, ulcer, kidney disorders, central nerve problems, Gastric troubles and dysentery<br>Critically Endangered |

- **Aconitum* heterophyllum**<br>- **Aconitum* violaceum**<br>- **Aconitum* rotundifolium**
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