



## Ethnobotany of *Juniperus polycarpus* C. Koch (Cupressaceae) in the Himalayan cold desert of Union Territory of Ladakh, India

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Union Territory of Ladakh is phytogeographically Trans-Himalayan region located in the northernmost part of India and known for unique biological, cultural diversity and rich traditional knowledge. The report presents first ethnobotanical survey on the traditional usage of a gymnosperm plant commonly known as ‘Himalayan Pencil Cedar’ or ‘Turkistan Juniper’ (*Juniperus polycarpus* C. Koch, syn. *J. excelsa* subsp. *polycarpus* (C. Koch) Takht). Many ethnobotanical trips were made to collect ethnobotanical information in the year 2015-16 in different villages where habitats of *J. polycarpus* were present. The survey revealed that *J. polycarpus* is deeply rooted in the cultural, religious practices of the locals and considered as one of the most sacred trees among the Buddhist. The study showed that *J. polycarpus* has been used as raw material for aromatic incenses preparation, timber in construction of Buddhist monasteries, medicinal plant by local healers, fuel wood and fodder, making of household articles and for decoration of *Lha-thos* in Ladakh region. The plant is classified under least concern (LC) category by IUCN but reported as declining in its natural habitat. The paper gives an account that such an extensive use is the key causal factor for its decline and therefore conservation required.

**Keywords:** Conservation, Ethnobotany, *J. polycarpus*, Juniper, Ladakh, *Lha-thos*

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The juniper, *Juniperus polycarpus* C. Koch (syn. *J. excelsa* sub sp. *polycarpus* (C. Koch) Takht; *Juniperus macropoda* Boiss.) from Cupressaceae family, is commonly known as Himalayan “pencil cedar”. The plant is an evergreen coniferous tree or shrubby plant of about 30-60 ft in height. The genus *Juniperus* comprises more than 60 species and 28 varieties across globe and represent one of the important coniferous trees distributed in Northern Hemisphere. The junipers are most abundantly distributed in the temperate regions of Europe and North America<sup>1</sup>. The plant is distributed throughout the temperate and alpine regions of Western Himalayas, from Afghanistan, Pakistan to Jammu and Kashmir, Union Territory of Ladakh (hereinafter Ladakh), Himachal Pradesh, Uttarakhand and Nepal at an altitude of 5,000-14,000 ft<sup>2</sup>. There has been debate over number and name of juniper species in India but their existence is well established<sup>3,4</sup>. Seven species of junipers have been reported from India. The four species occur in the Eastern Himalaya, four

in the Western Himalaya and one species is common to both regions<sup>5</sup>. Out of seven, three species namely *J. polycarpus* (syn. *J. macropoda* Boiss.), *J. recurva* Buch.-Ham. ex D. Don. and *J. communis* L. are exclusively distributed in the Ladakh region<sup>4</sup> and Wanla, Hanupata, Dha-Bema, Hanu Yokma, Skurbuchan, Allam-Tillat of Chilling-Sumda and various parts of Nubra valley at an altitudinal range of 7,000-14,000 ft are the places where they grow dominantly (Fig. 1). In general, Junipers are the major dominating species of alpine scrub forest. They are found between 2800 m to 3650 m and receive average annual precipitation of up to 1500 mm<sup>6</sup>. Ecologically, the plant survives the freezing temperature and grows luxuriantly in the cold arid climate of Ladakh. The plant is considered as an important species in the fragile ecosystem of cold desert. The plant is locally known as ‘Shukpa’ in Buddhist communities and ‘Chilgi’ among the Brokpa tribes of Ladakh. The plant has immense socio-cultural and religious significance for the local community living in Ladakh region and considered as sacred tree among the Buddhist communities. Several researchers have

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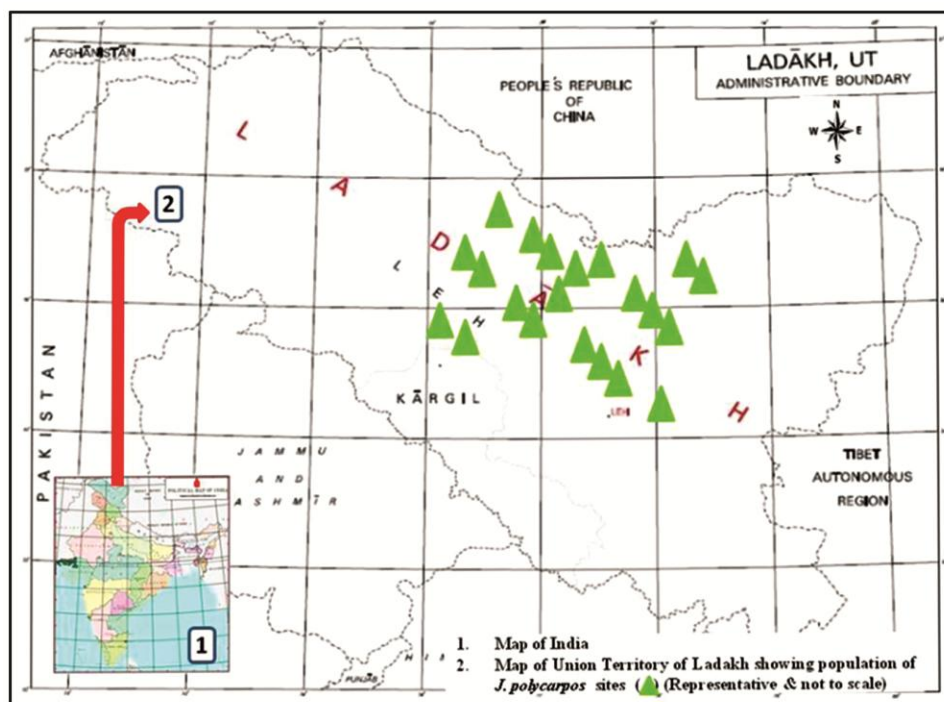


Fig. 1 — Map of the study area showing habitat of *J. polycarpus* in Union Territory of Ladakh, India.

made extensive floristic investigation in past from different sub-regions of Ladakh to document the ethnobotanical knowledge, the usage pattern of local plant based dishes, traditional phytofoods and medicinal usage of plants<sup>7-12</sup>. However, the ethnobotany of Juniper in general and *J. polycarpus* in particular, has been poorly studied and documented especially in Ladakh region. To fulfill this knowledge gap, an ethnobotanical survey study was conducted in different sub-regions of Ladakh to bring forth the traditional usage of *J. polycarpus* and to know the extent of threats that has arisen due to excessive uses for religious and cultural purposes by local people and propose few measures for conservations.

## Methodology

### Study location

Ladakh is located in the Trans-Himalayan region in northernmost part of India. It is a high altitude mountainous cold desert surrounded by Karakoram and Greater Himalayan Range. The region is one of the highest places in the world, with an altitude of the inhabited places varying from 8,000 ft. above mean sea level near Kargil to around 20,000 ft. in some areas of Chang-thang sub-division of Leh district of Ladakh<sup>13</sup>. Ladakh is located in rain shadow portion of Indian Himalayan region and called as 'Little Tibet'<sup>14</sup>.

Ladakh has been recently created (October 31, 2019) as Union Territory carving out two districts-Leh and Kargil from erstwhile Jammu & Kashmir state<sup>15</sup>. Ladakh shares international boundaries by Pakistan in West, Afghanistan in the North-West, People's Republic of China in the North and Tibet Autonomous Region in the Eastern part. Internally, Jammu and Kashmir is making boundary by South-West and Himachal Pradesh in South-Eastern Part of Ladakh. The region experiences extremely cold arid climate. The area is characterized by the extreme heat and cold, dryness, low oxygen and atmospheric pressure. The temperature fluctuates between 35°C during summer months to minimum of (–) 35°C during extreme winter. The annual precipitation (snowfall/rainfall) is very little (80-300 mm) and consequently, the low relative humidity (<30%) makes the area forbiddingly arid<sup>10</sup>.

Geographically Ladakh region can be divided into two provinces viz. Ladakh Mountain and Eastern plateau<sup>16</sup>. Ladakh Mountain consists of rugged mountain ranges and valleys whereas Eastern plateau is an undulating elevated landscape. Snowline in this region starts from 5800-6000 m altitude<sup>14</sup>. The region is one among the climatically very inhospitable region for human habitation, resulting in assemblage of Central Asian and Tibetan rare flora and fauna along

with combination of unique culture, tradition and religion. People are predominantly Buddhist in Leh and Muslim in Kargil district of Ladakh. Tribes constitute 90% population of Ladakh. Ladakh represents an amalgam of diverse and unique tribes of different origin including 'Boto', 'Balti', 'Khache', 'Broga', 'Changpa' and 'Purigpa'. The people of Ladakh were self-sufficient farmers in the past, living in secluded villages scattered along the river valleys using glacio-fluvial sediments for crop farming. Barley (*Hordium vulgare* L.) is the major crop of Ladakh region followed by Wheat (*Triticum aestivum* L.)<sup>17</sup>. Pea (*Pisum sativum* L.) and several other vegetables grown in high-altitude environment. The vegetation of the region differs significantly from other parts of India and varies from temperate to alpine mesophytes and desert shrubs. Temperate deciduous forests of *Salix* spp. and *Populus* spp. along with patches of Juniper and Birch forest and trees of *Prunus armeniaca* L., *Juglans regia* L. and *Pyrus malus* L. constitute the principle tree vegetation in the region. However, shrubs and herbaceous aromatic plants form the main alpine vegetation in Ladakh. (Fig. 1)

#### Data collection

Many ethnobotanical surveys were conducted mainly in remote villages (Wanla, Hanupata, Skurbuchan, Hanu Yokma, Chilling-Sumda and Nubra valley) in different parts of Ladakh during 2015-16 for the collection of ethnobotanical information related to uses of *J. polycarpus* growing abundantly in the natural habitat.

Ethnobotanical information's were gathered by semi-structured interviews involving local populace with 70 elderly informants of survey villages (Table 1). Interviews were conducted in local dialect 'Boti' or 'Ladakhi'. Their beliefs and knowledge about juniper plant in Ladakh were recorded and cross checked. Further, the information related to religious aspect of the plant was collected by visiting different sacred places and interviewing with the *Lamas* (the local priests). During survey, efforts have been made to reach the eldest people as they were considered as knowledgeable and good informant of biodiversity, ethnics and culture.

During the field trips, plant materials were collected for the purpose of herbarium and specimen for identification. Botanical features including leaf size and shape, branching pattern, male flowers and female cone, number of seeds per cone etc. were

noted in the field.

Photographs of habit and habitat, traditional and sacred usages of *J. polycarpus* were taken using digital camera (Sony DSC-S-3000).

#### Data analysis

The qualitative analysis of collected data and interview process revealed that Himalayan Pencil Cedar (*J. polycarpus*), locally referred as 'shukpa' or 'chilgi' has great ecological, socio-cultural and religious significance among locals and especially Buddhist of Ladakh, where this plant is regarded as the 'sacred tree'. The information extracted through interviews clearly showed that juniper trees have developed a deep symbolic religious and traditional value. The study also revealed several unique practices associated with this plant in Ladakh since time immemorial. Therefore, *J. polycarpus*, regarded as *Lha-shing* – trees of god and thereby, the people were forbidden to destroy such trees.

## Results and Discussion

#### Taxonomic description

*Juniperus polycarpus* C. Koch, member of Cupressaceae, commonly known as Himalayan pencil cedar and locally called as 'Shukpa' or 'Chilgi'. It is an evergreen coniferous tree or large shrubby plant reaching 30-60 ft in height (rarely above 60 ft) and 3-6 ft in diameter. It is conical to broadly conical or rounded or sometimes irregular in habit and grows luxuriantly along the mountain slopes and deep valleys in the cold desert of Ladakh (Fig. 2a-b). The plant is profusely branched with green juvenile needle-shaped leaves of 6-8 mm long and adult scale-like ovate leaves of 1-2.5 mm long. *J. polycarpus* is dioecious plant with separate male and female individuals with male cones and female cones. Female cones are solitary axillary in position, berry-like, 5-10 mm in diameter, globose, green in young to blue-black colored on maturity (Fig. 2c). Each female cone contains 3-6 seeds at maturity. Male cones are solitary terminal in position; yellowish-brown colored and somewhat oval shaped (Fig. 2d).

#### Ethnobotanical studies

##### *Juniper as sacred tree*

It was found that many *J. polycarpus* trees were found commonly growing near *Gompas* (monasteries) and other sacred places. Their occurrence in the premises of the places of worship was ascribed to one of the most incredible beliefs among Ladakh's people

Table 1 — Demographic features of the informants (n=70)

Features	Frequency of informants						Total
	*S1	*S2	*S3	*S4	*S5	*S6	
<b>Gender</b>							
Male	10	06	08	06	05	10	45
Female	08	04	04	03	02	04	25
<b>Marital status</b>							
Married	14	08	10	08	07	12	59
Single	03	02	02	0	0	02	09
Widow	01	0	0	01	0	0	02
<b>Age</b>							
Between 25-45	04	02	02	0	01	04	13
Between 46-65	08	06	05	05	03	06	33
Between 66-85	06	02	05	04	03	04	24
<b>Level of education</b>							
No formal education	04	04	02	04	04	04	22
Primary education	12	06	08	04	03	08	41
Adult education	0	0	0	0	0	0	0
Secondary education	02	0	02	01	0	02	07
College education	0	0	0	0	0	0	0
University education	0	0	0	0	0	0	0
<b>Employment status</b>							
Employed	02	0	03	0	0	02	07
Unemployed	03	02	01	03	0	04	13
Farmer/pastoralist	12	08	08	06	07	08	49
Retired	01	0	0	0	0	0	01
<b>Tribe</b>							
Boto	18	10	12	0	07	12	59
Brogpa	0	0	0	09	0	0	09
Balti	0	0	0	0	0	02	02

\*Survey Sites: S1-Wanla, S2-Hanupata, S3-Skurbuchan, S4-Hanu-Yokma, S5-Chlling-Sunda, S6-Nubra valley

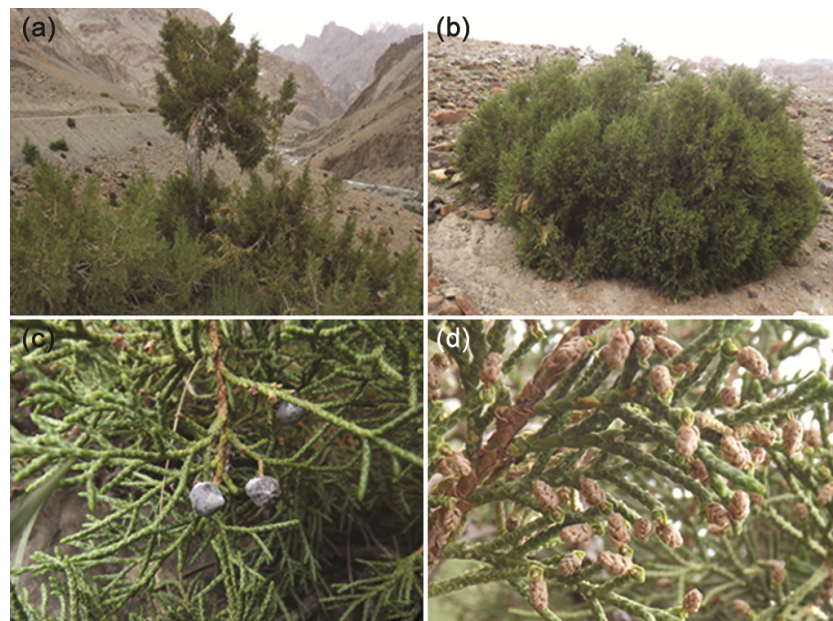


Fig. 2 — *Juniperus polycarpus*: (a & b) Plant habit in natural habitat; (c) Female cone; (d) Male cones.



that some kind of divine spirit or god (locally known as *Lha*) likes and inhales the pleasant fragrance of Juniper and resides in them. These trees were, therefore, regarded as *Lha-shing* (trees of god) and thereby, the people were forbidden to harm, cut or destroy such trees (Fig. 3a). One can easily find such large population of 'Shukpa' growing in sacred groves at higher elevations of Ladakh.

#### *Juniper for decorating Lha-thos*

It was revealed during the survey that for centuries, the local inhabitants of Ladakh and Tibet have often been using green twigs of *J. polycarpus* for decorating *Lha-thos*, a typical structure that comprised of a bunch of Juniper twigs (*Lha-shuk*) fixed in between the rock edges or in a small square wall (locally termed as *Lha-bang*) made of clay, bricks or/and stone, at the elevated top of a hill or roof (Fig. 3b-c). The term *Lha-thos* is derived from the word *Lha* that stands for god and *thos* means a square wall. As per Buddhist mythology, the people considered *Lha-thos* as the shrine of gods and goddesses and believed that *Lha* or god resides in *Lha-thos* and protect people from the evil spirits and undesired incidents.

*Lha-thos* were decorated annually during the auspicious occasion of the local New Year known as *Losar* that falls during the month of December. During this event, it was customary to replace old Juniper twigs from *Lha-thos* with fresh bunches. After that the *Lha-thos* and *Lha-shings* were worshiped by offering 'phokk' (Juniper incense) and 'kalcholr' (sacred barley drink) and illumination with earthen lamps containing apricot (*Prunus armeniaca* L.) oil. The people were prohibited from any sort of unhygienic or unlawful activity around the sanctum sanctorum and it was commonly believed that *Lha-thos* and its surrounding areas must be kept clean, or else *Lha* or the god would be annoyed and may spell havoc on the polluter. Whenever such harmful incidents happened, the local people would rush to call the local priests called *Lamas* who would then perform some exceptional prayers known as '*Lhab-sangs*'. These prayers were supposed to purify the guilty from his sins and would create a sanitized environment in the vicinity of the *Lha* or god.

#### *Use of juniper for incensing*

Owing to the pleasant aroma of Juniper twigs, the local people were known to generate mesmerizing aromatic smoke from the leaves and twigs of *J. polycarpus*. For incensing, raw coal or dried dung cakes were placed in a typical earthen bowl locally

called as '*phokspor*' specially designed for this purpose (Fig. 3d). After that the dried crushed leaves and twigs of *shukpa* were put over the burning coal. This produced incense with pleasant smell of Juniper. It is now known that the aromatic fragrance is due to presence of essential oils, terpenoids, diterpenoids and some phenolic compounds<sup>18-20</sup>. For getting better and more aromatic incense, people would mix *shukpa* with several other plant products locally known as *khampa* (*Tanacetum dolichophyllum* (Kitam.) Kitam, *palu* (*Waldheimia glabra* (Decne.) Regel) and *Sia mentok* (*Rosa foetida* Herrm. and *R. webbiana* Wallich ex Royle) (Fig. 3e).

#### *Juniper in ladakhi folk songs*

The cultural heritage and sacredness of *J. polycarpus*, locally called 'Shukpa', was well depicted in several



Fig. 3 — Traditional usage of *Juniperus polycarpus*: (a) A sacred Juniper tree- *Lha-chang*; (b and c) Mystical *Lha-thos* with Juniper twigs; (d) Traditional *Phokspor* producing juniper aromatic juniper smoke; (e) Green Juniper twigs mixed with other plant materials for incensing; (f) Juniper wood used for *Lakshing*- wooden cover for Buddhist holy manuscript; (g) Juniper timber used as pillar in Buddhist monasteries; (h) *Zem*- a container made from Juniper wood.

Ladakhi traditional folk songs that describe the cultural and religious values of these trees. For e.g,

*Ka langtakh yahgi ni tsamsteh ruhh Pa lalu rulugsteh ruh chehnn*

*Ka langtakh yahgi ni tsamsteh ruhh Yah lalu rulugsteh ruh chehnn*

*Pa lalu Yalu tahng majalahh... La lashing shkpa tangh jaal*

*La lashing shukpa weh tuludpa woh Stang chhogi Layul lang jung*

*La lashing shukpa weh tuludpa woh Yog djugs ki luyul lang jung*

*La lashing shukpa weh tuludpa woh Par choggs ki charms yul lanh jung*

Translated in English as:

*Along the foothills of huge mountains Went in search of Palu (aromatic plant)*

*Along the foothills of huge mountains Went in search of Yalu (a plant)*

*Palu and Yalu could not be found The tree of god Juniper appeared*

*The fragrant smoke of trees, Juniper Spreads to the upper world (heaven) of god*

*The fragrant smoke of trees, Juniper Spreads to the god of under-earth*

*The fragrant smoke of trees, Juniper Spreads to the middle world (earth)*

#### **Uses of Juniper in Buddhist Monasteries**

The sun dried and finely powdered twigs and leaves of *J. polycarpus* along with other material including some precious stones locally known as *Yuhh*, *Churu* and *Motigg*, were used for filling the inner hollow space of Buddhist statues or idols made from special local clay called *Markalaga* mixed in crushed wool. This amalgam was known as *Zungs*.

#### **Use of juniper as timber**

The wood of *J. polycarpus* is highly aromatic and is used for a variety of purposes. The wood was carved out for making *Lak-shing*, a wooden plate for covering the Buddhist manuscripts (Fig. 3f). The *Lak-shing* was usually rectangular with average length of 30-60 and 12-20 cm width. These were varnished or painted and/or decorated with some sacred paintings. Since the juniper wood is believed to be strong, durable and highly resistant, the large wooden logs of *shukpa* were also used in erecting pillars, making doors and window frames in monasteries (Fig. 3g).

#### **Use of juniper in making of household articles**

Twigs of *J. polycarpus* have been in Ladakh for making nose-ring, locally called 'sNachu' for Yak, a

high-altitude domestic animal. Similarly, its woods were carved out to make a multi-purpose container, locally called 'Zem', used for storing barley wine, curd and wheat flour (Fig. 3h).

#### **Medicinal use of juniper**

Local healers use *J. polycarpus* in the traditional Amchi system of medicine. The whole plant is used in treatment of nervous disorders, heart related diseases and kidney disorders. The plant is also used as antibiotic for animals and for repelling flies.

#### **Threats and conservation status**

##### **Threats**

During the survey, it was realized that *J. polycarpus* C. Koch population growing in Trans-Himalayan Ladakh is highly threatened in their natural habitat and may go extinct in near future if the prevailing factors continue to put pressure on the species existence. Although, there are number of other factors responsible for declining population of *J. polycarpus*. Among them, the indigenous overuse of juniper for cultural and religious purposes is considered to be predominant factor leading to decline in its natural population. Other most prevailing factors include:

##### **Excessive use for incensing**

One of the most potent factors for overexploitation of Juniper leaves and twigs used during incensing in religious and cultural activities organized in every part of Ladakh region throughout the year has led to decline in the population of this plant.

##### **Excess collection during Losar**

Additionally, collection of Juniper during the eve of *Losar* the local New Year, for decoration of *Lhatos* has unintentionally led to overexploitation and destruction of the natural habitat of *J. polycarpus*. During the days of *Losar*, indigenous people are intentionally or unintentionally found engaged in ruthless cutting and collection of wild Juniper while some irresponsible locals are blindly involved in illegal marketing of juniper twigs.

##### **Over-grazing**

Another significant threat to *J. polycarpus* is the biotic pressure due to overgrazing of young seedlings by livestock, especially during winter when every green plants senescence and dries up, leads to habitat destruction and decline in tree number.

##### **Low regeneration, viability and long dormancy**

Unfortunately, *J. polycarpus* shows very poor regeneration potential in natural as well as artificial habitat<sup>21</sup>. Seed germination is very low due to prolong seed dormancy because of which seeds do not

germinates even in the presence of favorable environmental conditions necessary for seed germination in soil<sup>22</sup>. These features of Juniper become a resilient barrier in its propagation and growth in natural as well as outside habitat.

#### **Lack of management**

Lack of proper management plan from local government and concerned authorities is another factor responsible for declining Juniper species population in Ladakh.

#### **Conservation Status**

*J. polycarpus* is placed under the Least Concerned (LC) category during the global data assessment in the year 2011 by IUCN. It shows that the current global population is showing declining trend in number of mature individuals and populations are severely fragmented<sup>23</sup>. In view of continuous anthropogenic and abiotic pressure originating due to changing climate on *J. polycarpus* population in the survey areas, and given the socio-cultural significance of Juniper, the conservation of juniper forest patches in Ladakh are of urgent priority. A similar suggestion for conservation of this species has been placed in Himachal Pradesh<sup>4, 5</sup>. At present, very little endeavor has been made for *in-situ* and *ex-situ* conservation of juniper forests in this region. Overexploitation and excessive collection of juniper for the purposes of incensing and *Lha-thos* redecoration during the occasion of Losar, the local New Year, needs to be regulated to reduced pressure on juniper population. *In-situ* conservation of natural juniper woodland must be given priority for successful conservation and re-establishment of *J. polycarpus* in its natural habitat in the cold desert of Ladakh. The present paper also suggests establishment of juniper nurseries for *ex-situ* propagation and establishment of Juniper forest. Further, authorities must support rehabilitation programs and distribute seedlings among the local farmers for successful cultivation of Juniper on private land. This would compensate the requirement of juniper leaves and wood for personal purposes, and would reduce pressure on the natural forest.

In addition research and scientific studies on ecological and historical knowledge of Juniper forest must be encouraged. Such knowledge could provide a reference point for framing of management policies and legal liabilities for conservation of juniper forest. Further, open grazing of juniper seedlings by livestock needs to be regulated to reduce biotic

pressure and conserve the natural forest. Ladakh Vision Document (2025) clearly states that measures like conservation of trees needs to be paid attention, community woodlots should be raised and individual efforts should be encouraged to plant more trees<sup>24</sup>. There should be selective and priority driven plantation of timber trees along with regulatory legal measures should be introduced to discourage or completely ban on conversion of agricultural land beyond a point in ecologically sensitive Ladakh. Establishing juniper nurseries and checking the harvesting of juniper for ritualistic purposes are other parallel measures that can be adopted. However, the unfortunate part is that the previous local government and concerned authorities have miserably failed to accomplish the vision of conserving trees in general and junipers in particular. But, after getting Ladakh as Union Territory status has given new hope for its promotion and conservation. As of now when Ladakh has got status as UT, the threatened juniper population in Ladakh may be covered, after due assessment for conservation under Wildlife (Protection) Act, 1972. The section 17A of Chapter IIIA (Protection of specified plants) of this Act strictly prohibits picking, uprooting, damaging, destroying and collecting any specified plants from any forest land, protected areas or any other protected area specified by government. With incorporating and implementing all these measures will not only help in rise in population of Juniper but also help in maintaining the ecological fragile and sensitive region of Ladakh for sustainable development.

#### **Conclusions**

The outcome of the present investigation indicates that *J. polycarpus* C. Koch in Ladakh showcase in-depth linkage with rich cultural, traditional and sacred values associated with local people, particularly in villages along with playing a significant role in ecological conservation in fragile environment of Ladakh. In addition, the blooming Junipers, growing in the jagged terrain 'as sacred groves' in the mountains of Himalaya give an enchanting view to the forbidden land of Ladakh. However, extensive usages of *J. polycarpus* due to society myths, cultural significance and sacredness associated with it have threatened its existence in natural habitat. Therefore, there is an urgent need of comprehensive research to estimate the species richness of Juniper, degree of anthropogenic pressure, future prospects and propagation techniques which would help in effective

conservation of juniper plants in highly sensitive and fragile high-altitude ecosystem of Ladakh.

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### Conflicts of Interest

Authors declare that there are no conflicts of interest.

### Author Contributions

KD contributed to the designing and collection of data. KD and AKM jointly analyzed the data, interpreted results and wrote of the manuscript.

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