

Need for conservation and sustainable utilization of *Juniperus communis* in Western Himalaya, India

The genus *Juniperus* (Cupressaceae) is represented by about 75 species limited to the landmass of the former northern supercontinent Laurasia¹, with the exception of *J. procera* Hochst. ex Endl. occurring in the southern hemisphere along the rift mountains in East Africa, and *J. oxycedrus*, *J. phoenicea* and *J. thurifera* in the mountains of Morocco and Algeria in the northernmost part of Africa^{2,3}. In Uttarakhand (part of Western Himalaya), India, the genus is represented by 13 species⁴, six species, namely *J. communis*, *J. indica*, *J. semiglobosa* (found in Milam, Darma and Byans valley), *J. macrospoda*, *J. recurva*, *J. squamata*. Among these *J. communis*, *J. indica* and *J. semiglobosa* are found only in the cold desert region of Uttarakhand and Himachal Pradesh (Lahaul valley)^{4,5}. The ability of *J. communis* species to inhabit areas with a continental climate, rocky outcrops and poorly developed soil allows them to be a major element of xeric forests⁶, making them a major source of fuelwood in the cold desert areas of the valley. The rapid decline in *Juniperus* populations due to overexploitation and habitat degradation in recent times has drawn attention towards the conservation needs of this genus^{7,8}, particularly in the cold desert ecosystems (Figures 1 and 2). Thus, the present study was aimed to examine the population of *J. communis* in the cold desert region of Byans valley (31°046'–32°05'N lat. and 76°50'–77°04'E long.) in Pithoragarh district, Uttarakhand, with respect to: (i) collection and assessment of utilization pressure on *J. communis* species, and (ii) management intervention of this species for future research. The Byans valley covers an area of 278 km² with an altitudinal range of 2800–7600 m amsl and is inhabited by tribal communities residing in four fringe villages (Table 1). Byans valley forms the most venerated area in the Kailash Sacred Landscape (KSL), with unique cold desert habitats which support rich, representative and unique elements of biodiversity. The area is also important for tourists and pilgrims.

Based on the field survey, 30% of households were randomly selected in each village, namely Gunji, Navi, Napalchu, Kuti of the valley. It was observed that fuelwood collection was mainly carried out between April and October. On average, fuelwood collection was done by the villagers for

about 128 days and the collected wood was utilized for 195 days during their stay in the villages. Further, on average, one person from each family went to the forest to collect fuelwood. The total collection of *J. communis*, probability of use (PU) and resource use index (RUI) were calculated following the method of Samant *et al.*⁹. Further, to identify the patterns of species availability, a detailed phyto-sociological study was conducted in the nearby forests. Three plots of 20 m × 20 m each were marked in the nearby forest area of the respective villages (Table 2). Within each plot, four (5 m × 5 m) quadrats were enumerated for shrubs (including *Juniperus* spp.). The size and number of quadrats were determined following Misra¹⁰ and Muller-Dombois and Ellenberg¹¹. The available biomass (tonnes/ha) was calculated using the method of Chaturvedi and Singh¹².

Among the fuelwood species, the highest PU of 0.89–0.70 was recorded for *J. communis*. The total mean collection of fuelwood was found to be maximum (1395.2–2662.4 kg/household/yr; 1.3–2.6 tonne/household/yr) for *J. communis* followed by

J. indica, *Rosa macrophylla* and *Salix elegans*. About 9124 kg (76.03 kg/household/day) of wood and 5293 kg (44.11 kg/household/day) of leaves were removed annually from nearby *Juniperus* forests by the inhabitants of Lahaul valley⁵. The collection of fuelwood was maximum in Lahul valley compared to Byans valley. This may be because in Lahul valley, the local inhabitants stay permanently, and collect fuelwood throughout the year. The roots of *J. communis* are also used by the locals in the preparation of incense. *J. communis* is used for the treatment of epilepsy, asthma, diarrhoea, abdominal pain, ear ache, toothache and diseases of the spleen, kidney and abdomen⁵, and also used for the same purpose in the Byans valley. The inhabitants of region also burn *juniper* leaves in the morning and evening as offerings to their deities. However, considering the high use-value, the availability of *J. communis* (132–252 individuals ha⁻¹) was recorded to be very low in the Byans valley (Table 2). Rawat and Everson⁵, reported a low density of *J. communis* in the natural forests of Lahaul valley. They also reported that *J. communis*



Figure 1. *Juniper communis* plant.



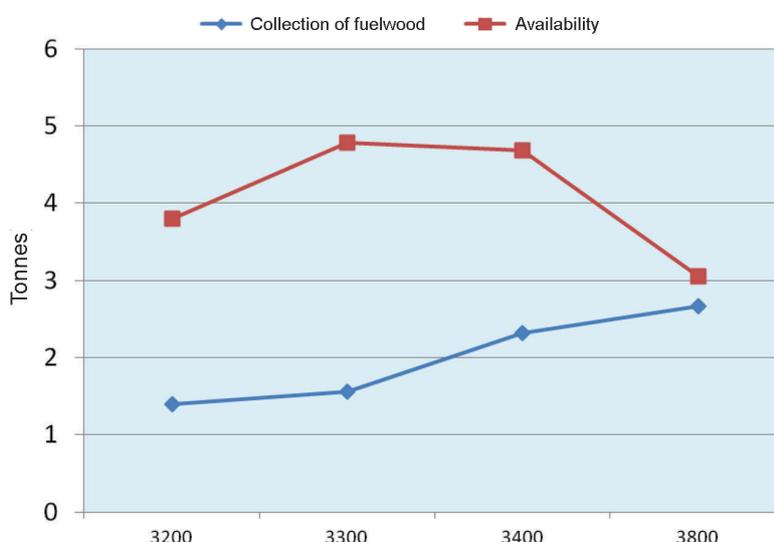
Figure 2. Extensive felling of *J. communis* in Byans valley, Pithoragarh, Uttarakhand, India.

Table 1. Selected study villages of Byans valley, Pithoragarh, Uttarakhand, India

Village	Elevation (m amsl)	Location	Total number of households	Total population	Average family size
Gunji	3200	30°11'13.88"N, 080°51'4.58"E	194	335	1.72
Navi	3300	30°11'29.59"N, 080°51'15.14"E	32	78	2.43
Napalchu	3400	30°11'7.37"N, 080°51'10.17"E	25	74	2.96
Kutti	3800	30°18'28.53"N, 080°45'39.80"E	115	363	3.15

Table 2. *Juniperus communis* collection for fuelwood from the forest area in the Byans valley

Village	Altitude (m amsl)	Utilization of <i>J. communis</i>				Availability	
		Total mean collection per day	Total mean collection per year kg (tonne)/house hold	PU	RUI	Biomass (tonnes/ha)	Density (individuals ha ⁻¹)
Gunji	3200	10.9 (±2.10)	1395.2 kg (1.3 tonne)	0.70	976.6	3.8	164.1
Navi	3300	12.2 (±1.13)	1561.6 kg (1.5 tonne)	0.75	1171	4.7	252.0
Napalchu	3400	18.1 (±4.8)	2316.8 kg (2.3 tonne)	0.83	1923	4.6	219.3
Kutti	3800	20.8 (±3.0)	2662.4 kg (2.6 tonne)	0.89	2370	3.0	132.5

**Figure 3.** A reverse trend with altitude between availability (tonne/ha) and collection for fuelwood (tonne/household/yr) of *J. communis* in the Byans valley.

occurred at all four study sites with the highest density of 500 individuals ha⁻¹ at the Jahlma site, followed by 218 individuals ha⁻¹ at Hinsar site, 29 individual's ha⁻¹ at Kuthar site and only 6 individuals ha⁻¹ at Khoksar site in Lahul valley. Rawat *et al.*⁷ reported the density of *J. communis* as 200 individuals ha⁻¹ in Jahlmanal watershed in Lahul valley. In the present study, a reverse trend was observed with altitude (m) between fuelwood collection/harvesting (tonnes/house hold/yr) and availability in the forest area (tonnes/ha) in the Byans valley (Figure 3).

For conservation and sustainable management of the *J. communis*, the following

actions are necessary: (i) A systematic scientific approach is required for harvesting/collection of *J. communis* from the forest area. (ii) Plantations of other ecologically suitable fuelwood species such as *Hippophae salicifolia* (seabuckthorn) and *Salix elegans* (willow) can be promoted in the valley to reduce the pressure on *J. communis*. (iii) In order to regenerate *J. communis*, open grazing land needs to be regulated and saplings of *J. communis* must be planted. (iv) Mass plantations can be promoted on private land to fulfil the personal requirements of wood. (v) Provision should be made to provide solar-based equipment (like solar cooker and solar

heater) for cooking and heating purposes to the local community. (vi) Strengthening traditional community forestry institutions (e.g. Van Panchayats) through capacity-building and promoting awareness and education regarding the potential of fuelwood species, availability of their stock in the forest, scientific and sustainable harvest practices, and less wasteful fuelwood consumption practices among the local community.

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