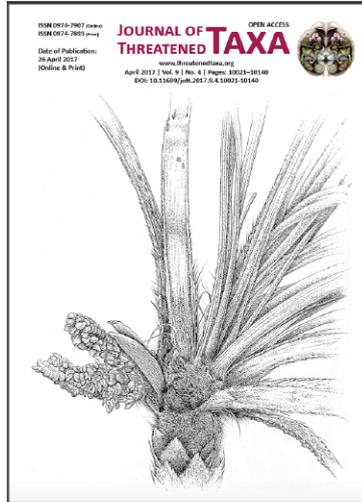


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Short Communication

CONSERVATION STATUS ASSESSMENT AND NEW POPULATION RECORD OF THE THREATENED GOLDEN HIMALAYAN SPIKE *PHLOMOIDES SUPERBA* (ROYLE EX BENTH.) KAMELIN & MAKHM. FROM JAMMU & KASHMIR, INDIA

Amber Srivastava, Yash Pal Sharma, O.P. Sharma Vidyarthi & Sunil Kumar Srivastava

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CONSERVATION STATUS ASSESSMENT AND NEW POPULATION RECORD OF THE THREATENED GOLDEN HIMALAYAN SPIKE *PHLOMOIDES SUPERBA* (ROYLE EX BENTH.) KAMELIN & MAKHM. FROM JAMMU & KASHMIR, INDIA

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Abstract: This paper deals with distribution and conservation status of the Golden Himalayan Spike *Phlomooides superba* (Royle ex Benth.) Kamelin & Makhm. (syn. *Eremostachys superba* Royle ex Benth.), an endangered herb in India. A new locality report from Jammu & Kashmir along with population status in previously reported localities of occurrence of this species is also provided. Since the species is reported from a very few localities in India and is facing critical threats in the wild, the addition of a new locality holds significance in terms of its declining population status.

Keywords: Conservation, endangered, endemic, *Eremostachys superba*, new locality, *Phlomooides superba*.

The Golden Himalayan Spike *Phlomooides superba* is a rare, handsome and threatened tuberous herb found in the lower Shiwalik belt of northwestern Himalaya. The species has attracted the interests of different workers due to its beautiful flowers, rarity and ethno-

botanical uses. *P. superba* was first collected by J.F. Royle from Kheeree Pass (now Mohand Pass), Dehradun, Uttarakhand. As mentioned by Chowdhery & Wadhwa (1984) in the flora of Himachal Pradesh, Mukherjee (1940) found this species growing in the Kangra region of Himachal Pradesh while Sharma & Kachroo (1981) reported this species from Domel, Jammu & Kashmir. Later, a few populations were also located from Suketor and Khandel hamlets of Jammu (Koul et al. 1997) and Sunderbani area of Rajouri District (Verma et al. 2003). Interestingly, the alarming decline in its population led other workers to locate this species from other places resulting in the discovery of two more localities in Himachal Pradesh, one from Una (near Gujreda) and the other from Kangra (near Khundian) (Uniyal et al. 2012).

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Competing interests: The authors declare no competing interests.

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MATERIALS AND METHODS

The data related to occurrence and distribution of *Phlomoides superba* was collected from available sources like herbaria, literature and personal communication to locate the population of the species in different regions of India. During the study on the population size and conservation status of the species in all the reported localities in India, the data related to GPS location and altitudes have also been recorded. The area of occupancy (AOO) and extent of occurrence (EOO) values of the taxon were obtained using the geo coordinates of the reported localities in online GeoCAT software (<http://geocat.kew.org/editor>) and taking standard grid size (2km) for each site as per the guidelines developed by the International Union for Conservation of Nature (IUCN 2016).

RESULTS AND DISCUSSION

During the field surveys conducted to locate the populations of *P. superba* in different regions of Indian Western Himalaya, the authors found a hitherto unreported population of this species in Udampur District of Jammu & Kashmir. The locality is about 7 km from Ramnagar on the way to Udampur in a small village Jallow near Kaghote. A luxuriantly growing population of nearly 200 mature plants with more than 300 saplings was found in an area of approximately 450m². This new population is unique in itself due to its complete natural habitat growing along the sides of a small stream with few individuals scattered in the adjoining crop fields along the stream. The habitat is situated on a gentle rocky slope having sandy loam soil. Unlike other earlier reported populations from the state, growing on edges of crop fields, this population is relatively undisturbed.

Phlomoides superba (Royle ex Benth.)

Kamelin & Makhm. in Bot. Žurn. (Kiev) 75: 248. 1990.

Eremostachys superba Royle ex Benth.

in Hook., Bot. Misc. 3: 381. 1833; Lab. Gen. Sp. 637. 1833. (Image 1)

Family: Lamiaceae

Description

Perennial, tuberous herbs, 0.5–1.5 m high. Stems erect, hairy, branched or unbranched. Basal leaves oblong to ovate in outline, simple and crenate to pinnatifid or pinnatisect with lobed or serrated margins, with a sparse indumentum of simple hairs on both surfaces; lamina 10–20 x 5–10 cm; petioles upto 10cm long; cauline leaves sessile, pinnatifid. Roots thick, woody, vertical; collar woolly or scarcely. Verticillasters 5–17, each having 6–14 flowers, arranged distantly,

white lanate. Bracts 1/2–2/3 length of calyx (6–10 mm), ovate-lanceolate to lanceolate, margins spinulose. Calyx broadly ovate-campanulate, 12–15 mm, subcoriaceous, with an indumentum of simple nonglandular hairs sometimes also with some shorter glandular hairs; teeth ending in 1–2 mm spines. Corolla 25–30 mm, yellow; upper lip villous and white-bearded with simple hairs only; lower lip subequal to or longer than upper lip, sometimes with a very broad median lobe; tube 0.5–1 cm long, included in calyx, without an annulus. Nutlets trigonous, 7x3.5 mm, brownish-black (Image 1).

Flowering & Fruiting: March–May

Vernacular Names: ‘Gajar-moola’ (Dogri - Jammu & Kashmir); ‘Gorein’ ‘Goreyan’ (Pahari, Kangri - Himachal Pradesh); Ban muli (Hindi)

Distribution: Western Himalaya [eastern Afghanistan, Pakistan, India (Jammu & Kashmir, Himachal Pradesh and Uttarakhand)] (Fig. 1)

Specimens examined: 120821 (BSD), Jammu & Kashmir, Ramnagar, Jallow Village, 32.79490°N & 75.22942°E, 640m altitude, coll. Amber Srivastava.

CONSERVATION STATUS ASSESSMENT

This taxon has not yet been included in the IUCN Red List of Threatened Species; however, different conservation status were proposed by previous workers, viz., ‘Vulnerable’ (Jain & Sastry 1980; Ved et al. 2003; Samant et al. 2007; Pant & Pant 2011), ‘Endangered’ (Jain & Sastry 1984; Garg & Rao 1997; Verma et al. 2007; Panwar & Srivastava 2015; Panwar et al. 2015; Pundir 2015), ‘Critically Endangered’ (Verma et al. 2007; Panwar 2014; Panwar et al. 2014) and ‘Near to Extinction’ (Som 1968; Rao & Garg 1994), which were based on the study of one or a few localities.

In India, the species is reported from only 10 localities occurring in the States of Jammu & Kashmir (seven locations), Himachal Pradesh (two locations) and Uttarakhand (one location). Maximum number of locations are reported from Jammu & Kashmir and only a single location is reported from the type locality Mohand, Uttarakhand (Table 1).

Since most of the reported localities of the species are near the cultivated fields or road sides, the magnitude of the threat has increased manyfolds owing to conversion of agricultural lands, road broadening etc. The population of the type locality though falls in the outer boundary of Rajaji Tiger Reserve but is located near road side adjacent to Saharanpur-Dehradun highway as a result of which this population is at the verge of extinction. The human interferences in terms of crop field extension, grazing by cattle, and exploitation for medicinal and

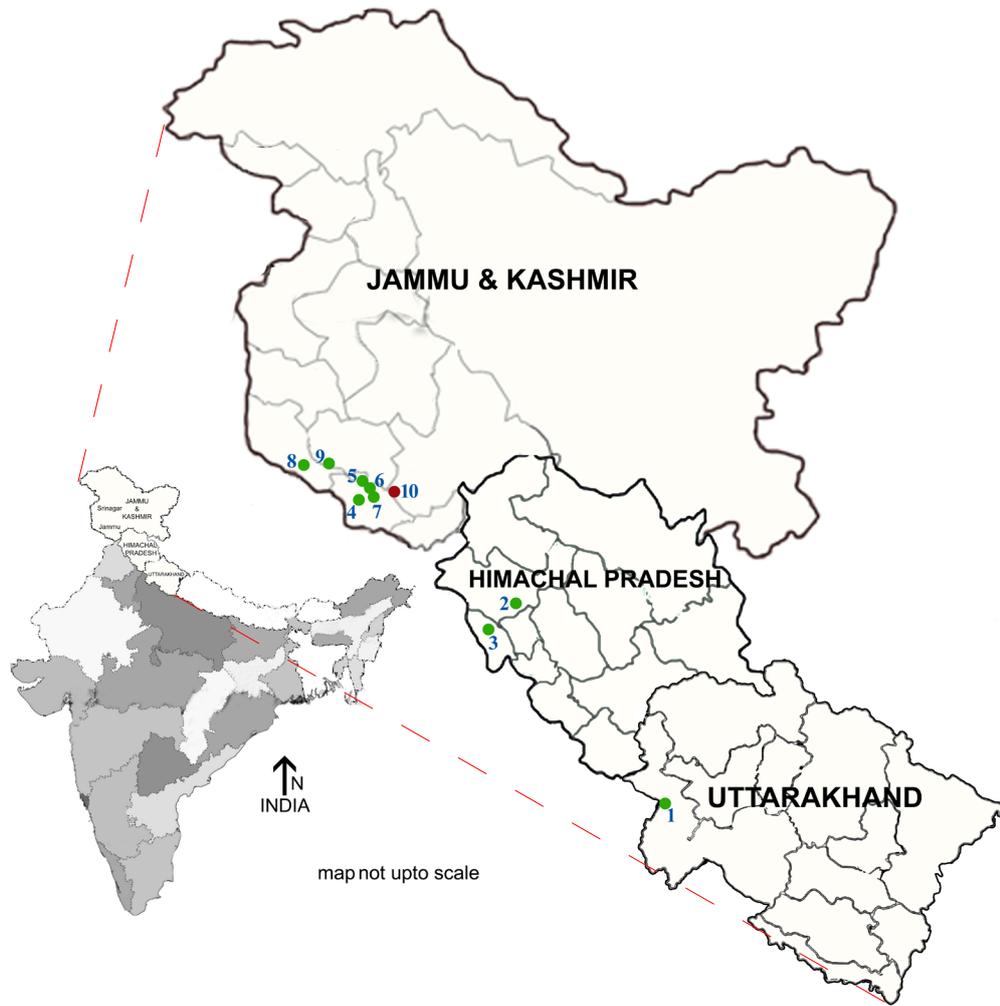


Figure 1. Distribution of *P. superba* in India; viz., Mohand¹ (Dehradun, Uttarakhand), Khundian² (Kangra, Himachal Pradesh), Gujreda³ (Una, Himachal Pradesh), Panj Garain⁴, Domel⁵, Suketor⁶, Tara⁷ (Jammu, Jammu & Kashmir), Bal Shama⁸, Pouni⁹ (Reasi, Jammu & Kashmir), Jallow¹⁰ (Udhampur, Jammu & Kashmir)

Table 1. Showing total number of localities reported in India, population size and percentage decline

	Locality	Altitude	Habitat	Earlier population reports (approx.)	Present population 2016 (approx.)	Percentage decrease in years (approx.)
1	Jammu & Kashmir, Domel	580m	On the edges of crop fields	400 in 1996 (Koul et al. 1997)	50	87% in 20 years
2	Jammu & Kashmir, Tara	450m	On the edges of crop fields	122 (Verma et al. 2007)	70	43% in 9 years
3	Jammu & Kashmir, Jallow	650m	On the sides of a stream adjacent to crop fields	Not known	500	–
4	Jammu & Kashmir, Bal Shama	550m	Adjacent to road side on the edges of crop fields	1022 (Verma et al. 2007)	450	56% in 9 years
5	Jammu & Kashmir, Suketor	400m	On the edges of crop fields	108 (Verma et al. 2007)	45	58% in 9 years
6	Jammu & Kashmir, Panj Garain	480m	Forest edges adjacent to crop fields	Not known	15	–
7	Jammu & Kashmir, Pouni	615m	On the edges of crop fields	Not known	25	–
8	Himachal Pradesh, Khundian	730m	On the edges of crop fields	500 (Uniyal et al. 2012)	350	30% in 4 years
9	Himachal Pradesh, Gujreda	570m	Forest edges	22 (Uniyal et al. 2012)	14	36% in 4 years
10	Uttarakhand, Mohand	550m	Forest edges adjacent to road	18 (Verma et al. 2007)	3	83% in 9 years
Total number of present population - approx. 1522 individuals						



Image 1. Natural habitat of *Phlomoidea superba* at (a) Jallow Village, J&K; (b) In between crop fields at Khundian, HP; (c) Enquiring about ethnobotanical uses of *P. superba* from a local farmer; (d) Local farmer showing mature plants and dug-up tubers; (e) *P. superba* plants flowering in ex situ conservation at Botanical Survey of India, Dehradun, (f) Botanical Garden, University of Jammu; (g) Mass scale propagation at BSI Dehradun for ex situ conservation and re-introduction. © Amber Srivastava & Yash Pal Sharma.

veterinary uses are major threats to the species. Besides these, biotic factors such as low regeneration potential, insect infestation and forage of tubers by wild animals (porcupines, boars and rats) are the other causes of population decline.

Area of Occupancy (AOO): 40km²

Extent of Occurrence (EOO): 9,317.213km²

Conservation status: Endangered B2ab(ii,iii,v) version 3.1. The assessment is done as per the IUCN guidelines (IUCN 2016) and is based on the frequent field surveys carried out from 2013–2016 in all the reported localities of occurrence in India. The population decline of the

species was also determined by comparing the earlier population records reported by different workers (Jain & Sastry 1980; Verma et al. 2007; Uniyal et al. 2012; Pundir 2015) with the present number of surviving individuals. Justification for the threat assessment is included in Appendix 1.

ECONOMIC IMPORTANCE

Ornamental: The plant has high ornamental potential due to its beautiful yellow spikes of flowers that last for nearly one month. For the beauty of its flowers, well known botanist J.F. Duthie has called it an “extremely local and very handsome plant” (Duthie 1911).

Veterinary: The tuberous roots of *Phlomooides superba* are used for increasing lactation in cattle. Interviews with the people in the present locality revealed the use of its tubers for increasing lactation in cattle as also reported by earlier workers (Koul et al. 1997; Verma et al. 2003; Pant & Pant 2011). But presently, partially due to the rarity of this species and also due to the increasing use of chemical galactagogue drugs, only a few people use this for the purpose and that too it is only fed to buffaloes.

Medicinal: During the field surveys in different areas of Himachal Pradesh it is found that the tuberous roots of the species are also used by local herbal healers for treatment of human ailments related to liver, stomach, gout etc. Some of these medicine men used to cultivate it in their gardens for medicinal use while others generally exploit it from the wild habitats.

CONCLUSION

The natural populations of *Phlomooides superba* are declining at an alarming rate from all the reported localities of its occurrence in India and urgently need conservation measures both ex situ and in situ. Efforts have been made for ex situ conservation of this species and a large germplasm is being maintained at the Botanical Survey of India, Dehradun and the Botanical Garden of the Department of Botany, University of Jammu, Jammu. Saplings of this species raised at BSI are also distributed to various institutes and individuals (Yash Pal Sharma, pers. obs.) for planting; however, it is still lacking an in situ approach, as a result of which the species is nearing its extinction from its type locality Mohand, Uttarakhand. The high ornamental value of this species makes it suitable for planting in botanical gardens for both aesthetic value and ex situ conservation. In view of the ethno-botanical utilization of this species, further studies are needed to analyze its phytochemistry and its potential use in treating human ailments.

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Appendix 1. IUCN Red List Assessment: *Phlomooides superba* (Royle ex Benth.) Kamelin & Makhm. (syn. *Eremostachys superba* Royle ex Benth.)

Common name: Gajar-moola (Dogri); Gorein, Goreyan (Pahari, Kangri); Ban muli (Hindi)

Taxonomic notes: The species was first collected by Dr. Royle in 1832 from Kheeree Pass (now Mohand Pass) on the basis of which George Bentham described it in 1833 in Botanical Miscellany. It was earlier treated in the genus *Eremostachys* Bunge but later on merged into *Phlomooides* Moench on the basis of upper corolla lip not laterally compressed and with tuberous lateral roots (Kamelin & Machmedov 1990).

ASSESSMENT INFORMATION

National Red List Category and Criteria for India: Endangered B2ab(ii,iii,v) ver. 3.1

Justification: *Phlomooides superba* is treated as Endangered in the present assessment as the species is restricted to only ten severely fragmented locations in India. Though the extent of occurrence is 9,317.213km² which qualifies for Vulnerable category. The area of occupancy is estimated to be about 40.00km², which meets criterion B2 for Endangered.

Most of the reported locations are severely fragmented due to anthropogenic activities (Habitat destruction and degradation) and are located far apart from each other. Also, the low dispersal ability (dispersal distance: 50m-500m) of the taxon meets the sub-criteria B2a under Endangered.

Continuous decline in area of occupancy and habitat quality due to extension of agricultural lands and other anthropogenic activities is also observed and the total population size is squeezed down to nearly 1500 mature individuals mainly due to habitat loss and change in land use pattern (Table 1), which qualifies for the Endangered category under sub-criteria B2ab(ii,iii,v).

Since the species distribution is not contiguous with the neighbouring country subpopulations in Pakistan and Afghanistan, the Indian distribution is not influenced by the effects of colonization from the neighbouring populations. The assessment of EN therefore is retained for the Indian population of the species.

GEOGRAPHIC RANGE / DISTRIBUTION INFORMATION

Range description: The species is distributed in the lower Shivalik belt of western Himalaya at an altitude range of 400-800 m.

Countries of occurrence: Afghanistan, Pakistan, India (Jammu & Kashmir, Himachal Pradesh and Uttarakhand).

Extent of Occurrence (EOO): EOO is approximately 9,317.213km², which is based on the total 10 recorded populations from India and is calculated by using Minimum Convex Polygon (MCP).

Area of Occupancy (AOO): Area Of Occupancy (AOO) value is nearly 40.00 km² considering the total number of reported populations in India and taking the standard grid size of 2km as per IUCN guidelines (Fig. 2).

Number of locations (severely fragmented): In India, the species is reported from only ten localities occurring in the States of Jammu & Kashmir (seven locations), Himachal Pradesh (two locations) and Uttarakhand (one location). The maximum locations are reported from J&K and only a single location is reported from the type locality Mohand in Uttarakhand.

Range map: Distribution of the taxon is given in Fig. 1.

POPULATION INFORMATION

Population: The species is estimated to have nearly 1500 individuals distributed in ten reported localities in India.

Population trend: The population is continuously decreasing in size as estimated from the previous records and present field surveys. The population of the type locality Mohand is nearly at the verge of extinction as only three individuals were sighted during the recent field surveys. The maximum decline in population is observed in the type locality of this species.

HABITAT AND ECOLOGICAL INFORMATION

Habitat and ecology: The species is generally found on exposed to semi-exposed gentle slopes of forest edges in sandy or rocky soil at an altitude range of 400-800m. With the extension of agricultural lands, some of these habitats came near or in between the agricultural fields resulting in increased threat to the population.

The species flowers during the months of March and April and after the maturity of fruits in May and June the species undergoes short-term dormancy for 2-3 months between June to August.

INFORMATION ON THREAT

Threats: Different factors both natural and anthropogenic are responsible for the population decrease of this species in wild habitats. During the field surveys following threat factors are noticed in the natural habitats:

a) Habitat destruction and degradation: The habitat destruction is caused due to extension of agricultural lands resulting in destruction of wild populations of *P. superba*. Since most of the reported populations are near the agricultural fields, with the extension of agricultural lands, some of these habitats came near or in between the agricultural fields resulting in increased threat to the population. Also, the grazing of cattle in wild habitats also affected the habitat quality in other locations (*viz.* Mohand, Bal Shama etc.).

b) Low regeneration potential: Low regeneration potential is also observed and reported by earlier workers (Garg & Rao 1997, Verma et al. 2007, Pundir 2015) as one of the main causes of population decline. The low regeneration potential is due to low seed set and lower germination percentage with short viability period.

c) Over exploitation: The species is generally uprooted for medicinal uses by local people and Gujjar tribe for increasing lactation in cattle and other medicinal uses of its tuberous roots resulting in rapid population decrease in many localities near human settlements.

d) Biotic factors: The tuberous roots are eaten by wild animals like porcupines, wild boars and rats resulting in loss of mature plants. The mature spikes are attacked by different pests resulting in heavy loss of seeds in wild populations (personal observation).

The combined effect of all these factors has played an important role in the destruction of this species from its wild habitats mainly in the type locality of the species (Mohand Pass) where the population is gradually squeezed down to near extirpation.

Additional threats: The species is exploited for its ornamental flowers.

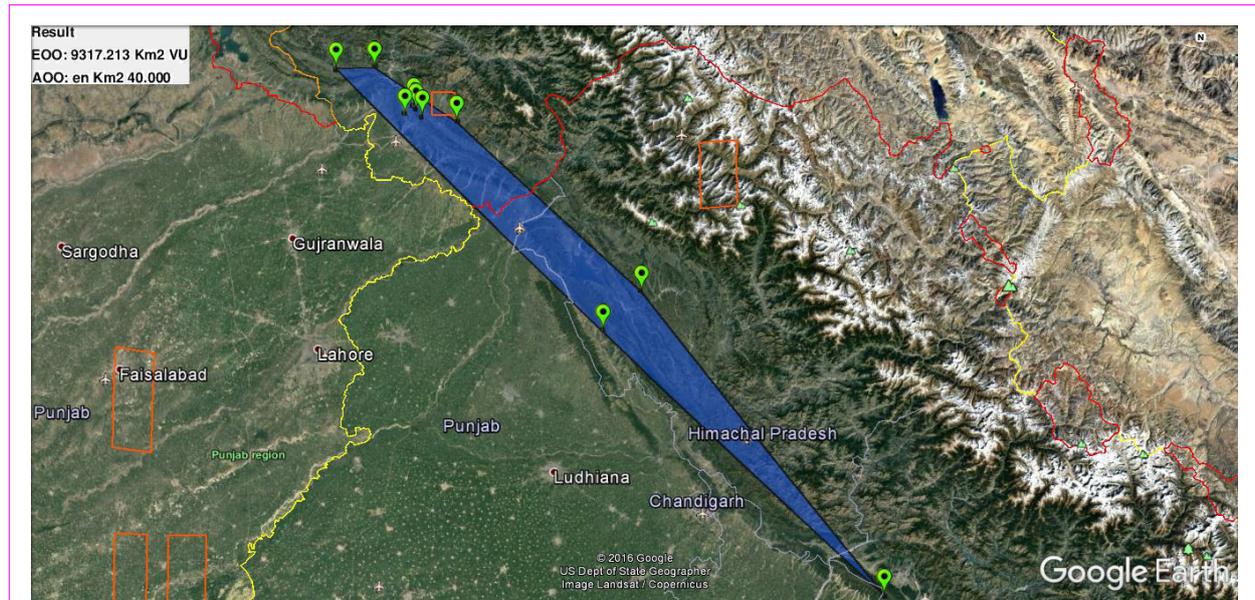


Figure 2. Area of Occupancy (AOO) and Extent of Occurrence (EOO) of *Phlomoides superba* in India

USE AND TRADE INFORMATION

Use: The species is used as veterinary medicine and for increasing milk production in cattle by Gujjars. The species is also used medicinally by local people for human ailments.

Livelihoods and sustenance: The communities depend on this species only for local uses and no commercial use is reported.

Trend in off take from the wild: Generally uprooted for its medicinal use by local people and Gujjars. Also, occasionally uprooted for its beautiful flowers by the trespassers. The trend is decreasing due availability of modern medicines and also due to rarity of the species.

Trend in off take from cultivation: The species is only found cultivated under ex situ conservation in Botanical Survey of India, Dehradun and Botany Department of University of Jammu, Jammu. It is also cultivated by some enthusiasts for its beautiful flowers.

Commercial value: The species is presently not having any commercial demand but has high commercial potential due to its ornamental and medicinal uses.

INFORMATION ON CONSERVATION ACTIONS

Conservation actions in place: Botanical Survey of India, Dehradun is actively working on the conservation of this species under ex situ conservation programme for the past 10 years. Attempts are also made to reintroduce the species in other suitable wild habitats near the type locality.

Conservation actions needed: In situ conservation through habitat protection and along with reintroduction and benign introduction of the species is needed in suitable natural habitats.

Research in place: Researches have been carried out in taxonomy, regeneration potential, propagation, relocation, reproductive biology and ex situ conservation.

Research needed: Systematic surveys, effects of threats and mitigation, in situ conservation measures by introduction of propagated saplings in suitable habitats and development of cultivation protocol are some of the much needed research actions.

Monitoring in place: Population monitoring has been done only in the type locality of the species.

Monitoring needed: Monitoring in population trends and habitat trends is essential and must be implemented at the earliest for all the reported localities.

Education in place: No formal or informal education about the species is in place.

Education needed: Outreach programmes about the species to local communities and forest department are crucially needed.

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