Conservation of rare orchid (*Cypripedium cordigerum*) in Nagtibba, Western Himalaya, India

Final Report Submitted

To

San Diego County Orchid Society, USA

By

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2008

SAN DIEGO COUNTY ORCHID SOCIETY

SDCOS

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Photographs: Jeewan Singh Jalal

Cover photo: C*ypripedium cordigerum*

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Acknowledgments

To see my conservation dream come to life is no doubt like being blessed and I feel that this project has been one of the important steps towards this dream coming true. This wouldn't have been possible without positive guidance, academic help and professional encouragement which Dr. G.S.Rawat, Dr. Y.P.S.Pangety and Dr. B.S.Adhikari were more than happy to provide and I will always be grateful to them. In such projects sincere field help can not be compared to anything else and my friends Mr. Pankaj Kumar and Mr. Gajendra Singh deserve a special mention in this context.

But without the necessary funds, even the best of dreams hibernate in the minds. Hence I would like shower San Diego County Orchid Society (SDCOS)-USA with millions of drops of gratitude for considering my work up to the mark and I pray that their work to help preservation of nature will expand its boundaries.

As far as the Gujjar families and local villagers are concerned, I will always feel indebted to all of them for their whole hearted involvement to not only make this project a successful one but also for helping it acquire meaningful outcome.

Last but not the least, I would like to thank my wife Dr. Neha for her unconditional support without which my dreams would fall to ground like a tower of cards.

SUMMARY

The temperate forest of Nagtibba is one of the potential sites of the beautiful lady's slipper orchid *Cypripedium cordigerum*. This species, once reported to be abundant in the North-western Himalaya, has now become rare and close to extinction due to the ever shrinking natural habitats. The present exercise is an attempt to know the current status of this species in Nagtibba and also to educate the Gujjar community about the importance of this species. During the present survey ca 230 individuals were recorded in the entire hill top area. Most of the individuals were found to be helpless cattle lunch. To protect this site, I would suggest that the Gujjars should immediately be shifted to other areas. But for a long term of conservation of this species, we have to concentrate more on its ecology, reproductive biology and pollinators. It would be a pity to lose these precious species especially when we know that we can help them stay on.

1.0 INTRODUCTION

Cypripedium is a beautiful word that first referred to Linnaeus in 1737. The name Cypripedium was born out of the land of *Cyprus* where the Goddess of love from Greek mythological Aphrodite was born. The other word he used pedilum which means shoe or slipper. The credit goes to Conrad Gesner for being the first describe slipper orchid (Cribb, 1997). The genus *Cypripedium* consists of some 50 species found in the northern temperate region of Asia, Europe and North America, reaching as far south as Honduras, Guatemala and part of tropical Himalaya. The center of diversity of the genus lies in China where most Cypripedium species are found. They grow in a wide range of habitats from coniferous or mixed deciduous woodlands, to marshes and grasslands. They are terrestrial, with leaves that, in most species, grow fresh from the base each year. The flowers are slipper-like and range in colour from green through white and yellow to red and deep purple.

Six species of *Cypripedium* are distributed across the Indian Himalaya. They are mainly distributed in Uttarakhand (Kumaun and Garhwal), Himachal Pradesh and Jammu & Kashmir. Three species of Cypripedium *viz. Cypripedium cordigerum, Cypripedium himalacium and Cypripedium elegans* are found in the state of Uttarakhand. The beautiful *Cypripedium cordigerum* grows at an altitude of 2200 to 3200m in the Himalaya of Uttarakhand. This species once reported to be abundant in the North-western Himalaya, has now become rare and close to extinction, due the ever shrinking natural habitats. Being lower the population graph of the state this beautiful lady's slipper orchid has been officially classified as rare in the Red Data Book of Indian Plants (Nayar and Sastry, 1987).

In Uttarakhand, very few localities are known where this species is found. Nagtibba, in the outer Himalayan range of Uttarakhand state of India, is one of the potential sites for the beautiful lady's slipper orchid. But due to increasing threats to this species in its natural habitats are largely due to anthropogenic pressures on the unsustainable utilization of the forest resources by the local communities especially Gujjars these wonderful species are in danger. Therefore, to save these rare and novel orchid species of the Nagtibba area, there is an urgent need for *in-situ* conservation. Keeping this in mind, a short term conservation project was proposed for conservation of this species. The overall objectives of this project were to know the current status of population, evaluation of the threats to the species and to educate local people (the Gujjar communities) and forest department for *in situ* conservation.

A plant 40-65 cm tall, rhizome is short and robust, growing in the uppermost soil layer. The rhizome grows annually with a growth bud at one end and dies off at the other end. Stem usually pubescent or glandular-hairy, especially on upper part, with several sheaths at base, sheaths with 2-5 leaves above. Leaf blade elliptic or broadly elliptic, 10-15 X 4-10 cm, margin sparsely ciliate, apex acute or acuminate. Inflorescence a terminal solitary flower, rarely 2-flowered; peduncle; glandular hairy, especially on upper part; floral bracts leaflike, elliptic to lanceolate, 6-9 X 2-4 cm, abaxially pubescent at veins, apex acuminate. Pedicel and ovary 2-4 cm, densely glandular hairy. Flowers 7-10 cm in diam, usually with pale green to pale yellowish green sepals and petals and white labellum, staminodes often yellow and red spotted (Deva and H.B.Naithani, 1986). Petals not resupinate, linear-lanceolate, 2.5-3.5 X 7-9 cm or wider, adaxially pubescent at base, apex acuminate; Lip oblong, white and slipper shaped. Flowering: June-July.

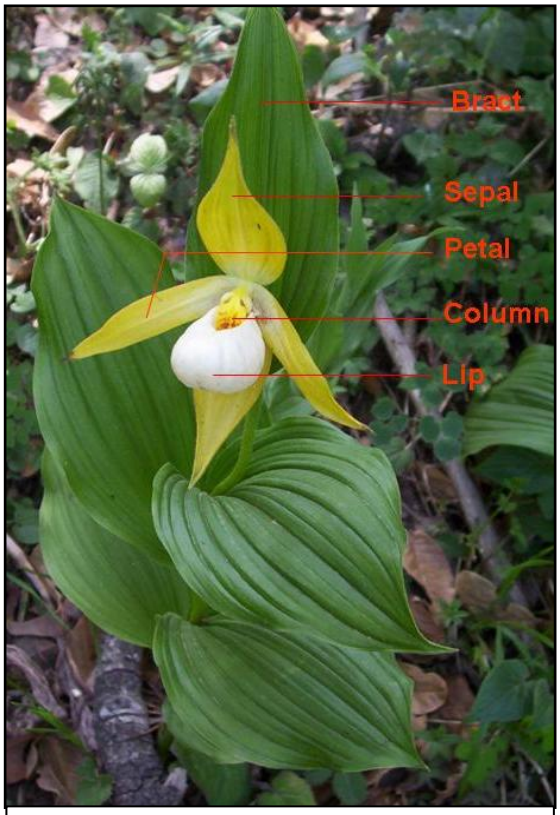

Figure 1. A plant of *Cypripedium cordigerum* showing different parts

3.0 Pollination:

Different species of orchid have a unique floral architecture. In case of *Cypripedium cordigerum* different parts off the flower are attached to the ovary. Pollinators are often visually attracted by the shape and colours of the labellum. When the pollinator enters into the flower, it touches a viscidium, which promptly sticks to its body, generally on the head. While leaving the flower, it pulls the pollinium out of the anther, as it is connected to the viscidium by the caudicle. The caudicle then bends and the pollinium is moved forwards and downwards. When the pollinator enters another flower of the same species, the pollinium takes such a position that it will stick to the stigma of the second flower just below the rostellum, pollinating it.

4.0 Legal status: The plant has been included in the Appendix II of CITES.

5.0 Comparison to other species: *Cypripedium* is differentiated from other genera in the Orchidaceae by the two fertile anthers and slipper shaped lip or labellum. *Cypripedium* species can also show morphological differences among individuals and populations. Table 1 shows the differences of ***Cypripedium cordigerum*** to the other species of ***Cypripedium*** found in the state Uttarakhand (Uttaranchal).

Table 1. Distinguishing characteristics among other species of Cypripedium

Species	Plant height (cm)	Leaves Numbers	Lip colour and length	Staminode length
Cypripedium cordigerum D. Don	40-60	3-6	White with irregular spots, semiglobose, 3 cm long,	10 mm long, ovate or oblong cordate
Cypripedium elegans Rchh.f.	3-10	2 opposite	Subglobose, 1 cm, front with 3 longitudinally arranged purple papilla	transversely elliptic, small, ca. 1.5 mm
Cypripedium himalacium Rolfe.	15-30	3	Purpulish, 2.3 cm, almost globose many longitudinal lines	broadly ovate-cordate, ca. 7 mm

Figure 2. ***Cypripedium himalacium***

Figure 3. ***Cypripedium elegans***

Nagtibba is located to the east of Mussoorie and falls in the Tehri district of Uttarakhand state (Lat. 30° 35′ 15.27″ N and 78° 78′ 21.26″ E Long.). The hill tops an altitude of 3048 m and offers an excellent view of the mountain peaks in all directions (Fig. 1). The temperate climate of Nagtibba generally supports the vegetation of Oak and Rhododendron forest. The area is surrounded by dominant oak species, *Quercus floribunda* locally known as *Moru* and few scattered trees of *Rhododendron arboretum* which is locally called *Burash*. Before starting the actual work a short field visit was made to field site to set-up a temporary base camp. Nagtibba is around 12km away from the nearest road way. In the month of June 2007, I started actual field work. Two local boys from the near by village of Nagtibba were selected as team members.

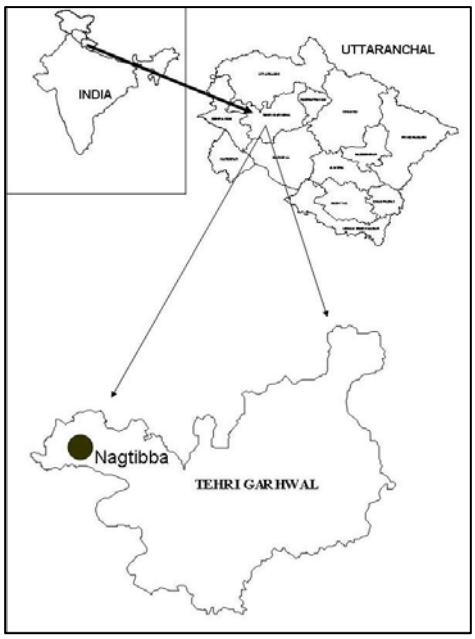

Figure 4. Map that shows the location of Nagtibba

Figure 5. View of study area from digital globe

To understand the ecological features of this species I used opportunistic sampling. I laid 5 x 5 m plot and in each plot habitat parameters viz, Slope, aspect, litter depth, canopy, associate species, altitude and soil moisture were recorded. Adequate soil samples were brought to the laboratory to analyse the other parameters viz, pH, NPK and Organic carbon and soil texture. All the laboratory methods and precautions were followed. A total of 18 plots were laid in different elevations and aspects. Data were analyzed through the software PCORD4 and ARCGIS. During the field work, threat parameters viz, lopping of trees, grazing pressure and number of cattle grazing were recorded. For conservation awareness a get together was conducated with all the local shepherds and the Gujjar (transhumant pastoralist community) community. Simple talks were delivered and field tour was conducted in and around the Nagtibba area. During this exercise I trained two local youth about the importance of this species. With the help of both of them I convinced the other local villagers. I located a number of patches of Cypripedium *cordigerum* plant and showed them to the Gujjars, so that they would be able to identify independently this plant and protect it in the future.

What is known of the ecology of *Cypripedium cordigerum* is based largely on some of the floristic books. Detailed studies on the ecology of *Cypripedium cordigerum* have not been done. However in the European countries much of the work has been done on the ecology, reproductive biology and population genetics of other Cypripedium species (Ballard 1990; Sheviak 1992; Harrod and Knecht 1994; Knecht 1996). In India no such detailed studies have been done on the ecology of any terrestrial orchid especially on Cypripedium genus. This present study is just an attempt to know the ecology of *Cypripedium cordigerum*. Correlation of microhabitat variables was done with the distribution of plots and the correlation was significant and Monte Carlo's test for significance was 0.035. This score of NMS was used in Arc Gis to

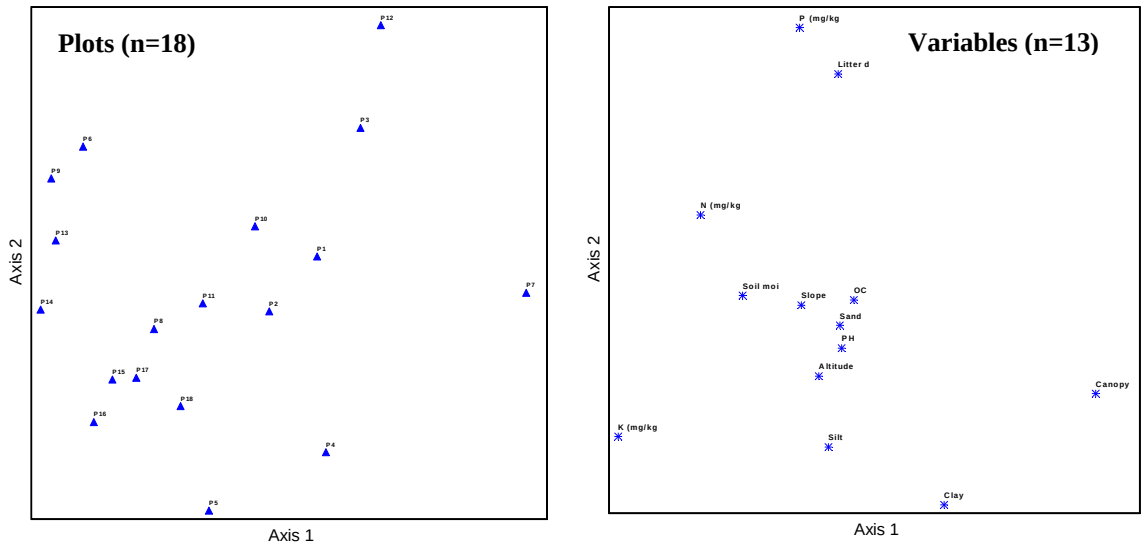

Figure 6. Non metric Multidimensional Scaling (NMS)

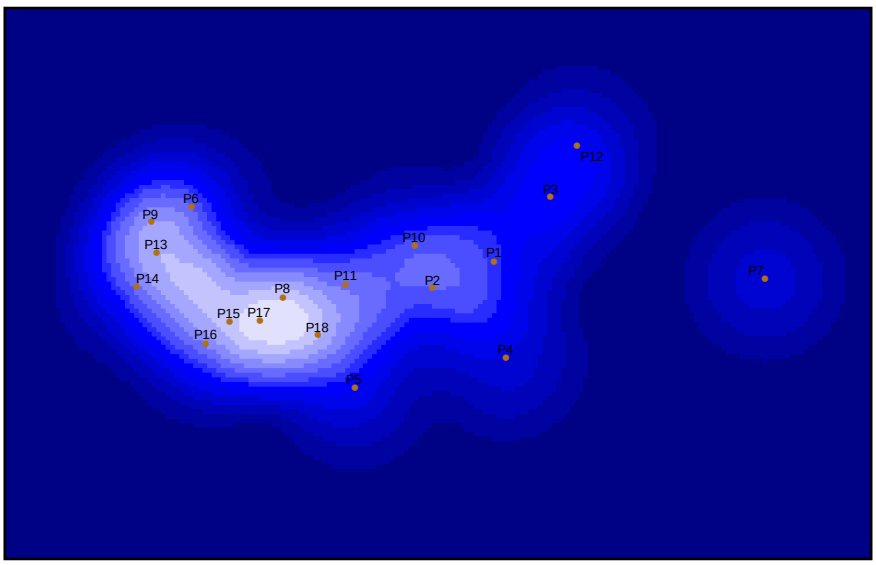

Figure 7. Scatter plot of *C. cordigerum* species showing clusters at different confidence intervals

study the cluster formation at different confidence intervals. Only one cluster was found at 90 and 95% confidence intervals but at lower confidence intervals all the plots of *Cypripedium cordigerum* were separated (Fig. 6-7). This shows that in general at broad level orchids have similar environment of microhabitat variables but at species level each species has a unique environment. The ideal condition for Cypripedium *cordigerum* in Nagtibba is given on the table 2. Main associate species are *Viburnum cotinifolium* (Shrub), *Viburnum foetens* (Shrub), *Podophyllum hexandrum* (Medicinal herb), *Fragaria daltoniana* (Herb), *Anemone rivularis* (Herb), *Galium asperuloides* (Herb), *Rosa macrophylla* (Shrub), *Quercus floribunda* (Evergreen tree), *Quercus semecarpifolia* (Evergreen tree), *Aruncus dioecus* (Herb), *Seneio altus* (Herb), *Pimpinella denticulate* (Herb), *Ranuncolous hirtellus* (Herb) and *Lyonia ovalifolia* (Tree).

Table-2 Microhabitat condition of *Cypripedium cordigerum*

Variables	Average	Range
Litter depth	2.6	1-5 cm
Canopy	26.1	5-65
Altitude	2794.4	2600-3000m
Soil moisture (%)	25.5	22-31
Coarse	48.1	46.8-65.5%
Sand	25.4	21.5-31.2
Silt	17.6	14-20.9
Clay	7.9	4.1-16
N (mg/kg)	0.50	0.307-1.053
P (mg/kg)	542.9	408-773
K (mg/kg)	3539.8	2971-3808
OC (%)	3.4	2.3-3.7
pH	6.2	5.6-7.1

During the present survey it was observed that the major threats to the species population in its natural habitats have been largely due to anthropogenic pressures. The Gujjars community is the main factors responsible for the destruction of these natural habitats of this rare orchid in Nagtibba. Gujjars are forest dwelling semi-nomadic, pastoralist indigenous community, which resides in the forests in the foothills of the Himalayas. They migrate from the lowland plains in the winter to the upper reaches of the Himalayas during the summer. They practice a forest-based form of animal husbandry and produce good quality milk and dairy products, which are

sold in the towns around the forest. They own a large herd of cattle and they use this forest land in Nagtibba for grazing them. These cattle were often found to be eating young flowering bud and sometimes the whole plants. More than hundred plants of this species were found to be growing near a Gujjar's hut that shows that these Gujjars are extensively using this land rich in *Cyperipedium cordigerum*, which has resulted in the depletion of the population of this orchid at Nagtibba. Besides this, the local shepherds also stay on the hill top and contribute to the destruction of habitat. Cutting wood, lopping the oak for cattle and goats are the major threats to this plant.

8.0 Recommendations:

- Maintain or restore habitat conditions of *Cyperipedium cordigerum* in Nagtibba.
- Gujjars should sift to the other areas.
- Population monitoring program should undertake by the state forest department.
- This area should be declared as Special Area of Conservation in Uttarakhand.

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Figure 8. Hill top of Nagtibba (3000m)

Figure 9. A Gujjar hut near the hill top

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Figure 11. Getting information from the local shepherd

Figure 12. During sampling

Figure 13. Local villager having a close view of *C. cordigerum*

About the author

My whole hearted interest in orchids comes not only from the fact that I have grown up among them in the Himalayas but also from my childhood mission to conserve the helpless plants. With the completion of my Post-Graduation in Botany in 2002 from Kumaon University, Nainital, I joined Wildlife Institute of India as a Junior Research Fellow. I obtained a Ph.D. degree in 2005 in Taxonomy of orchids in Uttarakhand. I conducted a short term orchid conservation project in Gori valley 2003 funded by SDCOS. In 2007 I was awarded as a Young Scientist from Department of Science and Technology, Government of India.

ISSN 1934-4880

The McAllen International Orchid Society Journal

Volume 10(2)
February, 2009

Peer-Reviewed Paper

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Conservation of a Rare Lady's Slipper Orchid (*Cypripedium cordigerum* D. Don) in Uttarakhand, Western Himalaya

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(all photos and tables are credited to Dr. Jalal)

Cypripedium is a beautiful word that was first referred by Linnaeus in 1737. The name *Cypripedium* was born out of the land of *Cyprus* where the Goddess of love from Greek mythological Aphrodite was born. The other word he used was pedilum which means shoe or slipper. The credit goes to Conrad Gesner for being the first to describe the slipper orchid (Cribb, 1997). The genus *Cypripedium* consists of some 50 species found in the northern temperate region of Asia, Europe and North America, reaching as far south as Honduras, Guatemala and part of tropical Himalayas.

Cypripedium is differentiated from other genera in the Orchidaceae by the two fertile anthers and a slipper shaped lip or labellum. Six species of *Cypripedium* are distributed across the Indian Himalayas (Fig. 1). They are mainly distributed in Uttarakhand (Kumaun and Garhwal), Himachal Pradesh and Jammu & Kashmir. Three species of *Cypripedium*, *viz. Cypripedium cordigerum, Cypripedium himalacium and Cypripedium elegans*, are found in the state of Uttarakhand (Jalal, 2005). They grow in a wide range of habitats from coniferous and mixed deciduous woodlands to alpine meadows. The beautiful *Cypripedium cordigerum* grows at an altitude of 2200 to 3200m in the Himalayas of Uttarakhand. This species once reported to be abundant in the North-western Himalayas, has now become rare and close to extinction due the ever shrinking natural habitats. In Uttarakhand, there are very few localities where this species is known . Nagtibba in the outer Himalayan range of Uttarakhand state of India, is one of the potential sites for the beautiful lady's slipper orchid (Jalal, 2007).

Fig. 1. Hilltops in Nagtibba (3,000 meters).

Cypripedium cordigerum is a terrestrial herb. It generally grows in small colonies and is rarely found individually (Fig. 2). The rhizome is short and robust, growing in the uppermost soil layer. The rhizome grows annually with a growth bud at one end and dies off at the other end. The height of the plant is variable ranging from 25 to 65 cm, with glandular-hairy stem, especially on

Fig. 2. A cluster of *Cypripedium cordigerum*.

upper part, with several sheaths at base, sheaths with 2-5 leaves above. The leaves are often elliptic or broadly elliptic, and margin sparsely ciliate. It bears a terminal flower, rarely two. Floral bract is leaf like, elliptic with acuminate apex. The ovary is densely glandular or hairy. The flower is 7-10 cm in diameter, usually with pale green to pale yellowish green sepals and petals and white labellum. The staminodes are often yellow and red spotted. The lip is generally oblong, white and slipper shaped (Deva and H.B.Naithani, 1986).

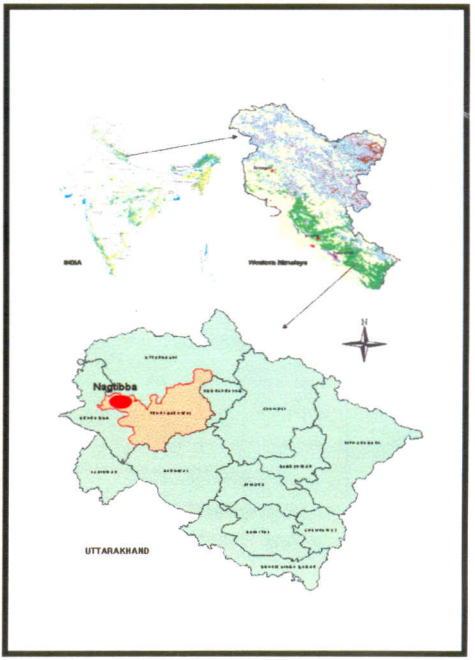

Fig. 3. Location map of Nagtibba.

As per our preparation, we have visited Nagtibba (Fig. 3) in the month of June, 2007, which is the best flowering time of *Cypripedium cordigerum*. Nagtibba is located to the east of Mussoorie and falls in the Tehri district of Uttarakhand state (Lat. 30° 35′ 15.27″ N and 78° 78′ 21.26″ E Long.). Nagtibba is almost

12 km beyond the road head. The hilltops are at an altitude of 3048 m and offer an excellent view of the mountain peaks in all directions.

The temperate climate of Nagtibba generally supports the vegetation of Oak and Rhododendron forests. The area is surrounded by dominant oak species, *Quercus floribunda* locally known as *Moru* and few scattered trees of *Rhododendron arboreum* which is locally called *Burash*. We selected two local boys from the nearby village of Nagtibba as team members and a base camp was setup at the altitude 2000m. The approximate area of the hill top was 6 sq km. The entire hill top was intensively searched. We used forest trail and hill ridges. In each trail, *Cypripedium cordigerum* was counted and habitat parameters, viz, slope, aspect, litter depth, canopy, associate species, altitude and soil moisture were recorded. Adequate soil samples (n=17) were brought to the laboratory to analyze the other parameters viz, pH, N, P, K, organic carbon and soil texture.

During our survey, we reported 468 individuals. The maximum species were found in the northern aspect often under the shade of *Viburnum cotinifolium*. Main associate species were *Viburnum cotinifolium* (Shrub), *Viburnum foetens* (Shrub), *Podophyllum hexandrum* (Medicinal herb), *Fragaria daltoniana* (Herb), *Anemone rivularis* (Herb), *Galium asperuloides* (Herb), *Rosa macrophylla* (Shrub), *Quercus floribunda* (Evergreen tree), *Quercus semecarpifolia* (Evergreen tree), *Aruncus dioecus* (Herb), *Seneio altus* (Herb), *Pimpinella denticulate* (Herb), *Ranuncolous hirtellus* (Herb) and *Lyonia ovalifolia* (Tree). Based on our soil parameters and other variables the ideal condition for *Cypripedium cordigerum* in Nagtibba is given on table 1.

Table 1. Microhabitat condition of *Cypripedium cordigerum*.

S. No.	Variables	Average	Range
1	Litter Depth (cm)	2.6	1-5
2	Canopy (%)	26.1	5-65
3	Altitude (m)	2794.4	2600-3000
4	Soil Moisture (%)	25.5	22-31
5	Sand (%)	48.1	46.8-65.5
6	Silt (%)	17.6	14-20.9
7	Clay (%)	7.9	4.1-16
8	N (Mg/kg)	0.50	0.307-1.053
9	P (mg/kg)	542.9	408-773
10	K (mg/kg)	3539.8	2971-3808
11	OC (%)	3.4	2.3-3.7
12	pH	6.2	5.6-7.1

During the field work, three additional parameters were also recorded, viz,

lopping of trees, grazing pressure and number of cattle grazing. Like other orchid species, *Cypripedium cordigerum* is sensitive to the environment that requires a specific niche in the environment and is typically associated with a specific set of habitat conditions, such as associating mycorrhizal fungi, nutrient availability and sunlight. Destruction of the protective canopy of the oak forests has adversely affected the physicochemical variables of the soil and microclimatic conditions. If changes take place in the habitat, a certain given population may perish.

In our study, it was observed that the major threats to the species population in its natural habitats have been largely due to anthropogenic pressures. The Gujjar community is the main factor responsible for the destruction of these natural habitats of this rare orchid in Nagtibba. Gujjars are a forest dwelling semi-nomadic, pastoralist indigenous community, residing in the forests in the foothills of the Himalayas (Fig. 4). They migrate from the lowland plains in the winter to the upper reaches of the Himalayas during the summer.

Fig. 4. A Gujjar Family.

The Gujjars practice a forest-based form of animal husbandry and produce good quality milk and dairy products, which are sold in the towns around the forest. They own a large herd of cattle and they use this forest land in Nagtibba for grazing them. These cattle were often found to be feasting upon young flowering buds and sometimes the whole plants. More than a hundred plants of this species were found to be growing near a Gujjar's hut. This shows that these Gujjars are extensively using this land rich in *Cypripedium cordigerum*, which has resulted in the depletion of the population of this orchid at Nagtibba. Besides this, the local shepherds also stay on the hill top and contribute to the destruction of habitat. Cutting wood, lopping the oaks for cattle, and goats are the major threats to this plant.

For conservation awareness a meeting was conducted with all the local shepherds and the Gujjars (Fig. 5). Simple talks were delivered and a field tour was conducted in and around the Nagtibba area. During this exercise, we trained two local youths about the importance of this species. With the help of both of them we convinced other local villagers. We located number of patches of Cypripedium *cordigerum* and showed them to the Gujjars, so that they would be able to identify them independently and protect it in the future.

Fig. 5. A local villager having a close view of *C. cordigerum*.

Being lower on the population graph of *Cypripedium cordigerum* in the state, this beautiful lady's slipper orchid has been officially classified as rare in the Red Data Book of Indian Plants (Nayar and Sastry, 1987) and only very few areas in the state are left where this plant is found. Thus there is an urgent need for the conservation of this rare orchid in its natural habitat. In this regard, the government should take immediate action to shift the Gujjars to other areas, and a population monitoring program should be undertaken by the state forest department and other organizations.

Acknowledgments:

We are thankful to the Director of the Wildlife Institute of India for providing us with facilities and encouragement. Many thanks are due Mr. Gajendra Rawat and Dr. Sumit Dokiya for their help during the field work. However, the maximum gratitude has been reserved for the San Diego County Orchid Society (SDCOS)-USA without whose support and financial help this work might have never reached this stage.

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