



THREAT STATUS ASSESSMENT OF *CEROPEGIA ANJANERICA* MALPURE ET AL. (MAGNOLIOPSIDA: GENTIANALES: APOCYNACEAE) FROM ANJANERI HILLS, NASHIK DISTRICT, MAHARASHTRA, INDIA

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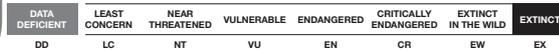
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Abstract: *Ceropegia anjanerica* is endemic to the Anjaneri Hills area of Nashik District. It is assessed as Critically Endangered as per the IUCN red list criteria using primary and secondary information on trends in EOO, AOO and sub-populations. Factors affecting this species and its habitat, and community conservation efforts are described and recommendations are made for its protection.

Keywords: Anjaneri, Anjaneri Wax Fountain, *Ceropegia anjanerica*, Critically Endangered, India, IUCN Red List assessment, northern Western Ghats.



Ceropegia anjanerica
Anjaneri Wax Fountain



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Competing Interest: The authors declare no competing interests.

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Author Contribution: First and second author conducted detailed field studies, photodocumentation, participatory assessment and writing of the paper. Third author helped with analysis and writing the threat assessment.

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INTRODUCTION

Ceropegia anjanerica Malpure, Kamble & Yadav, 2006, was described from the Anjaneri Hills in Nashik District. At the time of description, it was reported to have “about 100 individuals” based on observations in September 2005. Yadav & Kamble (2008) listed it as threatened, and described its status as “endemic to Maharashtra and Critically Endangered”. However, justification of the status was not provided. Population trend data, extent of occurrence (EOO) or area of occupancy (AOO) were not reported by Yadav & Kamble (2008). Observed, estimated, inferred or suspected decline in EOO, AOO or population size has not been reported until now. The species assessment was not compiled as per the IUCN guidelines and has not been reviewed. Hence, the species status remains unassessed on the IUCN Red List (IUCN 2013).

The species was known from only a single location, Anjaneri Hills, Nashik, which is under high biotic pressure such as cattle grazing, tourism and trampling, land use changes, etc. In view of this, detailed field studies were conducted for gaining more information regarding its status and trends in the wild. This paper presents a threat assessment of *Ceropegia anjanerica* based on primary and secondary data, and following the IUCN guidelines (IUCN 2013).

METHODS

Anjaneri Hills is a reserved forest (RF) area and has been given the status of medicinal plant conservation area (MPCA) in 2009-2010. In July 2012, a floristic study project for Anjaneri Hills was started with the support of the state forest department, west Nashik, Maharashtra. Regular fortnightly visits were made to the Anjaneri Hills as a part of ongoing floristic studies of the area. *Ceropegia anjanerica* population was observed since the beginning of June 2012. During each visit individuals of this species were located and their geo-coordinates were obtained using a hand-held GPS (Garmin N72). The information reported here is based on field surveys from June 2012 to December 2012, spanning the entire growth period of *Ceropegia anjanerica*, covering all the stages from vegetative growth, flowering, fruiting to seed dispersal.

The plants in situ were shown to field forest department staff, Joint Forest Management Committee (JFMC) members from local villages and other villagers who frequently visit the area. During village meetings

it was described along with photographs to all the villagers around Anjaneri Hills. The JFMC members and forest staff participated in the field survey and reported additional information used in this assessment.

Inquiries regarding the population of this species were also made in the neighbouring villages (Pahine, Pegalwadi, Kharoli, Talwade, Bramhanwade, etc) and with floristically knowledgeable individuals (e.g., shepherds, traditional healers in the community).

Semi-structured interviews were conducted for documenting its past and present occurrence in this region, growth, population trend and threats from the local people's perception. Photographs of other *Ceropegia* species known to occur in the area (*C. media*, *C. panchganiensis*, *C. oculata*) were shown during discussions to check the local criteria for identification and accuracy level for identifying the target species *C. anjanerica*. Photographs of *Ceropegia attenuata*, the species morphologically closely allied to *C. anjanerica* (Malpure et al. 2006) were also shown. The primary and secondary information is used for the assessment based on IUCN Red List Categories and Criteria Version 3.1 and guidelines for assigning these criteria.

RESULTS

Anjaneri Hill (19°55'11.14"N & 73°34'18.0"E) is a basalt mesa, a flat-topped hill with steep cliff edges. It is one of a cluster of five hills (Image 1), together known as 'Trimbak Range' of the northern Western Ghats. The topmost plateau of Anjaneri (1300m) can be approached by a steep climb from Hanuman-wadi hamlet of Anjaneri Village (680m), located 20km from Nashik City. Another extensive, plateau is present at 1100m along the northeastern ridge of the hill.

Ceropegia anjanerica is a 5–20 cm tall erect tuberous herb (Images 2–3) which is sometimes found to be twining around grasses and other herbs. Vegetative growth was seen in heavy rainfall season (July to August). Flowering initiated in August and continued till October. In 2012, peak flowering was seen during September–October, coinciding with partially sunny but moist and misty climate. Mature fruits were seen during October–November and seed dispersal took place during November. By December the plants had withered away and the tuber had become dormant.

The interviews indicated that the *C. anjanerica* is very well known to the local people who call it 'Lahani Kharpudi'. All the local respondents could identify it with 100% accuracy as they collect and eat the tubers

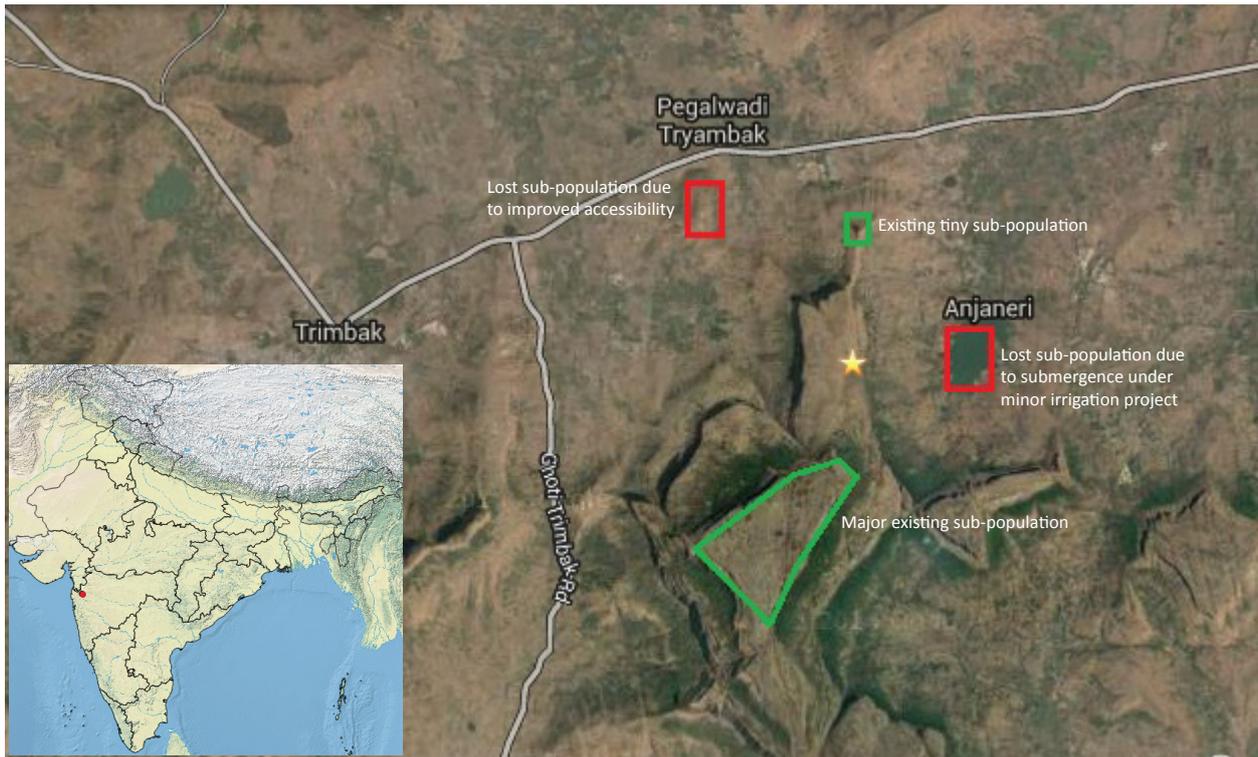


Image 1. Locations of existing sub-populations and extirpated sub-populations of *Ceropegia anjanerica*.



Image 2. *Ceropegia anjanerica* plant with flower.



Image 3. *Ceropegia anjanerica* follicles on withering plant.

raw throughout the monsoon. During the field visits we also came across Bonnet Macaques and Hanuman Langurs consuming the tubers of *C. anjanerica*.

Villagers also identified *C. panchganiensis* with complete accuracy as its tubers and tender shoots are also collected and eaten. The respondents could identify *Ceropegia media* and *C. oculata* correctly and were able to point out individuals throughout the area in participatory visits, though they are not eaten. The

respondents easily distinguished *C. anjanerica* from *C. attenuata*, and clearly stated that the *C. attenuata* does not occur anywhere in the region at present and had not occurred in the past. The ability to identify and distinguish between the different species of *Ceropegia* gives high credibility to the information provided by the respondents regarding its populations in the past and present.

Other species of *Ceropegia* like *Ceropegia sahyadrica*,

C. vincifolia, *C. media*, *C. bulbosa*, etc. have been reported from the Borgad Hills, Trimbak, Brahmagiri Hills and slopes. But surveys and inquiries in these villages confirmed that *C. anjanerica* has never occurred in any of these hills.

Image 1 shows Anjaneri Hills with locations of sub-populations and EOO of *Ceropegia anjanerica*. A total of 870 individuals of *Ceropegia anjanerica* were located on the topmost Anjaneri plateau. They were generally found in 3–12 cm deep soil along with the clumps of herbs like *Justicia betonica*, *Senecio dalzellii*, *Celosia argentea* and *Lepidagathis* sp. No individuals were seen on the lower plateau of Anjaneri. Local respondents reported that the species is found on an adjoining cliff top (Image 1) called Navar-dev.

Ceropegia anjanerica at present occurs in two sub-populations, viz:

- Topmost plateau of Anjaneri (1200m): Number of mature individuals observed in 2012: 870, approximate AOO of sub-population = 0.93 sq.km.

- Top of a small cliff called 'Navar-dev' (19°56'43.0"N & 73°34'50.52"E) just adjoining the main Anjaneri cliff: The cliff is inaccessible except by technical climbing and not regularly accessed by local people. However, as a tradition, once a year, a skilled villager climbs it for certain rituals. The information of *C. anjanerica* presence is based on villager's reports. The area extends to less than 2000m². The sub-population occupies only a fraction (less than 0.25%) of the total AOO.

Though the habitat conditions in which *Ceropegia anjanerica* exists at present are seen all over the main plateau, the individuals are limited specifically to well aerated, shallow, gravelly soil. Local people state that the population of *Ceropegia anjanerica* on Anjaneri plateau has reduced drastically in the past 9–10 years. Many factors like cattle grazing, continued consumption by humans and monkeys, increasing religious tourism leading to trampling of the area, littering and medicinal plant extraction are operative on this plateau. Further autecological studies are necessary to understand the factors affecting the population and recruitment.

Local respondents added that 10–12 years ago, two more sub-populations occurred in the region (Image 1)

- Foothills of Anjaneri to the east (approx. 19°56'11.15"N & 73°35'23.65"E) (approximate AOO of sub-population = 0.27km²). This was submerged under an earthen dam constructed in 2007–08 for supplying water to the adjoining villages.

- Foothills of Anjaneri to the northwest (approx. 19°56'49.86"N & 73°33'57.58"E) (approximate AOO of sub-population = 0.24km²). This population has been lost

since 2000. The possible reasons of loss stated by the local respondents were increased human interference, grazing and closeness to the Nashik-Trimbakeshwar-Jawhar-Dahanu State Highway No. 30.

Inquiries regarding *Ceropegia anjanerica* populations in surrounding villages (Pahine, Pegalwadi, Kharoli, Talwade, Bramhanwade) supported our observations that *C. anjanerica* is restricted only to the Anjaneri surroundings and is or was never present elsewhere.

The above discussion shows that the EOO of *Ceropegia anjanerica* has reduced by almost 60% and four sub-populations have now reduced to two sub-populations, of which one is very small. Increasing human interference of diverse nature is the primary cause. This phenomenon underlines and emphasizes the threats to this restricted species and the need to assign appropriate conservation status.

Threat Assessment: Information collected during the course of this study clearly indicates that *Ceropegia anjanerica* satisfies the criteria necessary for placing it in the Critically Endangered category (IUCN 2013) and is therefore considered to be facing an extremely high risk of extinction in the wild. Its EOO is currently approximately 7.73km², main area of the hill top and adjacent cliff which is far less than 100km², thus satisfying condition B1. The AOO is less than 1km². Local communities have stated that there were four sub-populations some 15–20 years back. AOO then was a little less than 1.5km². The current AOO is found to be less than 0.95km². There is thus considerable reduction in AOO. The above mentioned facts satisfy the criteria for the Critical Endangered category B.

From the information of its past occurrence, the species was spread over a larger area of which only two sub-populations remain and is thus severely fragmented. The larger of the sub-populations is in an area of heavy human disturbance, such as trampling by grazers, livestock, pilgrims. A road to the plateau and development activities may come up in the near future increasing the threat to the larger population. The fate of the smaller population remains unknown. A continued decline has been observed in EOO, AOO, number of sub-populations and area, extent as well as quality of habitat as described above. Thus, it satisfies subcriteria a and b (2 of 3 as required). As seen from above, *Ceropegia anjanerica* fits both CR B1 and CR B2 criteria. We have chosen to designate its status based on EOO and AOO, which are clearly identifiable and quantifiable criteria, and can be measured for future monitoring of the species. Thus the status is Critically Endangered B1ab(iii,v)+2ab(iii,v).

DISCUSSION

Ceropegia anjanerica population is larger than previously reported by Malpure et al. (2006). But two sub-populations have been lost in the past. The pressure of grazing cattle and trampling by tourists has been increasing at a constant rate according to local perception. Additionally, people continue to collect and consume the edible tubers from the existing population putting further pressure on existing resources. Recruitment has not been studied. *Ceropegia* genus is a horticultural curiosity and many other species have been widely collected from this area by plant enthusiasts and grown in private collections. Botanical collection of this *Ceropegia* species is also common in spite of the general awareness of its rarity.

A programme has been initiated with the help of the forest department and JFMC for generating awareness regarding special importance of this species and discouraging the over-exploitation of tubers. Members of JFMC and local forest guards and researchers have held village meetings and sensitization programmes for local people. An article has appeared in the local newspaper mentioning the restricted nature of *Ceropegia anjanerica*, urgency of conserving the species and its habitat and the need for public participation in the process. In spite of this, there has also been drastic increase in trampling due to tourism growth observed during the annual fair on Anjaneri. Many of the plateaux of northern Western Ghats are marked for windfarms. There has been already a request for creating a tar road to the temple on Anjaneri Hills. All these are serious threats which could drastically affect both the remaining sub-populations of *C. anjanerica*. The area harbouring this species also includes other rare, endangered

and medicinal species of plants and animals. The present status of the site is reserved forest with the designation of MPCA. However, stronger measures along with involvement and awareness amongst the local community and visitors are required to protect the species in situ.

CONCLUSION

Ceropegia anjanerica is assessed as Critically Endangered (CR B1ab(iii,v)+B2ab(iii)) and requires urgent attention to stop further reduction in its population.

Based upon field observations, suggestions were made for the protection and control of plant resources from the area. The Forest Division (territorial) staff and JFMC of the Anjaneri Village initiated special protection measures since 2013 to limit overexploitation of plant resources from this area. There is an urgent necessity to continue this community initiative for long-term protection of this highly threatened species.

REFERENCES

- IUCN (2013). IUCN Red List of Threatened Species. Version 2013.1. <www.iucnredlist.org>. Downloaded on 07 July 2013.
- Malpure, N., M. Kamble & S.R. Yadav (2006). A new species of *Ceropegia* L. (Asclepiadaceae) from the Western Ghats of India with a note on series *Attenuatae* Huber. *Current Science* 91(9): 1140–1142.
- The Plant List (2013). Version 1.1. Published on the Internet; <http://www.theplantlist.org/tpl/record/kew-2603917> (accessed 20 March 2015).
- Yadav, S.R. & M.Y. Kamble (2008). Threatened *Ceropegias* of the Western Ghats and Strategies for Their Conservation, pp 123–134. In: Rawat, G.S. (ed.). *Special Habitats and Threatened Plants of India*. ENVIS Bulletin: Wildlife and Protected Areas, Vol. 11(1). Wildlife Institute of India, Dehradun, India.

RED LIST ASSESSMENT: CEROPEGIA ANJANERICA

Kingdom: Plantae
 Phylum: Tracheophyta
 Class: Magnoliopsida
 Order: Gentianales
 Family: Apocyanaceae
 Genus: *Ceropegia*
 Species: *anjanerica*
 Authority: Malpure, Kamble & Yadav, 2006

Common name: Anjaneri Wax Fountain (English); Lahani Kharpudi (Marathi)

Taxonomic notes: The species was described by Malpure et al. (2006) from the rocky plateau of Anjaneri Hills in Nashik District of Maharashtra with the holotype deposited at CAL. The species is considered valid and *Ceropegia anjanerica* is an accepted name as per version 1.1 of The Plant List (2013).

ASSESSMENT INFORMATION

Red List Category and Criteria (Version 3.1): Critically Endangered B1ab(iii,v)+2ab(iii,v)

Justification: *Ceropegia anjanerica* is assessed as Critically Endangered as it is restricted to a very small range of less than 10km² and area of occupancy of less than 1km² in two severely fragmented locations with one location having more than 98% of the total population of around 900 mature individuals. The species is under threat from various human activities such as collections for local use and both species and habitat quality are threatened from grazers, livestock and pilgrims. In the last 15 years the species has been extirpated in two of the four locations. Due to these threats there is a continuing decline observed in the area/extent and quality of habitat, and continuing decline inferred in the number of mature individuals.

GEOGRAPHIC RANGE / DISTRIBUTION INFORMATION

Range description: The species is restricted in its distribution to Anjaneri Hill, a basalt mesa with steep cliff edges, in the Trimbak Range of northern Western Ghats in Nashik District of Maharashtra, India.

Countries of occurrence: Native to India (Maharashtra State).

Extent of Occurrence (EOO): EOO is estimated to be less than 10km² (7.73km²) considering the two existing severely fragmented sub-populations on Anjaneri Hill plateau and the remote cliff Navar-dev, and the two extirpated populations in the foothills of Anjaneri to the east and to the northwest.

Area of Occupancy (AOO): AOO is estimated to be less than 1km² (0.95km²) considering the extant sub-populations on Anjaneri plateau (0.93km²) and on Navar-dev cliff (0.02km²). The two extirpated sub-populations had an estimated AOO of 0.27km² in the eastern foothills of Anjaneri and 0.24km² on the northwestern foothills of the plateau.

Number of locations: The species is currently restricted to only two locations, which are severely fragmented. The species is extirpated from two other locations.

Range map: See Image 4.

POPULATION INFORMATION

Population: The species is estimated to have less than 1000 mature individuals, of which 870 individuals are restricted to Anjaneri plateau.

Population trend: The population is declining. Over the last 10 years more than 50% of the population has declined due to various anthropogenic threats. Populations in two of the four locations have been extirpated.

HABITAT AND ECOLOGICAL INFORMATION

Habitat and ecology: It is a 5–20 cm tall erect tuberous herb growing in well aerated, shallow, gravelly soil on basaltic plateau; sometimes found twining around grasses and other herbs. Vegetative growth happens during heavy rainfall season from July to August with flowering starting in August and continuing until October. Peak flowering occurs in September–October, coinciding with partially sunny but moist and misty climate. Mature fruits are seen during October–November and seed dispersal during November. By December the plants wither away and the tubers become dormant. The herb is generally found growing in 3–12 cm deep soil along with herbs like *Celosia argentea*, *Justicia betonica*, *Lepidagathis* sp. and *Senecio dalzellii*. It grows in an altitudinal range of 1300 to 1500 m. Although the habitat in which *Ceropegia anjanerica* exists at present are seen all over the main plateau, the individuals are limited specifically to microhabitats with well aerated, shallow, gravelly soil.

System: Terrestrial annual herb.

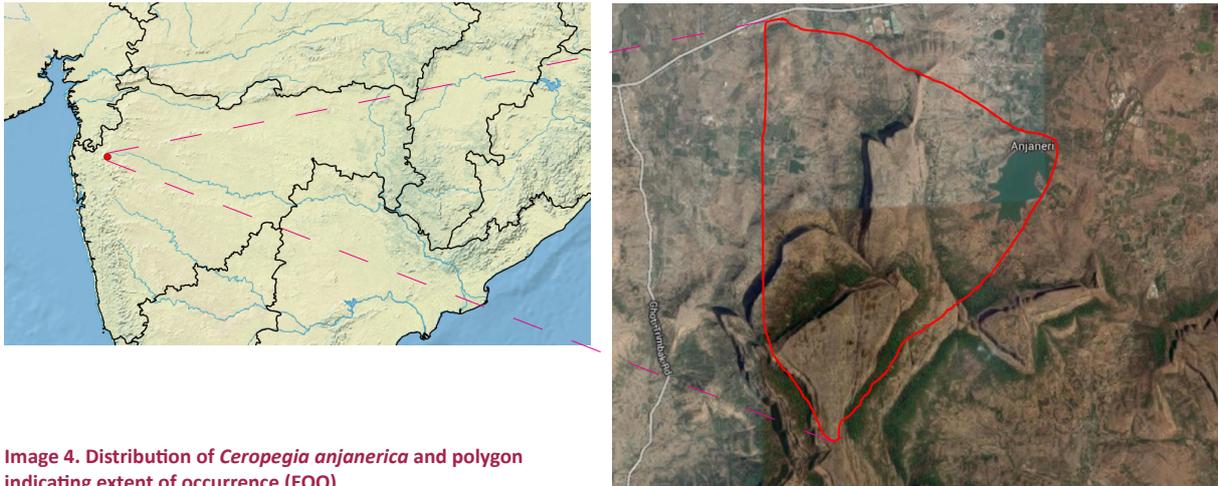


Image 4. Distribution of *Ceropegia anjanerica* and polygon indicating extent of occurrence (EOO)

INFORMATION ON THREATS

Threats: The main threats to the remaining larger sub-population are from heavy human disturbance including trampling by grazers, livestock and pilgrims. Many factors like cattle grazing, continued consumption of the species by humans and monkeys, increasing religious tourism leading to trampling of the area, littering and medicinal plant extraction are operative on this plateau. The Anjaneri East foothills sub-population was extirpated due to submergence of the area under an earthen dam constructed in 2007–08 for supplying water to adjoining villages. The Anjaneri northwest sub-population was extirpated in 2000 due to increased human interference, grazing and closeness to the Nashik-Trimbakeshwar-Jawhar-Dahanu State Highway No. 30. There are no known threats to the Navar-dev cliff sub-population.

Additional threats: Local people continue to collect and consume the edible tubers from the existing population putting further pressure. Botanical collection of this species is also common in spite of the general awareness of its rarity. A road to the plateau is planned and associated development activities in the near future will increase the threat to the larger population.

USE AND TRADE INFORMATION

Use: Local communities collect and eat the tubers of this species, along with other *Ceropegia* species, raw throughout the monsoon.

Livelihoods and sustenance: Communities are not dependent on this species for their livelihoods or sustenance.

Trend in off take from the wild: Since the population of the species is shrinking, the overall off take for local consumption is on the increase.

Trend in off take from cultivation: Although occasionally cultivated along with other *Ceropegia* species in botanical gardens, it is not for sustenance of local needs, rather for ornamental purposes.

Commercial value: The species has no local, domestic, national or international commercial value.

INFORMATION ON CONSERVATION ACTIONS

Conservation actions: The species is not in any systematic conservation programme. The site of the larger sub-population on Anjaneri Plateau is a reserve forest classified as a Medicinal Plant Conservation Area, but these classifications do not imply conservation of the species, as harvest for local use is rampant from the site. The species does not occur in any formal protected area. Urgent conservation action needed to protect the species from harvest and anthropogenic threats as well as site protection. Local communities are being mobilized for conservation.

Research in place: There is no systematic research in place other than opportunistic surveys.

Research needed: Systematic surveys, monitoring, propagation studies, effects of threats on populations, and wild population germination are some of the much needed research actions on the species.

Monitoring in place: There is no monitoring of the species, population or habitat in place.

Monitoring needed: Population and site monitoring is essential and must be implemented at the earliest.

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

Education needed: Outreach programmes about the species to local communities, tourists, pilgrims and forest department are critical.