18.0 Threatened *Ceropegias* of the Western Ghats and Strategies for Their Conservation

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Introduction

Ceropegia L. (Asclepiadaceae), a pantropical Old World genus of about 200 species exhibits a tremendous diversity with reference to habit, habitat, flower architecture and ecological adaptations. It is distributed over most of Africa, Madagascar, the Arabian Peninsula, the Indian subcontinent, the Far East and Northern parts of Australia. Ansari (1984) revised the Indian *Ceropegia* and reported 44 species, of which 28 are said to be endemic to India. After this revision, some 5 novelties have been added to the list. Presently the genus is represented by about 50 species of which about 38 occur in Western Ghats. Several species of *Ceropegia* are narrow endemics and fall under one or another IUCN Red-List category (Nayar and Sastry, 1987-89). In recent years, the genus has attracted an attention of several workers due to rarity of its species and recognized importance of conservation of rare plants of the globe. Species of *Ceropegia* possess curious flytrap flowers (Percival, 1969) with great diversity in flower design; corolla size, shape and coloring patterns; corona structures and mechanisms for illumination of essential organs (Yadav, 1996). Pollination biology of Indian species has been studied to some extent by Chaturvedi, 1993a, 1993b and Yadav, 1996. Morph-taxonomical (Patil, 1990) and physiological studies (Gaikwad *et al.*, 1989; Supate *et al.*, 1990) on some of the Indian species of *Ceropegia* have helped in better understanding of morpho-physiological adaptations in the genus.

Most of the endemic species of *Ceropegia*, by virtue of being restricted only to a special habitat and narrow ecological niche, are highly vulnerable and merit special consideration in their conservation. Reasons for their decline are many, *e.g.*, destruction of forests, modifications of habitats, industrialization, pollution and introduction of exotic weeds, *etc.* In order to evolve long term conservation strategies for this group, it is essential to collate information on their distribution, present status, immediate threats, *etc.* In this article, we give a brief overview of the threatened Ceropegias of Western Ghats (Plates 18A & 18B), information on their habitats, threats and ways to conserve them.

The Threatened Ceropegias of Western Ghats

The IUCN criteria for assigning threat categories to species of *Ceropegia* are at times difficult to meet. For example, some of the endemic species are known only from type locality and the individuals are to meet very sparsely distributed. It would be virtually impossible to come up with information on total population especially in case of sparsely distributed species which can be identified only in flowers. In any case, all the endemic *Ceropegias* deserve special status and demand immediate conservation measures. So far 38 species of *Ceropegia* have been reported from the Western Ghats. Based on an extensive and intensive search of this genus made by the authors, especially in the Northern Western Ghats, it can be said that of the 38 species 15 are narrow endemic and all of them are highly threatened. Based on detailed field investigations, present distribution and status, phenology, ecology and threats for these species have been summarized below.

1. *Ceropegia anantii* Yadav, Sardesai & Gaikwad in J. Bombay Nat. Hist. Soc., 101 (1): 141-143, Jan.-Apr. 2004.
Fls. & Frts : Aug.-Oct.

Distrib. : Maharashtra (Salva hills in Sindhudurg district).
Present Status : Endemic to Maharashtra & Endangered. Recently described species.
Field note : It is a tuberous, erect, narrow leaved species with one-flowered cyme. It grows on top of hill at an altitude of about 500 m in rocky places among grasses. About 100 individuals were observed in type locality during September 1998. Later it is found growing in shrubby vegetation in rocky places around Salva hills. It is restricted to about 20 sq. km. only.
Remarks : It is closely related to *Ceropegia attenuata* but differs in shape of corolla, type of light window and has characteristic dark purple two spots on either side of corolla lobe in lower region.
It is one of the endangered species and needs conservation measures.

2. *C. anjanerica* Malpure, Kamble & Yadav in Current Science, 91 (9): 1140-1142. 2006.
Fls. & Frts : Aug.-Nov.
Distrib. : Maharashtra (Anjaneri hills near Nasik)
Present Status : Endemic to Maharashtra & Critically Endangered. Recently described species,
Field note : It is a tuberous, erect, narrow leaved species with one-flowered cyme. It grows at an altitude of about 1296 m in well drained soil. The hill tops enjoy misty, humid climate throughout the rainy season during which the species shows vegetative growth and start flowering in August. The species is restricted to about 1 sq. km.
Remarks : It is closely related to *C. attenuata* but differs in having shorter flowers, flat corolla lobes forming an obovate head. It is restricted to exposed plateau of Anjaneri hills in Nasik district of Maharashtra. About 100 individuals were located in September 2005. It needs immediate action for conservation.

3. *C. attenuata* Hook. Ic. Pl. 9: t. 867. 1852.
Local Name : *Tilori*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra, Goa, Karnataka, Rajasthan.
Chr. No. : 2n= 22.
Present Status : Endemic and Vulnerable.
Field note : It is a tuberous, erect, narrow leaved species with one-flowered cyme found throughout shrubby open forest of Konkan, Goa and North Kanara. It grows in crevices of lateritic rocks in hilly tract ranging in altitude between 300-700 m.
Remarks : Tubers are edible. Flowers are long and are of ornamental value. It is easy to grow in gardens. It shows good fruit and seed setting both under cultivation as well as in wild. It shows great variations with reference to corolla size and colour. Due to forest clearing, the populations of the species are decreasing day by day.

4. *C. bulbosa* Roxb. var.*bulbosa* Roxb., Pl. Corom. 1: 11, t. 7. 1795 & Fl. Ind. 2: 38. 1832.
Local Name : *Kharpudi*
Fls. & Frts : July-Oct.
Distrib. : India, Bangladesh, Pakistan, Saudi Arabia, Oman, N Yemen, Ethiopia, Somalia, Kenya, Tanzania
Chr. No. : 2n= 22.
Present Status : Widely distributed species.
Field note : It is a tuberous, twining, broad leaved variety with many flowered cyme. Found in drier hilly regions amongst spiny and thorny bushes, which provide protection from grazing animals.
Remarks : Leaves and tubers are edible. It is easy to grow in gardens. It is a CAM plant (Gaikwad *et al.*, 1989) which explains its wide distribution range in drier parts.

5. *C. bulbosa* Roxb. var. *lushii* (Grah.) Hook.f. in Fl. Brit. India 4: 68. 1883. *C. lushii* Grah. in Bot. Mag. t. 3300. 1834.
Local Name : *Kharpudi*
Fls. & Frts : July-Oct.
Distrib. : India
Chr. No. : 2n= 22.
Present Status : Endemic & Common.
Field note : It is a tuberous, twining, narrow leaved variety with many flowered cyme. It is comparatively rare in occurrence but usually found in vicinity of *C. bulbosa* Roxb. var.*bulbosa*.
Remarks: Leaves and tubers are edible. It is easy to grow in gardens and shows good fruit setting in wild as well as under cultivation.

6. *C. evansii* McCann in J. Bombay Nat. Hist. Soc. 45: 209. 1945.
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Satara, Pune, Ratnagiri, Kolhapur).
Present Status : Endemic to Maharashtra & Endangered.
Field note : It is a tuberous, twining, broad leaved species with many flowered cyme. It is sparsely distributed throughout Sahyadri range from Khandala in North to Amboli in South. Usually it grows in *Carvia callosa* canopy on steep slopes at an altitude of 300-1000 m.
Remarks : It is difficult to locate in thick canopy of *Carvia callosa*. It does not thrive under garden conditions. During last 20 years author could locate only 10-15 mature individuals in the field.

7. *C. fantastica* Sedgwick in J. Indian Bot. Soc. 2: 124. 1921.
Fls. & Frts : July-Oct.
Distrib. : Maharashtra (Amboli), Karnataka (Sulgeri, North Kanara) and Goa (South Goa, Netravali)
Present Status : Endemic to Western Ghats & Critically Endangered.
Field note : It is a tuberous, twining, broad leaved species with many flowered cyme. It grows in partly cleared up semi-evergreen open forest at an altitude of about 300-700 m.
Remarks : The species can be easily distinguished from all other species by the curiously much elongated sepals longer than corolla. It is extremely rare species and on the verge of extinction. It is very sparsely distributed in its area of occurrence and needs immediate steps for its conservation. Department of Botany, Shivaji University, Kolhapur has under taken a program funded by DBT, New Delhi on its restoration. It performs well in home gardens.

8. *C. hirsuta* Wight & Arn. in Wight, Contrib. 30. 1834.
Local Name : *Haamana*
Fls. & Frts : Aug.-Nov.
Distrib. : Throughout India except Himalayan region and Thailand.
Chr. No. : 2n= 22.
Present Status : Common.
Field note : It is a tuberous, twining, broad leaved species with many flowered cyme. It grows in and around bushes in hilly tracts and shows wide ecological amplitude.
Remarks : The tubers are edible. The flowers show great variations in corolla size, colour and blotching pattern. The flowers are elegant. It is easy to grow in gardens and shows fairly good fruit formation and seed setting.

9. *C. huberi* Ansari in Bull. Bot. Surv. India 10 (2): 219. 1968 (1969).
Local Name : *Kharpudi*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Kolhapur, Ratnagiri, Satara).
Chr. No. : 2n= 22.
Present Status : Endemic to Maharashtra and Critically Endangered.

Field note: It is a tuberous, twining, narrow leaved species with many flowered cyme. It is restricted to higher peaks of Sahyadri ranges. It grows among the grasses (*Tripogon lisboe*) on steep western slopes of Sahyadri from 700 to 1200 m altitude. It enjoys misty climate prevailing in the region from June- Sept.
Remarks: It has glistening snow-white flowers and flat topped curiously formed corolla. It grows well in garden. Larvae of some butterflies feed on the leaves. Tubers are edible. It is of phytogeographical significance as the species possesses form of corolla similar to some of the species found in Africa.

10. *C. jainii* Ansari & Kulkarni in Bull. Bot. Surv. India 22 (1-4): 221. 1980 (1982).
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Satara, Kolhapur, Sindhudurg)
Chr. No. : 2n= 22.
Present Status : Endemic to Maharashtra and Endangered.
Field note : It is a tuberous, erect, narrow leaved species with one-flowered cyme. It grows in crevices of lateritic plateaus of higher altitudes (1200-1400 m). It grows in open rocky grounds on tops of Sahyadri ranges.
Remarks : The tubers are edible and mostly eaten by cowboys. It has curiously formed and beautifully coloured flowers. It faces problems in sexual reproduction probably due to disappearance of the pollinators. As the species is very specific in its edaphic and climatic requirements, it is difficult to maintain in gardens and needs *in-situ* conservation.

11. *C. juncea* Roxb. Pl. Corom. 1: 12, t. 10. 1795.
Local Name : *Kanvel*
Fls. & Frts : Aug.-Oct.
Distrib. : Peninsular India and Sri Lanka.
Chr. No. : 2n=66.
Present Status : Rare.
Field note : It is a non-tuberous, twining, scaly leaved, succulent species with many flowered cyme. It grows in rocky places along hill slopes throughout drier parts of Peninsular India. The stem is thick, fleshy and photosynthetic.
Remarks : It is the only Indian species which has thick fleshy twinning stem with Crassulean Acid Metabolism (CAM) [Supate *et al.*, 1990]. It is under cultivation in number of gardens for its curiously formed flowers and as a succulent. It performs very well under cultivation.

12. *C. lawii* Hook. f. in Fl. Brit. India 4: 67. 1883.
Local Name : *Tilori*, *Kharpudi*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Ahmednagar, Pune, Satara, Ratnagiri)
Present Status : Endemic to Maharashtra and Endangered.
Field note : It is a tuberous, erect, broad leaved species with many flowered cyme. It grows on steep slopes at inaccessible places of higher altitudes of about 1000-1400 m. It is closely related to *C. sahyadrica*.
Remarks : The tubers are edible. Very few individuals are found in its places of occurrence. The major threat to the species is destruction of habitats. It is of botanical interest. It needs immediate focus for its survival and conservation.

13. *C. maccannii* Ansari in Bull. Bot. Surv. India 22 (1-4) : 227. (1980) 1982. *Ceropegia lawii* auct. plur. nom Hook. f. Fl. Brit. India 4: 67. 1883.
Local Name : *Kharpudi*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Ahmednagar, Pune)
Chr. No. : 2n= 22.
Present Status : Endemic to Maharashtra and Endangered.

Field note: It is a tuberous, erect, broad leaved species with many flowered cyme. Flowers are small and bottle shaped. It grows on slopes of hills at an altitude from 600 to 1200 m.
Remarks: It has very narrow range of distribution and it could be eliminated in few decades if appropriate steps are not taken towards its conservation. It is allied to *C. panchganiensis.*

14. *C. mahabalei* Hemadri & Ansari in Indian Forester 97(2): 105. 1971.
Local Name : *Gauti Kharpudi*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Pune, Thane)
Present Status : Endemic to Maharashtra and Critically Endangered.
Field note : It is a tuberous, erect, narrow leaved species with one-flowered cyme. It is found growing on steep slopes of Ralegaon and Kasara hills. It grows at an altitude of about 750-1000 m.
Remarks : It has probably longest flower among Indian species of *Ceropegia* and is very closely related to the rather little known African *C. campanulata -C. insignis- C. turricula* group (Bruyns, 1997). It is of ornamental, botanical and phytogeographical significance. It needs immediate steps for its conservation.

15. *C. media* (Huber) Ansari in Bull. Bot. Surv. India 11: 199-201. 1969. *Ceropegia evansii* McCann var. *media* Huber in Mem Soc. Broter. 12: 67. 1957.
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Pune, Satara, Ratnagiri)
Chr. No. : 2n= 22.
Present Status : Endemic to Maharashtra and Endangered.
Field note : It is a tuberous, twining, narrow to broad leaved species with many flowered cyme. It grows around the bushes, shrubs and in grasses on steep slopes along forest borders of higher elevations of main Sahyadri ranges. It shows fairly good fruit and seed setting.
Remarks : The tubers are edible. The flowers are delicate and of ornamental value. It is difficult to maintain in Gardens and *in-situ* conservation is essential.

16. *C. mohanramii* Yadav, Gavade & Sardesai in Rheedea 16 (1): 33-36. 2006.
Fls. & Frts : Aug.-Nov.
Distrib. : Maharashtra (Sindhudurg)
Present Status : Endemic to Maharashtra and Critically Endangered. Recently described species.
Field note : It is a tuberous, erect, narrow leaved species with one-flowered cyme. The species grows on lateritic plateau at an altitude of 50-60 m in accumulated soil in rocky places.
Remarks: The species is extremely rare and so far known only from type locality-Kochara. Even in type-locality the population is restricted to 1-2 sq. km. It is critically endangered species and needs immediate steps for its conservation.

17. *C. noorjahaniae* Ansari in J. Bombay Nat. Hist. Soc. 69: 250, t. 1, f. 1-5. 1972.
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Satara, Amravati)
Present Status : Endemic to Maharashtra and Critically Endangered.
Field note : It is a tuberous, erect, sometimes twining, narrow leaved species with three-flowered cyme. It grows in grasslands on slopes of hills.
Remarks : The species has elegant, delicate flowers of great ornamental value. As it is sparsely distributed and restricted to few localities, it needs immediate steps for its conservation. It is easy to grow in gardens.

18. *C. oculata* Hook. in Bot. Mag. t. 4093. 1844.
Local Name: *Kharpudi*, *Khapar-khutti*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Ahmednagar, Amaravati, Mumbai, Kolhapur, Pune, Raigad, Ratnagiri, Satara, Sindhudurg), Kerala, Tamil Nadu.

Chr. No. : 2n= 22.
Present Status : Endemic to Western Ghats and Vulnerable.
Field note : It is a tuberous, twining, broad leaved species with many flowered cyme. It grows in bushes at an altitude ranging between 300 to 1200 m.
Remarks : The tubers are edible and the flowers are very curious and of great ornamental value. It shows great variations in the form of corolla, its colour and variegation pattern. It performs well in garden and deserves place in any home garden for its fascinating flowers.

19. *C. odorata* Nimmo in Grah. Cat. Bomb. Pl. 118. 1839, (*nom. nud.*) *ex* Hook. f. Fl. Brit India 4: 75. 1883.
Local Name : *Sulati Khutti*
Fls. & Frts : Aug.-Oct.
Distrib. : Rajasthan(Mt. Abu), Gujarat (Pavagadh in Panchamahal), Maharashtra (Amravati, Bombay, Nandurbar, Dhule and Thane).
Present Status : Endemic and Critically Endangered.
Field note : It is a tuberous, twining, narrow leaved species with many flowered cyme. It flowers profusely under cultivation and the flowers are odorous.
Remarks : It is very sparsely distributed species. It needs immediate conservation measures.

20. *C. panchganiensis* Blatter & McCann in J. Bombay Nat. Hist. Soc. 36: 534. 1933.
Local Name : *Kharpudi*, *Khartundi*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Satara, Ahmednagar)
Present Status : Endemic to Maharashtra and Critically Endangered.
Field note : It is a tuberous, erect, broad leaved species with many flowered cyme. It is known from Mahableshwar range in Satara district and Harishchandragad in Ahmednagar district. It grows on steep slopes of highest peaks of an altitude of about 1200 m.
Remarks : It is restricted to very small area and there are few individuals only. In nature, it has been observed that some butterflies larvae feed on leaves of the species. There is an urgent need for its conservation.

21. *C. rollae* Hemadri in Bull. Bot. Surv. India 10(2): 123-125, t. 1, f. 1-6. 1969.
Local Name : *Kharpudi*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Pune).
Present Status : Endemic to Maharashtra and Critically Endangered.
Field note : It is a tuberous, erect, broad leaved species with many flowered cyme. During September, 1998 about 50 individuals were observed at Durga fort and Dhaka fort in Pune district which is it's type locality. It grows on the open top of both the forts at an altitude of about 1200-1300 m.
Remarks : Fruit setting is rare. It is difficult to maintain in gardens. As it is restricted to a very small area of about 2 acres with countable number of individuals (about 50-75), which may be wiped out at any time. It needs immediate measures for its conservation.

22. *C. sahyadrica* Ansari & Kulkarni in Indian Forester 97: 688, t. 1, f. 1-4 & t. 2, f. A(1 & 2) & B (1). 1971.
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Pune, Kolhapur, Sindhudurg).
Chr. No. : 2n= 22.
Present Status : Endemic to Maharashtra and Critically Endangered.
Field note : It is a tuberous, erect, broad leaved species with many flowered cyme. It grows on steep, slopes and plateaus of altitude at about 700-1000 m in Sahyadri range. It grows on Western most main crest of the Sahyadri. Although it shows profuse flowering, fruit setting is very rare.

Remarks: Land slides and destruction of tubers by cowboys are the two major threats to the species. Similarly failure of seed setting (probably failure of pollination in absence of pollinators) seems to be major reason for its rarity. It is easy to grow in gardens. Butterflies larvae feed on the leaves. It needs steps towards conservation.

23. *C. santapaui* Wadhwa & Ansari in Bull. Bot. Surv. India 10: 95, t. 1, f. 1-9. 1968.
Local Name : *Khartundi*
Fls. & Frts : Aug.-Oct.
Distrib. : Maharashtra (Ratnagiri, Satara)
Chr. No. : 2n= 22.
Present Status : Endemic to Maharashtra and Critically Endangered.
Field note : It is a tuberous, twining, narrow leaved species with many flowered cyme. It grows among grasses on the unstable rocks along roadsides in Mahabaleshwar- Mahad ghat at an altitude of about 1150 m. Flowers are small and white.
Remarks : As the species is restricted to a very narrow area, it faces high risk of extinction due to landslides and road repairs and roadside clearing. It needs careful steps towards *in situ* and *ex-situ* conservation.

24. *C. spiralis* Wight, Ic. Pl. Ind. Or. 4: t. 1267. 1848.
Fls. & Frts : Aug.-Oct.
Distrib. : Andra Pradesh, Karnataka, Kerala, Tamil Nadu.
Present Status : Endemic to Peninsular India and Endangered.
Field note : It is a tuberous, erect, some times twining, narrow leaved species with one-flowered cyme. It has wide distribution in Peninsular India.
Remarks : It has flowers with spirally twisted corolla lobes and the architecture of the flower is of great ornamental value. It needs *ex situ* as well as *in situ* conservation.

25. *C. vincaefolia* Hook. in Bot. Mag. t. 3740. 1839.
Fls. & Frts : Aug.-Nov.
Distrib. : Maharashtra (Culaba, Pune, Ratnagiri, Raigad, Satara, Sangli, Kolhapur, Sindhudurg).
Chr. No. : 2n= 22.
Present Status : Endemic to Maharashtra and Vulnerable.
Field note : It is a tuberous, twining, broad leaved species with many flowered cyme. It grows at higher altitudes ranging between 800 to 1200 m along forest borders. It is sparsely distributed throughout Northern Western Ghats. It shows great variations with reference to size, colouring pattern and shape of flower.
Remarks : It is one of the highly variable species. It grows well in gardens and it is easy to maintain. The tubers are edible. It is one of the *Ceropegia*s with beautiful and curiously formed flowers. The flower has distinct kind of light window of translucent ring and small circular pore like areas in inflated bottom.

Numerical Analysis of *Ceropegia* species :

On the basis numerical analysis of morphological characters, 24 species studied fall under five following groups indicating their relationship:
Group I: *C. anantii*, *C. anjanerica*, *C. attenuata*, *C. jainii*, *C. mahabalei*, *C. mohanramii*, *C. noorjahaniae* and *C. spiralis.*
Group II: *C. lawii*, *C. sahyadrica*, *C. rollae*, *C. panchganiensis*, *C. maccannii.*
Group III: *C. odorata*, *C. media*, *C. santapaui*, *C. huberi*
Group IV: *C. evansii*, *C. fantastica*, *C. hirsuta*, *C. oculata*, *C. vincaefolia.*
Group V: *C. bulbosa*, *C. juncea*

Conservation Significance of Ceropegias :

In India, *Ceropegia bulbosa* and *C. hirsuta* are the only two widespread species. Out of the 38 species in Western Ghats, 32 are endemic to the region. About 15 species of Northern Western Ghats are narrow endemics and some of

them are known only from their type localities. *Ceropegia anjanerica*, *C. evansii*, *C. fantastica*, *C. huberi*, *C. lawii*, *C. maccannii*, *C. mahabalei*, *C. mohanramii*, *C. noorjahaniae*, *C. odorata*, *C. panchganiensis*, *C. rollae*, *C. sahyadrica*, and *C. santapaui* are critically endangered and if not cared for may vanish during the next few decades.

Indian species could be grouped into three groups on the basis ecophysiological and leaf characters. *Ceropegia bulbosa* possess succulent stem as well as leaves while *C. juncea* has small reduced scaly leaves and fleshy green stem. Both the species show Crassulean Acid Metabolism (CAM) (Supate *et al.* 1990; Gaikwad *et al.* 1989) and grow in comparatively drier parts of the country. Majority of the species have membranous broad or narrow leaves, C_3 pathway of photosynthesis and grow in semi-evergreen, evergreen forests, shrubby vegetation and on plateaus. Erect species usually grow in open grassy grounds, while climbing species grow in open shrubby forest. While erect habit is the inevitable result of open situations, climbing habit is in response to the support.

Tubers are starchy and edible. Some of the wild animals feed on *Ceropegia* tubers. Some of the butterflies rear on *Ceropegia* species and complete their life cycles. Some of the butterflies are host specific and disappearance of *Ceropegia* species may also lead to their disappearance from the region. Therefore, Ceropegias have well-established biological role. The tubers are used as a nutritive tonic in the bowel complaints of children that cure dysentery and diarrhoea. The alkaloid ceropegin from the tubers of *C. bulbosa* is used in Bihar in cold, eye-diseases and to cure sneezing (Kirtikar & Basu 1975.). The tuber of *C. bulbosa* is bitter, cures diarrhoea and dysentery, inflammation of gums and delirious fevers of parturition [Ayurveda] (Kirtikar & Basu 1975).

The Stapelieae to which Ceropegias belong are principally adapted to fly-pollination and have reached a great diversity in flower architectures (Leach 1978, Dyer 1983, Bruyns & Forster 1991, Endress 1994). The most complicated flowers of dicots are found in the genus *Ceropegia*, which, in itself, is a wealth of wonderful radiation (Huber 1957, Vogel 1961, Endress 1994). Indian *Ceropegia* species possess strange flowers of beauty and curiosity (Yadav 1996). The flytrap flowers and pollination mechanisms in the species of *Ceropegia* are interesting in understanding diversification and evolution of the genus.

Both Africa and Peninsular India belong to the same Gondvanaland and possess closely allied *Ceropegia* species of phytogeographical significance, which like many other examples, support theory of continental drift. *Ceropegia bulbosa* shows close relationship with *C. linophyllum* from West Africa; *C. mahabalei* has clear affinities to African species *C. campanulata-C. insignis - C. turricula* group; some of the non-succulent species without tubers from the Western ghats seem to be both vegetatively and florally quite similar to species from West Africa and even to *C. cumingiana* from Australia while *C. juncea* is not closely allied to any other species (Bruyns 1997).

Most of the Indian species of *Ceropegia* are very specific in their habitat preferences. The starchy tubers are prone to fungal infections and thus decay of tubers is major problem in their cultivation and maintenance. They dislike organic manure and excess watering. There is an urgent need for both *ex-situ* as well as *in-situ* conservation of Ceropegias. Species of *Ceropegia* are very difficult to propagate, cultivate and maintain in gardens. Conservation of *Ceropegia* species is a challenge to biologists. Concentrated and co-ordinated efforts by universities, forest departments, and local communities are needed to save Ceropegias of Western Ghats.

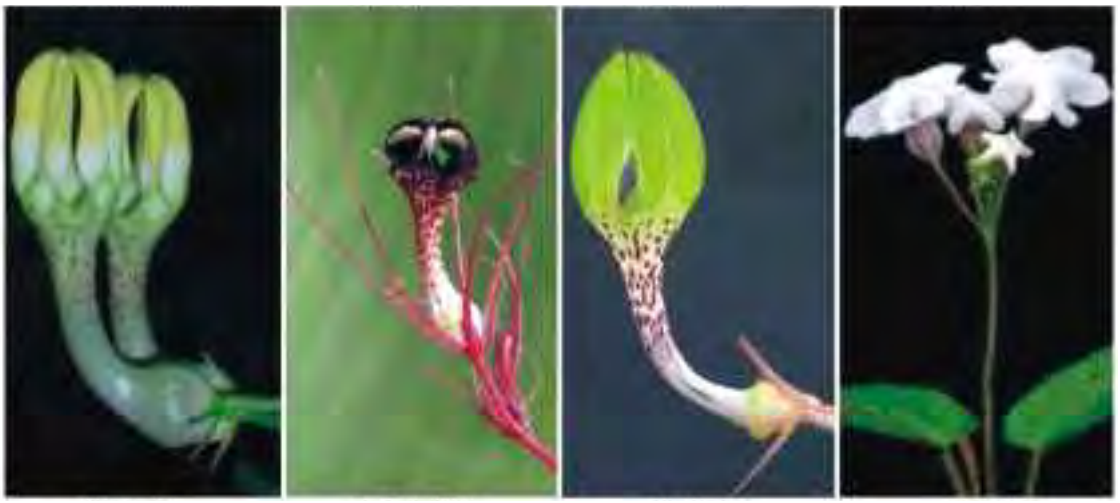
Short Term and Long Term Conservation Strategies

Prodigious task of saving vanishing Ceropegias of Western Ghats:

1. They are restricted in distribution and each has species-specific edaphic/climatic requirements.
2. The individuals of endemic species are very sparsely distributed and extremely rare in occurrence being restricted to small areas in remote places.
3. The tubers of Ceropegias are exploited by cowboys, cattlemen and also eaten by wild animals.

Plate 18A
Threatened *Ceropegias* of Western Ghats - I

Ceropegia anantii *C. anjanerica* *C. attenuata* *C. bulbosa*



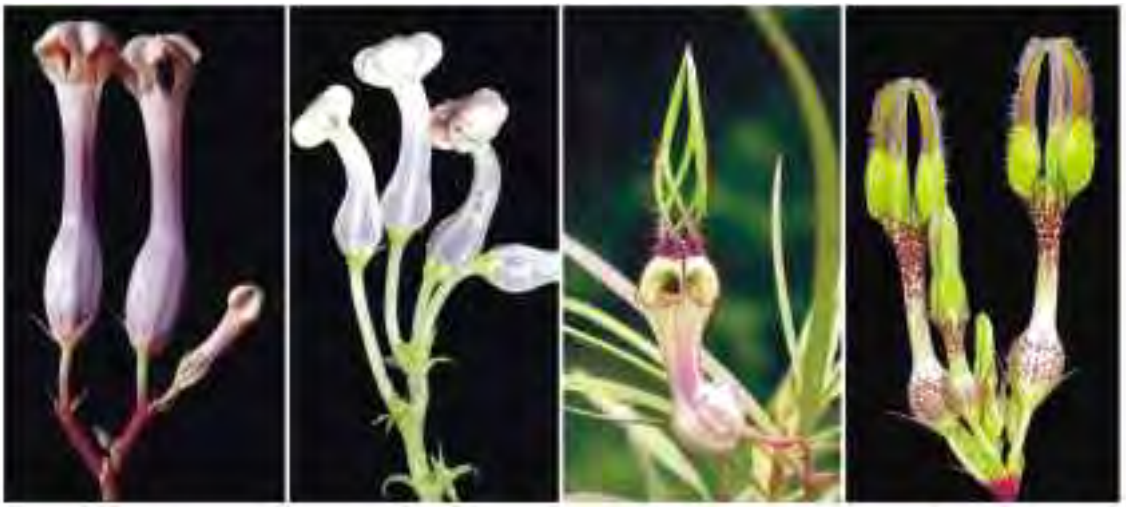
C. evansii *C. fantastica* *C. hirsuta* *C. huberi*

C. jainii *C. juncea* *C. lawii* *C. maccannii*

Plate 18B
Threatened *Ceropegias* of Western Ghats - II

C. mahabalei *C. mohanramii* *C. media* *C. noorjahaniae*

C. oculata *C. odorata* *C. panchganiensis* *C. rollae*



C. sahyadrica *C. santapaui* *C. spiralis* *C. vincaefolia*

4. There is a great pressure on Western Ghats due to modification and destruction of the habitats leading to further decline and fragmentation of populations.
5. Most complicated flowers with highly specialized pollination mechanisms and species-specific pollinators resulting into low fruit and seed setting.
6. Many of seeds are worn out as they do not reach to proper place for seed germination and seedling establishment.
7. There is no easy way for their propagation.
8. The tubers are highly susceptible to microbial/fungal decay.
9. It is extremely difficult to maintain and store the tubers during dry spell of the year.
10. It is difficult to simulate growth requirements in *ex situ* conditions.
11. Destruction of aerial plant parts by caterpillars.
12. There are no apparent direct economic gains from *Ceropegia* species and unawareness of policy makers, people and researchers.

Ways to save Ceropegias of Western Ghats :

Micro-propagation is the only viable means to get planting materials. Hardening of plant materials is another critical step in reintroduction of planting material, which needs to be standardized. Following are probable and appropriate steps in saving the fascinating group of Ceropegias of Western Ghats.

1. Protecting habitats of Ceropegias.
2. Micropropagation and reintroduction.
3. Study pollination biology and fruit setting in *Ceropegia* species and to know constraints in sexual reproduction and production of seeds.
4. Establish methods for maintenance, storage and protection of tubers from microbes/fungi,
5. Understand suitable edaphic and climatic factors in maintenance of *Ceropegia* species.
6. Training forest officials in identification, protection and maintenance of *Ceropegia* species.
7. Cryo-preservation of germplasm of Ceropegias.
8. Develop package of practices to grow, maintain and protect *Ceropegia* species.
9. Coordinated efforts of researchers, forest officials and people to grow, maintain and protect *Ceropegia* species.
10. Popularization of Ceropegias through workshops, greeting cards, calendars, and photographs and distribution of planting materials to nurseries, botanical, private and home gardens.
11. Provision of finance for micro-propagation and hardening of *Ceropegia* species.
12. Establish field gene bank of all the *Ceropegia* species of Western Ghats.
13. Undertake restoration programs on Ceropegias

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