



Ceropegia jainii and *C. rollae* (Apocynaceae) at the brink of extinction

The highly economic, botanically curious genus *Ceropegia* L. (Apocynaceae Juss.) is native to India with the greatest number of species concentrated in Western Ghats which may be designated as the ‘cradle of *Ceropegia*’. Of the global 200 species of the *Ceropegia*, 58 species, two subspecies and four varieties are found in India (Malpure *et al.*, 2006; Diwakar & Singh, 2011; Kambale *et al.*, 2012), of which 35 species and one variety (ca. 56%) are endemic to Western Ghats where most are either critically endangered, endangered or vulnerable as per the IUCN categories and are also listed in the *Red Data Book of Indian Plants* (Nayar & Sastry, 1987). Of these, 50% (17 species and one variety) are strictly endemic to Maharashtra. Locally known as ‘Hanumangada’, ‘Kharpudi’, ‘Khartundi’, and ‘Tilori’, the genus is found mostly on plateaus and regions with gravelly and lateritic soils. Grazing, habitat destruction by anthropogenic agents, and pollination stress are the major causes of population shrinkage and collapse. Severity of anthropogenic pressures is extreme in these regions where shepherds and local inhabitants relish and devour these plants to a great extent. As a result, several species of the genus are critically endangered or endangered, and face the risk of extinction in the near future. The current status of two species: *Ceropegia jainii* Ansari & B.G. Kulk. (Fig. 1) and *C. rollae* Hemadri (Fig. 2), are reviewed here as their population status have dwindled drastically within a short span of about two decades.

Ceropegia jainii was described in 1982 on the basis of collections made in 1971 from Amboli Ghat in Sindhudurg District of Maharashtra (Ansari & Kulkarni, 1982), the type locality from where it was soon extirpated. In 1993, it was relocated to two sites on Chalakewadi and Kaas plateaus in the Satara District (Bachulkar,

1993). Further, in 1997, its status was assessed when plants at the type locality were found to have been extirpated and in the Satara District only 35 individuals remained of the Kaas Plateau population (Mishra & Singh, 2001).



Figure 1: *Ceropegia jainii* Ansari & B. G. Kulk.



Figure 2: *Ceropegia rollae* Hemadri

Ceropegia rollae was described in 1969 on the basis of 1965 collections from Dhak Khilla,

Junnar, Pune District in Maharashtra (Hemadri, 1969). In 2001 the species was found to be restricted to a small pocket on the Ahmednagar - Pune border (Mishra & Singh, 2001) at Dhak Khila, Durga Khila (in Pune) and Harishchandragarh (in Ahmednagar).

During assessment of endemic and threatened angiosperm taxa in Goa, Karnataka and Maharashtra of Western Ghats from 2007 to 2012, an attempt was also made to assess the population status of *Ceropegia jainii* and *C. rollae*. Hence, an intensive search was made to locate the two species in the entire area. Although *C. jainii* was found in two earlier locations on the Chalakewadi and the Kaas plateaus in the Satara District, their population numbers were found to be extremely low with some 30 individuals on Kaas Plateau and about 35 on Chalakewadi. This confirmed its 'critically endangered' status as the species was found over only about 3 sq. km (down from about 6 sq. km) suggesting that the species had already reached the brink of extinction. Further, this species was never recollected from the type locality after its type was gathered in 1971; and, alarmingly, the present survey confirmed the extirpated status in its type locality, the Amboli Ghat, which was a site along narrow paths adjacent to a road. Natural landslide, road repair process and expansion, coupled with extreme anthropogenic disturbances were responsible for the demise of the species. Similarly, *C. rollae* could not be located from any other site except the earlier three in Ahmednagar and Pune districts. However, the entire area of occupancy was only some 25 sq. km indicating a drastically collapse of about 75% of an area that once covered approximately 100 sq. km. Additionally, there was also disruption in the continuity of the populations as originally *C. rollae* was more or less evenly spread throughout its entire region while the current population consists of only sporadic and fragmented small patches of 12 to 15 individuals each. In Junnar, Pune District, the type locality population at Dhak Khila consisted of about 50 individuals and Durga Khila had only some 30 individuals while the Harishchandragarh population in Ahmednagar district comprised 35 individuals. This brings the total population strength to some 115 extant plants. The current population appraisal suggests that there has been a further shrinkage of population of *C. rollae* which confirms its 'critically endangered' status.

The above population analysis of these two species of *Ceropegia* indicates that these remarkable botanical entities are facing severe anthropogenic pressures in their native habitats in Western Ghats, the 'cradle of *Ceropegia*', and needs immediate focus for conservation in the wild, least this cradle might lose its species diversity through gradual extinction as already three strictly endemic species, *C. barnesii* E. A. Bruce & Chatterjee, *C. kachinensis* Prain and *C. omissa* H. Huber have already become extinct. This signals an urgent focus on other species treading in this direction. The Western Ghats plateaus and its surroundings comprised gravelly and lateritic soils and thus an ideal habitat for the genus *Ceropegia*. Unfortunately, these plateaus are exposed to significant anthropogenic disturbances with continuous human intrusions mainly as recreation and picnic centre during the rainy season when the entire plateau is adorned with beautiful flowers propelling the region into a valley of spectacular flowers. This is the most threatening season as the human interference only adds to other developmental pressures such as grazing and the uprooting of tubers of edible values in other seasons. The magnitude of the destruction may even amount to the complete loss of a given species' habitat. The highly ornamental, elaborate flowers of *Ceropegia*, also called lantern blooms, are pollinated mainly by specialised insect pollinators. Pollination takes place during the process of gathering nectar by imprisoned insects and is also an elegant example of sapromyophilous syndrome (pollination by carrion-flies, see Faegri & Pijl, 1979; Chaturvedi, 1993). Such a specialised pollination syndrome is the most plausible cause of failure of cross-pollination within the population as the highly specialised flower morphology, which almost conceals the reproductive organs localised within the inflated basal part of corolla, is quite inaccessible for pollinating flies. Therefore the pollinators tend to get distracted by other floral resources thereby neglecting *Ceropegia* flowers. Any normal reproduction that takes place in this genus is therefore through selfing, leading to inbreeding depression causing a reproductive barrier and demographic stochasticity upon the endemic and restricted species localised in the now highly fragmented populations of each rare species.

Conclusively, the main factors responsible for the dwindling of *Ceropegia jainii* and *C. rollae*

populations are: (1) The attractive flowers catch the attention of people hence they may face anthropogenic disturbances; (2) the flower structure is highly complicated which restricts the number of potential pollinators which results in limited cross-pollination so that any crossing which occurs also amounts to inbreeding due to the narrow restricted population size; (3) the ramet population, perpetuated by means of the deeply penetrating tubers, having edible and medicinal properties which results in their being harvested by local people; and, (4) seed germinability is negligible for among the entire population of the two species observed in the field only five flowers of *C. jainii* and 16 of *C. rollae* produced follicles but even then their seeds failed to germinate *in-situ* as well as under *ex-situ* conditions.

If these causal factors continue unimpeded there is no doubt that both *Ceropegia jainii* and *C. rollae* might soon be extinct. Hence, measures are suggested here to arrest the operative causal factors, to wit: (1) The anthropogenic disturbances must be curtailed as a first step to safeguard the extant population simply by fencing and strictly restricting encroachment; (2) banning the digging of tubers by local inhabitants and increasing general awareness of the botanical significance of these species; and, (3) species multiplication through culture techniques may be acquired to promote the regeneration of plants through vegetative parts other than tubers to prevent damage to the population. The juvenile plantlets, after acclimatisation, can be reintroduced in their natural habitat and then monitored for successful establishment in wild.

Specimens examined: *Ceropegia jainii* Ansari & B. G. Kulk. INDIA. Maharashtra: Amboli Ghat, Ratnagiri District (now in Sindhudurg District), 13 Aug 1971, *B. G. Kulkarni 121885* (holotype: CAL; isotypes: BLAT, BSI, CAL); Amboli Ghat, Moose Plateau, Ratnagiri District (now in Sindhudurg District), 13 Aug 1971, *B. G. Kulkarni 131615* (BSI); Kaas Plateau, Satara District, 22 Aug 1997, *D. K. Mishra 176845* (BSI); Kaas Plateau, Satara District, 28 Aug 2011, *R. Kr. Singh 185383* (BSI); Chalakewadi Plateau, Satara District, 29 Aug 2011, *R. Kr. Singh 185384* (BSI).

Ceropegia rollae Hemadri INDIA. Maharashtra: Dhak Khilla, near Junnar, Pune District, 29 Sep

1965, *K. Hemadri 107472* (Holotype: CAL; isotype: BSI); Durga Khilla, ca. 30 km west of Junnar, Pune District, 1 Oct 1965, *K. Hemadri 107547* (BSI); Malshej Ghat, near Junnar, Pune District, 3 Sep 1996, *D. K. Mishra 175500* (BSI); Dhak Khilla, near Junnar, Pune District, 30 Sep 2011, *R. Kr. Singh 185385* (BSI); Durga Khilla, ca. 30 km west of Junnar, Pune District, 31 Sep 2011, *R. Kr. Singh 185386* (BSI).

IUCN conservation status: Based on assessment and field observations from 2007 to 2012, *Ceropegia jainii* is currently categorised as Critically Endangered [B2b (i,ii,iii,v), c (i,ii,iv); C2a (i), b]. Based on assessment and field observations from 2007 to 2012, *Ceropegia rollae* is currently categorised as Critically Endangered [B1b (i,ii,iii,iv,v), c (i,ii,iii,iv); C2b].

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