


STUDIES ON CRITICALLY ENDANGERED GENUS *CEROPEGIA* FROM WESTERN GHATS OF NASHIK DISTRICT, MAHARASHTRA, INDIA

Madhukar Pandharinath SANGALE¹, Sanjay Ragho KSHIRSAGAR²,
Hemendra Prabhakar SHINDE^{*} 

¹ Department of Botany, Kr. V. N. Naik Arts Commerce & Science College, Nashik, Maharashtra – India.

² Department of Botany, Late Karmaveer Dr. P. R. Ghogrey Science College, Dhule, Maharashtra – India.

* Corresponding author. E-mail: shindehemant79@gmail.com, ORCID ID 0000-0002-0582-4039

Abstract: *Ceropegia* is tuberous herb, mostly found growing on grassy slopes of hills and plateaus. Species of *Ceropegia* are recognized mostly for its peculiar ornamental and/or medicinal properties. Most species from the genus *Ceropegia* are included in threatened category because of special requirements in terms of climate and habitat. Earlier studies have indicated that habitat destruction and collecting of tubers for local consumption are the major threats. However, during recent years, their populations have been found declining rapidly due to habitat modifications and anthropogenic pressures like grazing, tourism and trampling, land use changes, etc. Since the majority of the reported *Ceropegia* species were previously classified as vulnerable or endangered by the IUCN, conservation efforts ought to be pursued in order to slow the rate at which these species are becoming extinct. Present research article deals with taxonomy, flowering and fruiting period, present status, threats of critically endangered *Ceropegia* species found in and around Western Ghats region of Nashik district. The present study would help in identifying the species habitats and the areas to be prioritized for their conservation.

Key words: *Ceropegia*, Western Ghats, Nashik, Conservation.

Introduction

The Western Ghats is also called the ‘Sahyadri’ and the northern part of Western Ghats is the ‘hotspot’ having very high biological diversity. The Western Ghats range begins south of the Tapti River, close to the Gujarat-Maharashtra boundary. It passes 1,600 km across the states of Maharashtra, Goa, Karnataka, Tamil Nadu, and Kerala before terminating in Kanyakumari, which is located at the southernmost point of India [VENCATESAN & DANIELS, 2008]. The north-south run of Western Ghats is about 750 km and average breadth is 85 km. In Maharashtra, there are numerous naturally occurring vulnerable, rare, endangered and threatened (RET) plant species found in districts of northern Western Ghats, like Dhule, Jalgaon, Nandurbar, and Nashik [KSHIRSAGAR & PATIL, 2008; SANGALE & al. 2023]. Vegetation of the Northern Western Ghats can be divided into altitudinal zones. At elevations of 200-500 m, there is semi-deciduous and shrub vegetation. The moist deciduous forests with pockets of evergreen type in areas with more rainfall are found on the windward side of the Ghats, which receives the most rainfall [GAIKWAD & al. 2014].

Genus *Ceropegia* L. is tuberous herb and found growing on grassy slopes of hills.

It belongs to the Apocynaceae family and is indigenous to Australia, southern Asia, and Africa. Carl Linnaeus gave it its name; he originally described this genus in volume 1 of his 1753 publication *Species plantarum*. The blooms appeared to Linnaeus like a wax fountain. The

scientific word, “keros” (wax) and “pege” (spring) were taken from this. There are 160-200 different species of genus *Ceropegia*.

It has been reported as critically endangered and endemic to Western Ghats of Maharashtra [MISHRA & SINGH, 2001]. It is one of the genera in the Apocynaceae family's subfamily Asclepiadoideae (milkweeds). The genus *Ceropegia* comprises 244 species distributed in Africa and Madagascar, extending in the east to Arabia, India and China, northern part of Australia as far as Canary Islands [BRUYNS, 2014; WFO Plant List, 2024; NIKAM & al. 2023]. Highest diversity of the genus occurs in South Africa, followed by Kenya, Madagascar and India [MURTHY & al. 2012]. In India, the genus is represented by 53 species, 2 subspecies and 6 varieties of which 37 are endemic to Peninsular India [AHMEDULLAH & NAYAR, 1986]. Majority of *Ceropegia* species in India occurs along steep hill slopes, rock crevices at low to high elevation lateritic plateaus, along with bushes, forest margins, grasslands of dry deciduous forests, shola forest margins and still others prefer to grow at slightly drier habitats. The northern Western Ghats region of Nashik district, includes places with dense vegetation like Peth, Baglan, Igatpuri, Trambakeshwar, and Sinnar which are exhibiting the presence of *Ceropegia* species.

Due to the habitat destruction or destructive collecting, most of the *Ceropegia* species are threatened. Not only these are genetically rare, but also scarcely available. It is noted that the majority of the species listed were previously classified as vulnerable or endangered by the IUCN RED list; as a result, conservation efforts ought to be made to slow the rate of extinction of these species [SUBBAIYAN & al. 2015].

Diverse conservation measures are available viz. *in situ*, *ex situ*, *in vitro*, participatory approach, local biodiversity boards etc. for critically endangered plants species like *Ceropegia*; However; there is a need for more research in terms of adoption of microhabitat/climatic specific, most suitable and feasible strategies [PATEL & al. 2017; AVHAD & al. 2023].

Germplasm conservation measures are being undertaken effectively so as to conserve narrowly endemic and critically endangered *Ceropegia* species. For example, *C. andamanica* acclimatized successfully through an *ex situ* conservation measures at Andaman & Nicobar Islands of India [DHOLE & al. 2023]. Recently a new species of *Ceropegia* namely *C. shivrayiana* is described at the Vishalgad fort in the Kolhapur district of Maharashtra state, India that resembles *Ceropegia lawii* Hooker f., which is distinguished by its hairy peduncles, obovate corolla cage, and reflexed corolla lobes [JANGAM & KAMBALE al. 2024].

Material and methods

Study area

Nashik district is located between latitudes 19°35' and 20°50' and the longitudes 73°30' and 74°55'. It covers the area of 15,582 sq. km. The prominent areas surveyed repeatedly, include mainly hilly areas like Anjaneri, Salher-Mulher, Ramshej, Saptashringi hill, Peint, Surgana, Chambhar leni, Sinnar ghat, and Igatpuri etc. (Figure 1).

Field visits and observations

Extensive field visits and botanical excursions were conducted during monsoon months (June to December) of year 2020-2022 covering to different corners and pockets of the northern part of Western Ghats of Nashik district. Systematic enumeration of observed *Ceropegia* species within their natural habitat, was done with reference to taxonomy, flowering and fruiting period, precise locations, ecology, threats, present status, etc. (Table 1). The

identification was done with the help of floras and available standard literature [COOKE, 1957; NAYAR & SASTRY, 1988; LAKSHMINARASIMHAN & SHARMA, 1991; PRADHAN & SINGH, 1999; MISHRA & SINGH, 2001]. Voucher specimens have been deposited in the Herbarium, Department of Botany, Kr. V. N. Naik Arts Commerce & Science College, Nashik, Maharashtra.

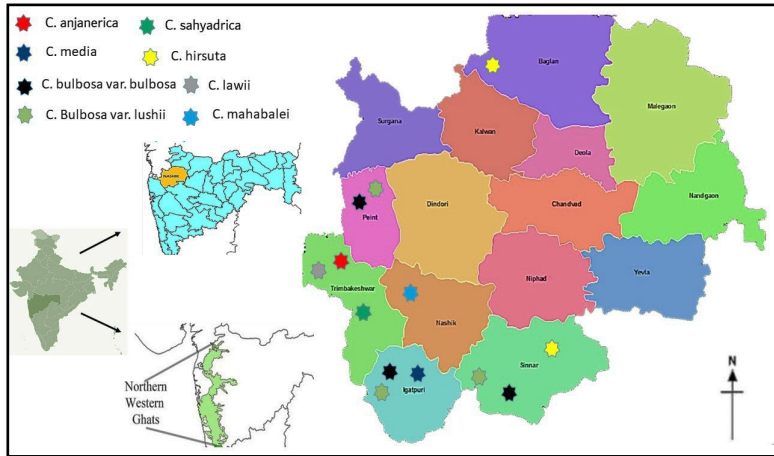


Figure 1. Location map showing distribution of *Ceropegia* species within Nashik district (Source: Maps of India.com)

Results and discussions

Systematic Enumeration

1. *Ceropegia anjanerica* Malpure, M. Y. Kamble & S. R. Yadav, Curr. Sci. 91(9): 1141. 2006; Karthik. *et al.*, Fl. Pl. India 1: 160. 2009; Kambale & S. R. Yadav, Asklepios 115: 29. 2012. *Type*: INDIA, Maharashtra, Nashik district, Anjaneri hill, 10.09.2005. *N.V. Malpure* Malpure 1 (holo CAL! iso K! BSI! BLAT! SUK!).

Herb, flowers 2.5-3.5 cm long, usually slightly curved greenish yellow. Flower-tube is 1.2-1.5 cm gradually dilated at base, channelled with purple lines inside, lower inflated part deep purple. Petals are narrowly obovate. Flowers arise singly, on stalks 1-3 mm long. Bracts are solitary, linear, sepals linear long-pointed, rough. Stem is round, rough, usually unbranched, up to 20 cm high. Leaves are opposite narrowing into stalks 2-5 mm long. Seeds 5×2 mm, ovate, coma white, silky. The tubers are edible and consumed by locals is one of the major threat observed during the study. The status of *C. anjanerica* recorded as endangered and endemic [PETHE & TILLU, 2016; NIKAM & al. 2023].

2. *Ceropegia bulbosa* var. *bulbosa* Roxb, cor. Pl. v. 1 (1795) p. 11, t. 7. Fl. B. I. v. 4, p. 67; Woodr. In Journ. Bomb. V. 12(1898) p.168; Watt, Dict: Econ. Prod. V. 2, p. 262.

Twiner, root tuberous, the size of a small turnip, a little flattened, with several fibres from its base, stem very slender, usually glabrous. Leaves excessively variable. Flowers pedunculated, umbellate cymes. peduncles long, arising from between the petioles; pedicels long slender. Corolla long greenish tube inflated at the base lobes long linear from

STUDIES ON CRITICALLY ENDANGERED GENUS *CEROPEGIA* FROM WESTERN GHATS OF ...

deltoid base, hairy, connate at the tips, violet-purple inside outer corona-lobes inner corona-lobes narrowly linear, in long follicles, cylindrical, tapering towards an acute apex. Seeds long, ovate-oblong, flattened, with a broad sub membranous margin.

Over exploitation and habitat degradation are the important threats recorded during study. The status of *C. bulbosa* var. *bulbosa* is recorded as endangered

3. *Ceropegia bulbosa* var. *lushii* (Grah.) Hook. f. Fl. Brit. India 4: 68. 1883; Cooke, Fl. Pres. Bombay 2: 241. 1958 (Repr.); Ansari in Fasc. FL India 16: 11. 1984; Jagtap et al. Singh, N.P. in Fasc. Fl. India 24: 218. 1999. *C. lushii* Grah. in Bot. Mag. t. 3300. 1834. *C. acuminata* Roxb. Pl. Corom. 1: 12, t. 8. 1795; Hook. f. Fl. Brit. India 4: 78. 1883.

Tuberous twiners. Leaves 6-7 x 1.2-2.1 cm, acuminate. Flowers in axillary cymes; corolla 1.0-1.1 cm long; corona biseriate. Major threats were recorded as its over exploitation and habitat degradation. The status of *C. bulbosa* var. *lushii* is endangered.

4. *Ceropegia hirsuta* Wight & Arn. in Wight, Contrib. (1834) p.30. Fl. B. I. v. 4, p. 71; Woodr. in Journ. Bomb. Nat. v. 12 (1898) p. 168. *Ceropegia jacquemontiana* Dalz. and Gibs. Bo. Fl.p.153. *C. ophioccephala* Dalz. in Kew Journ. Bot. v. 2 (1850) p. 259; Dalz. & Gibs. p. 154.

Saffruticose, twining, hirsute or pubescent roots tuberous, membranous, 5-10 cm. long, varying from ovate-cordate, obtusely cuminata, to narrowly lanceolate, acute, petioles long. Flowers umbellate cymes, peduncles long, arising from the petioles, acute, hirsute with rigid hairs. Corolla greenish, blotched with a very large club-shaped head tube inflated at base, enlarged at the mouth lobes as long as the tube. Seeds long, narrowly oblong.

Over exploitation and habitat degradation are the major threats recorded and the status of *C. hirsuta* is endangered.

5. *Ceropegia lawii* Hook f. Fl. Brit. India 4: 67, 1883; Cooke, Fl. Pres. Bombay 2: 240. 1958 pp. (Repr,ed.); Blatt, in J. Bombay nat. Hist. Soc. 36 (3): 534. 1933; Sant. Fl Purandhar 80. 1958, Sant. & Irani in Bull. Bot. Soc.

Herbs, erect, tuberous; stems pubescent above. Leaves opposite, petiolate, ovate-lanceolate, usually rounded at base, puberulous above. Cymes many flowered; peduncles and pedicels hairy. length of corolla 1.8-4 cm, with a tube length of 1.5 - 3.1 cm., inside a ring of hairs at the bottom of inflated base, rest glabrous; lobes 5-9 x 3-5 mm, ovate-cordate, hairy or glabrous inside. Outer corona of 10 obtuse lobes, hairy; inner linear, erect, 3-4 times as long as outer. Major threats recorded was its over exploitation and the status of *C. lawii* is endangered.

6. *Ceropegia media* (Huber) Ansari in Bull. Bot. Surv. India 11 (1 & 2): 199. (1969) 1971; Raghavan & Singh in Jain & Sastry (eds.), P1. Cons. Bull 3: 9. 1983; Ansari in Fasc. Fl. India 16: 24, t. 4 (18), f. 13. 1984; Singh & Raghavan in J. Econ. Tax. Bot. 8(1): 31. 1986.

Herbs, twining, tuberous; stems glabrous. Leaves opposite, petiolate, 5-15 x 1.5 cm, linear-lanceolate, puberulous above. Cymes 2-4-flowered; peduncles 1-2 cm long, pubescent; pedicels up to 1 cm long, hairy; length of bracts and bracteoles ranges 1-4 mm, lanceolate, glabrous. length of corolla 2.8 cm, with a tube length 2 cm, base slightly inflated, glabrous inside; lobes ca 8 x 2.5 mm, oblong, glabrous. Major threats were recorded as its over exploitation and the status of *C. media* is endangered.

7. *Ceropegia mahabalei* Hemadri et al. & Ansari in Indian For. 97(2)7 105. t, 1 (b). f. 1-4, 1971. Raghavan Singh in Jain & Sastry (eds.). Pi. Cons. Bull, 3: 9. 1983; Amain in Fast Fl.

India 16: 24. t. 3 (17). 1984; Raghavan & Singh in J. Econ. Tax. Bot. 5(14): 159. 1984; Singh & Raghavan in *ibid.* 8 (1): 31. 1986.

Herb, erect ca 20-65 cm high, tuberous; stem hairy. Leaves opposite, subsessile, 3-15 x 0.3-1 cm, linear to linear-lanceolate, hairy above. Cymes 1-flowered; peduncles 1.3 mm long, hairy; pedicels 5-10 mm long, hairy bracts 5-15 mm long, subulate. Calyx 5-partite, lobes 1.1-1.75 cm long, hairy. Corolla 5.5-10 cm long; tube 3.5-6.5 cm long, base largely inflated. Narrowed in the neck, enlarging towards mouth, glabrous inside; lobes 1.5-3 cm long, linear, elongated above from ovate deltoid base, hairy within. Seeds many, ovoid; coma ca 6 mm long, white. Major threats were recorded as its over exploitation and the status of *C. mahabalei* is endangered.

8. *Ceropegia sahyadrica* Ansari and B.G. Kulk. in Indian For. 97 (12): 68S, t.1, f. 1-4, t. 2, f. A (1, 2). 1971; Raghavan & Singh in Jain & Sastry (eds.), Pl. Cons. Bull. 3: 10. 1983 et in J. Econ. Tax. Bot. 5 (1): 159. 1984; Ansari in Fasc. Fl. India 16: 29, t. 4 (24). 1984; Mistry, Fl. Ratnagiri. I: 391. 1986 (*PhD. Thesis*); Ahmedullah & Nayar, Endemic Pl. Indian Reg. 1: 122. 1987.

Herbs, erect, 30-100 cm high, tuberous; stems, pubescent above, leaves opposite, 4-11 x 2-8 cm, ovate or ovate-lanceolate, cordate or rounded at base. Cynics few to ninny flowered; peduncles 1-5.5 cm long, hairy; pedicels 10-17 mm long, hairy; bracts 5-7 x ca 1 mm, linear, Sepals 5-7 mm long, glabrous. Corolla slightly curved, tube up to 4.4. cm long, base inflated with a ring of hairs inside at bottom, rest glabrous; lobes up to 2 x 8 mm, ovate, subcordate, glabrous. Follicles in pairs, up to 1.5 cm long, many seeded. Major threats were recorded as its over exploitation and the status of *C. sahyadrica* is endangered.

The present record of *Ceropegia* species are from different locations across the Nashik district like Sinnar, Anjaneri, Chambhar leni- Nashik, Igatpuri etc. which is restricted to small biogeographical areas and are rare in occurrence. (Table 1, Figure 1). Moreover, their populations have been declining rapidly due to habitat modifications and anthropogenic pressures. Therefore, *ex situ* and *in situ* conservation practices are recommended so as deal with various threats recorded during the study. Out of total *Ceropegia* species recorded, most species have been reported earlier from the Konkan region of Western Ghats. [PUNEKAR & al. 2006; KAMBALE & YADAV, 2019]. Species like *C. mahabalei*, *C. sahyadrica*, *C. bulbosa*, *C. hisrsuta* and *C. media* were discovered to be mostly growing on the dry cliffs and hill passes of the Western Ghats of Nashik district; which are known as ecologically specialized microhabitat. [DATAR & WATVE, 2018; SANGALE & al. 2021.

STUDIES ON CRITICALLY ENDANGERED GENUS *CEROPEGIA* FROM WESTERN GHATS OF ...

Table 1. Checklist of *Ceropegia* species observed at different locations within Nashik district

Species	Local Name	Habit	Habitat	Flowering Season	Locations	Latitude	Longitude
<i>Ceropegia anjanerica</i> Malpure, M.Y. Kamble & S.R. Yadav	Lahani Kharpudi	Herb	High altitude, Moist soil, Open Plateaus Rocky areas among the grasses.	August-September	Anjaneri, Trymbakeshwar	19.921 N	73.570 E
<i>Ceropegia bulbosa</i> var. <i>bulbosa</i> Roxb,	Hamil	Twiner	Moist soil, among the bushes and cactus plants	August-September	Igatpuri	19.704 N	73.568 E
					Sonambe	19.767 N	73.927 E
<i>Ceropegia bulbosa</i> var. <i>lushii</i> (Grah.) Hook.	Hamil	Twiner	Moist soil, among the bushes and cactus plants	July-October	Peth forest	20.258 N	73.510 E
<i>Ceropegia hirsuta</i> Wight & Arn	Khutti, Haaman	Twining Climber	Hilly slopes, among Cactus	August-September	Sonambe	19.767 N	73.927 E
					Adwadi	19.737 N	73.922 E
					Dubere	19.794 N	73.958 E
					Salher	20.723 N	73.945 E
<i>Ceropegia lawii</i> Hook f.	Moti Kharpudi	Twining Herb	High altitude, hilly slopes, moist soil, rocky areas	August-October	Adwadi,	19.737 N	73.922 E
					Anjaneri hill	19.921 N	73.570 E
<i>Ceropegia media</i> (Huber) Ansari	Medi Kharchudi	Twining Herb	High altitude, hilly slopes, moist soil, rocky areas	July-October	Igatpuri	19.704 N	73.568 E
<i>Ceropegia mahabalei</i> Hemadri et al. & Ansari	Kharchudi	Herb	Moist soil, Open Plateaus Rocky areas among the grasses.	August-October	Chambhar leni Nashik	20.068 N	73.788 E
<i>Ceropegia sahyadrica</i> Ansari & B.G. Kulk.	Kharpudi	Herb	Moist soil, Open Plateaus among the grasses.	August-October	Advadi Sinnar	19.737 N	73.922 E
					Anjaneri, Trymbakeshwar	19.921 N	73.570 E



A



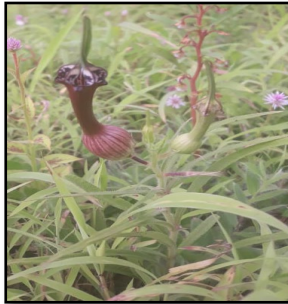
B



C



D



E



F



G



H

Figure 2. *Ceropegia* species records in Western Ghats region of Nashik district

A – *Ceropegia anjanerica* Malpure, M. Y. Kamble & S. R. Yadav; B – *Ceropegia bulbosa* Roxb. var. *bulbosa*; C – *Ceropegia bulbosa* Roxb. var. *lushii* (Graham) Hook. f.; D – *Ceropegia hirsuta* Wight & Arn.; E – *Ceropegia mahabalai* Hemadri & Ansari; F – *Ceropegia media* (H. Huber) Ansari; G – *Ceropegia lawaii* Hook. f.; H – *Ceropegia sahyadrica* Ansari & B. G. Kulk.

Conclusions

It is found that except the places like Anjaneri, Trymbakeshwar and Igatpuri in the northern part of Nashik Western Ghats, most of the locations in the study area are not densely forested. These pockets were explored in earlier similar works and most of the *Ceropegia* species recorded have already been documented during earlier studies. However, few *Ceropegia* species were observed at places like Advadi, Sonambe, Dubere of Sinnar tehsil and Chambhar leni from Nashik City area, where the forest cover is relatively low and the rainfall is also less.

Moreover, human intervention is increasing on a large scale in all the above areas due to local development projects and continuously changing rainfall patterns etc. Thus the habitats of few *Ceropegia* species are also found changing to a large extent. Similarly, there are some new habitats that have not been recorded in such previous studies.

It is found that insufficient study has been done in case of recorded critically endangered and endemic species especially, *C. anjanerica*. Prompt conservational actions should be undertaken by the concerned authorities as well as NGO's and other conscious peers of the society. Also, the *Ceropegia* species enumerated in the present study require a species recovery program, whereby these are conserved in botanical gardens and in order to ensure their establishment; these can be reintroduced in their original habitats under careful observation. This study would help in identifying the species habitats and the areas to be prioritized for conservation.

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