MINI REVIEW

Occurrence and Conservation Status of *Ceropegia anjanerica* Malpure *et al.,* in Nasik District

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Abstract

The present review article deals with the distribution, morphology, habitat, ecology, threat, and conservation status of *Ceropegia anjanerica* Malpure *et al*., in and around Nasik district. The genus *Ceropegia* L. belongs to the subfamily Asclepiadoideae (milk weeds) within the family Apocynaceae. A total of 6 species and 2 varieties of this genus have been recorded in Nasik district viz., *C. anjanerica* Malpure; Kamble and Yadav, *C. bulbosa* Roxb. var. *bulbosa*, *C. bulbosa* Roxb. var. *lushii* (Graham) Hook.f., *C. hirsuta* Wight and Arn., *C. lawii* Hook.f., *C. mahabalei* Hemadri and Ansari, *C. media* (H. Huber) Ansari and *C. vincifolia* Hook. Of these species, *C. anjanerica* is the 'endangered' plant species endemic to Anjaneri hills of Nasik district part of the northern western Ghats. The plant body is erect herbaceous with tuberous rootstock, tubers are generally 2-5 cm in diameter, globose or discoid with fibrous roots. Recent investigations show that this species has been recorded from hill tops, plateaus, and adjacent village areas.

Keywords: *Ceropegia anjanerica,* occurrence, conservation, Anjaneri Plateau, Nasik.

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Introduction

Ceropegia L. is the genus consists of 244 species that have been distributed in Africa and Madagascar which extends from the east to Arabia, India and China, northern part of Australia up to Canary Islands (Mabberley,1997; Bruyns, 2014). Studies revealed three genera viz. *Ceropegia, Brachystelma* and *Riocreuxia* has a generic complex that leads to many interesting taxonomic problems at the generic and specific levels. (*Botanical Survey of India;2002*).

Ceropegia is one of the genera belonging from subfamily Asclepiadoideae (milkweeds) within family Apocynaceae. This genus represents about 260 taxa worldwide (*The plant list,* 2013) distributed around the Canary Islands, India, Madagascar, New Guinea, northern Australia, South East Asia, tropical Arabica, and Africa (Meve, 2002; 2017). In India, this genus represents 62 species of which 26 are found in Maharashtra (Karthikeyan *et al.,* 2009; Kambale and Yadav, 2019; Murugesan *et al.,* 2019).

In IUCN red data book this species has been assigned in the endangered category under the criteria B1ab(iii)+2ab(iii) ver. 3.1. (Pethe and Watve,2021). There are 6 species with 2 varieties of *Ceropegia* recorded in Nashik district viz., *Ceropegia bulbosa* Roxb. var. *bulbosa*, *C. hirsuta* Wight and Arn., *C. lawii* Hook.f., *C. bulbosa* Roxb. var. *lushii* (Graham) Hook.f., *C. mahabalei* Hemadri and Ansari, C. media (H.Huber) Ansari, *C. anjanerica* Malpure et.al, and *C. vincifolia* Hook (Lakshminarasimhan and Sharma, 1991). Out of which *C. anjanerica* is the species that is endemic to Northern-Western Ghat. Records on adjacent villages and hill tops of Anjaneri plateau revealed the occurrence of this species in 'Navardev', 'Kushegaon' and Igatpuri tehsil of Nashik district (Auti *et al*.., 2019).

With the geographical location (19^{0}55'11.14" N and 73^{0}34'18.0"E), Anjaneri plateau is the basalt rocky, flat-topped hill with the steep and cliff edges which is actually the group of 5 hills collectively known as "Tryambak range" from the Northern-Western Ghats. *C. anjanerica* generally grows rocky areas at an altitude of 700-1,100 meters (IUCN Assessment 2021, Pethe and Watve, 2015). It has been reported little above the middle portion of Anjaneri plateau. (Auti *et al*., 2020). All species from the series Attenuatae have a restricted distribution in Konkan ranges, while *C. anjanerica* is the only species that grows at a high altitude. Major threats to the species include degradation of habitat, over-exploitation of tubers and various human interferences. Apart from the unavailability of pollinators, less seed formation and associated reproductive biological barriers lead to the continuous decrease in the species' natural population. (Chavan *et al..,* 2018).

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Systematic enumeration

Kingdom: Plantae
Phylum: Tracheophyta
Class: Magnoliopsida
Order: Gentianales
Family: Apocynaceae

Scientific Name: *Ceropegia anjanerica* Malpure, Kamble and Yadav, 2006.

Common name: Anjaneri wax fountain (English); Lahani Kharpudi (Marathi).

Utility Of The Species

The species' Tubers have traditionally eaten by tribals (IUCN Assessment 2021, Pethe and Watve;2015). Many *Ceropegia* species contain starch, sugars, gum, albuminoids, fats, crude fibres. Species like *C. bulbosa, C. hirsuta* have been recognized as edible tuberous plants. (Deshmukh and Rathod, 2013). Few species have been described for their utility as food plant for insects like butterflies. (Almeida; 1996). These valuable constituents are important in many Ayurvedic formulations that are effective against the diseases like diarrhea and dysentery. The major pharmacological importance of *Ceropegia* is due to the presence of "Ceropegine" which is pyridine alkaloid (Sukumar *et al..,* 1995), that is an analgesic drug can be used against ulcers and inflammations (Adibatti *et al..,* 1991; Khare, 2007).

Morphology And Phenology

Ceropegia anjanerica also called as flytrap flower (Auti *et al..,* 2019) is a perennial erect herbaceous plant species and has a few floral morphological similarities with *attenuate;* however, it's distinguishing features includes it's shorter, obovate, flat corolla lobes that make obovate head (IUCN Assessment 2021, Pethe, and Watve;2015).

The plant attains vegetative growth in monsoon season (July to August) before flowering in August and continues until October. September to October is the peak flowering period with moist, misty and sunny climates. Fruits mature in October-November and then seed dispersal which occurs in the month of November. In December month, the plant withers and all mature tubers become dormant and undergo perennation. The rootstock is tuberous and the size of the tubers varies from 2–5 cm which are discoidal or globose in shape with fibrous roots. (IUCN Assessment 2015, Pethe and Watve;2015). Flowering and fruiting season have been recorded from September to October and the chromosome number of the species is 22 (2n) (Gosavi *et al..*, 2012).

Habitat And Ecology

C. anjanerica is an erect tuberous herbaceous with about 20 cm in height. The species generally grows in well-aerated, shallow and gravel soil. Sometimes found along with grasses and other small herbaceous plant species. *C. anjanerica* is generally found growing well in lateritic soils with high elevated mountains as compare to its other counterparts (Kambale and Yadav; 2019).

According to some reports this species is found growing in soils with 2-12 cm depth along with some medicinal herbs like *Celosia argentea*, *Justicia betonica*, *Lepidagathis sp.* and *Senecio dalzellii* (IUCN Assessment 2021, Pethe and Watve,2015). Also, the species have been found growing at an altitude of 1300 meters in well-drained soils with plant species viz. *Cyanotis fasciculata* (B. Heyne ex Roth) Schult. f., *Justicia procumbens* L., *Senecio bombayensis* Balakr. and *Swertia minor* (Maity *et al.,* 2021). Some recent reports and field explorations revealed the appearance of *C. anjanerica* in localities viz. Bramhagiri and Bramha hills, Vatwad hills, Harihar fort, etc. (Fig. 1). (Maity *et al..,* 2021).

Threat And Conservation Status

IUCN assigned *C. anjanerica* in Red data book as Critically Endangered (CR B1ab (iii,v)+B2ab(iii)) (Pethe *et al..,* 2015). The species was reported from the Anjaneri hills of Nasik district and

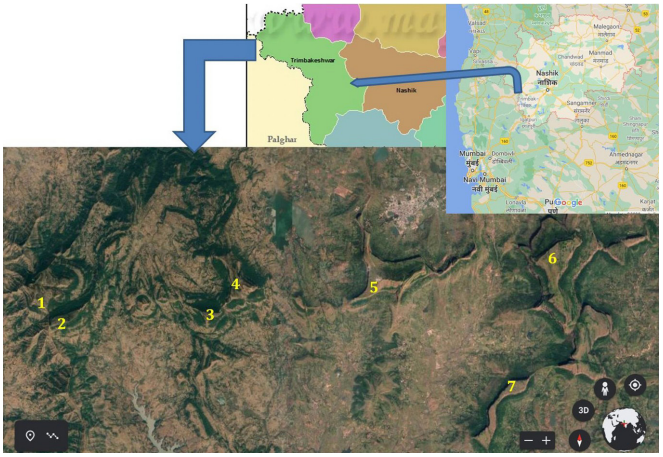

Fig. 1: Distribution of *C. anjanerica* Malpure *et al.*: 1-Vatvad Hill | 2-Bhaskargad | 3-Harihar fort | 4-Bramha Hill | 5-Bramhagiri Hill | 6-Anjaneri Hill (Type locality) | 7-Kushegaon. (Maity *et al.* 2021).

about 100 individuals of species were reported in September 2005. Initially, this species was assigned threatened in Red data book with threat status as "Critically endangered" and endemic to Maharashtra (Mishra and Singh, 2001; Yadav *et al.*, 2006; Yadav and Kamble, 2008). The species has not been reported elsewhere in Western Ghats since. The species was newly described that's why there were very less or no reports have been found on its occurrence after an extensive field exploration. The area of occupancy was found to be below 10 sq. km. and hence the species has been assigned Critically endangered [CR: B2 a, b (i, ii, iii)] (Kambale and Yadav; 2019).

However; very less or no supporting data like Population trends, Extent of Occurrence (EOO) or Area of Occupancy (AOO) is available and this fact depicts the need of review and reassessment of the current status of this species according to IUCN guidelines. According to some earlier studies by some workers, anthropogenic operations like over-exploitation of tubers, tourism, habitat degradation, etc., are the major threats to this species. Along with this poor pollination, less seed formation are some other important factors responsible for the reduction in the population of species. (Chavan *et al..,* 2018).

Earlier assessment of *anjanerica* Malpure *et al..*, by IUCN placed it under the assessment category Endangered B1ab (iii)+2ab(iii) ver 3.1. The current population trend was found to be decreasing. It was in the critically endangered category (IUCN; 2013) and was therefore facing an increased risk of extinction. Many of anthropogenic activities are operative in this area leading to the continued depletion of this species (Pethe and Watve, 2021).

Anjaneri hill area is visited by many pilgrims, amateur tourists, trekkers, mountaineering groups and nature photographers. The habitat is subjected to degradation caused by anthropogenic pressures such as free grazing of cattle and fires. As a part of

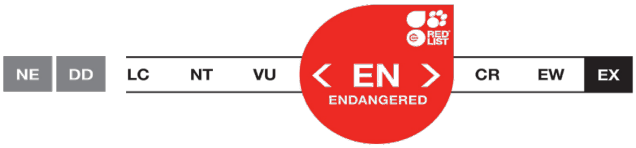

Fig. 2: Red List Assessment category *C. anjanerica* Malpure *et.al.*

developmental initiatives taken up by local government and forest department, a permanent road has been proposed to the plateau top for developing tourism that imposes a threatening pressure on population of *C. anjanerica* on the top of plateau. Apart from Anjaneri hill; the other three locations are under threat due to the enhanced tourism and its impacts in terms of trampling and infrastructure development. (IUCN Assessment; Pethe and Watve; 2021).

C. anjanerica has been assessed as "critically endangered" under the criteria "CR B1ab (iii,v) + B2 ab (iii)" by Pethe *et al..,* (2015) and subsequently as "Endangered" under the criteria "B1ab(iii)+2ab(iii)" by Pethe and Watve (2021) of the IUCN Red List. (Fig. 2). Though the type locality, i.e., Anjaneri hills, Nasik, is declared as an 'Anjaneri Conservation Reserve' and due care has been taken by Maharashtra state forest department for its conservation. Other than Anjaneri Conservation Reserve, all the localities are tourist places; therefore, frequent tourist visits generally destroy the habitats. (Table 1). Controlled tourism and awareness among tourists will help in reducing the threat to some extent. Unnecessary uprooting of the tuber just for growing this endemic species in captivity should be avoided as it will not survive outside its habitat for more than a year or so, if appropriate care is not taken. Surveys undertaken to Bhaskargad, Harihar fort, Bramha Hill and Bramhagiri Hill resulted in the collection of *C. anjanerica*. This study highlights the need for designated surveys to locate such endemic species reported from their type localities only. Moreover, earlier workers emphasize the need for research to monitor life history and distribution trends, ecological threats, and conservation planning. (Table 2). This will help in prioritizing the conservation of threatened species (Fig. 2). (Maity *et al..,* 2021).

With potential pharmacological, ornamental and medicinal use this species has least reproductive success, so attempts for *in-vitro* propagation of *C. anjanerica* have been done by many workers. Well-grown plantlets hardened, acclimatized and established in the greenhouse which exhibited 78% survival. (Nalawade *et al..,* 2014). Likewise, *in-vitro* propagation attempts have been done for many *Ceropegia* species such as *C. bulbosa* (Shete; 2014), *C. woodii* (Barakat; 2021). Molecular phylogenetic analysis of 81 *Ceropegias* aligned them in many clades (Surveswaran *et al..,* 2009). The methanol extract of *C. juncea* are medicinally valuable and possess various pharmaceutical applications (Visveshwari *et al..,* 2017).

Table 1: Threats to the Species (IUCN Red List Assessment 2021, Pethe and Watve, 2021).

Threat	Timing	Scope	Severity	Impact Score
2. Agriculture & aquaculture -> 2.3. Livestock farming & ranching -> 2.3.2. Small-holder grazing, ranching or farming	Ongoing	Whole (>90%)	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		
4. Transportation & service corridors -> 4.1. Roads & railroads	Future	Whole (>90%)	Very rapid declines	Medium impact: 7
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		
6. Human intrusions & disturbance -> 6.1. Recreational activities	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance		

Table 2: Research Needed (IUCN Red List Assessment 2021, Pethe and Watve, 2021).

1. Research -> 1.2. Population size, distribution & trends
1. Research -> 1.3. Life history & ecology
1. Research -> 1.5. Threats
2. Conservation Planning -> 2.1. Species Action/Recovery Plan
2. Conservation Planning -> 2.2. Area-based Management Plan
3. Monitoring -> 3.1. Population trends
3. Monitoring -> 3.4. Habitat trends

Conclusion

C. anjanerica Malpure *et al..,* has been reported to have the least reproductive success and it has potential in the medicinal field. It can be concluded that insufficient study has been done so far on *C. anjanerica,* As the species has ornamental and medicinal potential, conservational actions should be undertaken. Also, there is a need to undertake reproductive biological studies along with phytochemical and pharmacological examinations so as to asses and evaluate the reproductive barriers.

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Author Contributions

Shinde H.P has conceptualized the review article; Nikam P.D did the methodology and draft preparation. The formal analysis was conducted by Pawar, R.P. and Software technical assistance was contributed by Waghmode A.V.

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