

# NOTES ON THE TAXONOMIC HISTORY, REDISCOVERY AND CONSERVATION STATUS OF TWO ENDANGERED SPECIES OF *CEROPEGIA* (ASCLEPIADACEAE) FROM SIKKIM HIMALAYA

D.C. Nautiyal, S.K. Sharma, and M.K. Pandit<sup>1</sup>

Centre for Interdisciplinary Studies of Mountain & Hill Environment  
Academic Research Centre Building  
University of Delhi, Delhi - 110007, INDIA

## ABSTRACT

*Ceropegia hookeri* C.B. Clarke ex Hook.f. and *C. lucida* Wall. have been reported to be endangered or possibly extinct from India. This contribution marks rediscovery of the *C. lucida* from Sikkim after a gap of nearly 133 years. We could locate a single population of *C. hookeri* comprising about 8–10 individuals near Lachen village. These individuals showed a patchy distribution in about one square kilometer area. Likewise, we observed only two populations of *C. lucida* restricted to Lachung area of North Sikkim. Both these species have low population sizes and are faced with degradation and loss of habitat. Our studies confirm the critically endangered status of these species and we report that a large number of their populations have already gone extinct from the wild. In this paper we discuss collection history, taxonomy, habitat characteristics and conservation status of these two species in view of the various threats to their survival in nature and suggest urgent ex situ and in situ conservation measures for these species.

KEY WORDS: *Ceropegia hookeri*, *C. lucida*, endangered, habitat degradation, geographic range shift, Sikkim Himalaya

## RESUMEN

*Ceropegia hookeri* C.B. Clarke ex Hook.f. y *C. lucida* Wall. se han citado como amenazadas o posiblemente extintas de la India. Esta contribución marca el redescubrimiento de *C. lucida* de Sikkim después de unos 133 años. Pudimos localizar una sola población de *C. hookeri* con unos 8–10 individuos cerca del pueblo de Lachen. Estos individuos mostraban una distribución irregular en un área de cerca de un kilómetro cuadrado. Así mismo, observamos sólo dos poblaciones de *C. lucida* restringidas al área de North Sikkim. Ambas especies tienen tamaños de población pequeños y se enfrentan a degradación y pérdida de hábitat. Nuestros estudios confirman el estatus críticamente amenazado de estas especies y confirmamos que un gran número de miembros de sus poblaciones ya se han extinguido en la naturaleza. En este artículo discutimos la historia de las colecciones, taxonomía, hábitat características y estado de conservación de estas dos especies a la vista de las varias amenazas a su supervivencia en la naturaleza y sugerimos medidas de conservación urgente ex situ e in situ para estas especies.

## INTRODUCTION

*Ceropegia* L. is represented by about 44–45 species, 1 subspecies and 2–3 varieties in India, of which 28 species are endemic (Ansari 1984; Jagtap & Singh 1999). *Ceropegia* has greater representation in Peninsular India with 23 species (Kavade & Diwakar 2004). There are 9 species of this genus known from Himalaya of which five are present in Eastern Himalaya. Sikkim harbors 3 out of 5 known species from the Eastern Himalayan region. East Himalayan species of *Ceropegia* have been studied by Wallich (1831), King (1874), Hooker (1885), Kanjilal and Bor (1939) and Hara et al. (1982). However, based on our information from Indian herbaria as well as published literature, these species are highly underrepresented in collections (Nayar & Sastry 1988). *Ceropegia* is represented by a disproportionately higher number of endangered species with at least 12, out of 44 species, reported to be endangered or possibly extinct from the Indian subcontinent.

The *Red Data Book of India* (Nayar & Sastry 1987–90) was the first serious attempt at making authentic assessment of the status of Indian plants. This publication paved way for further intensive studies, which unfortunately could not be followed up by action. Nearly 158 Himalayan plant species were reported to face various degrees of threat. In Sikkim, Eastern Himalaya, more than 40 species of higher plants are reported to be facing survival risks. Being a rich zone of biodiversity, it is crucial to understand and reassess the

<sup>1</sup>Corresponding author, e-mail: mkpandit@cismhe.org

status of various endangered/rare species in Sikkim. The habitats in Sikkim are under severe pressure from increasing human population, expanding agriculture, and large-scale developmental activities. Recent studies have shown that a number of species are likely to be consigned to extinction in Himalaya as a result of unprecedented deforestation and land use changes (Pandit et al. 2007). A number of proposed hydro-power projects along Teesta River and its tributaries pose a serious threat to habitats which may further exacerbate species population losses in these habitats (CISMHE 2007). This contribution is a part of the studies aimed at reviewing the status of endangered species in Sikkim. In this paper we have attempted to assess the magnitude of loss of species populations of *Ceropegia* and appropriate steps for their effective conservation are indicated.

#### MATERIAL AND METHODS

During plant explorations carried out during 2002 to 2006 in Sikkim, covering various habitats from subtropical to alpine zones, we collected a few specimens of *Ceropegia* L. from North Sikkim (Fig. 1). After a thorough screening and consultation of herbaria at Central National Herbarium (CAL), Kolkata and Botanical Survey of India, Sikkim Himalaya Circle, Gangtok (SHC), followed by review of literature, these species were identified as *Ceropegia hookeri* C.B. Clarke ex Hook.f. and *C. lucida* Wall. The voucher specimens are deposited at the Herbarium, CISMHE, University of Delhi, Delhi, India. During the survey we also recorded the habitat conditions, associates of these species as well as biotic and abiotic pressures so as to assess various threats to their populations.

#### RESULTS

The taxonomic description of *Ceropegia hookeri* and *C. lucida* is given below. Line diagrams of the collected specimens are given in Figures 2 and 3, respectively. The photographs of the flowers of *C. hookeri* and *C. lucida* in Figures 4 and 5, respectively.

***Ceropegia hookeri*** C.B. Clarke ex Hook.f., Fl. Brit. India 4:73. 1885; Ansari, Fasc. Fl. India 16:17. 1984.

Erect or decumbent twining, hairy herbs, with a strong tuberous rootstock. Stem very slender, 20–60 cm long and 0.2–0.3 cm wide, slightly pubescent. Leaves membranous, ovate, acuminate, 2–4 cm long and 0.5–3 cm wide, hairy on both surfaces as well as on margins; petiole short, about 0.5 cm, hairy. Peduncles hairy, longer than petioles, about 1 cm long. Flowers in axillary peduncled cymes, 1–2 cm long, dark purple; pedicels glabrous. Calyx minute, 0.2–0.3 cm long; corolla tube 1–1.2 cm long; narrow from base to the mouth; upper lobes short, linear-lanceolate, one third the length of the tube, gently curved and forms a short crown. Outer corona entire, hairy; inner erect, linear. Follicles cylindrical, terete, 4–6 cm long.

**Habitat.**—A single population of the species on temperate grassland slopes and scrub near Nyakha-Lachen village (North Sikkim) was located at an altitude of 2700 m. It grew with other herbaceous species like *Anaphalis contorta* (D. Don) Hook.f., *Anemone obtusiloba* D. Don, *Drosera peltata* Thunb., *Eulalia mollis* (Griseb.) O. Kuntze., *Euphorbia wallichii* Hook.f., *Polygonatum cirrhifolium* (Wall.) Royle, *Pteris nepalensis* H. Ito, *Roscoeia purpurea* Sm. and *Vincetoxicum hirundinaria* Medik. Among shrubs, the associates of the species were *Eurya acuminata* DC., *Gaultheria nummularioides* D. Don, *Pieris formosa* (Wall.) D. Don, *Rhododendron arboreum* Sm., etc. This locality has shallow to moderately deep coarse loamy soil with sandy loam surface texture. The area receives high rainfall during June to August with an average rainfall of ca. 2500 mm. The average minimum/maximum temperature range between 4.2°C–17.1°C and 13.9°C–23.9°C in this region. In winter this region receives high snowfall and remains under snow intermittently from late December to February.

**Distribution.**—India: North Sikkim; Bhutan; Nepal; Tibet.

**Status.**—During the explorations only a single population of 8–10 individuals (Fig. 1) could be located. The majority of the individuals in this locality were adults and in flowering/fruitlet stages. Juvenile stages of the species were not encountered. Attempts to relocate the species from localities like Zemu area, from where it was recorded earlier, were unsuccessful.

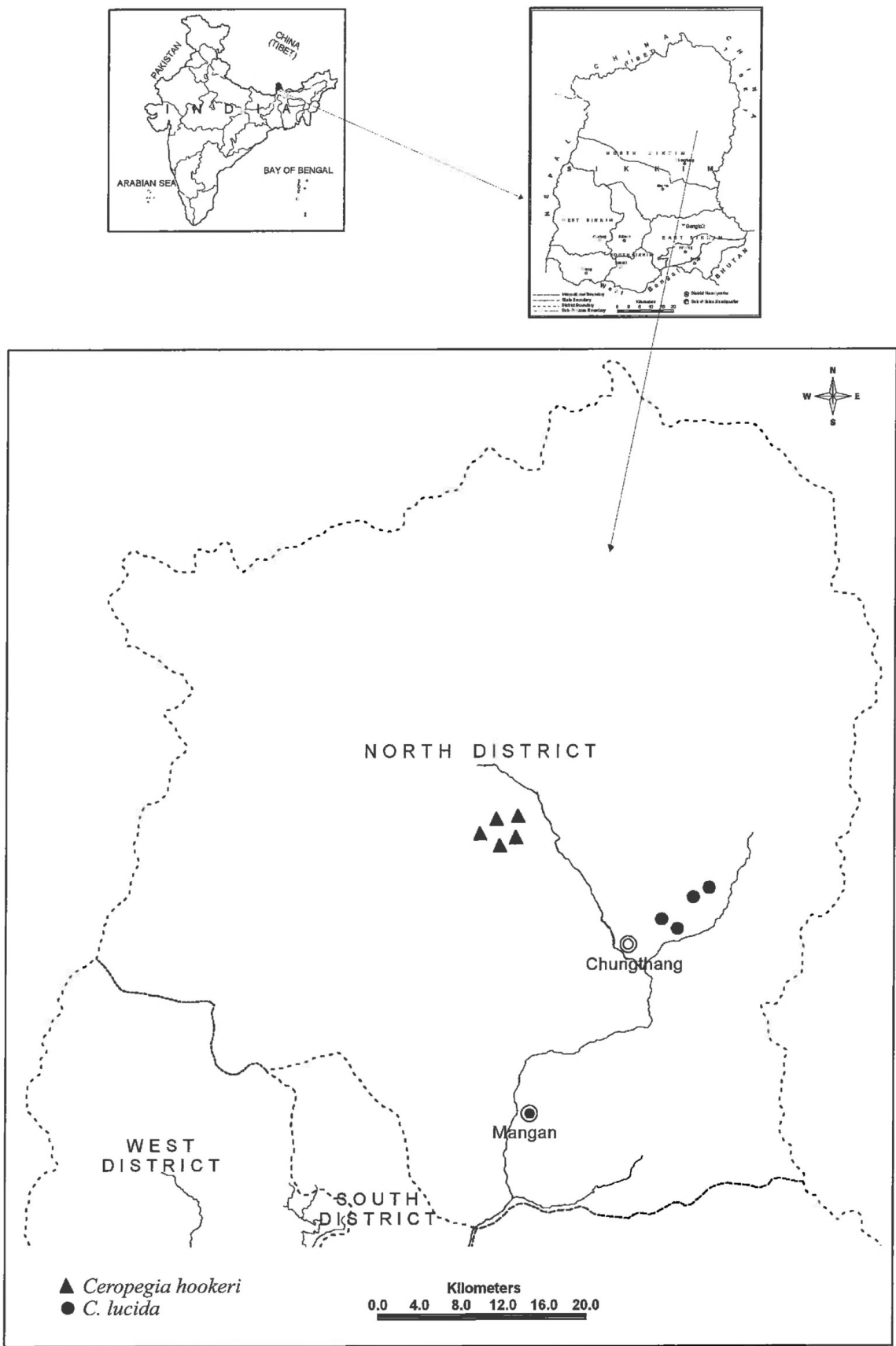


Fig. 1. Map of the study area showing collection sites of *Ceropegia* spp.

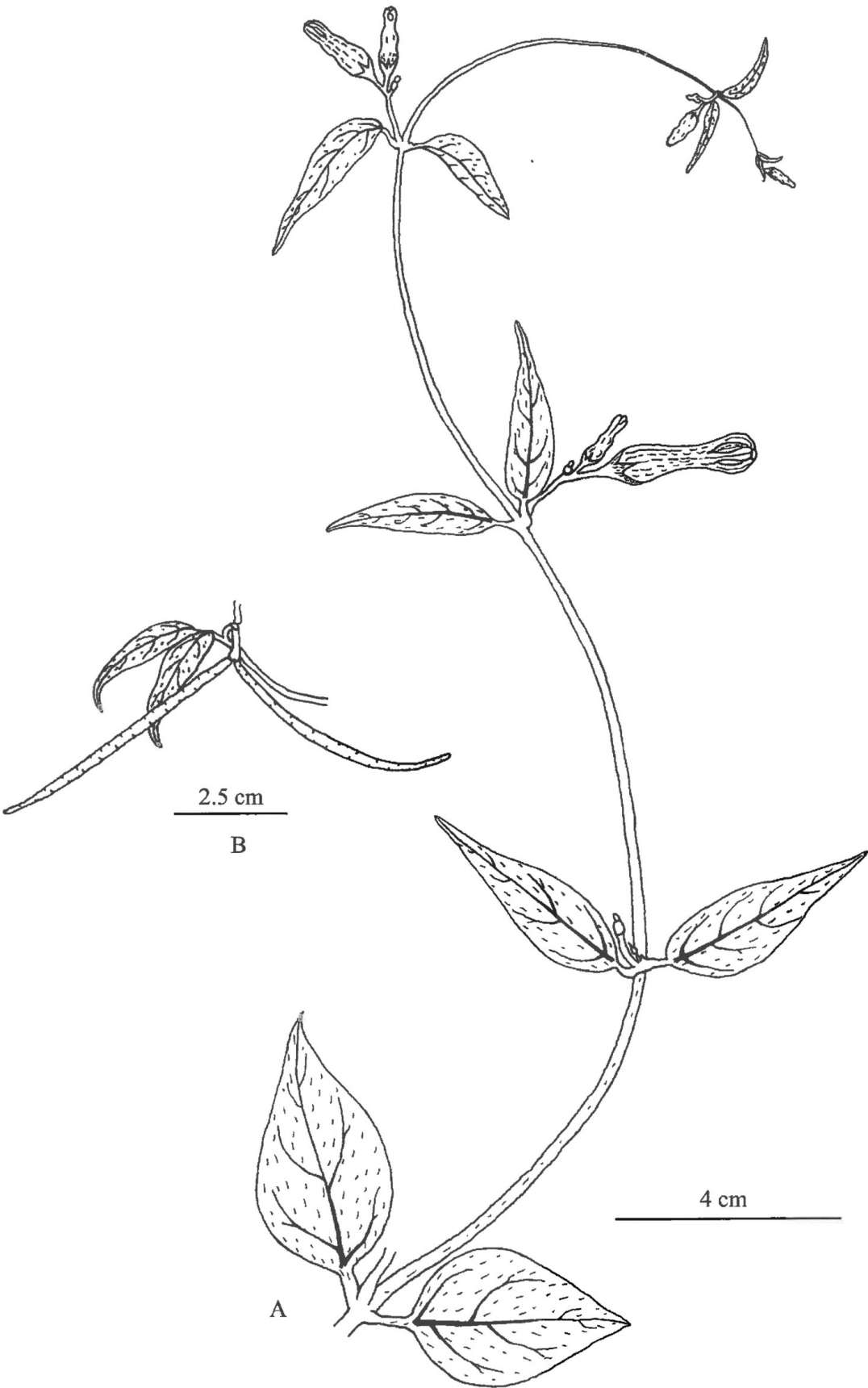


FIG. 2. Line diagram of *Ceropegia hookeri* C.B. Clarke ex Hook.f. Flowering twig (A) and Fruit (B).



FIG. 3. Line diagram of *Ceropegia lucida* Wall.

*Conservation threat.*—The species is threatened by habitat loss due to a number of human activities. These include agricultural expansion, road building and grazing by domestic animals. A number of tourists also visit these areas and owing to its showy flowers, these plants become targets of removal, which is also poses a serious threat to the survival of this species.

***Ceropegia lucida*** Wall. Pl. As. Rar. 2:33, t. 139. 1831; Hook.f. Fl. Brit. India 4:73.1885; Kanjilal & Bor. Fl. Assam 3:309. 1939; Ansari, Fasc. Fl. India 16:22. 1984.



FIG. 4. A flower of *Ceropegia hookeri*.



FIG. 5. A plant of *C. lucida* in its natural habitat. Note its showy flowers; the shape of the flower resembles a fountain from where the genus derives its name.

Long twining, sparsely hairy or glabrous herbs, with tuberous roots. Stem solid, long creeping, up to 2 m long. Leaves membranous, ovate or lanceolate, petiolate, 6.5–10.5 cm long and 1.5–2.5 cm wide; petiole short, 0.5–1.1 cm long. Peduncles short, 1.5–2 cm long, hairy in line. Flowers few (5), in axillary peduncled cymes; pedicels glabrous. Calyx small, about 0.7 cm long; corolla curved, 3.5–4.5 cm long, sparsely dialated at the base, green spotted with purple; upper corolla lobes linear, about 2 cm long, ciliate within the spatulate apex. Outer corona of 5 bifid-deltoid ciliate lobes; inner erect, linear-clavate.

**Habitat.**—Two populations of *C. lucida* were located near Lachung village (North Sikkim) at an altitude of 1750 m in a damp grassland/scrub (Fig. 4). The scrub was comprised of scattered trees such as *Alnus nepalensis* D. Don, *Carpinus viminea* Wall. ex Lindl, *Erythrina arborescens* Roxb., *Lyonia ovalifolia* (Wall.) Drude, *Rhus hookeri* Sahni & Bahadur and *Salix disperma* Roxb. ex D. Don. *Ceropegia lucida* often twines on other herbaceous species like *Artemisia parviflora* D. Don, *Chrysopogon gryllus* (L.) Trin., *Capillipedium assimile* (Steud.) A. Camus, *Colocasia affinis* Schott., *Commelina benghalensis* L., *Cynoglossum glochidiatum* Wall. ex Benth., *Didymocarpus pedicellatus* R. Br., *Heracleum nepalense* D. Don, *Persicaria capitata* (D. Don) H. Gross and *Stephania elegans* Hook.f. & Thomson. This locality has shallow, loamy skeletal soil with gravelly sandy loam surface texture. The area is humid almost round the year and receives high rainfall during June to August with an annual average rainfall of ca 3000 mm with the average minimum/maximum temperatures ranging between 5–16°C and 14.7–24.8°C.

**Distribution.**—India: Sikkim, Meghalaya; Bangladesh, Burma, China, Hong Kong, Malaysia, Thailand.

**Status.**—During the exploratory surveys two populations comprising 8–10 individuals could be located (Fig. 1). All the individuals in this locality were adults and in flowering and fruiting stages. We undertook



field exploration to various localities in Sikkim from where the occurrence of this species was reported earlier. We could not relocate this species at the known localities like Lower and Upper Rayang.

**Conservation threat.**—The populations suffer from habitat loss due to agriculture expansion, overgrazing and road construction activities, particularly in Rayang valley from where it was recorded earlier. These habitats have undergone major land use changes due to on-going human activities.

#### DISCUSSION

*Ceropegia hookeri* C.B. Clarke ex Hook.f. is one of the poorly known endangered species of Himalaya. It was first reported from its type locality, Lachen valley in North Sikkim (Clarke 1879). In the nineteenth-century, the species was collected from Zemu valley and the adjacent Tibet Himalaya and its specimens deposited in the Central National Herbarium, Kolkata (see Nayar & Sastry 1988). Apart from the type, only a few specimens from Zemu valley are available at CAL (July, 1909; 2 sheets). Since then, this species has remained elusive, though the area of its occurrence has been extensively surveyed by different research groups from India and abroad. Grierson and Long (1999) reported the species from Lachen and Chumbi valleys. A few sheets—reportedly of this species—from Lingthem in upper Zongu, Rang Rang, Bichu and Chungthang areas, are in the Botanical Survey of India herbarium, Sikkim Himalaya Circle (SHC), Gangtok. These sheets neither matched Hooker's description of the species (Hooker 1885) nor with the few specimens at CAL. It seems that the sheets at SHC may have been wrongly ascribed to *C. hookeri*. In view of the wrong identity of the specimens at SHC, Gangtok, our paper places on record the occurrence of *C. hookeri* from its type locality, Lachen, North Sikkim. We collected this species from Lachen valley at an altitude of 2700 m during 2003 and continued to observe the population through 2004–2006. The specimen of *C. hookeri* from Lachen agrees with the Hooker's description (Hooker 1885) and confirms its type locality. It is apparently endemic to Lachen and possibly to the adjoining Nepal Himalaya, where it has been reported earlier (Hooker 1885).

*Ceropegia lucida* Wall. was first reported from Sylhet in Bangladesh (Wallich 1831). In India, its collection history dates back to nineteenth-century when Hooker collected it from Khasia Hills (Meghalaya), followed by the collection of Keenam from Cachar (Assam) and King (1874) from the banks of the Rayang River, in Sikkim. Since there was no fresh collection of this species after 1874, it was considered as endangered or possibly extinct (Nayar & Sastry 1988). Collection of this species from Lachung Valley is therefore of significant interest to conservationists and taxonomists and marks its rediscovery after a gap of over hundred years. Also, this species is reported for the first time from North Sikkim, thus extending its range of distribution from previously reported tropical zone to the temperate Himalayan region. It may be too early to suggest, but likely, that the species may have shifted its geographic range upwards under the influence of global warming (see Davis & Shaw 2001). The occurrence of the species in Lachung valley (1750 m) and its disappearance from its known localities like Lower and Upper Rayang, do suggest the possibility of a range shift. However, the other likely cause of species extinction of *Ceropegia lucida* from its known localities appears to be habitat destruction due to agricultural expansion, overgrazing, and road construction activities in Rayang Valley. These habitats have undergone major land use changes due to ongoing human activities (Pandit et al. 2007). Additionally, the tubers of some *Ceropegia* species are known to be consumed locally by humans during periods of scarcity (see Nayar & Sastry 1987, 1988). Enquiries among the local population, however, revealed that the tubers of *Ceropegia* are not consumed at present. However, the respondents did not rule out the possibility of consumption of tubers in the past, in these inaccessible terrains, during the times of food shortage. This biotic pressure on the species in the past might have accentuated the problem of dwindling numbers of this species in nature. All these pressures seem to be responsible for pushing the species to the brink of extinction.

Both *C. hookeri* and *C. lucida* have low population sizes and are threatened by habitat loss due to a number of human activities. It is well known that many Himalayan plant species with low population sizes face survival risks (Pandit 1998, 2003). Humid conditions and adequate amount of water in the soil seem

to be essential for their growth in the natural habitat. Due to these specific habitat requirements, the species are difficult to cultivate at other places. To save these species from extinction efforts are on to multiply them through seeds and tubers and reintroduce them in their natural habitats. Besides, there is an urgent need for carrying out detailed biological and ecological studies on these species and their habitats need to be brought under some kind of protective regulation.

### Ex-situ conservation strategies

Propagating by seeds in habitats with similar ecological conditions or in nearby botanic gardens will be useful in ex-situ conservation of these species. Micropropagation using tissue and organ culture needs to be explored for mass multiplication and reintroduction into the wild. Since the population sizes of these species are small, harvesting of plants or plant parts from the wild should be strictly prohibited. In addition, there is a need to understand the reproductive biology, genetic architecture, and evolutionary relationship of these species to ensure their reestablishment in nature and multiplication in botanic gardens, herbal gardens, and other protected areas.

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