

# Studies On The Endemic *Liparis* (Orchidaceae) In North-East India And Red List Assessment As Per IUCN Criteria

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## Abstract

Taxonomic studies on the genus *Liparis* Rich. (Orchidaceae) has been conducted in North-East India. Out of 32 taxa reported under this genus from North-East India, four species viz. *Liparis chunthangensis* Lucksom, *Liparis lydiae* Lucksom, *Liparis pygmaea* King & Pantl., and *Liparis torta* Hook.f. are endemic to India. These endemic species were studied for their taxonomy and threat status were assessed by following the IUCN guidelines. While *L. chunthangensis* and *L. lydiae* were assessed as Critically Endangered, *L. pygmaea* and *L. torta* were found as Endangered in global perspective. Detailed morphology, phenology, distribution and rationale for their red list assessments have been provided here.

**KeyWords:** Orchidaceae, Taxonomy, morphology, distribution, conservation, India.

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## INTRODUCTION

*Liparis* Rich. [ORCHIDACEAE-EPIDENDROIDEAE-MALAXIDEAE-MALAXIDINAE] represent one of the most diverse Orchid genera with 426 taxa globally (Chase *et al.*, 2015), distributed mainly in South-East Asia, Pacific Islands to Australia, Europe and North America. Pridgeon *et al.* (2005) have considered *Liparis* as polyphyletic which represent assemblage of taxa with diverse vegetative and floral morphology. The genus includes both terrestrial as well as epiphytic species. The plant size, nature of rhizome, pseudobulbs, number, position and nature of leaves, flower size, venation in petals and sepals, size, shape and ornamentation of labellum, nature of column and its wing are considered taxonomically important characters in species delimitation within this genus. In India, the genus is represented by 42 species and 1 variety (Singh *et al.*, 2019) which are distributed mainly in the Himalayan region with some species found in peninsular India and Andaman & Nicobar Islands.

Of the 43 taxa of *Liparis* known from India so far, 32 (31 species, 1 variety) are distributed in the North-East India, which includes four species that are endemic in India. Phytogeographically North-East India is extremely important due to its rich floristic composition owing to its favourable climatic conditions. The North-East India comprise eight states – Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. The area shares its territory with two global bio-diversity hotspots – The Himalayas and The Indo-Burma. It provides a continuous habitat for the mixture of Indo-Chinese, Indo-Burmese, Sino-Himalayan and Indo-Malayan biotic elements and extremely diverse in its species composition. Like the members of other plant families, Orchidaceae is represented by more than 70 percent of its total diversity in North-East India. The genus *Liparis* is no exception in this context. Therefore, the genus is studied comprehensively from North-East India for detailed documentation of the species diversity, distribution, phenology, population and threats which would help in planning for effective conservation measures and sustainable utilization of this important bioresource.

Present communication deals with the documentation of endemic *Liparis* species found in North-East India and their Red List Assessments as per IUCN guidelines (IUCN, 2012; 2024). While *L. chunthangensis*, and *L. lydiae* were assessed as Critically Endangered, *L. pygmaea* and *L. torta* were found as Endangered in global perspective. Detailed morphology, phenology, distribution with maps and rationale for their red list assessments have been provided here.

## TAXONOMIC TREATMENT

1. *Liparis chungthangensis* Lucksom, Orchid Rev. 112(1255): 14, f.11. 2004 and Orch. Sikkim NE Himalaya: 281, f.175, pl.10. 2007; Singh et al., Orch. India Pic. Guide: 341. 2019. Type: India, Sikkim, Chungthang, 12.06.2003, S.Z. Lucksom 314a (holotype-CAL); 314b and 314c (isotypes- Gangtok Forest Department Herbarium). **Figure-1**

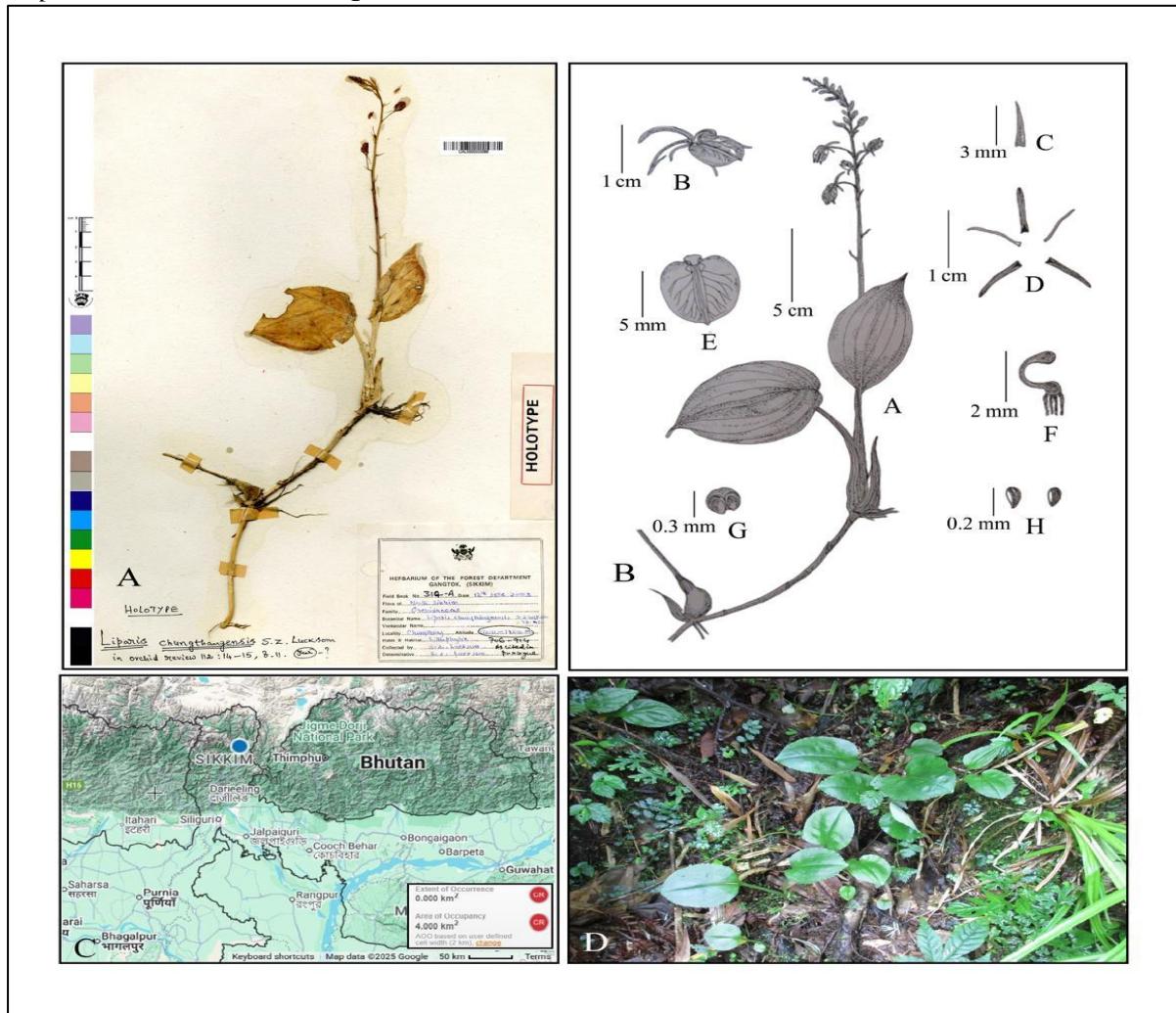


Figure-1: A. Holotype of *Liparis chungthangensis* Lucksom; B. Illustration of *Liparis chungthangensis* Lucksom from the protologue [A. Habit; B. Flower; C. Floral bract; D. Sepals and petals; E. labellum; F. Column; G. Anther; H. Pollinia]; C. Distribution map of *Liparis chungthangensis* (mapped through GeoCAT); D. Vegetative plants of *Liparis chungthangensis* Lucksom at the type locality.

**Description:** Terrestrial herbs, up to 23 cm tall. Rhizome elongated, 1.5 – 2.5 mm diam, covered with 2 – 3 cm long, tubular sheaths. Pseudobulbs inserted 6 – 9 cm apart on the rhizome, 9 – 17 × 9 – 12 mm, ovoid, laterally compressed, basally covered with one large prominent sheath, apically with sheathing leaf bases; sheaths 2.5 - 6.5 cm long, lanceolate, acuminate, developing shoot entirely covered with sheaths and sheathing leaf-bases. Leaves 2, unequal, 3.6 - 8 × 2 - 5.2 cm, ovate-elliptic, weakly undulate, acuminate, prominently 7-veined, glabrous; petiole 3.0 - 6.5 cm long, amplexicaul and abruptly narrowing, channelled. Inflorescence apical on the developing pseudobulb, 11.3 - 21.0 cm long; peduncle 6.8 - 15 cm long, striated or winged, glabrous, with many sterile bracts; sterile bracts 7 - 8 mm long, lanceolate, acute, glabrous, translucent white; rachis purplish, laxly many flowered, winged; floral bracts 6 - 7 × 1.2 - 1.5 mm, lanceolate, acuminate, erect, glabrous. Flowers 1.5 - 1.7 cm across, dark purple, tinged with translucent green; pedicel plus ovary 1.2 cm long, angular, glabrous, purplish. Sepals spreading, with convolute margins; dorsal sepal 7 - 8 × 1.5 - 2 mm, linear, reflexed, 3-veined; lateral sepals 8 - 8.2 × 1.5 - 2 mm, lanceolate, acute, 3-veined, lying parallel below the labellum; petals 7.8 - 8 × 0.4 - 0.5 mm, linear-filiform, coiled, 1-veined. Labellum simple, 7.9 - 1.0 × 6.5 - 9 mm, oblong-orbicular, flat, straight, obscurely 2-lamellate at base, shortly clawed at base, apex obscurely bilobulate with a median mucronate tip, margin entire, minutely glandular. Column 2.5 mm long, sharply curved, apically 2-winged, base slightly swollen, with a concavity. Anther 2-lobbed; pollinia in 2 pairs, oval. Fruits not seen.

Flowering: June.

Habitat: Terrestrial, on moist, shady rocky slopes at 1500 – 1800 m. altitude.

Distribution: INDIA: Sikkim (Chunghang), ENDEMICH

Specimen examined: This species is known only by its type collections. It could not be spotted during subsequent surveys in the type locality.

Notes: This species was described by Lucksom (2004) based on specimens collected from Chunghang at North district of Sikkim. Lucksom differentiated this species from the closely allied *Liparis cathcartii* Hook.f. (which is also distributed in the same area) based on its ovate-acuminate, many veined leaves; peduncle ebracteate or with 1 – 5 sterile bracts; oblong, flat labellum with two obscure callii at the shortly clawed base and obscurely bi-lobulate apex which is apiculate at tip; sharply curved column with quadrate wings and a cavity at base; and truncate anther. A closer comparison of Lucksom's type specimen with the protologue and types of *Liparis cathcartii* revealed close similarities in the vegetative and floral morphology but striking difference in the nature of peduncle-bracts, floral bracts and nature of flower opening. While, both peduncle bracts and floral bracts in *Liparis chunghangensis* were longer, lanceolate, acuminate and translucent; these are very short, ovate-acute and opaque in *Liparis cathcartii*. All the flowers are simultaneously opened in *L. cathcartii*, but they open successively in case of *L. chunghangensis*. During the present study, fresh vegetative specimens were observed at Chunghang – Hot Spring track, which unfortunately could not survive under cultivation for observation of the flowers.

Red list assessment as per IUCN guidelines and justification: Lucksom (2007) mentioned 'rare' for *Liparis chunghangensis* with no further information on its population size and threats. The species is known from its type collection only. The type locality 'Chunghang' provides an excellent habitat for the temperate and sub-alpine floristic elements, but subjected to considerable degradation due to developmental activities, construction of roads, hydroelectric dams in recent times. It is the gateway of two most visited tourist destinations – Lachen and Lachung in Sikkim. As it is known from a single location, the population size is not expected to be more than 250. The Area of Occupancy (AOO) is 04 km<sup>2</sup> with a grid size of 2 × 2 km. The pollination and seed germination are vector dependent and fruit setting in nature could not be observed. Considering the above, the species has been assessed as 'Critically Endangered' [CR B2ab(iii); C2a(i,ii)]. More survey, further research to confirm its identity and habitat management has been recommended for its conservation.

2. *Liparis lydiae* Lucksom, J. Bombay Nat. Hist. Soc. 89: 105. 1992 (as *lydiaei*) & Orch. Sikkim NE Himalaya: 288, f.190. 2007 (as *lydiaei*); N. Pearce & P.J. Cribb, Orch. Bhutan: 203. 2002; Singh et al., Orch. India Pic. Guide: 345. 2019. Type: India, Sikkim, Bhusuk valley, 10.10.1990, S.Z. Lucksom 198 (Holotype – Gangtok Forest Department, Herbarium, deposited at CAL), 198b (isotype – Gangtok Forest Department Herbarium). **Figure-2**

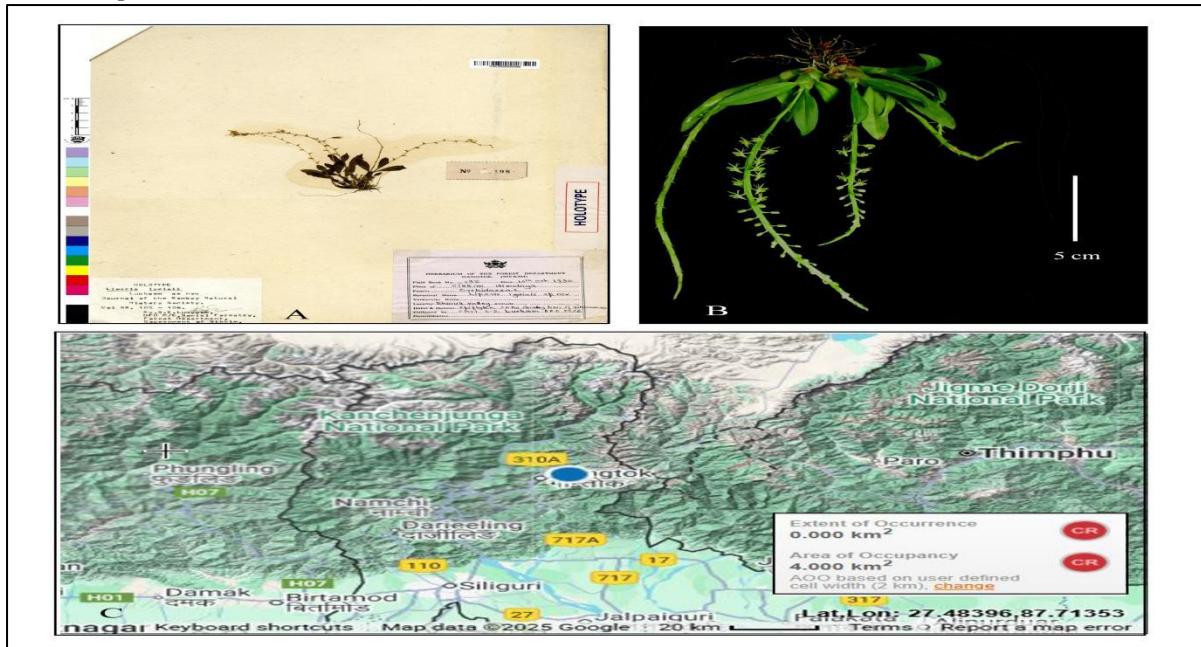


Figure-2: A. Holotype of *Liparis lydiae* Lucksom; B. Habit of *Liparis platyrachis* Hook.f.; C. Distribution map of *Liparis lydiae* Lucksom (mapped through GeoCAT).

[1] Description: Epiphytic herbs, plants up to 14 cm long. Pseudobulbs close together, 10–20 × 3.5–6 mm,

ovoid-cylindric, tapering towards apex, with membranous sheaths. Leaves 4, alternate along the length of pseudobulb, membranous,  $1-2.7 \times 0.4-0.9$  cm, ovate-oblong, undulate, acute-acuminate; base narrowed, sub-sessile, articulate, sheathing. Raceme terminal, 7-12 cm long, drooping, slender, weakly flexuous, glabrous, not winged; peduncle 1-2.5 cm long, erect at base, with 2-3, cordate-clasping sterile bracts; rachis laxly 4-14-flowered. Floral bracts  $3.5-4 \times 2-2.5$  mm, ovate-cordate, acute, clasping at base. Flowers 7-8 mm across, light greenish-pink. Pedicel and ovary 4-4.5 mm long. Sepals unequal, free, spreading, obtuse, margin revolute, 1-veined; dorsal sepal  $3.5-4 \times 2-3$  mm, broadly ovate-concave, reflexed; lateral sepals narrower,  $5.5-6 \times 0.8-1$  mm, spreading, oblong. Petals  $3-3.8 \times 0.2-0.4$  mm, linear, translucent, recurved, 1-veined, reflexed. Labellum  $2.3-2.5 \times 0.8-1$  mm, basal margins raised to form thickened auricles, ovate-cordate above, acute, with a median depression, slightly deflexed in middle; base with 2 erect, dark brown calli. Column c. 3 mm long, curved, prominently winged; anther ca. 0.5 mm long, ovate, dome-shaped; pollinia 2, clavate-oblong, translucent, orange-yellow.

**Flowering:** October - November.

**Habitat:** Epiphytic; grows on branches of shrubby *Viburnum* sp. in moist, shady places.

**Distribution:** INDIA: Sikkim (Bhusuk valley); ENDEMICH.

**Specimens examined:** This species is known by its type specimens only.

**Notes:** Lucksom (1992) described *Liparis lydiaii* based on plants collected from Bhusuk valley in the East district of Sikkim. The specific epithet was corrected to 'lydiae' in the IPNI and subsequently included in other literatures. The species is closely allied to *Liparis platyrachis* Hook.f., but differs in having ovoid-cylindric pseudobulbs (vs. oblong, compressed); ovate-oblong, thin textured leaves (vs. linear-lanceolate, thickly membranous); unwinged, terete peduncle, with 2-3 cordate-clasping sterile bracts (vs. intermittently winged, with short linear sterile bracts); greenish-pink flowers (vs. pale ochraceous yellow); dorsal sepal broader than the laterals (vs. narrower); and cordate labellum (vs. quadrate). Both *L. platyrachis* and *L. lydiae* share many common morphological features and comparison with more specimens at population level may prove that both are conspecific. *Liparis platyrachis* has been observed with variable flower colour in Sikkim and Arunachal Pradesh.

**Red list assessment as per IUCN guidelines and justification:** Lucksom (2007) mentioned 'rare' for *Liparis lydiae* with no further information on its population size and threats. The species is known from its type collection from Bhusuk at East District of Sikkim. The habitat quality is being declining due to developmental activities and other anthropogenic threats. Considerable forest area has been cleared in recent years for human settlements and expansion of agricultural land. The species is known from a single location with Area of Occupancy (AOO) of  $04 \text{ km}^2$  with a grid size of  $2 \times 2 \text{ km}$ . Population size is not expected to be more than 250. Pollination and seed germination depend on availability of suitable pollinators and mycorrhiza respectively. Fruits were not observed during its original discovery. The species could not be traced in the type locality during the several field survey in recent time. Considering the above, the species has been assessed as 'Critically Endangered' [CR B2ab(iii); C2a(i,ii)]. More survey, further research to confirm its identity and habitat management has been recommended for its conservation.

3. ***Liparis pygmaea*** King & Pantl., Ann. Roy. Bot. Gard. Calcutta 8: 34, t.44. 1898; Pradhan, Indian Orch. Guide Ident. Cult. 2: 234. 1979; N. Pearce & P.J. Cribb, Orch. Bhutan: 203. 2002; Lucksom, Orch. Sikkim NE Himalaya: 279, f.171. 2007; Singh et al., Orch. India Pic. Guide: 352. 2019; Manoj Singh & al., Richardiana, n.s. 4: 127, f.2. 2020. Type: India, Sikkim Himalaya, below Jongri (Dzongri), 13000 ft., Pantling 449 [K-000387807, Lectotype - inadvertently designated by Seidenfaden in Dansk Bot. Arkiv 31(1): 20. 1975; isolectotypes - CAL (CAL0000000079; CAL0000000081; CAL0000000082), E, LE, W].



**Figure-3: A.** Isolectotype of *Liparis pygmaea* King & Pantl. at CAL; **B.** Original illustration of *Liparis pygmaea* King & Pantl. (King & Pantling: t.44. 1898); **C.** Distribution map of *Liparis pygmaea* King & Pantl. (mapped through GeoCAT).

**Description:** Terrestrial herbs, plants up to 3–4 cm high. Stem pseudobulbous, 5–10 × 3–5 mm, narrowly ovoid, loosely enclosed by 2–3, whitish, membranous sheaths. Leaves 2, apical on pseudobulb, sub-opposite, thin textured, 13–16 × 6–8 mm, ovate to elliptic, margin entire, acute; base sessile, sheathing, non-articulate. Raceme terminal, 2–3 cm long, erect, glabrous, winged; peduncle ebracteate, clasped by the developing leaves; rachis laxly 2-3-flowered. Floral bracts 1.5–2 × 1 mm, lanceolate, acute, pale green. Flowers successive, 14–16 mm across, purplish-violet throughout, flushed with yellowish at sepals and labellum, dark purple at basal calli. Pedicel and ovary 4–6 mm long, erect. Sepals sub-similar, obtuse, margin revolute; dorsal sepal 7–8 × 1.5–2 mm, arched over the column, oblong; lateral sepals 6–7 × 1.5–2 mm, linear, lying parallel below the labellum. Petals 5–7 × 0.4–0.5 mm, linear, acute, spreading, margin reflexed, 1-veined. Labellum 5–6 × 2–3 mm, simple, slightly deflexed from middle, oblong-ovate, 5-veined; basal half entire, concave, with a large, 2-lobed callus just under the column; apical half entire to obscurely erose, apex broad, apiculate. Column 2–2.5 mm long, arcuate, broad at base, shortly winged at apex; anther with an acute beak; pollinia elliptic-oblong; rostellum well developed.

**Flowering:** June–July.

**Habitat:** Terrestrial; mainly found in alpine forests on moss covered rocky slopes in alpine area at 3800–4000 m.

**Distribution:** INDIA: Sikkim (Dzongri, Kokchurang chu, Jamlinghang, Tsomgo), Uttarakhand (Chamoli), West Bengal (Singalila); ENDEMICH.

**Specimens examined:** Uttarakhand, Chamoli district, on the way to Saptkund, Ghannsal Udiyar, 3800 m., 23.06.2020, Manoj Singh & Harish Negi 197758 (BSI); Sikkim, without precise locality, 1892, Gammie s.n. (CAL-450033); Sikkim, without precise locality, G. King 4161 (CAL-450032); West Bengal, Singalilah,

12000 ft., July 1896, Pantling 449 (CAL0000000080).

**Notes:** The species was described by King & Pantling (1898), based on specimens collected from Sikkim and Darjeeling Himalaya and known to be endemic there until Manoj Singh *et al.*, (2020) recorded it from Chamoli district of Uttarakhand. Seidenfaden (1976) believed the materials from Nepal and China could belong to this species, which led Pearce & Cribb (2002) to include *Liparis nana* Rolfe and *Liparis meniscophora* Gagnep. under *Liparis pygmaea*. Manoj Singh *et al.*, (2020) have justified that, *Liparis pygmaea* is a distinct species and endemic to India. The labellum of *L. pygmaea* was found to be oblong-ovate, entire, with a fleshy bilobed callus, whereas in *L. nana* has sub-quadrate labellum with erose margin and a U-shaped callus. Manoj Singh *et al.* (2020) also clarified about the inadvertent lectotypification by Seidenfaden (1976) and erroneous type citation by Pearce & Cribb (2002).

**Red list assessment as per IUCN guidelines and justification:** Manoj Singh *et al.*, (2020) had assessed the species as Vulnerable [VU B2ab(iii); C2a(i)] by taking the records from China and Nepal as belonging to this species. During the present study, the Nepal and China records are excluded (as they are reidentified as *Liparis nana* Rolfe) and more information were available for their distribution in Sikkim. Lucksom (2007) mentioned 'very rare' for this species with no further information on its population size and threats. He included Kokchurang chu, Jamlinghang, Tsomgo as additional localities for this species. It is now concluded that this species is endemic in India, distributed at Uttarakhand constituting one location; and five localities at Sikkim and West Bengal constituting another location. The species is not known for any commercial exploitation. Its habitats are subjected to unsustainable tourism and developmental activities. Manoj Singh *et al.* (2020) reported only 10 mature individuals from Uttarakhand. The species is known from Eastern Himalaya by some historic collections which are more than 100 years old. The Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated in GeoCAT domain as 25527.833 km<sup>2</sup> and 24 km<sup>2</sup> respectively. Pollination and seed germination depend on availability of suitable pollinators and mycorrhiza respectively. Considering the above, the species has been reassessed as 'Endangered' [EN B2ab(iii,v); C2a(i)]. More survey to relocate the species in Eastern Himalaya and habitat management has been recommended for its conservation.

**4. *Liparis torta* Hook.f.**, Icon. Pl. 21: t.2014. 1890 & Fl. Brit. India 6: 182. 1890; Rao & Singh, Wild Orch. Meghalaya: 37. 2015; Singh *et al.*, Orch. India Pic. Guide: 352. 2019; C.S. Rao *et al.*, Nelumbo 63(2): 38, fig. 1-4. 2021. *Stichorkis torta* (Hook.f.) Marg., Szlach. & Kulak. Acta Soc. Bot. Poloniae 77: 39. 2008. *Leptorkis torta* (Hook.f.) Kuntze, Revis. Gen. Pl. 2: 671. 1891. Type: India, Khasia hills, 3000 ft., October 1878, G. Mann s.n. (Holotype K000387798, Photo!). Meghalaya, K & J Hills, Cherra, 14.11.1968, Anonymous 37223-ASSAM (Epitype designated by C.S. Rao *et al.*, Nelumbo 63(2): 38. 2021).

Figure-4

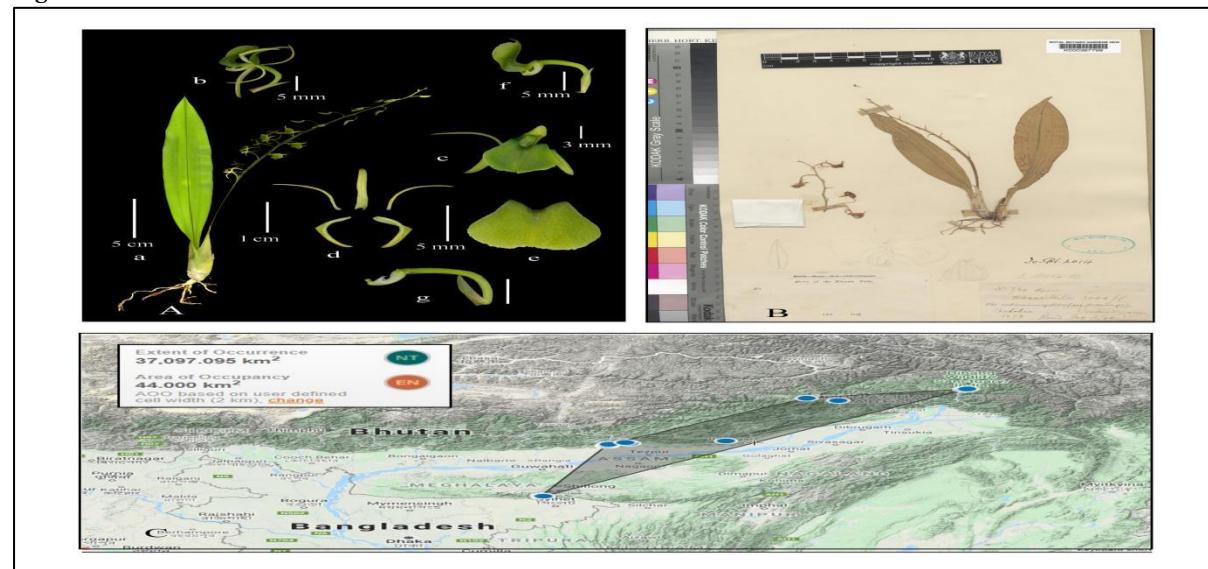


Figure-4: A. Illustrative photo-plate of *Liparis torta* Hook.f. [a. Habit; b. Flower (side view); c. Flower (front view); d. Sepals and petals; e. Labellum (front view); f. Column with labellum; g. Column]; B. Holotype (K000387798) of *Liparis torta* Hook.f.; C. Distribution map of *Liparis torta* Hook.f. (mapped through GeoCAT).

[2] **Description:** Epiphytic herbs, up to 25 cm long. Pseudobulbs clustered, 1.5–3.5 × 0.8–1.5 cm, ovoid-conical to narrowly cylindrical, young ones covered with 3–4 imbricate sheaths. Leaf solitary, apical on

pseudobulbs, thinly coriaceous, 10–18 × 3–3.5 cm, elliptic-lanceolate, entire, acute-acuminate, 9-veined; base sub-sessile, articulate, sheathing. Raceme terminal on developing shoot, as long as or longer than leaves, up to 25 cm long, erect or arched, glabrous; peduncle 3–4 cm long, terete, obscurely winged, covered at base with sheaths of developing shoot, ebracteate above; rachis prominently winged, straight or weakly flexuous, laxly few flowered. Floral bracts 6–8 × 1–1.5 mm, lanceolate, acute-acuminate, membranous, spreading. Flowers successively opening, 15–22 mm across, cadmium yellow to pale green, labellum yellowish-green. Pedicel and ovary 14–16 mm long, slender, strongly curved. Sepals sub-similar, free, spreading, strongly decurved, margins revolute, apex obtuse, 1-veined; dorsal sepal 10–12 × 2–2.5 mm, narrowly oblong; lateral sepals slightly shorter, oblique, projecting beyond labellum. Petals 9–11 × 0.5–0.7 mm, filiform, revolute, decurved, 1-veined. Labellum shorter than sepals, 8–10 × 7–9 mm, cuneate at base, broadly obovate above, angles rounded, reflexed from base, margin obscurely crenulate above, apex sub-truncate to shallowly emarginate, slightly mucronate at sinus; base with erect margins forming two auricles, with 2 erect, dark-green, tooth-like calli. Column white, 4–5 mm long, erect, arched forward, winged at apex; wings prominently hooked (see notes below); anther yellowish-green, 1 mm long, with elongated truncate beak; pollinia 4, in two unequal pairs, yellow, waxy; rostellum broadly ovate-triangular; stigmatic cavity large, broadly oblong-elliptic. Capsules 1.5 - 2.5 cm long, ellipsoid, ridged, with long, slender, fruiting pedicel.

[3] *Flowering*: October–January; *Fruiting*: December – February.

[4] *Habitat*: Epiphytic; on trees and rock boulders in tropical and sub-tropical evergreen forests at 500 - 1000 m.

[5] *Distribution*: INDIA: Arunachal Pradesh (West Kameng, Papum Pare, West Siang, Dibang Valley), Meghalaya (Khasi Hills); ENDEMIC.

[6] *Specimens examined*: Arunachal Pradesh: West Kameng district, Pinjuli nallah area, 600 m, 13.01.2015, D.K. Agrawala 37622 (cult. BSHC!); Foot Hills - Khellong, 30.01.1993, Hegde 6168, 6169 (APFH, OHT); Khellong, 31.01.1983, Hegde 6171, 6172 (OHT); Foot Hills, 24.01.1984, Hegde 6216 (OHT); 28.01.1984, Hegde 6209, 6230 (OHT); Tipi, 10.12.1990, Hegde 25721 (OHT); 01.02.1995, A.N. Rao 26103 (OHT); Koylajuli, 30.12.1987, Hegde 24196 (OHT); Papum Pare district, Itanagar, 30.12.2005, A.N. Rao & Chowlu 183 (OHT); West Siang district, Hiraro-Kying, 1000m, 19.11.2010, Bhaumik 25335 (ARUN); Tato - Menchuka, 1800 m, 09.11.2010, Bhaumik 25027 (ARUN); Dibang Valley district, Anini, 1800 m, 17.11.1996, Bhaumik 1375 (CAL); Alenye, 1540 m, 16.11.1999, Bhaumik 2636 (CAL); Meghalaya, Khasi Hills, Oct. 1878, Mann, 7/88 (K-photo!); Cherrapunjee, 14.11.1968, Anonymous 37223 (ASSAM).

[7] *Notes*: *Liparis torta* was described by Hooker (1890) based on collection from Khasia Hills, Meghalaya. This is one of the single leaved epiphytic *Liparis* and was obsolete for more than a century. The species has never been collected after its type collection and also excluded by Kataki (1986) from his book 'Orchids of Meghalaya'. It was in 2015 the species was rediscovered by us from Arunachal Pradesh during a floristic survey at West Kameng district. On critical observation, the species was found closely allied with *Liparis bootanensis* Griff. and many specimens were found mis-identified at CAL, ASSAM, OHT and ARUN. Rao *et al.* (2021) have comprehensively reported about its rediscovery, typification, amended description, relationship with *Liparis bootanensis*, extended distribution and red list assessment.

[8] *Red list assessment as per IUCN guidelines and justification*: *Liparis torta* is endemic to India and is known by five sub-populations distributed in Arunachal Pradesh and Meghalaya. The one in Meghalaya is known by historic reports of 53- and 130-year-old. From Arunachal Pradesh, the species has been reported from West Kameng, West Siang, Dibang Valley and Papum Pare districts. Present collection site at Pinjuli nallah area in West Kameng district harbor nearly 50 mature individuals. Its occurrence at other localities has also been observed as frequent (evident from the herbarium label information). The species is not known as commercially exploited for any purpose but has the potential of an ornamental species. The habitats are fragile and being epiphytic, its survival depends on that of host tree. All the known localities in Meghalaya and Arunachal Pradesh are under severe anthropogenic threats due to developmental work, tourism, coal mining and expansion of agricultural land. The Extent of Occurrence (EOO) and Area of Occupancy (AOO) have been estimated through GeoCAT map as 37097.095 km<sup>2</sup> and 44 km<sup>2</sup> respectively. The past population size and decline is not known for application of criteria A of IUCN. Considering the above data, the threat perspective of *Liparis torta* has been assessed as Endangered [EN B2ab(iii); C2a(i)]. Habitat management and further research is recommended for this species.

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