

**Full Length Article**

## New distributional records of *Primula* species in Arunachal Pradesh, India

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### ABSTRACT

The paper highlighted the three *Primula* species which are new records for Arunachal Pradesh, viz. *Primula gambeliana* Watt, *P. ioessa* W. W. Sm., and *P. involucrata* Wall. The scrutiny of literature and our field assessment ascertained that the occurrence and population status of these species is very rare and poor. During study it was observed that various natural and anthropogenic threats like landslides, grazing and development activities have led the pressure on the habitat of *Primula* species. Considering the rich and dense species diversity of *Primula*, the Arunachal Pradesh may be considered as centre of diversity of the Indo-Chinese *Primula* species and appropriate conservation strategy should be adopted for the conservation of this genetic resource diversity.

**Key word:** Diversity, distribution, *Primula*, Arunachal Pradesh, threats and conservation.

### INTRODUCTION

The genus *Primula* L. is one of the largest angiospermic herbaceous genera in the family Primulaceae. It includes 38 sections and 430 species distributed worldwide mainly in the temperate and alpine regions of the world with greatest diversity and major concentration (>75 %) in Sino-Himalayan region (Richards, 2003; Hu and Kelso, 1996). *Primula* species are mostly perennial or annual herb with simple leaves arranged in a basal rosette and beautiful attractive flowers. The Primulas bloom mostly during the spring. The other regions of *Primula* distribution are North America, 20 species (Richards, 2003); Siberia, 14 species (Richards, 2003) and Pakistan, 23 species (Nasir, 1984). In the Sino Himalayan region, the species are found in China Tibet, Bhutan and India particularly in the Indo-Bhutan and Indo-Chinese Himalayan region. The Indian Himalayan region is also considered as one of the centers of the rich species diversity of the *Primula* L. with 113 taxa distributed from Western to Eastern Himalaya (Ghosh, 1982). In India maximum species are

reported from Eastern Himalayan state of Arunachal Pradesh and Sikkim. A total 58 species are report from Sikkim ([www.sikkimforest.gov.in](http://www.sikkimforest.gov.in)); while total 35 species are reported from Arunachal Pradesh till date, of which there is no mention of these species under study. Records of 22 and 15 species are made from Western Himalayan state of Jammu & Kashmir and Himachal Pradesh respectively (Nasir, 1984; Chowdhery, 1984).

Arunachal Pradesh, by virtue of its geographical position, climate conditions and altitudinal variations, is a biodiversity rich region in North East India, with large zone of tropical wet evergreen, subtropical, temperate and alpine forests. The state is recognized as one among the 200 globally important regions (Olson and Dinerstein, 1998). The flora of Arunachal Himalaya comprises well over 4000 species of flowering plants which includes large number of species of *Ficus* L., *Primula* L., Bamboo, Orchid, *Rhododendron* L., *Begonia* L., *Piper* L., etc. Occurrence of many important medicinal plants like *Aconitum* L., *Berberis* L., *Coptis teeta* Wall., *Illicium griffithi*

Hook. f. & Thomson, *Podophylum hexandrum* Royle, *Panax* L., *Taxus wallichiana* Zucc., etc. and large number of None Timber Forest Product yielding species is another characteristic feature of the biodiversity of the state. Although, the state of Arunachal Pradesh occupies a unique place in the Eastern Himalayan biodiversity hot spot because of its rich biodiversity, but, the biodiversity is yet to be explored thoroughly and documented. The rich floristic diversity needs to be explored scientifically to know the taxonomic status of various families and genera. Like many other genera very limited information is available on the genus *Primula* L. in Arunachal Pradesh. Although this part of the globe has been aptly explored botanically many times by the different botanist since the period of Griffith (1836), Hooker (1882), F. K. ward (1929-1930), N. L. Bor (1931-1934), Pal (1986), Boardman *et al.*, 2010 etc. but none reported the existence of these species under study in the State of Arunachal Pradesh. The complete *Primula* diversity of the Arunachal Himalayan is still unknown, as no extensive study has so far been conducted in this area. This area is biogeographically linked with China, Bhutan and Myanmar, which are known as main centre of species diversity of Asian Primulas. Therefore, an attempt has been made here to understand the taxonomic diversity and distributional features of *Primula* L. in Arunachal Pradesh.

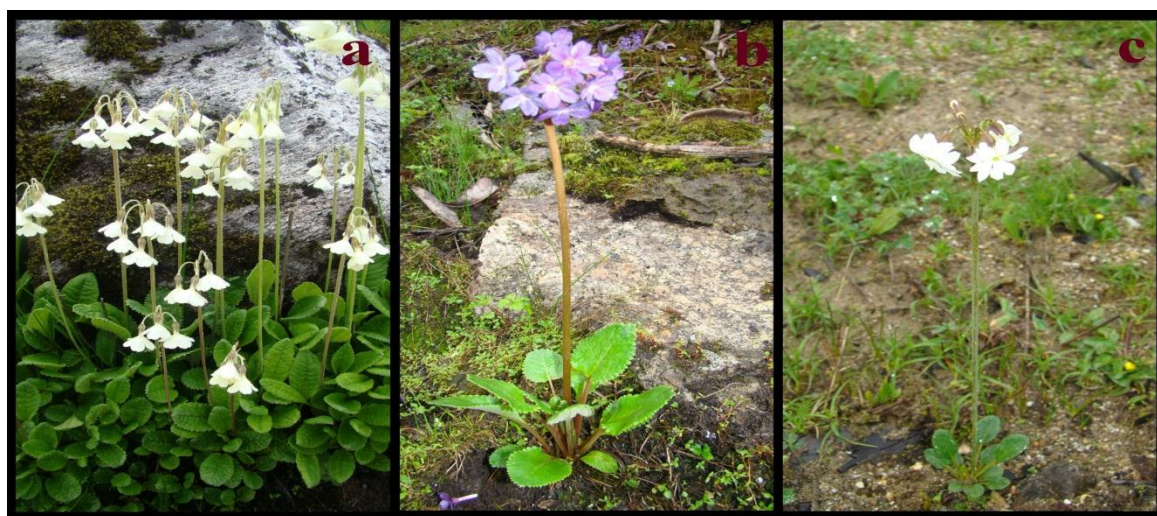
## MATERIALS AND METHODS

For exploration of diversity and distribution of the *Primula* species, extensive field surveys were conducted during the active growing season from February 2011 to September 2012 at the elevation between 1500 – 4500 m in various part of the state particularly West Kameng and Tawang districts. Specimens of *Primula* species were collected and herbarium of each species has been prepared following the methods outlined by Jain and Rao (1977). Species are identified by the consultation of various floras (Richards, 2003; Giri *et al.*, 2008; Chowdhery and Wadhwa, 1984; Hooker, 1882) and herbarium specimens at the major Indian herbaria namely ARUN, ASSAM, BSHC; CAL, BSD, and DD.

## Taxonomic Enumerations

During exploration, the authors came across three interesting species of *Primula* L. collected at Pangatengtso and Sella Pass area in Tawang district. After critical studies and consultation of herbarium specimens at CAL, these species are identified as *Primula gambeliana*, *P. ioessa*, and *P. involucrata*, which were not reported earlier from the state. The complete description and other relevant notes of these newly recorded species are appended here as these are poorly represented in Indian literature and herbarium collections. Colour plates of all these species are also provided to facilitate easy identification (Fig 1).

**Figure 1: New distributional recorded *Primula* species occurring in Arunachal Pradesh.(a) *P. ioessa* (b) *P. gambeliana* and (c) *P. involucrata***



***Primula gambeliana*** Watt, Linn. Soc. Bot. 20: 3. 1882; Hooker in Hook. Fl. Br. India 3: 483. 1882; Hu & Kelso in Wu & Raven, Flora of China 15: 39–189. 1996; Grierson & Long in Long, Fl. Bh. 2(2): 536. 1996; Richards, Pri. 215. 2003.

**Type:** India (Sikkim, above Jongri), 3<sup>rd</sup> June 1881, G. Watt, 5483, (E00024705, Isotypes)

Herbs perennial, with overlapping ovate farinose bud scales at base. Leaves in a rosette; petiole usually 3–4 × as long as leaf blade; leaf blade ovate to sub-orbicular, 1–10 × 0.5–6 cm, efarinose, surface glabrous and leathery, abaxially sparsely minutely glandular, base cordate to truncate, margin dentate, apex obtuse to acute. Scape 3–40 cm, glabrous or sparsely minutely glandular; bearing single or double umbel with 2 umbels (1 or) 2–8-flowered; bracts linear-lanceolate, 3–10 mm. Flowers heterostylous, Pedicel 2–10 mm, elongated to 2.5 cm in fruit, sparsely glandular. Calyx tubular-campanulate, 5–6.5 mm, parted to 3/5–2/3; lobes lanceolate, acute. Corolla purple-pink to violet-purple; limb 1.5–2.5 cm wide; lobes broadly obovate, deeply emarginate. Pin flowers: corolla tube ca. 1–1.5 cm; stamens at middle of tube; style nearly reaching mouth up to 1–1.4 cm. Thrum flowers: Stamens positions reciprocal, style 7–8 mm. Capsule cylindrical as long as calyx

**Flowering:** June–August; **Fruiting:** August–September

**Ecology:** Growing in humid areas and stream sides at the elevation of 3500–4000 m. Poor populations have been found in some isolated pockets.

**Distribution:** India (Sikkim, Arunachal Pradesh), China, Bhutan

**Exsiccatae:** India, Arunachal Pradesh, Tawang District, Pangatengtso area, 3800–4000 m, and 23.06.2012, A. Bawri, 23 (NERIST), Sikkim, G. Watt 5407, 1904; Iso-lectotype. (CAL 272064).

***Primula ioessa*** W.W.Sm. Notes Roy. Bot. Gard. Edinburgh 19: 216. 1937; Hu & Kelso in Wu & Raven, Flora of China 15: 39–189. 1996; Richard, Pri. 238. 2003.

**Type:** China (Xizang) 27<sup>th</sup> Aug. 1936, Ludlow & Sherriff 2514, (E00024721, Isotypes)

***Primula sikkimensis* var. *subpinnatifida*** W.W. Sm. Trans. Bot. Soc. Edinburgh 19: 218 218 1937.

Herbs perennial. Leaves in a rosette; petiole up to 11 cm or sometimes nearly as long as leaf blade; leaf blade narrowly oblong to oblanceolate, 6–12 × 1–2.5 cm, base attenuate, margin dentate, apex rounded, alternate venation 8–9 pairs. Scapes 10–35 cm, scarcely farinose toward apex; umbels 2–8-

flowered; bracts linear to linear-lanceolate, 0.7–1.5 cm, sparsely yellow farinose. Flowers heterostylous. Pedicel 1–4 cm, yellow farinose. Calyx campanulate to tubular-campanulate, 7–10 mm, scarcely farinose and stained with purple outside, abundantly farinose inside, parted to middle, 5-veined; lobes triangular, apex often slightly re-curved, acute. Corolla creamy white with light yellow mealy eye; tube 0.7–1 cm; limb 2–2.5 cm wide; lobes broadly obovate, emarginate to sub-entire. Pin flowers: stamens ca. 2 mm above base of corolla tube; style ca. as long as tube or up to 1.1 cm. Thrum flowers with positions reciprocal, style 0.2–0.4 cm. Capsule cylindrical, ca. as long as calyx.

**Flowering:** June - August; **Fruiting:** August - September

**Ecology:** Growing in humid and marshy areas and stream sides at the elevation of 3500–4000 m. A few populations have been found in some isolated pockets.

**Distribution:** India (Arunachal Pradesh), Tibet and China.

**Exsiccatae:** India, Arunachal Pradesh, Tawang District, Sella Pass area, 3800–4000 m, and 29.06.2012, A. Bawri, 26 (NERIST), Southern Tibet. F. Ludlow & G. Sheriff, 2514, 27 August 1936; Isotype (E 00024722).

***Primula involucrata*** Wallich ex Duby in A. de Candolle, Prodr. 8: 42. 1844; Hooker in Hook. Fl. Br. India 3: 492. 1882; Hu & Kelso in Wu & Raven, Flora of China 15: 39–189. 1996; Richards, Pri. 251. 2003.

**Type:** India: Uttar Pradesh: Badrinath, Garhwal, Wallich 7107 (E00024471, Isotypes)

***Primula munroi*** Lindl., Edwards's Botanical Register 33: 15. 1847; Grierson & Long in Long, Fl. Bh. 2 (2): 536. 1996.

Herbs perennial, efarinose. Leaves in a rosette; petiole up to 4.5 cm; leaf blade ovate to oblong or sub-orbicular, 0.9–1 × 1–3.5 cm, sub-fleshy, sparsely minutely glandular, base cuneate, rounded to slightly cordate, margin entire or slightly denticulate, apex obtuse to rounded, alternate venation 4–5 pairs. Scapes 10–35 cm; umbels 2–6-flowered; bracts ob-long to ovate-lanceolate, 0.8–1 cm. Flowers heterostylous. Pedicel 1–3.5 cm. Calyx narrowly campanulate, 7–10 mm, parted to 1/3 or slightly below, 5-ribbed; lobes lanceolate to triangular, glandular ciliolate, apex acute. Corolla white; limb 1–1.5 cm wide; lobes obovate, deeply emarginate. Pin flowers: corolla tube 0.8–1.2 cm; stamens ca. 4 mm above base of corolla tube;

style 1-1.2 cm slightly exerted. Thrum flowers: corolla tube 1.2–1.4 cm; stamens toward apex of corolla tube; style 0.5 – 0.6 cm, slightly shorter than calyx. Capsule oblong, as long as calyx.

**Flowering:**

June - August; **Fruiting:** August - September

**Distribution:** India (Sikkim, Arunachal Pradesh and Kashmir), China Bhutan and Nepal

**Ecology:**

Growing in humid and marshy areas and stream sides at the elevation of 3500-4000 m. Poor populations have been found in some isolated pockets.

**Specimen Examined:**

India, Arunachal Pradesh, Tawang District, Pangatengtso area and Sella Pass, 3500-3900m, and 24.06.2012, A. Bawri, 23 (NERIST), Sikkim, J. H. Lacc, 1496, 14. 09. 1896. (CAL 272389).

Primulas occupy a significant place in higher altitude ecosystem as the species become dominant elements in sub-alpine and alpine vegetation. Due to the attractive colorful flowers with nectars they support the life of numerous insects and flies which play crucial role in the food chain of ecosystem. During the study, it was found that the habitat of this species rapidly degraded due to anthropogenic pressure, developmental activities and natural activities; hence some species are facing threats. So, there is urgent need to initiate the appropriate steps to save their habitats and also conserve them in ex-situ conditions. Internationally various reports are available on the conservation and management through extensive research on *Primula* species, however research works supportive to conservation and management of Indian *Primula* are yet to be carried out. The present initiative to study the *Primula* of Arunachal Himalaya assumed to provide the baseline information on the genus that can be useful for formulation of conservation strategy.

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