

## ADDITIONS TO THE FLOWERING PLANTS OF INDIA FROM ARUNACHAL PRADESH

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Arunachal Pradesh is part of two most significant globally recognized biodiversity hotspots i.e. eastern Himalaya and Indo-Burma. The flora of the region is highly diverse and embedded in fragile ecosystems with high species diversity and endemism. The state is estimated to have more than 5000 flowering plants, 568 orchids, 114 *Rhododendron* taxa, 217 legumes, 85 species of bamboos, 29 Gymnosperms, and 462 species of pteridophytes (Hajra & Mudgal, 1997; Baisya, 2001; Rao, 2007; Mao, 2010). The state also supports one of the world's richest alpine flora with maximum endemism (Tse-ring & al., 2010). The materials for the flora of Arunachal Pradesh published in three volumes (Chowdhery & al., 1996; Giri & al., 2008 and Chowdhery & al., 2009) gives the baseline recorded floristic data of the state. Field studies in different parts of state are yielding increasingly interesting findings (Dash & al., 2009, Dash & Srivastava, 2009; Dash & al., 2011; Taj & al., 2009) in the context of recorded distribution.

The present paper is based on the recent fieldwork by the authors in the Vadse hills of the Kurung Kumey district of Arunachal Pradesh. During the plant exploration, many interesting plant specimens were collected. A critical study of these specimens in consultation with available literature (Long & Rae, 1991; Fang (R.C.) & al., 2005; Fang (M.Y.) & al., 2005; Sastry & Hajra, 2006), revealed that five species namely, *Gaultheria heteromera* R.C.Fang, *Gaultheria trichophylla* var. *eciliata* Rae & D.G.Long, *Lyonia villosa* var. *sphaerantha* (Hand.-Mazz.) Hand.-Mazz., *Rhododendron sanguineum* subsp. *sanguineum* var. *sanguineum* and *Vaccinium papulosum* C.Y.Wu & R.C.Fang hitherto not reported from India. Collection of *Pleione scopulorum* W.W. Sm. and *Rhododendron trilactorum* Cowan from Indian region are not found in any of the Indian herbaria. In the present communication, all these species are enumerated with their correct citation and nomenclature, family name in parenthesis, followed by a brief description, flowering and fruiting time, a short note on its occurrence. Photograph of all these species are also given for easy identification and future collection.

1. ***Berneuxia thibetica*** Decne., Bull. Soc. Bot. France 20: 159. 1873; Shu in Fl. China 14. 238 2005. *Shortia thibetica* (Decne.) Franch. Nouv. Arch. Mus. Hist. Nat., sér. 2, 10: 54. 1887. *Berneuxia yunnanensis* H.L.Li in Rhodora 45: 335.1943. *Shortia davidii* Franch. Nouv. Arch. Mus. Hist. Nat., sér. 2, 10: 54. 1887. (Diapensiaceae)

Perennial herbs, 10 - 18 cm high. Rhizomes woody, densely covered with ovate scales. Leaves basal, obovate-spatulate, 2.5 - 10 x 1 - 4.2 cm, widest at the middle, base attenuate or narrowed into basal petiole, margin entire, recurved, apex rounded, usually with a short apicula, coriaceous, glabrous, pale green above, deep green beneath; lateral veins 2 - 4 pairs, faintly impressed above; petioles 5 - 10 cm long, glabrous. Flowers in elongated racemose heads, 5 - 13 flowered, peduncles elongated, 9.5 - 18 cm long, pedicel 3 - 10 mm long, minutely pubescent or pappilose, bracts ovate, 2 - 3 mm, bracteoles 2, linear lanceolate, c. 2 mm long; fruiting pedicels elongated up to 23 cm long. Sepals reddish, broadly elliptic to ovate, 4 - 5 x 2 - 3 mm, margin entire. Corolla white or pinkish-red; campanulate, tube 7 - 10 mm long, lobes oblong or obovate, divided up to base, margin entire. Stamens 5, alternate with the corolla lobes, filaments minute, inserted at the base of the corolla, pubescent towards base; anthers 2 locular, staminodes short, usually ligulate, densely pubescent. Ovary subglobose, slightly trigonous, superior, style glabrous, exserted, stigma globose. Capsule globose, covered by persistent sepals.

*Fl. & Fr.* : May-August.

*Habitat:* *Berneuxia thibetica* Decne. is found commonly in the shady forest floors, wet mountain cliffs of *Rhododendron* forests at an elevation of 2900 - 4000m.



Plate 1. A. *Berneuxia thibetica* Decne.; B. *Gaultheria heteromera* R.C.Fang; C. *Gaultheria trichophylla* var. *eciliata* Rae & D.G. Long; D. *Lyonia villosa* var. *sphaerantha* (Hand.-Mazz.) Hand.-Mazz.; E. *Rhododendron sanguineum* Franchet, subsp. *sanguineum* var. *sanguineum*. F. *Rhododendron trilactorum* Cowan.

*Specimens studied:* Arunachal Pradesh, Lower Dibang valley District: Myodia hills, *A.A.Mao* 23232; Kurung Kumey District: Vadse hills, 3840 m *A.A.Mao & S.S.Dash* 31807.

*Notes:* *Berneuxia* Decne. is a uni-specific genus reported from Northern Yunnan, Sichuan, SE Xizang and NW Guizhou provinces of China (Chang, 1990) till date. The genus is considered to be endemic to this region. The present collections substantiate the southern and south-eastern extension of the genus from Sichuan and western extension from Yunnan provinces of China. The present collection of the species by the authors from Arunachal Pradesh forms its first report of occurrence in India. The species was collected from two locations, Myodia hills, Lower Dibang valley district (2900m) and Vadse hill of Kurung Kumey district (3840m) of Arunachal Pradesh. Field observations and studies on the herbarium specimens suggest that, the plants of lower elevation are having broader and larger leaves than the plants of higher elevations.

**2. *Gaultheria heteromera* R.C.Fang, Novon 9: 164. 1999; R.C.Fang et Stevens, Fl. China 14(3): 261.2005. (Ericaceae)**

Dwarf shrubs; stem 5–18 cm high, erect or spreading at base; densely puberulous, hairs up to 2 mm long, brown, with a basal gland. Leaves alternate, elliptic or oblong-elliptic, 8–25(-30) x 5–12(-14) mm, base rounded or broadly cuneate, margins dentate, teeth glandular or glandular ciliate, apex obtuse, mucronulate; coriaceous, glabrous above, very sparsely hirtellous beneath, lateral veins 3 pairs, secondary veins distinctly reticulate, impressed adaxially; petiole 1–3 mm, sparsely puberulous. Inflorescences shortly racemose, peduncles 10–13 mm long; terminal or axillary on upper leaves; Flowers white or pinkish white, pedicel 3–6 mm, glabrous; bracts broadly ovate, 1.5–2 mm, glabrous, acuminate; bracteoles 1 pair, similar to bract, attached towards the middle of the pedicle. Calyx lobes 4, triangular-ovate, 2–3 mm, glabrous. Corolla white or pinkish white, inflated, urceolate, tube 4–5 mm, glabrous, lobes reflexed at apex. Stamens 8, filaments *ca.* 1 mm, swollen at base, glabrous, papillate; anthers thecae 2-awned. Ovary densely hairy.

*Fl. & Fr.* : May- August.

*Habitat:* This species is commonly found in the alpine thickets, stiff mountain cliffs or on rocky crevice at an elevation of 3600–4000 m.

*Specimen studied:* Arunachal Pradesh, Kurung Kumey District: Vadse hills, 3870 m *A.A.Mao & S.S.Dash* 31873.

*Notes:* *Gaultheria heteromera* R.C.Fang has been reported from the SE Xizang province of China earlier. The present collection of this species from Arunachal Pradesh forms the basis of its first report for India. Occurrence of this species in Arunachal Pradesh is apparently due to its eastern migration from Xizang. *Gaultheria heteromera* R.C.Fang can be distinguished in the field by the presence of densely puberulent branch-lets, distinctly 4 lobed calyx, broadly globose urceolate corolla. The species is closely allied to *Gaultheria pyrolaefolia* Hook.f., & C.B.Clarke which is more commonly found in eastern Himalaya but differs by presence of smaller punctate leaves, 5 lobed calyx and glabrous ovary. The present collection from the Vadse hill differs from the protologue by having slightly pinkish white flowers.

**3. *Gaultheria trichophylla* var. *eciliata* Rae & D.G.Long, Notes Roy. Bot. Gard. Edinburgh 45: 334. 1988; R.C.Fang & Stevens, Fl. China 14(3). 262. 2005. (Ericaceae)**

Dwarf shrubs, stem prostrate, spreading, much branched below, terete, brown hirsute. Leaves elliptic or oblong, 3–13 x 2–5 mm, base acute, margins obscurely crenulate, eciliate, apex obtuse or rounded, thickly coriaceous, glabrous, occasionally sparsely pubescent along mid-vein beneath; petiole very short, *c.* 0.5 mm. Flowers solitary, axillary; pedicel 1–2 mm; bracteoles 2, towards apex of the pedicle, orbicular or broadly ovate, 1–2 mm across, glabrous. Calyx lobes ovate-oblong, 2–3 mm long, ciliolate, glabrous. Corolla white, campanulate, 5–6 mm, deeply 5-lobed, glabrous; lobes erect, oblong, 2–3 mm. Stamens 1.5–2 mm long; filaments spindle-shaped; thecae 1-awned. Capsule 6–10 mm across, glabrous with deep blue fleshy persistent calyx.

*Fl. & Fr.*: June-August.

*Habitat*: This species is found commonly in the alpine moorlands, rocky cliffs at an altitude of 3900 - 4500m.

*Specimens studied*: Arunachal Pradesh, Kurung Kumey District: Vadse hills, 3800 m *A.A.Mao & S.S.Dash* 31818.

*Notes*: The occurrence of this variety has been reported in NW Yunnan and Bhutan earlier. This variety can be differentiated from the typical form, by absence of long cilia along leaf margin and presence of one awned thecae in stamens. *Gaultheria trichophylla* var. *trichophylla* is found commonly in Sikkim, Arunachal Pradesh, Darjeeling district of West Bengal, Bhutan, Kashmir and Nepal. But the occurrence *Gaultheria trichophylla* var. *eciliata* S.J.Rae & D.G.Long has not been reported earlier from India. The collection of the species from Vadse hills of Arunachal Pradesh forms the first collection from India.

4. ***Lyonia villosa* var. *sphaerantha*** (Hand.-Mazz.) Hand.-Mazz., Symb. Sin. 7(4): 789. 1936; R.C.Fang & Stevens, Fl. China 14(3). 252.2005. *Xolisma sphaerantha* Hand.-Mazz. Akad. Wiss. Wien, Math.-Naturwiss. Kl., Anz. 62: 131. 1925. (Ericaceae)

Shrubs, deciduous, 1 - 1.8 m high, young branches pubescent or glabrescent; buds narrowly ovoid. Leaves obovate or oblong-obovate, 1.5 - 6 x 1 - 3.5 cm, thinly coriaceous, base rounded or broadly cuneate, margin entire, apex obtuse, shortly mucronate, upper surface glabrous, sparsely pubescent on veins, lower surfaces villous or densely pubescent on veins, lateral veins impressed above, raised beneath; petiole 3 - 6 mm, pubescent. Inflorescences 1 - 3.5 cm, glabrous or very sparsely pubescent; bracts 5 - 12 mm long, foliaceous; pedicel 3 - 5 mm, glabrous. Calyx lobes narrowly lanceolate to oblong linear, 3 - 4 mm, minutely pubescent with glandular hairs. Corolla urceolate. Capsule ovoid, with thick sutures, reddish, glabrous.

*Fl. & Fr.* : July-October.

*Habitat*: This variety is found scattered in Rhododendron forest thickets, rocky slopes at an elevation of 3000 - 4000m.

*Specimens studied*: Arunachal Pradesh, Kurung Kumey District: Vadse hills, 3450 m *S.S.Dash* 31562; *A.A.Mao & S.S.Dash* 23112.

*Notes* : The occurrence of *Lyonia villosa* var. *sphaerantha* (Hand.-Mazz.) Hand.-Mazz., has only been reported from China (Sichuan, SE Xizang, Yunnan) and Myanmar (R.C. Fang, 2005) and considered to be endemic to this region. The collection of this variety from the Vadse hills of Arunachal Pradesh forms its first distributional record for India and suggests a western extension of the species from Yunnan region. However, the closely allied variety *Lyonia villosa* var. *villosa* is found commonly in India (Arunachal Pradesh, Sikkim), SE China, Yunnan, Bhutan and Nepal in similar ecological habitats. *Lyonia villosa* var. *sphaerantha* (Hand.-Mazz.) Hand.-Mazz. can be differentiated from *Lyonia villosa* var. *villosa* by shorter habit, smaller inflorescence size, glabrous (or sparsely pubescent) nature of the inflorescence rachis or pedicle.

5. ***Rhododendron sanguineum*** Franch., J. Bot. (Morot) 12: 259. 1898. subsp. ***sanguineum*** var. ***sanguineum***. *Rhododendron sanguineum* Franch. subsp. *sanguineoides* Cowan, Notes Roy. Bot. Gar. Edinburgh 20: 69.1940. (Ericaceae)

Dwarf shrubs, 0.5 - 1.5 m tall; bark brownish, falling off in flakes; twigs slender, 3 - 4 mm in thickness, young branches green, sparsely pubescent with eglandular indumentums; bud scales often deciduous. Leaves thickly coriaceous, obovate or broadly elliptic, 3 - 8 x 1.5 - 3 cm; base cuneate, decurrent along petioles; apex obtuse or rounded, apiculate, upper surface green, glabrous, lower surface sericeous, indumentum silvery or grayish; midrib grooved beneath; lateral veins 17 - 20 paired, impressed above; petiole 5 - 8 mm, densely tomentose when young. Inflorescence umbellate, (3 -)5 - 7 flowered; pedicel 1 - 3 cm long, densely tomentose. Calyx pink, copular, lobes 5, 2 - 4 mm, orbicular, glandular-ciliate. Corolla campanulate, fleshy, bright crimson, basal portion tubular, 3 - 4 cm long; lobes broadly ovate or suborbicular, emarginated at apex, glabrous.

Stamens 10, filaments red, glabrous. Ovary ovoid, 3 - 5 x 2 - 4 mm, densely tomentose, with eglandular hairs; style 1.5 - 2 cm, glabrous; stigma capitate. Capsule cylindric.

*Fl.*: April - June; *Fr.*: July - August

*Habitat*: *Rhododendron sanguineum* subsp. *sanguineum* var. *sanguineum* is found commonly in alpine hill-slopes at an elevation of 3500 - 4000 m.

*Specimen studied*: Arunachal Pradesh, Kurung Kumey District: Vadse hills, 3750 m A.A.Mao & S.S.Dash 31866.

*Notes*: The occurrence of *Rhododendron sanguineum* subsp. *sanguineum* var. *sanguineum* has earlier been reported only from SE Xizang and North West Yunnan provinces of China (Fang M.Y. & al., 2005). The typical subsp. *sanguineum* var. *sanguineum* can be separated from other varieties by the presence of bright crimson corolla, densely tomentose ovary with eglandular hairs. The occurrence of this species in India has not been reported before and this collection forms the basis of the first report of occurrence of *Rhododendron sanguineum* subsp. *sanguineum* var. *sanguineum* in India.

6. ***Rhododendron trilectorum*** Cowan, Notes Roy. Bot. Gard. Edinburgh 21:144. 1953. Chamberlain, Notes Roy. Bot. Gard. Edinburgh 39(2): 401. 1982. M.Y.Fang & al. in Fl China 14(2): 415. 2005. (Ericaceae)

Shrub, up to 0.3 m tall, bud scales ovoid, persistent. Leaves obovate or obovate-spathulate, 1 - 3 x 0.5 - 2 cm, base attenuate, margin incurved, apex rounded and apiculate or mucronulate, glabrous, pale green beneath, lateral veins 7 - 11 pairs, usually raised and conspicuous beneath; petioles 3 - 5 mm long, winged. Inflorescence short, flowers 2 - 3, pedicels glabrous, 2 - 3 cm. Calyx coriaceous, fleshy, lobes 1 - 3 mm long, glabrous. Corolla campanulate or funnel shaped, tube 3 - 4 cm long, pale yellow; lobes 1.5 cm long, broadly ovate, emarginated at apex. Stamens 1 - 3 cm long, filaments pubescent at base. Ovary cylindrical, glabrous.

*Fl. & Fr.* : April - July.

*Habitat*: Common on the open slopes, cliff edges at an altitude of 3400 - 4100m.

*Specimens studied*: Arunachal Pradesh, Kurung Kumey District : Vadse hills, 3850 m A.A.Mao & S.S.Dash 31828, A.A.Mao & S.S.Dash 31886.

*Notes*: *Rhododendron trilectorum* Cowan has been reported to occur in SE Xizang and Arunachal Pradesh (Fang, M.Y. & al., 2005; Cox, 2006) but no authentic voucher specimens were found in Indian herbaria. This collection of the species from the Vadse hill of Kurung Kumey district of Arunachal Pradesh confirms its occurrence in India and forms the first collection for Indian herbaria.

7. ***Pleione scopulorum*** W.W. Sm., Notes Roy. Bot. Gard. Edinburgh 13(63-64): 218-219. 1921. *Bletilla scopulorum* (W.W. Sm.) Schltr. Repert. Spec. Nov. Regni Veg. 19(552-555): 375. 1924. *Jimensia scopulorum* (W.W. Sm.) Garay & R.E.Schult. Bot. Mus. Leaflet. 18(5): 184. 1958. (Orchidaceae)

Terrestrial or lithophytic herbs, 15 - 22 cm tall. Pseudo-bulbs oblique, ovoid, narrowed towards the top to a slender neck, neck 2.0 - 2.5 cm long, usually covered with old leaf sheaths when young. Leaves 2, fully developed during the flowering time, lanceolate to oblanceolate, 10 - 13.5 x 1.5 - 2.2 cm, base rounded, entire at margin, acute at apex. Inflorescences 1 flowered, peduncles terete, 12 - 16 cm long, bracts sheathing, oblanceolate, 1.5 - 3.5 cm long, obtuse to acute at apex. Flower rose purple, lip spread, streaked with dark purple; dorsal sepals elliptic-lanceolate, 2.5 - 3.2 x 0.5 - 0.9 cm; lateral sepals obliquely elliptic, 2.1 - 3.0 x 0.6 - 1.0 cm, subacute to obtuse. Lip inconspicuously 3-lobed, wider than long, margins denticulate towards the apex; side lobes erect, callus consisting of a lacerate lamellae; columns acute, narrowly winged, 1.5 - 2.2 cm long, denticulate at apex. Fruits fusiform, 3.5 - 5.5 cm long, usually pendulous.

*Fl. & Fr.* : June - August.

*Habitat*: The species grows in humus covered boulders in shady rocky mountain cliffs, mountain slopes of sub-alpine to alpine forests at an elevation of 3200 - 4100 m.



Plate 2. A. *Pleione scopulorum* W.W. Sm.; B. *Vaccinium papulosum* C.Y. Wu & R.C. Fang

*Specimens studied:* Arunachal Pradesh, Kurung Kumey District: Vadse hills, 3750 m S.S.Dash 32777; A.A.Mao & S.S.Dash 31801.

*Notes:* *Pleione scopulorum* W.W.Sm. is one of the less known species of genus *Pleione*. Due to its rarity in occurrences and important horticultural values, the species is enlisted in appendix II of CITES (UNEP 2003). The species is having a restricted distribution; only known to be found in the adjacent parts of western Yunnan, SE Xizang (Tibet), Northern Myanmar and a solitary record in Naga Hills of Assam (Cribb & Butterfield 1999). Earlier collections of the species from Yunnan by G. Foster in July 1917 are available in K & CAL herbarium; while collections from Northern Myanmar by Kingdon Ward in 1923 are available in Kew herbarium only. The present collection forms basis of recollection of the species from a different part in India after a gap of more than 80 years. The species shows a great display of colour dimorphism in flowers ranging from white, bright scarlet rose to vivid magenta, white with crimson spotted to bright sulphur yellow. (Cribb & Butterfield 1999). *Pleione scopulorum* W.W.Sm. can be differentiated from other members of *Pleione* by the presence of turbinated pseudobulb covered with distinct tubular sheath. Due to the presence of distinct lip and callus, *Pleione scopulorum* W.W.Sm. is allied to *Pleione hookeriana* Kuntz. but differs by having fully developed leaves during flowers time, dimorphism in flower and presence of lacerate lamellae.

8. *Vaccinium papulosum* C.Y.Wu & R.C.Fang, Acta Bot. Yunnan. 9(4): 388 - 90, pl. 8. 1987. R.C.Fang & Stevens, Fl. China 14(3). 284. 2005 (Vacciniaceae).

Shrubs evergreen, 0.5 - 1 m high, branches few, glabrous; twigs woody, rounded, older densely white lenticellate; bud scales subulate, lax, persistent. Leaves oblong-lanceolate or elliptic lanceolate, 10 - 17.5 x 3 - 5.5 cm, thinly coriaceous, glabrous, lateral veins 8 - 14 pairs, not reaching to the margin, secondary veins distinctly raised on both surfaces, base cuneate, margin dentate, teeth obtuse, basal gland 1 pair per side, apex acute or acuminate; petiole 2 - 6 mm. Inflorescences racemose, axillary, often from old leaf scar, peduncles 2 - 6.5 cm, slender, many secund flowered; bracts subulate; pedicel 8 - 11 mm. Hypanthium with several small, rounded verrucae; calyx lobes deltoid, minute, c. 0.5 mm. Corolla yellowish, urceolate, 5 - 6 mm; lobes small, recurved at apex. Stamens 8, filaments shorter, anthers 4 - 5 mm, spurs absent. Immature berry verruculose.

*Fl. & Fr.:* April - July.

*Field observation:* The species is found scattered in subtropical evergreen forests as undergrowth, often in mountain slopes, at an elevation of 900 - 1700 m.

*Specimens studied:* Arunachal Pradesh, Kurung Kumey District: Miri to Sangram, c.1450 m S.S.Dash 32998, Near Sangram, c.1400 m S.S.Dash 31775.

*Notes:* *Vaccinium papulosum* C.Y.Wu & R.C.Fang has earlier been reported only from the South East Xizang of China and considered to endemic to this region (Wu & Fang, 1987). The collection of the species from subtropical forests of Kurung Kumey district of Arunachal Pradesh, substantiate the southern extension of the species from its type locality. The species is allied to *Vaccinium vacciniaceum* (Roxb.) Sleumer but differs by the presence of glabrous branchlets, scattered leaves, one pair of glands at base and inflorescence born just above the fallen leaf scars. It is interesting to note that, the collections made from Arunachal Pradesh display a leaf width between 3.0 - 5.5 cm as against leaf width of 5 - 7.7 cm described in Chinese literatures (Wu & Fang, 1987).

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