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A REVIEW OF THE SUBTRIBE LOXOCARPINAE (FAMILY GESNERIACEAE) OF INDIAN PART OF EASTERN HIMALAYA

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ABSTRACT

The subtribe Loxocarpinae of the family Gesneriaceae was reviewed from Indian part of Eastern Himalaya. A total of two genera viz. *Dorcoceras* Bunge and *Middletonia* C. Puglisi and two species *D. wallichi* and *M. multiflora* have been recorded from the study area. The subtribe Loxocarpinae is an interesting subtribe having twisted capsule valves. In *Dorcoceras* anthers are coherent but in *Middletonia* anthers are facing each other but not coherent. Detailed morphological description, correct accepted name, synonym, key to the species, phenology, and distribution with the similarity and differences between the two genera have been discussed here.

Keywords: Eastern Himalaya, Gesneriaceae, Loxocarpinae, *Boea*, *Paraboea*, *Dorcoceras*, *Middletonia*

INTRODUCTION

Gesneriaceae, one of the 23 families of the order Lamiales **[1]**, consists of 139 genera with 2,900 species. The plants are distributed in the tropical to temperate climate of the world **[2]**. The family is characterized by herbs, undershrubs, shrubs or small trees; stemless or caulescent, terrestrial or epiphytic. Leaves are simple, opposite, alternate or whorled, equal or unequal pair, monophyllous. Indumentum of leaf surface, petiole, stems, glandular or eglandular. Inflorescence usually cymose (pair-flowered cymes) rarely racemose or solitary. Flowers showy, hermaphrodite, pentamerous, irregular, rarely regular. Calyx segments 5, free or connate to a

variable extent, valvate or sometimes two-lipped. Corolla with a distinct tube, gamopetalous, limb bilabiate, rarely actinomorphic, tubular, campanulate, rotate, infundibulum. Stamens 2 or 4, anthers two-celled, filaments usually adnate to corolla, cohering at apex or face to face, dehiscing longitudinally or by basal or apical pores. Ovary superior or inferior, usually unilocular with parietal placentae. Fruit dehiscent or indehiscent capsule, valves straight or twisted, rarely a berry. Embryo with two equal cotyledons (Gesnerioideae) or with one cotyledon growing fully and the other abortive (Cyrtandroideae). The subtribe Loxocarpinae belongs to the tribe Trichosporeae under the subfamily Didymocarpioideae of the family Gesneriaceae **[3]**. Gesneriaceae was traditionally divided into two subfamilies viz. (i) Gesnerioideae (New World) with isocotylous seedling and inferior ovary and (ii) Cyrtandroideae (Old World) with anisocotylous seedling and superior ovary **[4]**. Throughout the world 12 genera and 171 species have been recorded under the subtribe Loxocarpinae **[3]**.

MATERIAL AND METHODS

Herbarium specimens were studied from different branches of Botanical Survey of India such as CAL (Central National Herbarium, Howrah, West Bengal), BSHC (Gangtok, Sikkim), LBG (Lloyd Botanic Garden Herbarium, Darjeeling), ASSAM (Shillong, Meghalaya), ARUN (Itanagar, Arunachal Pradesh). Herbaria of research institutes, universities and colleges housing good collection of Gesneriaceae species were also consulted, viz., State Forest Research Institute, Itanagar, Arunachal Pradesh; North Eastern Hill University (NEHU), Shillong, Meghalaya; University of North Bengal (NBU), Siliguri, Darjeeling.

RESULTS AND DISCUSSION

The subtribe Loxocarpinae is characterised by 2 fertile stamens and differs from all other gesneriads having spirally twisted capsule valves. During taxonomic studies of the subtribe Loxocarpinae two genera and two species were recorded from the study area. The two species under the subtribe Loxocarpinae from the Indian part of Eastern Himalaya is being discussed critically with key to the genera, description, phenology, distribution and comparative analysis.

Key to the genera

Stemless, hairs long, simple and silky, corolla prominently zygomorphic, gibbous, anthers coherent……*Dorcoceras.*

Short stemmed, arachnoid tomentum, corolla not highly bilabiate, anthers facing each other, not cohering…….*Middletonia.*

Dorcoceras Bunge

Description: Stemless, rosette. **Leaves** few to many, opposite or spirally arranged,

equal to subequal in pair, lamina villous to puberulent, hairs unicellular, simple unbranched. **Inflorescence** lax, 1 to many flowered axillary cymes, bracts 2 opposite. **Calyx** actinomorphic, 5-sect from near base. **Corolla** white, blue or purple, zygomorphic, obliquely campanulate, bilabiate, adaxial 2-lobed, abaxial 3-lobed. **Stamens** 2 fertile, adnate to corolla tube near base, included, anthers dorsifixed, coherent, thecae nearly parallel, dehiscing longitudinally, staminode 2 or 3. Disc inconspicuous. **Ovary** oblong, 1-loculed, placentas 2, projecting inward, 2-cleft, stigma 1, terminal, capitate, divided. **Capsule** straight in relation to pedicel, narrowly oblong, dehiscing loculicidally to base, valves 2, spirally twisted. **Seeds** unappendaged.

Distribution: ca.4 species in China to tropical Australia and Solomon Islands, Vietnam, Thailand; 1 species in India **[5]**, same in study area.

Notes: The genus *Dorcoceras* has been separated from *Boea* for some species of *Boea* due to their stemless habit, broad campanulate corolla with included stamen and straight filament with parallel anther thecae **[6]**. The Indian species *Boea wallichi* R.Br. is being included in the genus *Dorcoceras.*

***Dorcoceras wallichi* (R. Br.) C. Puglishi**

Boea wallichii R. Br., Pl. Jav. Rar. 120. 1840; B. L.Burtt *Notes Roy. Bot. Gard. Edinburgh* 41 (3): 419. 1984. G. P. Sinha in Singh et al., Fl. Mizoram 2: 202. 2012.

Didymocarpus helicteroides Wall., *Numer. List 789 1829*

Type: Upper Burma, Taongdong, Wallich 789 (K Photo !)

Description: Rosette herbs, perennial. **Leaves** 0.7-7 x 0.5-5.5 cm, lamina sub-orbicular to ovate, adaxially sparsely white villous, abaxially densely white to brownish wooly, apex rounded to obtuse, base cuneate to truncate, margin dentate to crenulate, venation palmate, nearly parallel, petioles ca. 0.5 cm long. **Inflorescence** 5-10 flowered cymose cluster, peduncles 4-12 cm long, pubescent, bracts 1-3 mm long, linear to lanceolate, peduncles 6-12 cm long, pedicels 5-15 mm long. **Calyx** 1.5-3 x 0.6-1 mm long, segments 5, divided up to the base, triangular or nearly lanceolate, outside puberulent, inside glandular puberulent. **Corolla** 0.9-1.4 cm long, pale mauve or blue or blue-white, outside sparsely puberulent, inside sparsely to densely glandular puberulent, bilabiate, adaxial lip ca 4 mm long, abaxial lip 5-6 mm long. **Stamens** 2 perfect**,** filaments ca. 1 mm long, linear, inserted, glabrous to puberulent, staminode 3. **Pistil** 8-10 mm long, ovary 3-5 mm long, pubescent, style glabrous. **Capsules** 1.5-5 cm long, dehiscing loculicidally to base, glabrous, valves twisted.

Flowering and Fruiting: April-September

Habitat: On rocks and banks in shade near waterfall

Distribution: INDIA: Assam, Mizoram; MYANMAR, THAILAND.

***Exsicc*:** Lushai Hills, Mizoram, Champai, 1200 m, 1.7.1926, Parry 14 (CAL).

***Middletonia* C. Puglisi**

Description: Caulescent perennial herbs, branched or monocarpic, young stem usually woolly. **Leaves** opposite or spiral in some rosulate species, petiolate, upper surface thinly arachnoid tomentum, glabrescent, lower surface woolly. **Inflorescence** axillary pair-flowered cymes, many-flowered, brcts small. **Calyx** segment 5, divided upto the base. **Corolla** oblique, campanulate, short tube, flat limb, slightly bilabiate. **Stamens** 2 fertile, inserted near base of tube, filaments thick, anthers facing each other but not cohering, 2-celled, bright yellow. **Disc** very shallow ring. **Ovary** conical or cylindrical, stigma small, capitate. **Capsules** short, dehiscent along margins, spirally twisted. **Seeds** very small, ellipsoid, reticulate.

Distribution: ca. 4 species are distributed in SE Asia to West Malesia **[2]**; one species in India **[5]**, same have been recorded from study area.

Note: The genus *Middletonia* C. Puglisi has been separated from *Paraboea* for a few species of *Paraboea* due to presence of glandular indumentum in the ovary, inner anther faces and outer corolla faces **[6]**. The Indian species *Paraboea multiflora* (R.Br.) B. L. Burtt is being included in the genus *Middletonia*.

***Middletonia multiflora* (R. Br.) C. Puglisi**

Paraboea multiflora (R.Br.) B. L. Burtt. In *Notes Roy. Bot. Gard. Edinburgh* 41(3): 433.1984.

Boea multiflora R. Br. In Benn. Pl. Jav.Rar. 120, 1840; C. B. Clarke in Hook. f., Fl. Brit. India 4: 365. 1884.

Boea flocculosa, Clarke, Comm. & Cyrt. Beng. t. 83. 1874.

Didymocrpus multiflora, Wall. Cat. 793. 1829. Nom. nud.

Type: Bangladesh, Sylhet, in montibus Punduah, F. D. Silva 793 (BM-Holotype).

Description: Perennial aromatic herbs; **Stems** woody at base, simple, young parts brownish woolly ; **Leaves** alternate, lamina 10-20 cm. x 6-9 cm., elliptic, apex acute, base cuneate, margin crenate, upper surface smooth or sparsely pubescent, lower surface with arachnoid tomentum, hairs thick woolly, reddish-brown, more prominent along veins, **petioles** 2.5-3 cm. long. **Inflorescence** axillary cymose cluster, bract 1 mm. long, covered with dense hair, peduncles 8-15 cm long, pedicels 0.6-1 cm long. **Calyx** 5-lobed, 1.1 mm. long, lobes triangular, woolly-felted on backs. **Corolla** not so much bilabiate, tube straight, short, limb spreading widely campanulate, ca. 7 mm long, lobes sub-equal, nearly rotate, white, gland-dotted

outside. **Stamens** 2, unequal, one 2 mm., another 3 mm, covered inglobose glistening glands. **Carpel** 5 mm. long, ovary linear, 1 mm. long. style and stigma projecting straight forward. **Capsules** 1-1.2 cm. long with persistent style, valves spiral.

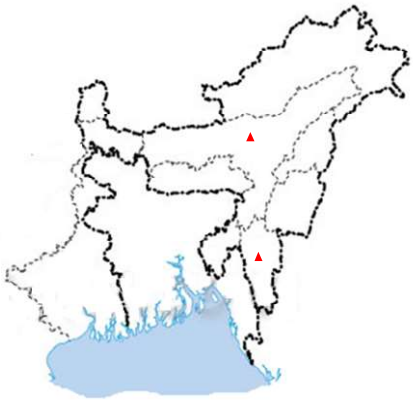
Habitats: Grows on damp rocks and banks of waterfalls, in shady places.

Flowering and Fruiting: June-July

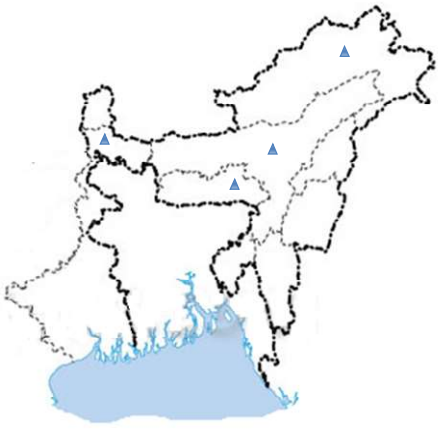
Chromosome Number: 2n=18 **[7]**

Distribution: INDIA: West Bengal (Jalpaiguri), Assam, Meghalaya, Arunachal Pradesh; BANGLADESH, BHUTAN, MYANMAR, CHINA, THAILAND, LAOS, VIETNAM.

Exsicc: North Lakhimpur, Kakoi Reserve, Assam, 13.5.1966, D. M.Verma 41776 (ASSAM,acc no-43948); Pynursla, 25.8.1956 R. S. Rao 3029 (ASSAM, acc no- 16268); Ngenpui Sanctuary, 8.3.1996 J. H. Lalramnghinglova 08106 (ASSAM, acc no-63868); K & J Hiils, Dawki, 26.8.1935, Shri Ram Sarma 12181 (ASSAM, acc no-20966); Khasia, 9.10.1886, C. B.Clarke 4494F (CAL, acc no-333141); Notrong, Assam, 10.11.38 Dr. K. Biswas 3841 (CAL); Khasia, Hook. f. et T, 119 (CAL, acc no-333132); Khasia, 1050 m, 13.3.1886, C. B. Clarke 43839 A (CAL, acc no-333149); Arunachal Pradesh, 20.5.2001, N Kabita & S. Haque 568 (ARUN, acc no-23947); West Siang, 150 m, 28.5.2012, M. Bhaumik 27471 (ARUN, acc no-26118).



Map 1: Distribution map of *Dorcoceras wallichi* (R. Br.) C. Puglishi



Map 2: Distribution map of *Middletonia multiflora* (R. Br.) C. Puglisi

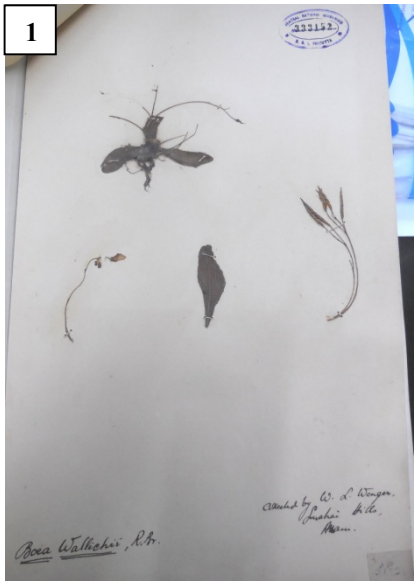


Plate 1 & 2: Herbarium sheets of *Dorcoceras wallichi* (R. Br.) *C. Puglishi* (CAL)

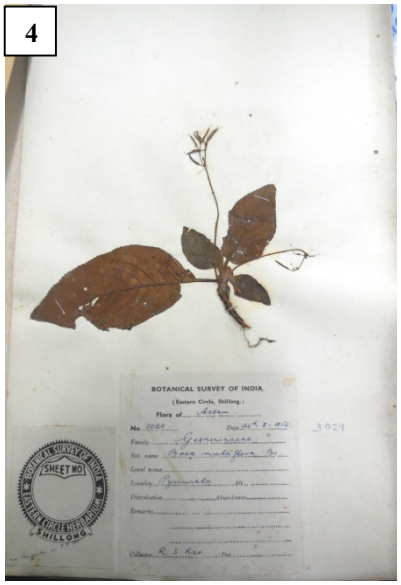


Plate 3 & 4: Herbarium sheets of *Middletonia multiflora* (R. Br.) C. Puglisi (CAL and ASSAM)

Table 1: Comparative Study of *Dorcoceras wallichi* and *Middletonia multiflora*

Character	*Dorcoceras wallichi*	*Middletonia multiflora*
Habit	Stemless rosette herb	Woody herbs with short stem ca. 12 cm
Leaves	Radical, indumentum long, simple, straight, silky, woolly hairs.	Cauline, alternate, indumentum arachnoid tomentum, hairs branched, dense on the lower surface specially along midrib.
Corolla	Short tube and flat limb, strongly bilobed, upper lip bilobed about half-way, lower lip shallowly 3-lobed.	Straight short tube with flat spreading limb, limb not highly bilabiate.
Stamen	Exserted, bent backwards, Anther bright yellow, thecae widely divergent, coherent face to face.	Included, anthers have widely divergent campanulate thecae.
Capsule	Twisted	Normally straight, twisted at the time of dehiscence

CONCLUSION

The plants of this group are more satisfactorily classified by using nature of the indumentum as the primary characters. The three genera *Boea*, *Paraboea* and *Trisepalum* are closely related having twisted capsule valves **[6]**. Here *Dorcoceras* was treated as a synonym of *Boea* and *Middletonia multiflora* was treated under the genus *Paraboea*. *Boea* with simple unbranched hairs, *Paraboea* and *Trisepalum* with arachnoid tomentum. *Trisepalum* differs from *Paraboea* having trisepalous calyx. A few number of *Middletonia multiflora* was recorded from CAL, LBG, ASSAM and ARUN but *Dorcoceras wallichi* was recorded from CAL only. *Dorcoceras wallichi* is distributed only in Assam and Mizoram but *Middletonia multiflora* is distributed comparatively more widely in West Bengal, Assam and Meghalaya, Arunachal Pradesh. The main advantage of twisted fruit of this group is that it sheds its seed more slowly and thus over a longer period. *Middletonia multiflora* is locally known as Buarte (Mizo). *Middletonia multiflora* is ethnobotanically important. Infusion of leaves/roots is taken to get relief from asthma.

This family is a very interesting having unusual morphology like monophylly, anisocotily, twisted capsule, and its adaptability. Collection of fresh specimens is difficult for the brief phenology and extreme habitat condition of the family. As India especially, Eastern Himalaya is a treasure land for gesneriads, there is possibility of getting new species of gesneriads. The Ethnobotanically important gesneriads like *Didymocarpus pedicillatus*, *Aeschynanthus parviflorus*, *Middletonia multiflora* etc trigger the chance of getting more ethnobotanically important gesneriads.

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