New combinations in *Borinda* (*Gramineae–Bambusoideae*)

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Summary. Following fieldwork in Yunnan and the recent introduction of several Sino-Himalayan bamboos, an additional 10 species are now considered to belong in the genus *Borinda* Stapleton. *B. albocerea*, *B. edulis*, *B. frigidorum*, *B. fungosa*, *B. hsuehana*, *B. lushuiensis*, *B. papyrifera*, and *B. perlonga* from Yunnan, and *B. fansipanensis* from N Vietnam, were all originally described in *Fargesia* Franch., while *B. schmidiana* from S Vietnam was originally described in *Arundinaria* Michx. This extends the distribution of *Borinda* along a continuous belt of mountain ranges from western Nepal to southern Vietnam, and brings the total number of species in the genus to 18.

The genus *Borinda* was created for clump-forming temperate Sino-Himalayan bamboos that could not be accommodated in *Fargesia* because of their more open synflorescences, with paniculate rather than racemose branching, and a cylindrical rather than unilateral arrangement of paraclades. Eight species from Nepal, Bhutan and Tibet were initially placed in the genus (Stapleton 1994). Field study in Yunnan, examination of herbarium material, and observation of introduced plants has now shown that the distribution of the genus is substantially wider, extending along a continuous chain of mountain ranges from Annapurna in West Nepal, to Lang Bian Mountain (Lam Vien) in southern Vietnam, only 150 miles from Ho Chi Minh City (Saigon). An additional ten species are now considered to belong in *Borinda*, increasing the number of species in the genus to eighteen.

Borinda was named in honour of Dr Norman Bor, Head of the Grasses Section and Deputy Director of the Royal Botanic Gardens, Kew, in recognition of his life's work, most of which was devoted to the forests and grasses of N E India (Hubbard 1975). *B. macclureana* (Bor) Stapleton is representative of the type of the genus.

Speciation and endemism in these temperate bamboos is apparently high. Valleys from the high Tibetan plateau, and well-separated peaks arising from the lower plateau of Yunnan and N Vietnam are all relatively isolated. Many of these montane habitats are severely threatened by deforestation, over-grazing or mining, and survival of these bamboos in degraded sites is not assured, especially after flowering. Nevertheless several *Borinda* species presently provide non-timber forest products of considerable economic importance, and their culms are systematically extracted from remaining areas of natural forest or cultivated clumps.

The majority of the species in this genus were described for the first time in the 1980s, nearly all from sterile material, and often from a very limited number of collections. Considerable work remains to refine species delimitation, and to relate newly described species to earlier names based upon inadequate flowering specimens, many lacking vegetative parts.

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In China there are two conflicting schools of thought about the generic attribution of these species, and it has been pointed out by each opposing school that the other Chinese treatment has substantial shortcomings.

Those who consider the synflorescence to be of overriding importance place these species in a broad interpretation of *Sinarundinaria* (Xue & Li 1987; Chao & Renvoize 1989; Yang & Chao 1994; Li 1996, 1997) on account of their relatively open synflorescences. The recent flowering of the species representative of the type of *Sinarundinaria*, *S. nitida* has revealed that it actually has a very dense synflorescence, and belongs in *Fargesia*. Consequently a proposal was made to conserve a collection of *Yushania confusa* as the type of *Sinarundinaria* (Li 1996), but as *Yushania* would then become a synonym of *Sinarundinaria,* it would lead to more rather than fewer name changes. If a very broad view is to be taken, then *Yushania* is the appropriate name for the polymorphic group of species with relatively open synflorescences (Demoly 1995, 1996). However, such derived synflorescences are found in many different bamboo genera and probably represent parallel evolution. Moreover, placement of *Borinda* species in *Yushania* conflicts with the original description of *Yushania* as a genus of spreading rather than clump-forming bamboos (Keng 1957) and the continued interpretation of the genus in that sense (Wang & Ye 1981; Chen & Chia 1988; Song & Wang 1994).

Those who consider vegetative characters such as rhizome form and clumping/spreading habit to be as important as floral characters, or of even greater importance, place these bamboos in a broad interpretation of *Fargesia* (Yi 1988; Keng & Song 1994; Keng & Wang 1996). However, their relatively open synflorescences clearly differ from the distinctive, consistently dense, unilateral synflorescences of many species in *Fargesia*, including the species representative of the type.

Thus both Chinese treatments are the result of much experience and diligent investigation, and they differ only according to which morphological characters are emphasised. This allows both schools to have valid and serious criticisms of each other's approach, and suggests that neither treatment is likely to be universally adopted. After consideration of a wider range of morphological characters, the recognition of a third genus *Borinda*, seems a more natural solution, given the distinct overall characteristics of this group of bamboos.

As with many grass genera it is difficult to specify a single character that can define *Borinda* consistently. Characters in the derived and reduced semelauctant bamboo synflorescence are scarce, but in *Borinda* the short erect paraclade branches and long awn-like projections on strongly-ribbed, basally less hirsute lemmas combine to give an appearance distinct from *Arundinaria* or *Yushania*. The strongest vegetative character linking these species is the presence of fine longitudinal ridges on fresh culms and branches. Although occasionally seen in other genera, this character is found in nearly all species of *Borinda*, if not on the culm then at least on the branches. *Fargesia* species usually have a smoother culm surface with purple spots, while *Yushania* species have a flat surface that is often scabrid. The short rhizome neck usually serves to separate *Borinda* species vegetatively from those of *Yushania*, although there remains the problem of some species of *Yushania* with unusually short necks such as *Y. andropogonoides* (Hand.-Mazz.) T. P. Yi. Texture of the culm sheaths is another important character. *Borinda* species nearly all have

prominent veins on the back of the culm sheath. *Yushania* species nearly all have a very smooth thickened surface, at least at the base of the culm sheath in the centre, and often covering much of the sheath. Such thickened sheaths are only known in the deciduous, high-altitude *Borinda* species where they may give added protection against winter cold. Leaf blade texture in *Borinda* is soft, and the thin, matt leaves are generally distinguishable from the tougher, glossier, smoother, more frost-tolerant leaves of *Yushania* species. High-altitude *Borinda* species are deciduous, while high-altitude *Yushania* species have hardier leaves, and are evergreen. New shoots of *Borinda* species often support a distinctive, strong tuft of long, erect blades at the apex. Together these characters fully justify the recognition of a separate genus.

Borinda can be separated into two groups, the larger evergreen species, including the type, and the smaller deciduous species from higher altitudes, presently including only *B. emeryi* and *B. frigidorum*, but with further possible members.

Although the flowers of *B. albocerea*, *B. fansipanensis*, *B. lushuiensis*, *B. papyrifera*, and *B. perlonga* are not yet known, their vegetative characters suggest very strongly that they are species of *Borinda* rather than *Fargesia*, and these new combinations are more likely to provide stable names under which they can be cultivated.

1. Borinda albocerea (*J. R. Xue & T. P. Yi*) *Stapleton* **comb. nov.** Type: China, Yunnan, Lushui Xian, 2860 m, 2 May 1978, *Yunnan Forestry College* 006 (holotype, Herbarium of Forestry School of Sichuan Province).

Fargesia albocerea J. R. Xue & T. P. Yi in J. Bamboo Res. 7(2): 45 (1988).

SPECIMENS EXAMINED. HOLLAND (CULT.). Kimmei Nursery, *Palen* Yunnan No. 1/95 (K!); Kimmei Nursery, *Palen* Yunnan No. 2/95 (K!); Kimmei Nursery, *Palen* Yunnan No. 3a/95 (K!); Kimmei Nursery, *Palen* Yunnan No. 3b/95 (K!). UK (CULT.). Cornwall, *Bell* Yunnan No. 1/95 (K!); Cornwall, *Bell* Yunnan No. 2/95 (K!); Cornwall, *Bell* Yunnan No. 3/95 (K!).

DISTRIBUTION. Known only from the type locality at 2860 m and cultivated plants, which were collected near Lushui (Xue, pers. comm.).

2. Borinda edulis (*J. R. Xue & T. P. Yi*) *Stapleton* **comb. nov.** Type: China, Yunnan, Kunming city (cult.), 1900 m, 20 June 1972, *J. R. Xue* s.n. (holotype, Herbarium of Forestry School of Sichuan Province).

Fargesia edulis J. R. Xue & T. P. Yi in J. Bamboo Res. 7(2): 53 (1988).

SPECIMENS EXAMINED: CHINA. Yunnan, 10 km N of Chao Jian, Zhi Beng Shan, 2350 m, *Stapleton* 1043b (K!).

DISTRIBUTION. Common in W Yunnan, 1900 – 2800 m.

3. Borinda fansipanensis (*T. Q. Nguyen*) *Stapleton* **comb. nov.** Type: Vietnam, Hoang Lien Son, Shapa, Fansipan, 2200 m, 25 June 1978, *V. D. Vu* s.n. (holotype, HNF).

Fargesia fansipanensis T. Q. Nguyen in Bot. Zhurn. (Moscow & Leningrad) 76(6): 876 (1991).

SPECIMEN EXAMINED. UK (CULT.). RBG Edinburgh 1992-0722, ex Vietnam, Fansipan [Phang Si Pang], *Rushforth*. Details of the cultivated plant fit the description of *B. fansipanensis* very well except that the living plant has ciliate sheath margins, a character which is not mentioned in the description.

DISTRIBUTION. Known only from type locality at 2200 m and one cultivated plant.

4. Borinda frigidorum (*T. P. Yi*) *Stapleton* **comb. nov.** Type: China, Yunnan, Yangbi Xian, 3100 – 3700 m, 13 Feb. 1984, *T. P. Yi* 84007 (holotype, Herbarium of Forestry School of Sichuan Province).

Fargesia frigidorum T. P. Yi in J. Bamboo Res. 7(2): 17 (1988), '*frigidis*'; Keng & Wang (eds.) in Fl. Reip. Pop. Sin. 9(1): 406 (1996), '*frigida*'.

SPECIMENS EXAMINED. CHINA. Yunnan, Yangbi Xian, Dali, Cang Shan, 3050 m, 24 Oct. 1995, *Stapleton* 1051 (K!); ibid. 24 Oct. 1995, *Stapleton* 1052 (K!); ibid. 3150 m, 24 Oct. 1995, *Stapleton* 1053 (K!); ibid. 3600 m, 24 Oct. 1995, *Stapleton* 1056 (K!); Yunnan, 10 km N of Chao Jian, Zhi Beng Shan, 3100 m, 21 Oct. 1995, *Stapleton* 1047 (K!); ibid. 21 Oct. 1995, *Stapleton* 1048 (K!) .

DISTRIBUTION. Known only from the type locality and localities cited, altitudinal range 3100 – 3700 m.

NOMENCLATURAL NOTE. The epithet *frigidis* is the ablative plural of the noun *frigidum*, and means 'from cold regions' (Glare 1982). The correct declension for this noun is the genitive plural, *frigidorum*, and under Articles 32.6, 23.1, and 61.4, and Recommendation 50F (Greuter *et al.* 1994) this must be used. The use of the adjective *frigida* instead of the noun *frigidum* is also incorrect.

5. Borinda fungosa (*T. P. Yi*) *Stapleton* **comb. nov.** Type: China, Yunnan, Dongchuan Shi, 2200 – 2600 m, April 1980, *Y. L. Li* s.n. (holotype, Herbarium of Forestry School of Sichuan Province).

Fargesia fungosa T. P. Yi in Bull. Bot. Res., Harbin 5(4): 121 (1985); *Yushania fungosa* (T. P. Yi) Demoly in Bambou 21: 15 (1995).

SPECIMEN EXAMINED. UK (CULT.). RBG Kew LCD 1994-3257.

DISTRIBUTION. Yunnan & Sichuan, 1800 – 2700 m. Seed collected by Professor J. R. Hsueh in 1992 at 2400 m and widely distributed for cultivation in Europe and USA.

6. Borinda hsuehana (*T. P. Yi*) *Stapleton* **comb. nov.** Type: China, Yunnan, Jinping, Yangping, Dong Zhu Shan, 2000 m, 23 Sept. 1983, *T. P. Yi* 83183 (holotype, Herbarium of Forestry School of Sichuan Province).

Fargesia hsuehana T. P. Yi in J. Bamboo Res. 7(2): 104 (1988), '*hsuehiana*'.

SPECIMEN EXAMINED. CHINA. Yunnan, Jinping, Yangping, Dong Zhu Shan, 2050 m, 12 Oct. 1995, *Stapleton* 1022 (K!).

DISTRIBUTION. Known only from the type locality at 2000 – 2050 m.

7. Borinda lushuiensis (*J. R. Xue & T. P. Yi*) *Stapleton* **comb. nov.** Type: China, Yunnan, Lushui Xian, 1780 m, 1 May 1978, *Forestry College of Yunnan* 002 (holotype, SWFC).

Fargesia lushuiensis J. R. Xue & T. P. Yi in J. Bamboo Res. 7(2): 111 (1988).

SPECIMENS EXAMINED. HOLLAND (CULT.). Kimmei Nursery, *Palen* Yunnan No. 4/95 (K!). UK (CULT.). Cornwall, *Bell* Yunnan No. 4/95 (K!). These specimens have more development of leaf sheath oral setae than would be expected from the description.

DISTRIBUTION. Known only from the type locality at 1780 m and cultivated plants, which were collected near Lushui (Xue, pers. comm.).

8. Borinda papyrifera (*T. P. Yi*) *Stapleton* **comb. nov.** Type: China, Yunnan, Yunlong Xian, 2750 – 3600 m, 8 Nov. 1977, *T. P. Yi* 77288 (holotype, Herbarium of Forestry School of Sichuan Province).

Fargesia papyrifera T. P. Yi in J. Bamboo Res. 7(2): 42 (1988).

SPECIMENS EXAMINED. CHINA. Yunnan, Yunlong Xian, 10 km N of Chao Jian, Zhi Beng Shan, 2900 m, 21 Oct. 1995, *Stapleton* 1046 (K!).

DISTRIBUTION. Known only from localities cited, altitudinal range 2750 – 3600 m.

9. Borinda perlonga (*J. R. Xue & T. P. Yi*) *Stapleton* **comb. nov.** Type: China, Yunnan City (cult.) 5 Feb. 1974, *J. R. Hsueh* s.n. (holotype, Herbarium of Forestry School of Sichuan Province).

Fargesia perlonga J. R. Xue & T. P. Yi in J. Bamboo Res. 7(2): 79 (1988).

SPECIMENS EXAMINED. China. Dali, Cang Shan, 2900 m, 24 Oct. 1995, *Stapleton* 1054 (K!). HOLLAND (CULT.). Kimmei Nursery, *Palen* Yunnan No. 6/95 (K!). UK (CULT.). Cornwall, *Bell* Yunnan No. 6/95 (K!). These specimens have the very long, papery culm sheaths described for the species. However, they lack the subsolid, level culms, the culm sheath oral setae are longer, and there are more oral setae on the leaf sheaths. The Lushui collection has more hairs on the culm sheaths than the Dali collection.

DISTRIBUTION. Origin of type collection unknown, western cultivated plants from near Dali at 2900 m, and near Lushui.

10. Borinda schmidiana (*A. Camus*) *Stapleton* **comb. nov.** Type: Vietnam, Annam, Lang Bian, 2000 m, Feb. 1950, *Schmid* 570 (holotype, P!).

Arundinaria schmidiana A. Camus in Notul. Syst. (Paris) 14: 253 (1953).

Sinarundinaria schmidiana (A. Camus) C. S. Chao & Renvoize in Kew Bull., 44(2): 360 (1989).

[*Sinarundinaria schmidiana* (A. Camus) T. Q. Nguyen in Bot. Zhurn. (Moscow & Leningrad), 75(2): 225 (1990)].

Yushania schmidiana (A. Camus) Ohrnberger in The Bamboos of the World 2 Introduction: 10 (1996).

SPECIMENS EXAMINED. VIETNAM. Annam, Lang Bian, 2200 m, 20 Sept. 1952, *Schmid* 1249 (P!); Chu Yang Sinh, 2200 m, 5 April 1954, *Schmid* 1819 (P!).

DISTRIBUTION. Known only from localities cited, at 2200 m.

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