

TOWARDS A TAXONOMIC REVISION OF THE GENUS *FOSTERELLA* (BROMELIACEAE)

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ABSTRACT: Five new *Fosterella* species are described: *F. batistana*, *F. christophii*, *F. elviragrossiae*, *F. kroemeri*, and *F. robertreadii*. Five taxa are reduced to synonyms: *F. chiquitana* and *F. latifolia* to synonymy of *F. penduliflora*, *F. fuentesii* to synonymy of *F. albicans*, *F. elata* to synonymy of *F. rusbyi*, and *F. nowickii* to synonymy of *F. weddelliana*. Further information on morphological variation and geographical distribution of *F. gracilis*, *F. pearcei* and *F. rojasii* is presented. Considering these results the total number of described *Fosterella* species amounts to 30.

Key words: Bromeliaceae, *Fosterella*, taxonomy, biogeography, Bolivia, Peru

INTRODUCTION

In the last few years diverse molecular methods have been applied to investigate interspecific relationships within the genus *Fosterella*, i.e., the random amplified polymorphic DNA (RAPD) technique (Rex 2001), amplified fragment length polymorphism (AFLP) analysis (Rex et al. 2007) and comparative sequencing of several chloroplast DNA loci (Rex, unpubl. data). Complementing these molecular studies, we continued our exhaustive taxonomic research, aiming at a revision of the genus *Fosterella*, which combines the molecular data with morphological and biogeographical information. Here we present the latest taxonomical results. Following the concept of the most recent, explicit taxonomic publication dealing with *Fos-*

terella (Ibisch et al. 2002), novelties and news on the existing taxa are presented in alphabetical order. Five recombinations and five new species are proposed.

- Fosterella albicans*** (Griseb.) L.B. Sm., *Phytologia* 7: 171. 1960. Basionym: *Cottendorfia albicans* Griseb., *Abh. Königl. Ges. Wiss. Göttingen, Math.-Phys. Kl.* 24: 330. 1879. TYPE: Argentina. Prov. Salta: Dpto. Orán, valley of Rio Seco below San Andres, 17–24 Sept. 1873, P.G. Lorentz & G. Hieronymus 502 (Lectotype: GOET!, photo: F!, designated here; Isotypes: B!, NY!, photo: F!, HUH!, SEL!).
- ≡ *Lindmania albicans* (Griseb.) Mez, in *C.D.C. Monogr. Phan.* 9: 537. 1896.
- = *Fosterella fuentesii* Ibisch, R. Vásquez, & E. Gross, **syn. nov.**, *Selbyana* 23 (2): 207. 2002. TYPE: Bolivia. Dpto. Santa Cruz: Prov. Florida, Municipio de Pampagrande,

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Manzanillares, east of Valle Hermoso, 17°53'59.1"S, 64°10'13.6"W, 1820 m, 10 Aug. 2001, A. Fuentes, A. Araújo & I. Ribera 3176 (Holotype: LPB!; Isotype: SEL!).

When Grisebach (1879) described *Cottendorfia albicans*, he did not choose a holotype, but just gave a short explanation of the origin of the described specimen(s). He stated explicitly that it was collected by Lorentz and Hieronymus. Baker (1889) cited two specimens, *Lorentz & Hieronymus* 288 and 502, which obviously were available to Grisebach. Baker did not choose a lectotype, but listed both as types, which was adopted in following publications dealing with this species (Mez 1896, Smith 1934). Most likely, in spite of the different numbering, the two collections were made at the same date and locality: In GOET, three specimens collected by *Lorentz & Hieronymus* are preserved: Two specimens were numbered as 288, and both consisted of a simple rosette only whereas the third, no. 502, contains two inflorescences, which—according to the length of peduncles—fit to the others very well. All three sheets bear labels from the same hand, indicating the same origin and date of collection. Anyway, Smith & Downs (1974) designated *Lorentz & Hieronymus* 502 (GOET) as holotype, obviously because it contains the generative parts of the plant, and in addition contained several original pencil drawings of floral elements. Nevertheless, according to the International Code of Botanical Nomenclature (ICBN), art. 9.9 (2005), this specimen should be considered as lectotype because Grisebach himself did not select a holotype, and three original specimens exist in GOET in addition to some more in other herbaria. Since the lectotype is fragmentary because of the missing leaves, the specimens *Lorentz & Hieronymus* 288 (B!, BA!, GOET!, NY!, US!), some of them containing both basal leaves and inflorescence, represent a most beneficial complement.

The recently described *Fosterella fuentesii* from an inter-Andean dry valley (Ibisch et al. 2002), which was assumed to be close to *F. petiolata*, was known from the type locality and dried material only. Meanwhile more specimens have been collected and documented in the field during an expedition to the area of the type locality: BOLIVIA. Dpto. Santa Cruz: Prov. Florida, north of Pampa Grande, Sierra Racete, Manzanillares, east of Valle Hermoso, 18°08'55"S, 63°55'48"W, 1530 m, 1 Oct. 2006, J. Peters, N. Schütz, R. Vásquez, & R. Lara JP 06.0002 (SEL), JP 06.0003 (LPB), JP 06.0004 (FR). Examination of plenty of living material has made it clear that these specimens have to be identified as *F. albicans*, which appears to be a more var-

iable taxon than previously thought. The subsequent critical recheck of the type material of *F. fuentesii* led us to the conclusion that it belongs to *F. albicans* as well. At first glance, the similarity to *F. petiolata* was striking because of the distinct petioles, the conspicuous primary bracts, and the rather lax inflorescence (as mentioned in the original description). However, with the serrate petioles, the thickly lepidote abaxial leaf surface, the villous-arachnoid peduncle and inflorescence-branches, the size of the floral bracts, sepals and petals, and the habitat, the specimen resembles much more *F. albicans*. For these reasons, we synonymize *F. fuentesii* Ibisch, R. Vásquez, & E. Gross under *F. albicans* (Griseb.) L.B. Sm.

Apart from this decision, preliminary molecular data (Rex et al. 2007) support the idea of *F. albicans* being a morphologically and ecologically variable species. A closer look at this group—also with molecular methods—is needed to decide whether it actually represents a single, very variable species, or perhaps several closely related species. The plants from the Tucuman-Bolivian forests in southern Bolivia and northern Argentina might be distinct from the central Bolivian ones which live in the Yungas rain forests.

Fosterella batistana Ibisch, Leme & J. Peters, sp. nov. TYPE: Brazil. State of Pará: Município de Itaituba, 400 km on the road from Santarém to Cuiabá, Curuá-una waterfall (west side of Serra do Cachimbo), *J.B. Fernandes da Silva s.n.*, cultivated specimen flowered in Jan. 2001, *E. Leme* 5078. (Holotype: HB, isotype: SEL).

FIGURES 1, 4 & 5.

Species nova *F. weberbaueri* (Mez) L.B. Sm. affinis, sed foliis sparse lepidotis, inflorescentia distincte lepidota, bracteis scapalibus internodia superantibus, bracteis primariis basem sterilem ramorum frequenter aequantibus, petalis per anthesim manifeste recurvatis sed haud recurvato-spiralibus differt.

Plant terrestrial, acaulescent, flowering up to 30 cm high. **Leaves** few, up to 10 in number, forming an open, flat rosette. **Sheaths** inconspicuous, about 10 mm long and 20 mm wide, entire, whitish, glabrous. **Blades** lanceolate, acuminate, narrowed towards base, up to 20 cm long and 3 cm wide, thin, entire, slightly undulate, abaxially whitish and sparsely lepidote, completely glabrous by maturity, adaxially dark green and very sparsely lepidote. **Peduncle** erect, slender, up to 15 cm long, 1–2 mm in diameter, green, floccose-lanate. **Peduncle bracts** in the middle section appressed to the axis, up to 10 mm long, shorter than internodes, entire, green to stramineous, abaxially and along the margins densely lepidote; basal ones sometimes

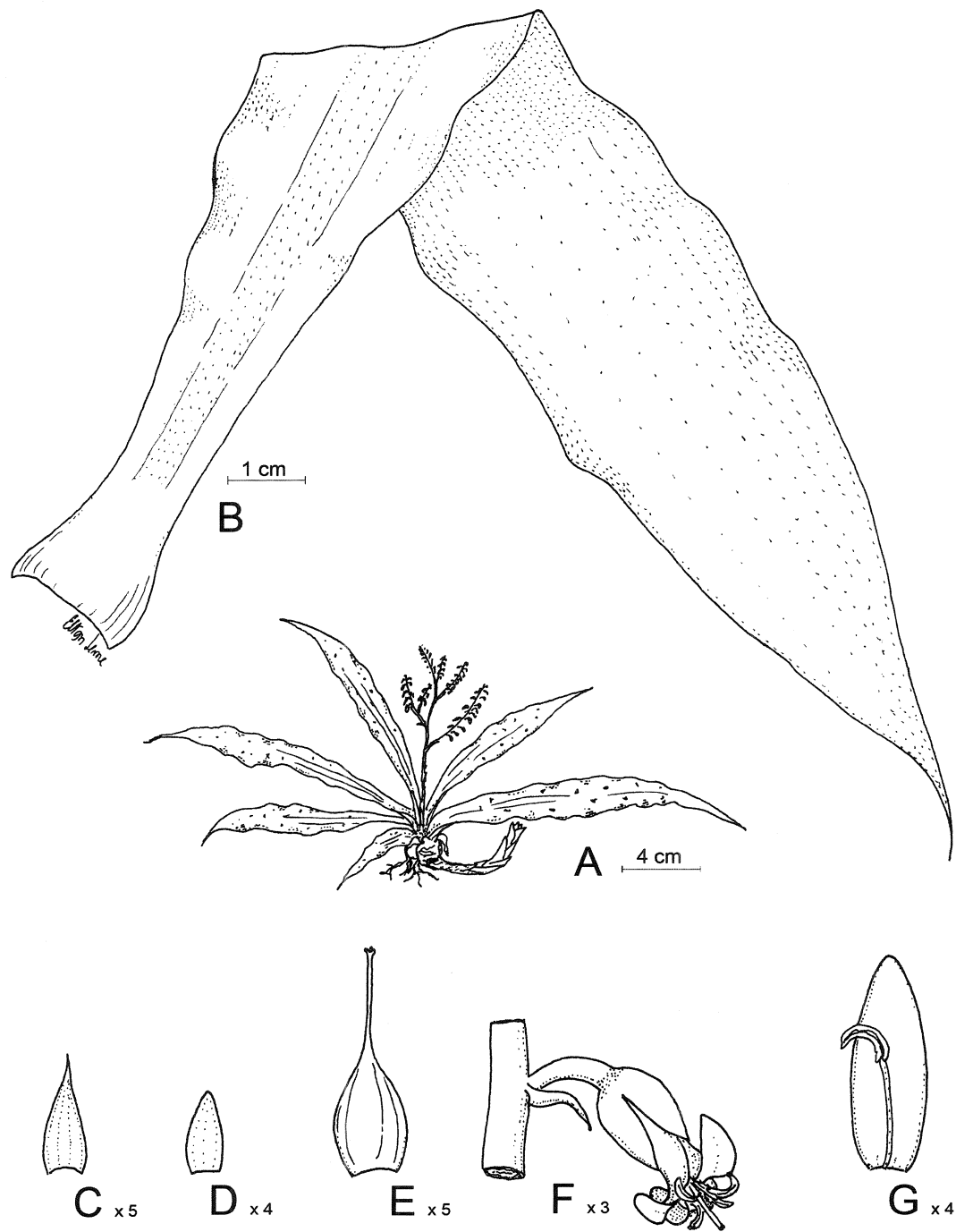


FIGURE 1. *Fosterella batistana*: A. Habit. B. Leaf. C. Floral bract. D. Sepal. E. Gynoeceum. F. Flower and floral bract. G. Petal and stamen (drawing of J. B. Fernandes da Silva s.n., fl. cult. Leme 5078 by Elton Leme).

subfoliaceous, up to 30 mm long, slightly longer than internodes. **Inflorescence** erect, racemose or paniculate, with lateral branches of 1st and rarely 2nd order, up to 15 cm long and 8 cm wide, axis slender, green, sparsely lanate. **Primary bracts** appressed to the lateral branches, middle ones up to 10 mm long, shorter than the first internode of the primary branches or equaling it, entire, green to stramineous, abaxially lepidote. **Primary branches** up to 8 in number, ascending, up to 7 cm long, bearing up to 15 flowers. **Secondary branches** up to 4 in number, ascending, up to 2 cm long, bearing up to 4 flowers. **Floral bracts** in middle part of inflorescence 2–3 mm long, equaling the pedicels, entire, green to stramineous, sparsely lanate. **Flowers** not secund, pendulous, 3–5 mm apart. **Pedicels** 2–3 mm long. **Sepals** about 2 mm long, green, glabrous. **Petals** 6 mm long, white, slightly recurved at anthesis, straight afterwards. **Stamens** 3–4 mm long. **Anthers** basifixed, 2 mm long, linear, recoiled at anthesis. **Capsule** ovoid, 3 mm long, 2 mm wide. **Style** apical, simple-erect, 3 mm long, white. **Stigmatic complex** discoid, margins crenulate. **Seeds** filiform, about 2 mm long.

Hitherto this new species is recorded from the type locality only. According to the collector, the Amazonian orchid specialist João Batista Fernandes da Silva, to whom the new species is dedicated, *F. batistana* was found as a saxicolous plant at a very humid site, near Curuá-una waterfall, in the middle of the Amazon forest. The collection site is about 400 km from the city of Santarém, which is situated in the confluence of Tapajós and Amazonas rivers, not far from the border of the State of Amazonas. Since this site is far away from any other known localities of *Fosterella*, this finding changes the distribution range of the whole genus, which is characterized by an interesting disjunction (FIGURE 2): The main range of *Fosterella* is located in Central South America with a diversity center in the Bolivian Andes and several species recorded in both the Argentinian and Peruvian Andes, as well as in the tropical to subtropical lowlands of Bolivia and adjacent areas of Brazil and Paraguay. Only one species is recorded from Central America and Mexico: *F. micrantha* (Smith & Downs 1974, Smith & Read 1992, Ibisch et al. 1999, 2002; Espejo et al. 2004).

Morphologically, the new Amazonian species is somewhat close to the Andean species *F. webbaueri*, but it differs by lepidote leaf blades and inflorescence. The separate position of *F. batistana* is underlined by its very special habitat requirements. Furthermore, molecular data inferred from AFLP-analysis (Rex et al. 2007)

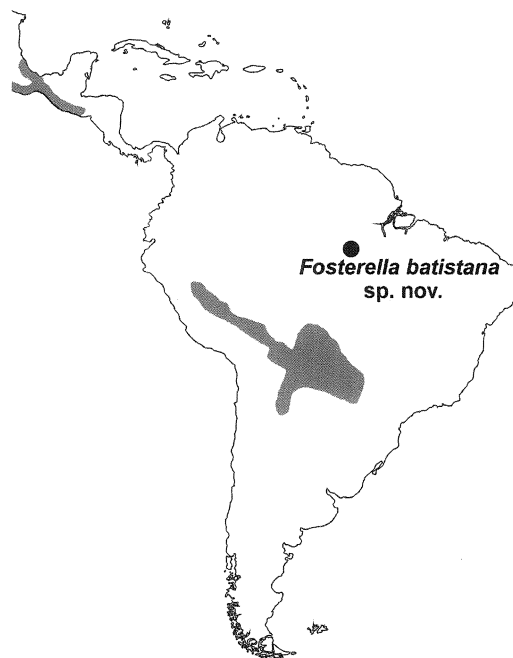


FIGURE 2. Distribution range of the genus *Fosterella* including the new found *F. batistana* from the Brazilian Amazon.

and comparative sequence-analysis of four chloroplast loci (Rex, unpublished data) also indicate a close relationship as well as a clear separation of these two species (see FIGURE 3).

Fosterella batistana also bears some morphological resemblance to *F. aletroides* from the Peruvian Andes, which is known from the type locality only. But in contrast to *F. aletroides*, *F. batistana* has larger leaf blades, a compound inflorescence, longer pedicels and only slightly recurved petals. Another important difference is the ecological origin as *F. aletroides* lives at a height of 900 m elevation in the Andes.

Fosterella christophii Ibisch, R. Vásquez & J. Peters, sp. nov. TYPE: Bolivia. Dpto. Santa Cruz: Prov. A. Ibáñez, Municipio de Terebinto, Arubay, 8 km north of Terebinto, nearby Rio Guendá and the property of G. Coimbra, in understory of semihumid forest, 17°44'S, 63°23'W, 450 m, 16 Nov. 1998, P.Ibisch & C.Nowicki 98.0173 (Holotype: LPB; Isotypes: FR, SEL, USZ, WU). FIGURES 6 & 7.

Fosterella villosula (Harms) L.B. Sm. affinis sed statura majore, inflorescentia minus villosa, bracteis florum et sepalis brevioribus, foliis subtus persaepe purpureis.

Plant terrestrial, acaulescent, flowering up to

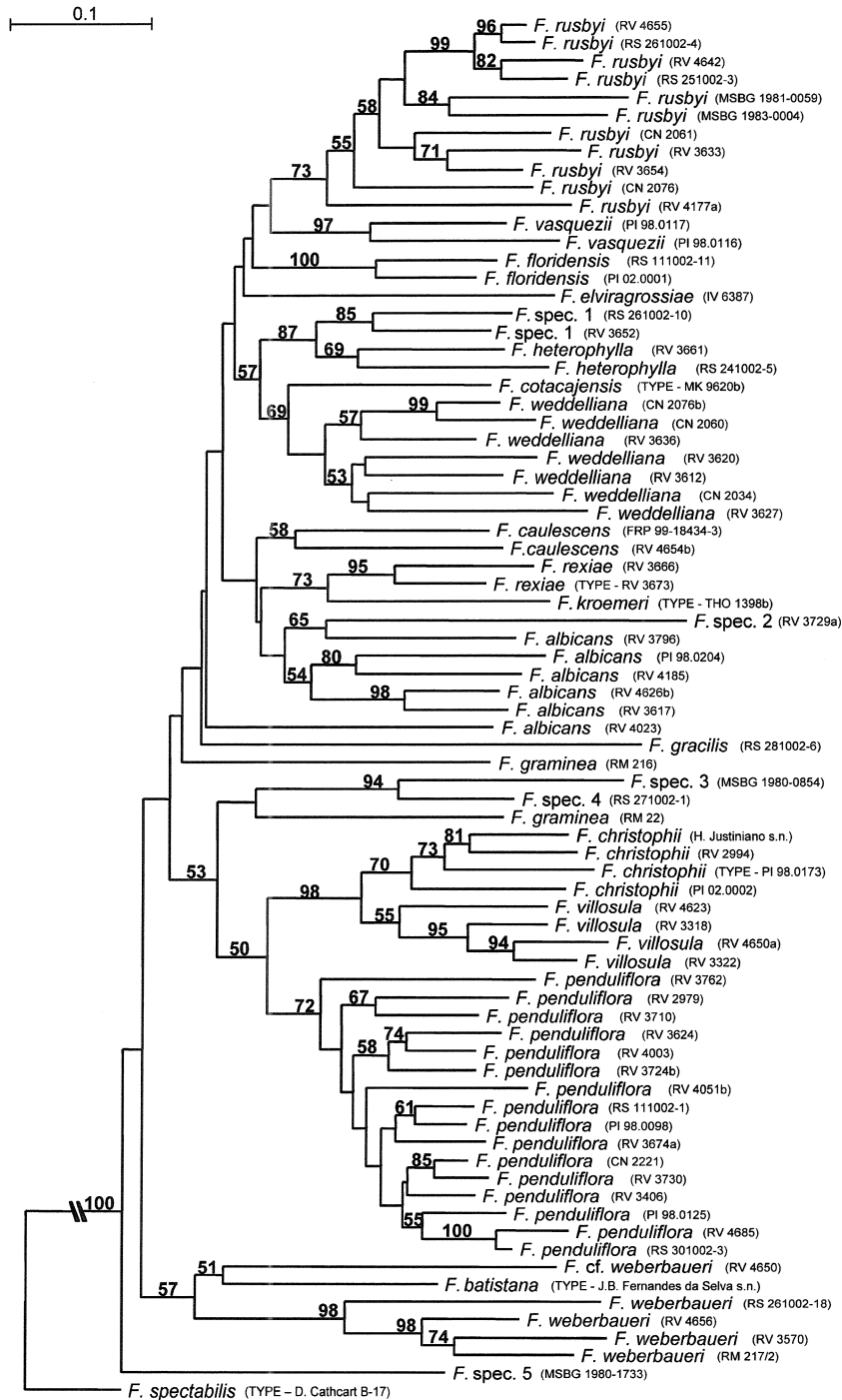


FIGURE 3. Neighbour-joining tree of 77 *Fosterella* accessions based on 310 band positions obtained with 8 AFLP primer pair combinations. The Nei and Li (1979) index of similarity was used to generate the distance matrix used for tree calculation. Numbers above the branches are bootstrap values obtained from 1000 replicates. The similarity scale is indicated by a horizontal bar (modified after Rex et al. 2007).



FIGURE 4.

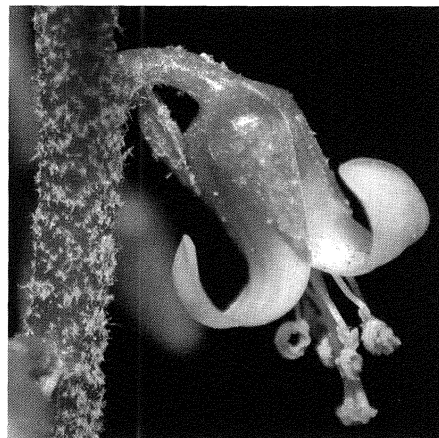


FIGURE 5.



FIGURE 6.

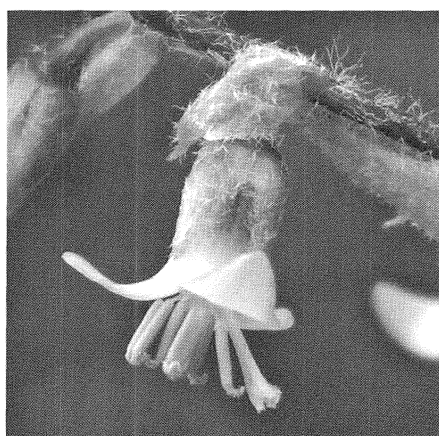


FIGURE 7.



FIGURE 8.

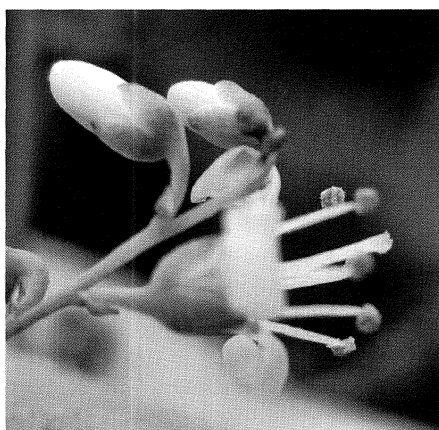


FIGURE 9.

PLATE 1 [FIGURES 4–9]. FIGURE 4. Rosette of *Fosterella batistana*. FIGURE 5. Flower of *Fosterella batistana*. FIGURE 6. Rosette of *Fosterella christophii*. FIGURE 7. Flower of *Fosterella christophii*. FIGURE 8. Rosette of *Fosterella kroemeri*. FIGURE 9. Flower of *Fosterella kroemeri*.

1 m high. **Leaves** 25–30 in number, forming a dense and arched rosette. **Sheaths** inconspicuous, up to 15 mm wide, entire, whitish, glabrous. **Blades** lanceolate to oblanceolate, acuminate, up to 50 cm long and 7 cm wide, entire, abaxially frequently reddish, stellate-lepidote, adaxially green, glabrescent. **Peduncle** erect, up to 80 cm long, 8 mm in diameter, frequently reddish, densely villous-arachnoid. **Peduncle bracts** in middle section up to 50 mm long, considerably longer than internodes, entire, stramineous, frequently reddish, stellate-lepidote. **Inflorescence** erect, paniculate, with lateral branches of 1st and 2nd order, up to 40 cm long, and 18 cm wide, axis frequently reddish, villous. **Primary bracts** ± spreading, middle ones up to 20 mm long, equalling the first internode of the primary branches, entire, stramineous, frequently reddish, villous. **Primary branches** 10–15 in number, ascending, up to 20 cm long, bearing up to 30 flowers. **Secondary branches** 8–10 in number, ascending, up to 7 cm long, bearing up to 15 flowers. **Floral bracts** in middle part of inflorescence 3–5 mm long, always longer than the pedicel, entire, stramineous, sparsely villous. **Flowers** secund, pendulous, 4 mm apart. **Pedicels** 2–3 mm long. **Sepals** 2–3 mm long, frequently reddish, sparsely villous. **Petals** 6–7 mm long, white, slightly recurved at anthesis, straight afterwards. **Stamens** up to 4 mm long. **Anthers** basifixed, 2 mm long, linear, recoiled at anthesis. **Capsule** ovoid, 5 mm long, 2 mm wide. **Style** apical, simple-erect, 3 mm long, tripartite at the top, white. **Stigmas** lanceolate. **Seeds** filiform, 2 mm long.

Other specimens seen: BOLIVIA. Dpto. Santa Cruz: Prov. A. Ibañez: Municipio de Terebinto, Arubay, 8 km north of Terebinto, nearby Rio Guendá and the property of G. Coimbra, in understory of semihumid forest, 17°41'S, 63°25'W, 460 m, 4 Oct. 1998, *R. Vásquez 2994* (LPB); *ibid.*: Municipio de Espejillo, 3 km south of La Guardia, Nov. 1999, *Justiniano s.n.* (SEL); Prov. Florida: Laguna Volcanes, nearby Bermejo, 1100 m, *P. Ibisch 02.0002* (FR); *ibid.*: between Angostura and Samaipata on the old street from Santa Cruz to Cochabamba, 18°06'S, 63°20'W, 11 Jun. 2001, *M. Mendoza 110* (LPB, NY).

Hitherto we understood *Fosterella villosula* as a quite variable species, but it was already assumed that the plants from the very humid rain forest of the Chapare region, Cochabamba, were distinct from those growing at the Andean knee, close to the city of Santa Cruz (Ibisch et al. 2002). Molecular findings strongly support this idea (see FIGURE 3) and encourage us to propose a new taxon, which is dedicated to Christoph Nowicki, who permanently supported the *Fos-*

terella research and was co-collector of the type specimen.

Fosterella elviragrossiae Ibisch, R. Vásquez, & J. Peters, sp. nov. TYPE: Bolivia. Dpto. Cochabamba: Prov. Ayopaya, Municipio de Atispaya, 16°36'S, 66°43'W, 1330 m, 22 June 2001, *R. Vásquez, G. Navarro, M. Fernández, F. Miranda, & H. Rocha 4177b* (Holotype: LPB; Isotype: SEL). FIGURES 11, 12 & 13.

Fosterella rojasii (L.B.Sm.) L.B.Sm. affinis sed statura minore, foliis prope basin constrictis, scapo viridi, bracteis scapi quam internodiis brevioribus, petalis tantum leviter recurvatis per anthesin et rectis post anthesin.

Plant terrestrial, acaulescent, flowering up to 35 cm high. **Leaves** up to 15 in number, forming a flat rosette. **Sheaths** about 20 mm wide, entire, whitish, glabrous. **Blades** lanceolate, slightly constricted at the base, up to 20 cm long and 2 cm wide, somewhat succulent and stiff, entire, undulate towards the base, abaxially sometimes reddish and appressed lepidote, adaxially sparsely lepidote towards the base. **Peduncle** erect, slender, up to 30 cm long, 1–2 mm in diameter, green or slightly reddish, glabrous, glaucous. **Peduncle bracts** in middle section up to 15 mm long, considerably shorter than internodes, entire, reddish, glabrescent. **Inflorescence** erect, racemose or paniculate with few lateral branches, up to 20 cm long and 7 cm wide, axis green, glabrous, glaucous. **Primary bracts** appressed to the lateral branches, middle ones up to 8 mm long, slightly longer than the first internode of the primary branches, entire, stramineous, glabrescent. **Branches** up to 3 in number, ascending, about 4 cm long, bearing up to 8 flowers. **Floral bracts** in middle part of inflorescence about 2 mm long, exceeding or equalling the pedicels, entire, stramineous, glabrous. **Flowers** secund, pendulous, 5–15 mm apart. **Pedicels** up to 2 mm long. **Sepals** about 1.5 mm long, green, glabrous. **Petals** 4–5 mm long, white, slightly recurved at anthesis, straight afterwards. **Stamens** about 4 mm long. **Anthers** basifixed, 1 mm long, linear, recoiled at anthesis. **Capsule** narrowly ovoid, 4 mm long, 2 mm wide. **Style** apical, simple-erect, 2 mm long, white. **Stigmatic complex** discoid, margins crenulate. **Seeds** filiform, 2 mm long.

This new species superficially resembles *Fosterella rojasii* but differs by the following characters: smaller stature, less branched inflorescence, leaves with constricted base, glabrous and green peduncle, small peduncle bracts which are considerably shorter than the internodes, and petals that are only slightly recurved at anthesis,

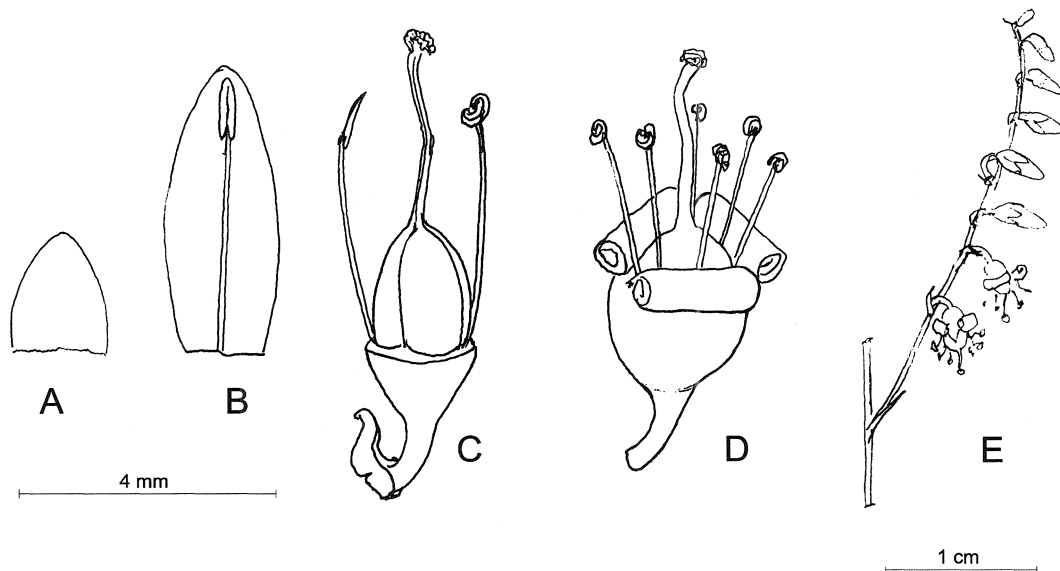


FIGURE 10. *Fosterella kroemeri*: A. Sepal. B. Petal and stamen. C. Gynoeceum and stamen. D. Flower. E. Inflorescence branch and primary bract (drawing of T. Krömer & A. Acebey 1398b by Roberto Vásquez).

straight afterwards. The type collection was made in the humid montane forests of the Cochabamba department while *F. rojasii* is known from the Paraguayan Chaco. Apart from obvious ecological differences, a careful revision of the type material of *F. rojasii* has shown that the new taxon is clearly distinct (compare FIGURE 3). Hitherto the new species is known from the type locality only. It is dedicated to the late bromeliad taxonomist Elvira Gross.

Fosterella gracilis (Rusby) L.B.Sm., *Phytologia* 7: 171. 1960. Basionym: *Catopsis gracilis* Rusby, *Bull. New York Bot. Gard.* 6: 489. 1910. TYPE: Bolivia. Dpto. La Paz: Prov. Larecaja, Guanay, 500 m, 27 Sept. 1901, R.S. Williams 738 (Lectotype: NY!, designated here; Isotype: BM!, K!).

We recently re-established this taxon (Ibisch et al. 2006), which had been synonymized by Smith & Downs (1992) under *Fosterella penduliflora*. Originally described as *Catopsis gracilis*, and temporarily shifted to *Lindmania*, this species had an astonishing taxonomic history. The disregard of information provided by the collector and included in the original description by later authors led to taxonomic confusion. *Fosterella gracilis* from the lower valleys and foothills of the North-Bolivian Andes is the only known yellow-flowering species in the genus. Not only the floral color, but also several other characters suggest that the species is distinct from *F. penduliflora*. These include the

abaxially tomentose leaves, and the very slender and glaucous inflorescence. Evidence from molecular studies (Rex et al. 2007) also confirms the genetic distinctness of *F. gracilis* from *F. penduliflora* (compare FIGURE 3).

When Rusby (1910), based on the collection R.S. Williams 738, described *Catopsis gracilis*, he did not choose a holotype from among the three specimens. Therefore, in accordance with the ICBN (2005), the designation of the specimen preserved in NY by Smith & Downs (1974) as holotype should be changed to lectotype.

Fosterella kroemeri Ibisch, R.Vásquez & J.Peters, sp. nov. TYPE: Bolivia. Dpto. La Paz: Prov. Caranavi, road from Caranavi to Sapecho, near the summit of the Serranía Bella Vista, 15°41'S, 67°29'W, 1500 m, 5 Aug. 2000, T. Krömer & A. Acebey 1398b (Holotype: LPB). FIGURES 8, 9 & 10.

Fosterella windischii L.B.Sm. et Read affinis sed vaginis et laminis latioribus, scapo longiore, bracteis scapi lepidotis internodia aequantibus, ramis brevioribus multioribusque, bracteis primariis base sterilis ramorum aequantibus, bracteis florum pedicellis paulo longioribus.

Plant terrestrial, acaulescent, flowering up to 60 cm high. **Leaves** 10 to 15 in number, forming an open, more or less upright rosette. **Sheaths** broadly ovate, up to 20 mm long and 30 mm wide, entire, whitish, glabrous. **Blades** oblanceolate, up to 50 cm long and 3 cm wide, entire or with minute spines at the base, abaxially with a

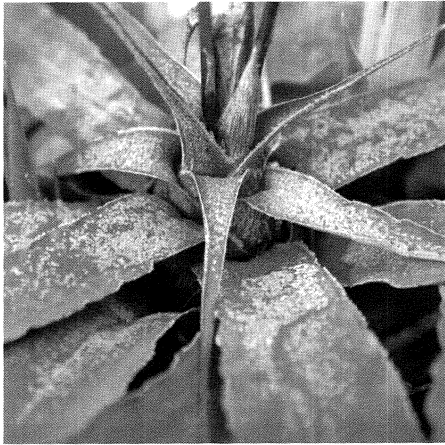


FIGURE 11.

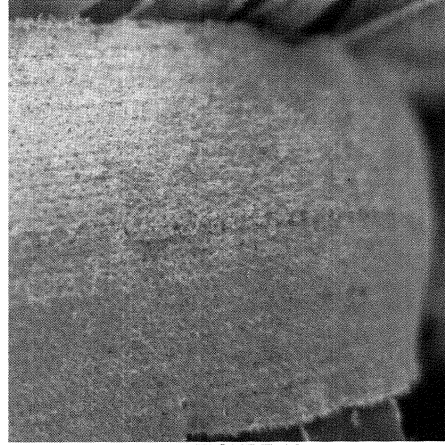


FIGURE 12.

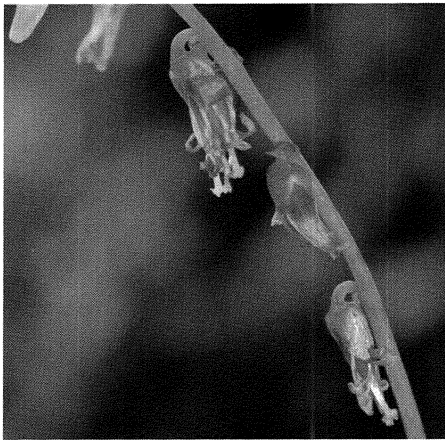


FIGURE 13.



FIGURE 14.



FIGURE 15.



FIGURE 16.

PLATE 2. [FIGURES 11–16]. FIGURE 11. Rosette of *Fosterella elviragrossiae*. FIGURE 12. Leaf surface (abaxially) of *Fosterella elviragrossiae*. FIGURE 13. Flower of *Fosterella elviragrossiae*. FIGURE 14. Type locality of *Fosterella robertreadii*. FIGURE 15. Rosette of *Fosterella robertreadii*. FIGURE 16. Flower of *Fosterella robertreadii*.

dense layer of appressed scales, adaxially slightly lepidote towards the base to glabrescent. **Peduncle** erect, up to 40 cm long, 4–5 mm in diameter, green, glabrous. **Peduncle bracts** in middle section up to 30 mm long, equalling internodes, entire, sometimes reddish, lepidote. **Inflorescence** erect, paniculate with branches of 1st and rarely 2nd order, up to 25 cm long and 8 cm wide, axis green, glabrous, somewhat glaucous. **Primary bracts** appressed to the lateral branches, middle ones up to 8 mm long, equalling the first internode of the primary branches, entire, sometimes reddish, lepidote. **Branches** up to 20 in number, ascending, up to 5 cm long, somewhat zigzag-shaped, bearing up to 15 flowers. **Floral bracts** in middle part of inflorescence 1–2 mm long, shorter than the pedicels, entire, sometimes reddish, glabrescent. **Flowers** almost secund, pendulous, 15 mm apart. **Pedicels** 2–3 mm long. **Sepals** 1 mm long, green, glabrous. **Petals** 4 mm long, white, recoiled like watchsprings during and after anthesis. **Stamens** 4 mm long. **Anthers** basifixed, 1.5 mm long, linear, recoiled at anthesis. **Capsule** ovoid, 5 mm long, 3 mm wide. **Style** apical, simple-erect, 3 mm long, white. **Stigmatic complex** discoid, margins crenulate. **Seeds** filiform, about 2 mm long.

In an earlier study, we already assumed that this plant from the Bolivian Yungas rain forests is distinct from *F. windischii*, which is confined to a small area of Precambrian rocks along the border of Bolivia and Brazil (Ibisch et al. 2002). Recent molecular results from comparative sequence-analysis of four chloroplast DNA loci show that the two specimens are not closely related with each other. According to the molecular trees, *F. windischii* belongs to a group of Precambrian outcrops that also includes *F. vasquezii* and *F. yuvinkae*, while *F. kroemeri* groups together with *F. caulescens*, *F. rexiae* and *F. albicans* (see FIGURE 3). In addition to the herbarium studies, we had the opportunity to study *F. windischii* in its natural habitat in the Noel Kempff National Park, Bolivia (Santa Cruz: 13°42'55"S, 61°41'43"W, 19 July 2003, P. Ibisch 03.0016 (LPB), which gave support to the morphological differences mentioned above.

The new species, which until now is known from the type locality only, is dedicated to the collector of the type, Thorsten Krömer, a bromeliad specialist and epiphyte ecologist who significantly contributed to the knowledge of the bromeliads of Bolivia.

Fosterella pearcei (Baker) L.B.Sm., Phytologia 7: 172. 1960. Basionym: *Cottendorfia pearcei* Baker, Handb. Bromel.: 128. 1889. TYPE: Western slope of the Andes; Butuco,

1865, *Pearce s.n.* (Holotype: BM!, photo: HUH!).

Until now it seemed to be impossible to locate the exact type locality of this species for the following reasons: Baker (1889), in describing *Cottendorfia pearcei*, gave it as "Butuco" which is a misinterpretation of Pearce's handwriting which said "Buturo" as was already assumed by Smith & Downs (1974). In addition, it was stated that the collection came from the "Western slopes of the Andes." This led Mez (1896) to the erroneous conclusion that Colombia is the home country of the species. In fact, the label gives no other information than "Buturo", and from the data on other specimens collected by Pearce the conclusion must be drawn that it is located in Bolivia. Buturo definitely is a Bolivian village on the eastern slopes of the Andes and is located close to Asariamas in the Province of Abel Iturralde in the department of La Paz (14°16'S, 68°34'W; approx. 990 m).

When Baker (1889) described *Cottendorfia pearcei*, he listed just the single specimen *Pearce s.n.* (BM). Therefore, Smith & Downs (1974) were correct in citing it as holotype.

Fosterella penduliflora (C.H.Wright) L.B.Sm.,

Phytologia 7: 172. 1960. Basionym: *Catopsis penduliflora* C.H.Wright, Bull. Misc. Inform. Kew: 197. 1910. TYPE: Peru, without further locality, *Forget s.n.* (Lectotype: K! sheet K000321535, designated here).

≡? *Lindmania penduliflora* (C.H.Wright) Stapf, Bot. Mag. 150: pl. 9029. 1924.

= *Fosterella chiquitana* Ibisch, R. Vásquez & E.Gross, **syn. nov.**, Rev. Soc. Boliviana Bot. 2(2): 118. 1999. TYPE: Bolivia. Dpto. Santa Cruz: Prov. Ñuflo de Chávez, about 10 km from Concepción on the road to San Javier, on granitic outcrops (zonal vegetation: semideciduous-semihumid Chiquitano forest), 16°10'S, 62°05'W, 500 m, 16 May 1997, P. Ibisch 98.0125, flowering in the garden of P. Ibisch, Santa Cruz, from 21 Aug. 1998 onwards (Holotype: LPB!; isotypes: USZ!, FR!).

= *Fosterella latifolia* Ibisch, R. Vásquez & E.Gross, **syn. nov.**, Rev. Soc. Boliviana Bot. 2 (2): 123. 1999. TYPE: Bolivia. Dpto. Santa Cruz: Prov. Florida, Refugio Volcanes, in understory of semihumid forests, 18°05'S, 63°40'W, 1000 m, 16 May 1998, P. Ibisch 98.0098 (Holotype: LPB!; isotypes: USZ!, FR!).

C.H. Wright, in describing *Catopsis penduliflora* from a living plant sent by Messrs. F. Sanders & Sons (1910), did not cite a voucher nor chose a holotype. Stapf, who recombined this

species in 1924 to *Lindmania penduliflora*, prepared detailed drawings on a herbarium specimen preserved at Kew in 1923. Obviously, he studied a voucher of the same living plant, which Wright had described and which was still cultivated in Kew at that time. Consequently, we designate that specimen as lectotype.

Previous molecular research based on RAPD data already suggested a close relationship between *Fosterella chiquitana*, *F. latifolia* and *F. penduliflora* ("penduliflora group"; Ibsch et al. 2002). Since then, the morphological revision of additional material collected has shown that the variability of *F. penduliflora* is larger than formerly expected, and that it is difficult to distinguish *F. chiquitana* from *F. penduliflora* by morphological characters. Recent AFLP data (Rex et al. 2007) suggest that plants previously considered as *F. chiquitana* from the Chiquitania lowlands do not represent a monophyletic taxon, but instead belong to the variable *F. penduliflora*. Similar problems have been detected in the case of the specimens that were collected in the valleys of the region at the Andean knee, and which had previously been assigned to *F. latifolia*. According to recent molecular analyses, these plants do not represent a monophyletic group as well, although they show a certain morphological distinctness (Rex et al. 2007). Thus, we now consider *F. chiquitana* and *F. latifolia* as synonyms of *F. penduliflora*.

Fosterella robertreadii Ibsch & J.Peters, sp. nov. TYPE: Peru. Dpto. Cusco: Prov. Quillabamba, Road from Quillabamba to Echarate, along the Rio Vilcanota, next to Maranura, 13°00'46''S, 72°38'32''W, 1168 m, 12 Nov. 2006, *J. Peters 06.0131* (Holotype: SEL; isotype: USM). FIGURES 14, 15 & 16.

Fosterella rojasii (L.B.Sm.) L.B.Sm. affinis sed foliis linearibus et longioribus, laminis adaxialiter lepidotis, scapo arachnoideo, bracteis primariis internodia superantibus, pedicellis brevioribus. *Fosterella graminea* (L.B.Sm.) L.B.Sm. affinis sed foliis subintegris, laminis adaxialiter lepidotis, scapo arachnoideo, floribus non secundis.

Plant terrestrial, acaulescent, flowering up to 1 m high. **Leaves** up to 30 in number, forming an arched rosette with a bulbous center. **Sheaths** broadly ovate, up to 30 mm long and 50 mm wide, entire, whitish, glabrous. **Blades** narrowly linear, not constricted at the base, slightly involute, up to 80 cm long and 2 cm wide, entire, (rarely some minute spines at the base), bearing an edge of multiserial trichomes, abaxially densely appressed lepidote, adaxially slightly appressed lepidote. **Peduncle** erect, up to 70 cm long, 5 mm in diameter, green, arachnoid, glabrescent. **Peduncle bracts** in the middle section up to 60 mm long, considerably longer than in-

ternodes, entire, sometimes reddish, densely lepidote; lower ones foliaceous. **Inflorescence** erect, paniculate, with lateral branches up to 3rd order, up to 40 cm long and 15 cm wide, axis green, arachnoid, glabrescent. **Primary bracts** appressed to the lateral branches, middle ones 20 mm long, exceeding the first internode of the primary branches, entire, lepidote. **Primary branches** up to 30 in number, ascending, up to 20 cm long, bearing up to 30 flowers. **Secondary branches** up to 6 per primary branch, up to 10 cm long, bearing up to 15 flowers. **Floral bracts** in middle part of inflorescence 1 mm long, shorter than pedicels, entire, sometimes reddish, glabrous. **Flowers** spreading, ± pendulous, 3–5 mm apart. **Pedicels** 2 mm long. **Sepals** 1.5 mm long, green, sometimes reddish, glabrous. **Petals** 4 mm long, white, recoiled like watchsprings during and after anthesis. **Stamens** 2 mm long. **Anthers** basifixed, 1 mm long, linear, recoiled at anthesis. **Capsule** ovoid, 3 mm long, 2 mm wide. **Style** apical, simple-erect, 2 mm long, white. **Stigmatic complex** discoid, margins crenulate. **Seeds** filiform, about 2 mm long.

Paratype: PERU. Dpto. Cuzco: Prov. Quillabamba, Road from Quillabamba to Echarate, along the Rio Vilcanota, next to Sietetinajas, 12°46'08''S, 72°38'02''W, 968 m, 12 Nov. 2006, *J. Peters 06.0126* (USM, LPB).

Other specimens seen: PERU. Dpto. Cuzco, Valley of Rio Vilcanota, 1200 m, Sept. 1967, *W. Rauh 20866* (HEID, WU); *ibid.*: Prov. Quillabamba, Road from Santa Maria to Quillabamba, along the Rio Vilcanota, 12°56'20''S, 72°39'34''W, 1150 m, 11 Nov. 2006, *J. Peters 06.0118* (USM, LPB); *ibid.*: Road from Santa Maria to Quillabamba, along the Rio Vilcanota, 12°57'19''S, 72°40'19''W, 1172 m, 11 Nov. 2006, *J. Peters 06.0122* (USM, SEL); *ibid.*: Road from Quillabamba to Echarate, along the Rio Vilcanota, next to Echarate, 12°46'06''S, 72°35'14''W, 902 m, 12 Nov. 2006, *J. Peters 06.0125* (USM, FR); *ibid.*: Road from Quillabamba to Echarate, along the Rio Vilcanota, next to Maranura, 13°00'46''S, 72°38'32''W, 1168 m, 12 Nov. 2006, *J. Peters 06.0129* (USM, SEL). Botanical Garden Berlin Dahlem 115-19-83-80 ex Botanical Garden Hamburg 81-G-496, origin unknown, flowered in cultivation, leg. Schwerdtfeger, 25 July 1984 (B). Marie Selby Botanical Gardens 1978-0905, origin unknown, flowered in cultivation, leg. L.Cobb, 13 June 1979 (SEL 026610), leg. R.W. Read, 18 June 1993 (SEL 090010), leg. R.W. Read, 28 May 1994 (SEL 090212).

We "discovered" this new taxon when we tried to identify a herbarium specimen; *M.D. Remmick 104* (SEL!), flowered in cultivation in Marie Selby Botanical Gardens (MSBG), which lacks any data of origin. We considered the possibility that this specimen could belong to a new

species identified—but never published—by Robert Read: in his unpublished key, which he had made available through Elvira Gross, a new species ‘F’ was based on the living plant MSBG 1978-0905, which lacks any geographical data as well. Later on, we revised herbarium material and living plants collected by Werner Rauh: *Rauh 20866* (HEID!, WU!), cultivated in the Botanical Gardens of Heidelberg (103751), Munich (1969/0378) and Osnabrück (94-17-0050-80). In addition to these studies, we had the opportunity to study the new species in its natural habitat, very close to the locality where Rauh already collected this species 40 years ago. Consequently, now we decided to describe it as a new species from Peru dedicated to the late Robert Read.

Fosterella rojasii (L.B.Sm.) L.B.Sm., *Phytologia* 7: 172. 1960. Basionym: *Lindmania rojasii* L.B.Sm., *Revista Argent. Agron.* 7: 162. 1940. TYPE: Paraguay. Dpto. Amambay: Cerro Corá, May 1934, *T. Rojas 6771* (Holotype: HUH!; Isotype: BA!).

Fosterella rojasii was known from Paraguayan Chaco only, until it was registered in a recent bromeliad checklist by Krömer et al. (1999) for Bolivia: Dpto. Santa Cruz: Serranía Santiago, entre Santiago de Chiquitos y Roboré, 480 m, 18°19’S, 59°39’W, Oct. 1995, *H. Amerhauser 5*, (WU!). After careful revision of the herbarium material it turned out that this specimen does not belong to *F. rojasii*, but instead to *F. yuvinkae*. Furthermore, we decided to describe the Bolivian specimen *R. Vásquez 4177*, which we first assumed to be allied to *F. rojasii* as well (Ibisch et al. 2002) as a new species (*F. elviragrossiae*, see above). Hence, *F. rojasii* remains endemic to Paraguay.

Fosterella rusbyi (Mez)L.B.Sm., *Phytologia* 7: 172. 1960. Basionym: *Lindmania rusbyi* Mez, *Bot. Jahrb. Syst.* 30, Beibl. 67: 6. 1901. TYPE: Bolivia. Dpto. La Paz: Yungas, *M. Bang 2571* (Lectotype: B! designated here; Isotypes: F!, K!, US!, NY!).
= *Fosterella elata* H.Luther, **syn. nov.**, *Selbyana* 5: 310. 1981. TYPE: Bolivia. Dpto. La Paz: Prov. Sud Yungas, terrestrial on rocky hillsides along the Rio Unduavi, 1500 m, 2 Feb. 1980, *C. Luer, J. Luer, R. Vásquez & R. Lara s.n.* (Holotype: SEL!).

When Mez (1901) described *Lindmania rusbyi*, he referred just to one specimen, *Rusby 2571*, but did not choose a holotype from among the rather many duplicates. Smith & Downs (1974) designated the specimen *Rusby 2571* (B) as holotype; however, following the ICBN (2005) it appears more appropriate to consider it as lectotype.

Fosterella rusbyi was only known from a few collections made in the first half of the last century. In 1981, Harry Luther described *F. elata*, which he compared to *F. penduliflora* but not to *F. rusbyi*. Perhaps Luther did not take into account *F. rusbyi* as a similar species, because Smith & Downs (1974) stated that it had greenish petals, shortening the original description by Mez (1901) who wrote: “Petala sepalis duplo longiora, ut videtur virentia,” which means: petals twice as long as the sepals, apparently greenish. Since its original description, *F. elata* has frequently been collected and has turned out to be a rather common species in the understory of the Yungas rain forests of the La Paz department. After careful revision of the type material of *F. rusbyi* we came to the conclusion that it is impossible to detect any differences between *F. rusbyi* and *F. elata*. The latter name therefore is reduced to synonymy.

Fosterella weddelliana (Brongn.) L.B.Smith, *Phytologia* 7: 172. 1960. Basionym: *Cottendorfia weddelliana* Brongniart ex Baker, *Handb. Bromel.* 129. 1889. TYPE: Bolivia. Dpto. La Paz, Yungas, 1200–2400 m, Dec. 1846, *Weddell 4233* (Lectotype: P!, here designated; Isotype: B!).

= *Lindmania weddelliana* (Brongniart ex Baker) Mez, *C.D.C.: Monogr. phan.* 9: 537. 1896.

= *Fosterella nowickii* Ibisch, R.Vásquez & E.Gross, **syn. nov.**, *Selbyana* 23 (2): 210. 2002. TYPE: Bolivia. Dpto. La Paz: Prov. Sud Yungas, nearby Irupana, 16°26’S, 67°28’W, 1200 m, 20 Feb. 2000 (cultivated specimen flowered in Oct. 2001), *C. Nowicki & R. Müller 2076* (Holotype: LPB!).

Brongniart ex Baker, in describing *Cottendorfia weddelliana*, cited two specimens, *Weddell 4233* and *Rusby 2541*, but did not choose a holotype. One of these specimens, *Rusby 2541*, was chosen as the type for the new described species *Cottendorfia rusbyi* by Baker (1902). Consequently, Smith & Downs (1974) named *Weddell 4233* (P) as the holotype of *Fosterella weddelliana*. However, in accordance with the ICBN (2005), it appears more appropriate to be considered as lectotype.

Fosterella weddelliana was difficult to interpret because of its very fragmentary type material and therefore misleading original description. The plant was considered to be acaulescent by Baker (1889), a character that has never been questioned, neither by Smith & Downs (1974) nor by Smith & Read (1992), nor by Read in his unpublished key from the 1990s. In the course of the recent molecular studies at first we became confused about the identity of both *F. weddelliana* and *F. nowickii*. By carefully com-

paring the leaves, the inflorescence and the flowers of the type material, we came to the conclusion that *F. nowickii* can not be separated from *F. weddelliana*. Therefore, here it is reduced to synonymy of *F. weddelliana*, which is clearly caulescent with flowering plants reaching heights of up to 150 cm. It tends to form large mats covering steep slopes.

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