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New species and nomenclatural changes in *Bulbophyllum* (Orchidaceae) from Madagascar

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Summary. Six new species: *Bulbophyllum caniceps, B. cochinealloides, B. fierenanaense, B. geminiflorum, B. oenanthum* and *B. rudolphus* are described for the first time. The identity and nomenclature of *Bulbophyllum cylindrocarpum* is discussed and its var. *andringitrense* is recognised at species rank as *B. jeanbosseri. Bulbophyllum aubrevillei* and *B. kieneri* are compared with the latter becoming a synonym. The history and identities of *Bulbophyllum pentastichum* vs *B. quadrifarium* are clarified and the necessary taxonomic changes and type selections are made. A new sect. *Inversiflora* is formally described.

Key Words. descriptions, Flacourt, IUCN Red List assessments, neotypes, sections, synonyms, taxonomy.

Introduction

Bulbophyllum Thouars (1822) is one of the largest genera in the Orchidaceae (subfamily Epidendroideae tribe Malaxideae subtribe Dendrobiinae) (Chase *et al.* 2015), comprising just over 2000 species (Vermeulen *et al.* 2018: 31) and has a pantropical distribution (Govaerts 2016). Recent molecular phylogenetic studies suggest that *Bulbophyllum* originated in the Asia-Pacific region during the early Miocene before reaching the tropical regions of Madagascar, Africa and S America in the mid to late Miocene (Gamisch *et al.* 2015; Gamisch & Comes 2019). One of the main diversification centres is in the Madagascar region with over 200 largely endemic species (Hermans *et al.* 2007; Gravendeel in Pridgeon *et al.* 2014: 7).

Since the major work on the orchid flora of Madagascar by Schlechter and Perrier de la Bâthie (henceforth Perrier) (Schlechter 1924; Perrier 1937, 1939) a number of novelties in the genus have been described by Bosser (1965, 1969, 1971, 1989, 2000, 2004), Bosser & Cribb (2001) and Fischer *et al.* (2007a, b, 2009) with a broad outline revision of the Madagascan sections by Fischer & Vermeulen (in Pridgeon *et al.* 2014: 15 – 19). Recent research into the phylogeny and morphology of the genus (at Salzburg and Vienna), taxonomic research (at Vienna and Kew) and fieldwork (by the Botanical Garden of the University of Vienna, University of Salzburg, PBZT Antananarivo and Royal Botanic Gardens, Kew, have resulted in the recognition of a number of new species and a better understanding of their nomenclature and genetic relationships. A new phylogenetic study based on five chloroplast and three nuclear regions of c. 180 Madagascan *Bulbophyllum* species is currently being prepared (Gamisch *et al.* unpublished). During this work six new species have been identified and several changes in nomenclature have become necessary.

IUCN Red List assessments

The conservation status of the new species given in this paper are summaries of the full IUCN Red List assessments which will be completed and submitted for review and publication by IUCN once the species names are validly published and therefore available for assessment. All the assessments have been compiled based on current knowledge of these taxa, by one of the authors (Landy Rajaovelona), who is an IUCN Red List assessor, using the IUCN Red List Categories and Criteria (2012).

New species

Bulbophyllum caniceps *Hermans, Sieder & Andriant.* **sp. nov.** Type: Madagascar, Fianarantsoa, Itaolana, E of

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Ambalavao, Jan. 2007, *Sieder, Stütz & Andriantiana* FS4073 (holotype SZU!).

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Very small squat epiphytic *plant*, on a very short branching rhizome; roots glabrous, wiry, c. 0.5 mm in diam. *Pseudobulbs* partly overlapping, globose, compressed into a flattened rounded disk 4 – 7.1 mm diam. × 1.2 – 2.1 mm thick, pale green, single-leaved, partly covered by a thin membranous sheath. *Leaf* somewhat coriaceous, flat, obovate, arising in the centre of the pseudobulb, tip emarginate, 4 – 7.1 × 1.2 – 2.1 mm, pale green, base narrowed into a short (1 – 2 mm) petiole. *Inflorescence* erect to arching, terete, emerging from beneath the pseudobulb, c. 15 mm long, with 1 – 3 apical flowers. *Peduncle* slender (c. 0.3 mm in diam.), reddish-brown, with 3 – 4 attenuate sheaths 0.9 – 1.2 × 0.3 – 0.5 mm. *Rachis* short, 4 – 6 mm long, red. *Floral bracts* lanceolate-attenuate, slightly serrate at the tip, 1.3 – 2 × 1 – 1.1 mm, dark pink. *Flowers* very small, overall c. 3.5 × 2.2 mm, petals and sepals pale yellow, the sepals sometimes with a red mid-vein, lip dark red. *Pedicel* and *ovary* corrugate, curved, widening towards the base of the flower. *Dorsal sepal* lanceolate, long-caudate, 3.4 – 3.9 × 1.1 – 1.2 mm, more or less ciliate at the basal margins. *Lateral sepals* lanceolate, longly caudate-falcate, 3.6 – 3.8 × 1.6 – 1.8 mm, more or less serrate-hirsute at the basal margins. *Petals* lanceolate, attenuate, 1.4 – 1.7 × 0.6 – 8 mm, minutely erose towards the tip. *Lip* lanceolate-elliptic, slightly recurved, elliptic, obtuse, 1.6 – 1.7 × 0.7 – 0.8 mm, margins recurved, broadly winged at the base, the base densely papillose, the margins densely hirsute on the adaxial side. *Column* short (c. 1.4 × 1 mm), the foot incurved, c. 0.7 mm long, the stelidia prominent, longly falcate with rounded wings at the base. *Anther* elliptic, c. 0.4 × 0.5 mm, with a small swelling on the abaxial side and a ciliate front margin. *Pollinia* ovoid, c. 0.3 × 0.2. *Seed capsule* fusiform, c. 3 × 1.8 mm. Figs 1, 2.

RECOGNITION. *Bulbophyllum caniceps* is recognised by the small flattened pseudobulbs, the single obovate leaf from the centre of the pseudobulbs, the thin few-flowered inflorescence, the small flowers with lanceolate, longly caudate-falcate sepals, broadly lanceolate petals, a rounded, recurved lip with an obtuse tip and the papillose base, the lip margin, basal edge of the sepals, tip of the petals and floral bract serrate-laciniate to hirsute, the long falcate stelidia and anther with a tiny lobule.

DISTRIBUTION. Recorded from SE Madagascar, Fianarantsoa province but recently (Jan. 2019) also observed and photographed by Jean-Michel Hervouet near Manompana in Toamasina province in NE Madagascar.

SPECIMENS EXAMINED. MADAGASCAR. Fianarantsoa, Itaolana, E of Ambalavao, Jan. 2007, *Sieder & Andriantiana* FS4073 (holotype SZU!); Fianarantsoa, Itaolana, E of Ambalavao, 996 m, Jan. 2006, *Sieder, Knirsch & Andriantiana* FS3154 (WU!).

HABITAT. Plants partly submerged in moss, humid evergreen forest, around 1000 m.

CONSERVATION STATUS. This species is endemic to Madagascar, distributed in Haute-Matsiatra region, Fianarantsoa. It is likely to be Endangered (**EN**), according to the IUCN Red List Categories and Criteria. It is found in only one confirmed locality, having a provisional status of protection as a private reserve. The area of occupancy AOO is estimated to be 8 km^2, the extent of occurrence EOO cannot be estimated, and two defined locations face major threats from human activity that cause the continuing decline of the habitat quality and the AOO of the species. This species is therefore assessed as Endangered under criterion B2ab(ii,iii).

ETYMOLOGY. The name refers to the resemblance of the flower to the head of a fluffy dog with a red tongue.

PHENOLOGY. January.

NOTES. As with many small few-flowered *Bulbophyllum* it is difficult to place the new species in any section circumscribed by Schlechter (1924) and more recently discussed by Fischer *et al.* (2007b). It has some of the characteristics (small single-leafed plant with floral parts hairy) of sect. *Pantobleparon* Schltr. but it lacks the short inflorescence. In plant habit and flower morphology it is also close to some species in sect. *Lichenophylax* Schltr. but has a single leaf and long (vs short) stelidia. With its small single-leafed pseudobulbs, a slender few-flowered rachis, caudate sepals and ciliate lip, the most appropriate section for the species is sect. *Trichopus* Schltr. as redefined by Fischer *et al.* (2007b: 6). This impression is confirmed by genetic data which place the new species, into a well-supported and relatively well-resolved clade comprising species of sect. *Trichopus* and *Pantobleparon* (Gamisch *et al.* unpublished) as one of the earliest diverging species of that group.

Bulbophyllum caniceps shares the plant habit and inflorescence characteristics with *B. moldenkeanum* A.-D.Hawkes from NE Madagascar; it has a somewhat similar lip and stelidia but in *B. caniceps* the sepals are longly caudate (vs acute) and about half the size, the petals shorter and lanceolate (vs linear) and the anther with a small swelling (vs a large rectangular appendage). It has a similar habit, inflorescence, flower size, serrate petals and falcate stelidia to the phylogenetically distantly related *B. bryophilum* Hermans from NW Madagascar but in *B. caniceps* the sepals are more longly caudate (vs acuminate), the lip lanceolate-elliptic (vs oblong-ligulate) with the surface

Fig. 1. *Bulbophyllum caniceps* from Itaolana, E Madagascar. **A** inflorescence; **B** flower side view; **C** flowers. PHOTOS: **A, B** ANTON SIEDER; **C** JEAN-MICHEL HERVOUET.

verrucose and the margins hirsute (vs densely papillose), the stelidia are simple (vs bidentate) and a little shorter.

Bulbophyllum cochinealloides *Hermans & Gamisch* **sp. nov.** Type: Madagascar, Anjozorobe area, hort. Malala Orchidées, Sept. – Oct. 2007, *Hermans* 6718 (holotype K!; isotypes SZU (OR1000/2009!), WU).

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Large creeping epiphytic *plant* up to 25 cm tall excluding the inflorescence, on a short repent rhizome (4 – 5 mm in diam.) hidden beneath the pseudobulbs, rhizome sheaths membranous; roots wiry, glabrous, forming a dense mass beneath the plant, c. 2 mm in diam. *Pseudobulbs* dense, overlapping each other by about ⅓, broadly ovoid to orbicular, very compressed, 2.3 – 3 × 2.5 – 3.3 cm, c. 8 – 12 mm thick, bifoliate, surface lustrous, more or less rugose, yellowish-green becoming yellow with age, a few thin bracts at the base. *Leaves* spreading, flat with a shallow mid-vein, base shortly petiolate, set within a thickened ring, oblong to lanceolate, tip rounded, 4 – 10 × 0.8 – 2 cm, coriaceous, green. *Inflorescence* erect, rachis slightly curved, up to 44 cm long, with c. 50 flowers. *Peduncle* emerging from below the pseudobulbs where the base is covered by 2 – 3 sheaths, terete, 28 – 30 cm long, c. 3 mm in diam., with 5 – 7 tubular peduncle sheaths c. 15 mm long. *Rachis* rather densely flowered (3 – 5 mm apart in each row) in 4 rows in an indistinct spiral, opening in succession from the base, 16 – 18 cm long, a little thicker than the peduncle, c. 5 mm in diam., hollowed at the inset of the ovaries, roundly ridged behind each flower, yellowish-green to pink, marked with paler streaks. *Floral bracts* scarious, lanceolate-triangular, attenuate, 5 – 6.5 × 1.8 – 2.1 mm. *Flowers* non-resupinate, becoming recurved to the rachis on opening, c. 12 × 12 mm, petals and sepals yellow marked with pale carmine, darker on the exterior, with 2 – 3 darker carmine red longitudinal lines, petals pale yellow, lip yellow, the margins carmine red, spotted red on the disk, more densely along the margins, column white spotted pink, anther white. *Pedicel* and *ovary* subsessile, turbinate, with rounded ribs, 2.8 – 3 × 0.9 – 1.2 mm, dark pink. *Dorsal sepal* linear-lanceolate, the base concave, attenuate, arching forward, 5.9 – 6.8 × 1.1 – 1.4 mm. *Lateral sepals* lanceolate, falcate, apex longly

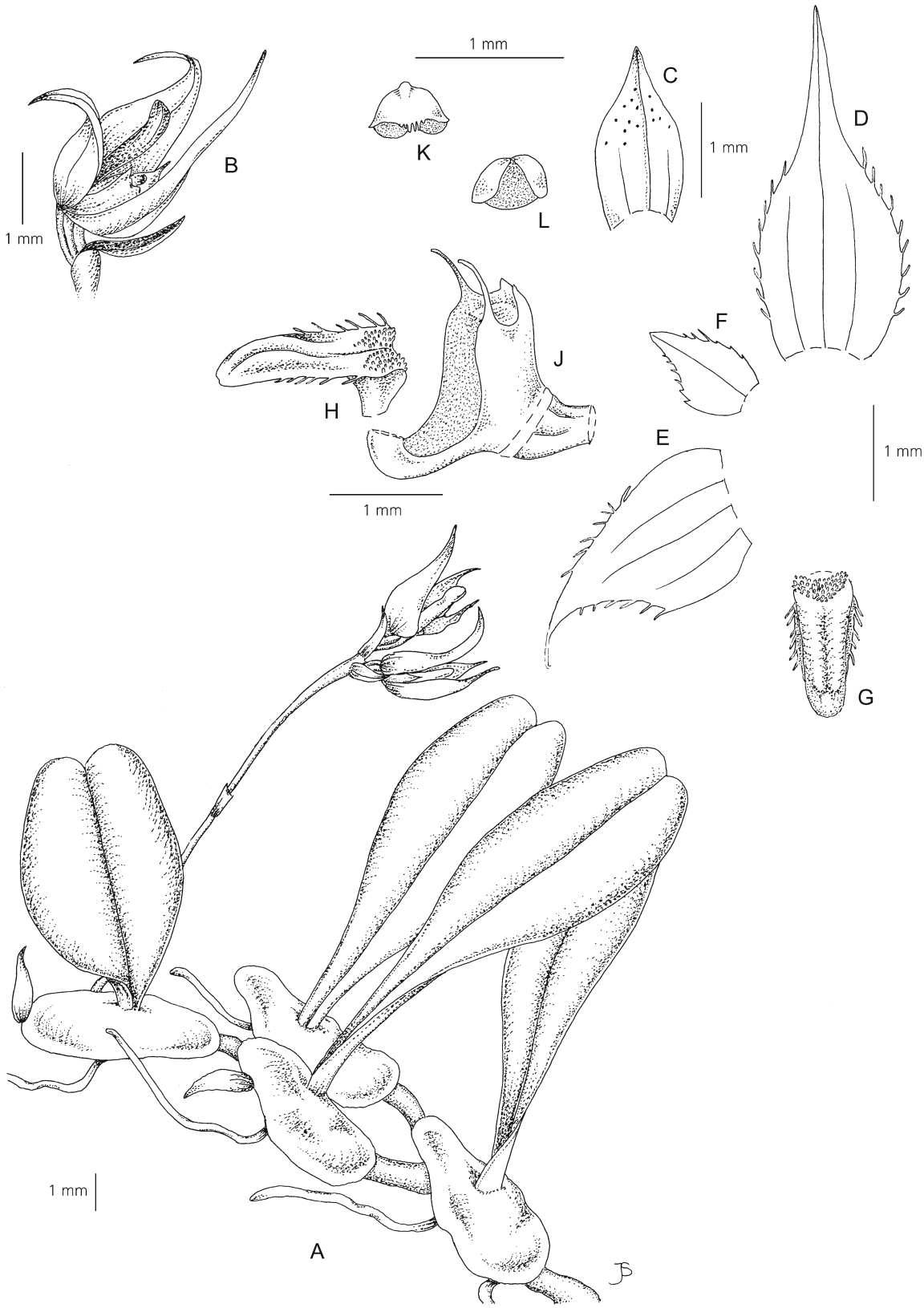

Fig. 2. *Bulbophyllum caniceps.* **A** habit; **B** flower; **C** bract; **D** dorsal sepal; **E** lateral sepal; **F** petal; **G** lip from above; **H** lip side view; **J** column; **K** anther from above; **L** anther from below. From *Sieder* FS4073. DRAWN BY JUDI STONE.

attenuate, 6.2 – 6.7 × 2 – 2.2 mm, adnate with the column foot forming a 1 – 1.5 mm mentum. *Petals* lanceolate-narrowly triangular, parallel with the column, 1.9 – 2.1 × 0.3 – 0.4 mm, margins entire. *Lip* fleshy, lingulate to oblong, 3 – 3.2 × 1.1 – 1.2 mm, the base auriculate, the margins finely verrucose in the basal third, the disc roundly convex, the tip acute, flattened, slightly curved forward. *Column* arching, 2.2 – 2.5 × 1.3 – 1.8 mm, with a subulate mid-lobe, prominent falcate stelidia c. 1 mm long, roundly lobed towards the base. *Anther* with two distinct orbicular chambers, 0.9 – 1 × 0.8 – 0.9 mm, with a distinct triangular lobe at the tip. *Pollinia* 2, ovoid, c. 0.5 mm. Figs 3, 4.

RECOGNITION. *Bulbophyllum cochinealloides* is characterised by its overlapping ovoid to orbicular flattened pseudobulbs, the long inflorescence with up to 50 non-resupinate flowers, the thickened, roundly ridged rachis, the lingulate-oblanceolate lip with auriculate basal wings, convex disk, finely verrucose margins, the long stelidia and the mid-lobe of the column and the lobed anther.

DISTRIBUTION. Endemic to Madagascar, Antananarivo province. Known from the Type only.

HABITAT. Humid evergreen forest, c. 1200 m.

CONSERVATION STATUS. This species is an endemic orchid of Madagascar, only known from a cultivated individual from the Analamanga region in 2009. It is currently considered to be Data Deficient (**DD**), according to the IUCN Red List Categories and Criteria with incomplete information on the distribution, population size and trend of this species. Further research is needed to check the population status, threats, habitat and distribution.

PHENOLOGY. September to October.

ETYMOLOGY. Named for the carmine red colouration of its flowers in reference to the dye cochineal which is extracted from scale insects of the genus *Dactylopius* which cling to the substrate of their host plant, as do the pseudobulbs of this orchid.

NOTES. *Bulbophyllum cochinealloides* shares its flattened pseudobulbs, a long inflorescence and overall flower structure with *B. cardiobulbum* Bosser (Fig. 3D) and *B. uroplatoides* Hermans & G.A.Fisch. (Fig. 3C) but it differs from both in its longer rachis which has more densely placed and more numerous flowers. The flowers are almost half the size of those of *B. cardiobulbum* and the lip is lingulate-oblanceolate (vs more spathulate), it is also slightly smaller than *B. uroplatoides*, especially the lip which is almost half the size and has a rounded disk of the lip (vs deeply longitudinally furrowed). See comparison in Table 1.

Phylogenetically the new species is closest related to *Bulbophyllum uroplatoides* and *Bulbophyllum cardiobulbum* as a part of a well-supported sub-lineage, distinct from the remaining Madagascan *Bulbophyllum* clades (Gamisch *et al.* unpublished). Due to its distinct phylogenetic position and its blend of morphological characters it was proposed (Fischer *et al.* 2007b; Gamisch *et al.* 2015) that *B. cardiobulbum*, which was originally assigned to sect. *Calamaria* Schltr. by Bosser (1965: 396) should be placed into a new section together with *B. uroplatoides* (Fischer *et al.* 2007b). For this purpose, a new sect. *Inversiflora* G.A.Fisch. & P.J.Cribb 'in prep' (in Pridgeon *et al.* 2014: 17) has been suggested but, to date, not formally described, it is described below. The new species is therefore placed into the same section as *B. cardiobulbum*, based on morphological and phylogenetic evidence.

Bulbophyllum fierenanaense *G.A.Fisch & Hermans* **sp. nov.** Types: Madagascar, Toamasina prov., near Fierenana, 1264 m, 17 Dec. 2008, *Fischer & Andriantiana* FS5152 (holotype SZU!, isotype K!).

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Slender epiphytic *plant* up to 15 cm tall excluding the inflorescence, scrambling on a long rhizome with the pseudobulbs c. 2.5 cm apart, at an almost 45 degree angle to the substrate, 2 – 3 mm in diam., partly covered by thin scales: roots wiry, c. 1 mm in diam. *Pseudobulbs* bifoliate, cylindrical, a little widened at the base, longitudinally ridged, 3.5 – 8.5 cm × 5 – 9 mm, purple-brown, with 2 – 3 membranous tubular basal sheaths, attenuate at the tip, 10 – 20 mm long. *Leaves* obliquely erect, narrowly ligulate, flat to somewhat revolute, subsessile to shortly petiolate, 5 – 7 cm × 8 – 12 mm, apex unequally incised with one part rounded, the other dentate. *Inflorescence* pendent to arching, somewhat curved, 9 – 18 cm long, with up to 16 flowers but generally fewer, pinkish-purple. *Peduncle* slender, becoming a little thicker towards the apex, about half the length of the inflorescence, with 4 – 6 thin scarious bracts c. 5 mm long. *Rachis* a little thicker than the peduncle, loosely racemose, the flowers 4 – 7 mm apart. *Floral bracts* triangular, attenuate, 2.5 – 4 × 1.2 – 2 mm, a little rugose. *Flowers* spreading, opening basipetally, c. 15 × 16 mm, the dorsal sepal creamy-white with 5 burgundy red longitudinal bands along the veins, lateral sepals creamy-white splashed with burgundy, creamy-white with 3 broad longitudinal deep burgundy bands along the veins, lip reddish pink, the upper surface darker, the epichile verrucae brownish green. *Pedicel* and *ovary* ovoid, slightly grooved, a little punctate, 1.5 – 3 × 1.2 – 3 mm, pink. *Dorsal sepal* lanceolate, attenuate, obtuse at the base, 7.7 – 10 × 2.1 – 3.1 mm. *Lateral sepals* ovate-lanceolate, strongly acuminate to caudate at the tip, 7.3 – 8.3 × 3.2 – 4 mm. *Petals* elliptic, truncate at the apex, somewhat curved, 3.1 – 4.1 × 1.3 – 1.9 mm. *Lip* very motile, attached with a thin filament to the column foot, narrowly lingulate, 5.8 – 6.5 × 1.5 – 2.1 mm, narrowed towards the base with 2 auriculate lobes, epichile concave, hollowed, minutely verrucose, the margins

Fig. 3. A, B *Bulbophyllum cochinealloides*. plant and rachis; C *Bulbophyllum uroplatoides*, flowers; D *Bulbophyllum cardiobulbum*, flowers. PHOTOS: JOHAN HERMANS.

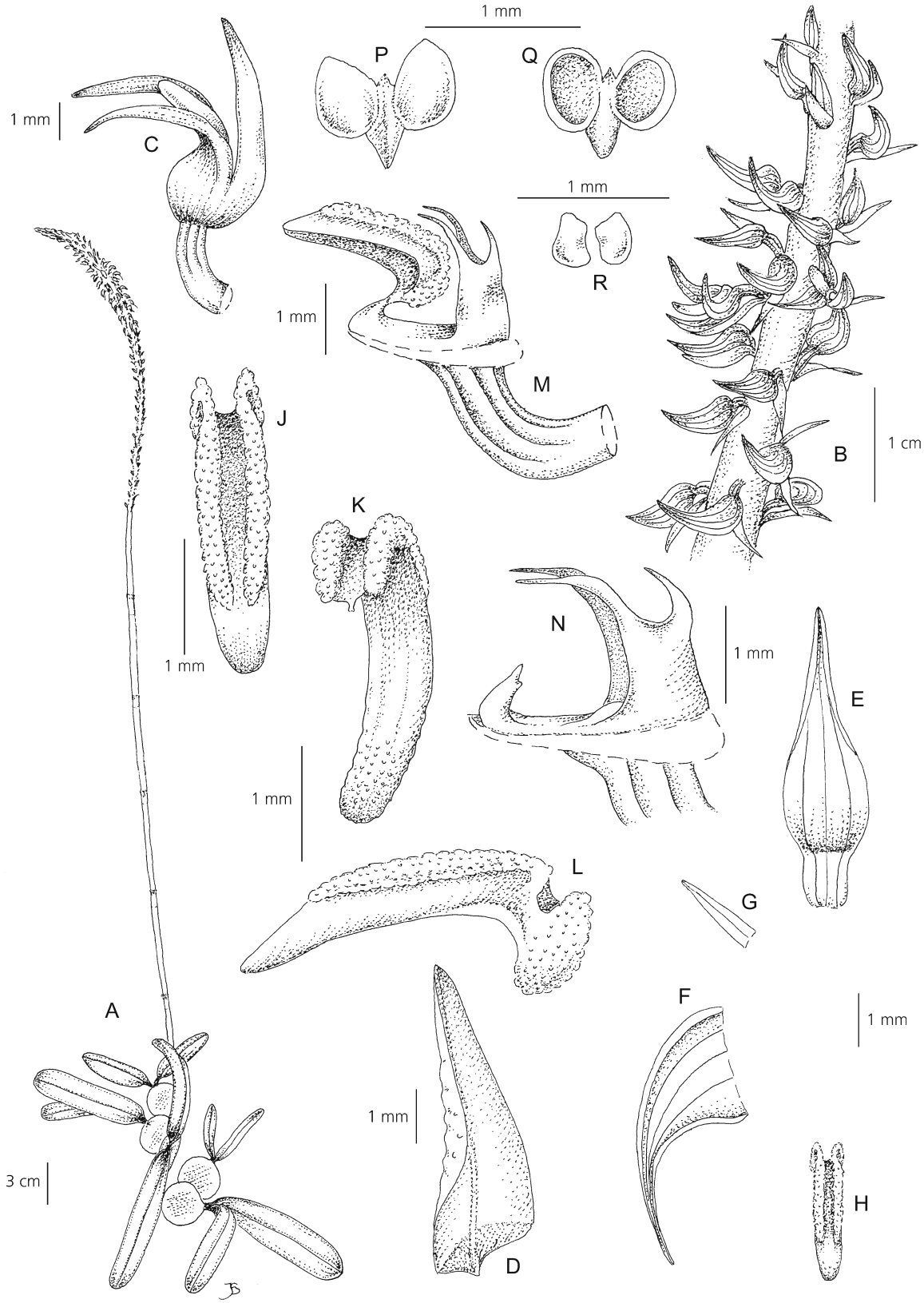

Fig. 4. *Bulbophyllum cochinealloides*. A habit; B part of inflorescence; C flower; D floral bract; E dorsal sepal; F lateral sepal; G petal; H lip; J lip enlarged, from above; K lip enlarged, from below; L lip side view; M column & lip side view; N column; P anther from above; Q anther from below; R pollinia. From *Hermans* 6718. DRAWN BY JUDI STONE.

Table 1. Comparison of *Bulbophyllum cochinealloides*., *B. cardiobulbum* and *B. uroplatoides*.

	Bulbophyllum cochinealloides	*Bulbophyllum cardiobulbum*	*Bulbophyllum uroplatoides*
Pseudobulb	very compressed, ovoid	very compressed, ovoid	very compressed, ovate
Leaves	2, oblong to lanceolate	2, oblong-ligulate	2, oblong-lanceolate
Inflorescence	up to 44 cm long, c. 50 flowers	up to 30 cm, 12 – 24 flowers	c. 22 cm, max 18 flowers
Dorsal sepal (mm)	5.9 – 6.8 × 1.1 – 1.4	13 – 14 × 3	7 – 8 × 2 – 2.5
Lateral sepals (mm)	6.2 – 6.7 × 2 – 2.2	14 – 15 × 4	8 × 4
Petals (mm)	1.9 – 2.1 × 0.3 – 0.4	2.5 × 0.8	2 × 0.7
Lip	3 – 3.2 × 1.1 – 1.2 mm, ligulate-oblanceolate, margins verrucose	12 × 3.5 mm, spathulate, margins verrucose	6 × 1.5 mm, oblanceolate, central furrow, margins minutely verrucose
Distribution	Antananarivo prov.	Fianarantsoa & Toamasina prov.	Antsiranana prov.
Altitude (m)	c. 1200	1300 – 1400	c. 1000

rounded-incurved, convex-rounded underneath, densely verrucose. *Column* short 3.2 – 4 × 2.3 – 3 mm, with c. 1.5 mm long, subulate stelidia, triangular at the base, falcate at the tip, foot recurved. *Anther* semi-globose, c. 0.7 × 0.6 mm, with a small conical appendage. *Pollinia* ovoid, c. 0.3 × 0.2 mm. Figs 5, 6.

RECOGNITION. This species, characterised by its long cylindrical pseudobulbs, two narrowly ligulate leaves, a long pendent inflorescence, and flowers with lanceolate to ovate lanceolate sepals, blunt elliptic petals, a long lingulate lip (at least three times longer than wide).

DISTRIBUTION. Endemic to Madagascar, Toamasina province only.

SPECIMENS EXAMINED. MADAGASCAR. Toamasina prov., near Fierenana, 1264 m, 17 Dec. 2008, *Fischer & Andriantiana* FS5152 (holotype SZU!, isotype K!; Toamasina prov., near Fierenana, 1264 m, 17 Dec. 2008, *Fischer & Andriantiana* FS5155 (SZU!); Toamasina prov., Vohibimany, N of Fierenana, 1128 m, 16 Dec. 2008, *Fischer & Andriantiana* FS5144! (SZU!); Toamasina prov. near Fierenana, 1256 m, 17 Dec. 2008, *Fischer & Andriantiana* FS5234 (SZU!).

HABITAT. Humid evergreen forest. 1128 – 1264 m.

CONSERVATION STATUS. This species is endemic to Madagascar, distributed in Atsinanana region, Toamasina province. It is known from four herbarium specimens collected in 2008 representing four subpopulations in unprotected areas. This species is considered to be threatened by habitat destruction due to grazing and frequent fires. Based on two defined threat locations, the area of occupancy AOO is likely less than 500 km^2, the extent of occurrence EOO estimated to be less than 5,000 km^2 and the continuing decline in the EOO, AOO and the habitat quality, this species is therefore assessed as Endangered (**EN**) under criterion B1ab(i,ii,iii)+B2ab(i,ii,iii).

PHENOLOGY. December.

ETYMOLOGY. Named for the area where the species was discovered.

NOTES. With a finely verrucose hollowed epichile and the long acicular stelidia, *Bulbophyllum fierenanaense* belongs in *Bulbophyllum* sect. *Elasmatopus* Schltr. In the section it shares the sepal shape and long lingulate lip with *B. oxycalyx* Schltr. but the latter has much shorter ovate (vs cylindrical) pseudobulbs, oblong (vs narrowly ligulate) leaves, and the margins of the sepals are serrate (vs glabrous). Morphologically it is closest to *B. amphorimorphum* H.Perrier and *B. aubrevillei* Bosser (Figs 14 – 15) which are also closely related phylogenetically in a well-supported group (Gamisch *et al.* unpublished). Table 2 compares their main characteristics. In overall floral morphology, it is closest to *B. amphorimorphum* but in the latter the pseudobulbs are much shorter and long-ovoid (vs cylindrical) and they are unifoliate (vs bifoliate), the lip is also more sigmoid and the stelidia shorter. Although the pseudobulbs are generally much longer, more evenly cylindrical and the inflorescence longer than the plant, it is similar in habit to *B. aubrevillei* but in that species the sepals are shorter and acute (vs lanceolate-attenuate) and the lip is ovate (vs lingulate) and less than twice as long than wide (vs three times longer than wide).

The flowers of the new species appear to open basipetally, from tip to base of the inflorescence. This seems more common in species in sect. *Elasmatopus*, including *B. amphorimorphum, B. aubrevillei* and *B. oxycalyx*. Most other Madagascan *Bulbophyllum* bloom acropetally.

Bulbophyllum geminiflorum *Hermans, Gamisch & Sieder* **sp. nov.** Type: Madagascar, Toamasina prov., Moramanga, Andasibe, Maromizaha, humid evergreen forest, 928 m, 18 Jan. 2018, *Gamisch, Sieder, Prehsler & Andriantiana* 7358 (holotype WU!, isotype K!).

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Small (8 – 20 × 2 – 4 mm) spreading epiphytic *plant* on a long verrucose, silvery white rhizome, c. 1.5 mm in diam. *Pseudobulbs* elliptic to ovoid, 7 – 9.5 × 3 – 4.5 mm, smooth with a few rounded raised ridges, with 1 – 2 membranous basal sheaths, reddish-green, with two apical leaves. *Leaves* narrowly lanceolate, 10 – 13 × 3 – 6.5 mm, with a short 2 – 4 mm petiole at the base, the

Fig. 5. *Bulbophyllum fierenanaense*. **A** plants in habitat at type locality; **B** inflorescence; **C** flower. PHOTOS: GUNTER FISCHER.

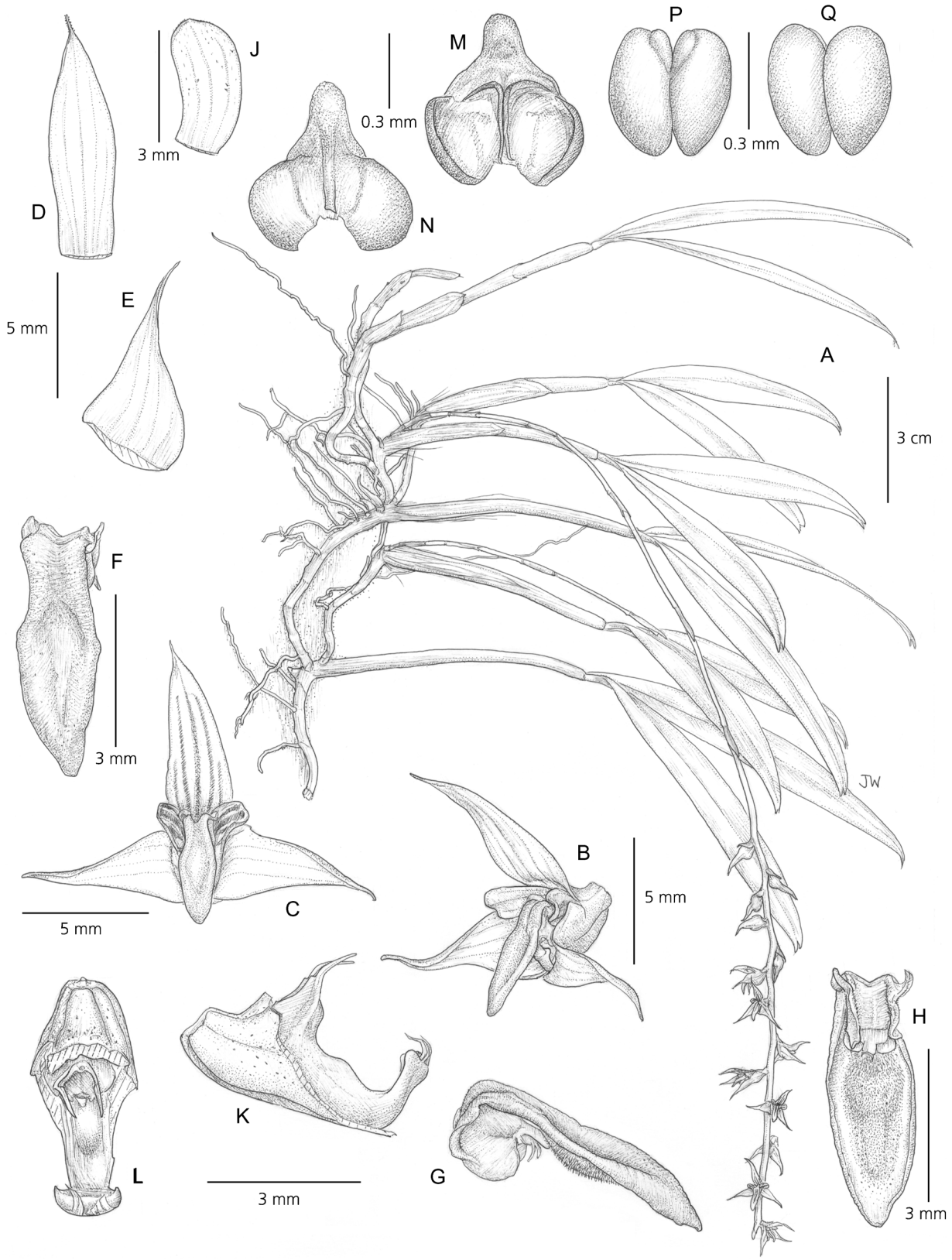

Fig. 6. *Bulbophyllum fierenanaense*. A habit; B flower; peduncle, ¾ view; C flower front view; D dorsal sepal; E lateral sepal; F – H lip; J petal; K – L column; M – N anther; P – Q pollinia. From *Fischer et al.* FS5152. DRAWN BY JULIET BEENTJE.

margins attenuate and a little erose, the dorsal mid-vein a little keeled and extended into a thorn-like extension at the apex, green, becoming reddish-green underneath when mature. *Inflorescence* short, emerging from the base of the mature pseudobulbs, slightly arching, up to 15 mm long, with 2 (or rarely 1) flowers. *Peduncle* terete, 5 – 7 × 1.2 – 1.5 mm, becoming thicker towards the base of the first flower, the basal third with 2 – rarely 3 long-acuminate sheaths, dorsally keeled, erose. *Rachis* very short, densely flowered. *Floral bracts* thin, lanceolate, longly acuminate, 1.9 – 3.2 × 1.3 – 1.6 mm, enclosing the pedicellate ovary and overlapping the base of the flower. *Flowers* very small, normally in pairs backing onto each other, overall c. 4 × 2 mm, yellowish-green, strongly marked with burgundy-pink, sepals and petals densely spotted burgundy with the tips white, the lip pink at the base, yellow in the anterior half, the basal wings burgundy, anther and pollen yellow-white. *Pedicel* and *ovary* ovoid, 1.1 – 1.3 × 1 – 1.3 mm, dorsally flattened, roundly ridged. *Dorsal sepal* ovate, attenuate, the apex reflexed, 3.1 – 3.4 × 1.3 – 1.6 mm. *Lateral sepals* fused except for the extreme apex, concave, obliquely ovate-lanceolate, 3 – 3.2 × 2 – 2.1 mm, laterally carinate, hollowed beneath the lip, adnate to the column foot. *Petals* narrowly lanceolate acuminate, 2.1 – 2.2 × 0.7 – 0.9 mm, the tip concave and minutely serrate. *Lip* fleshy, subglobose, ventricose, 1.3 – 1.4 × 1.1 – 1.2 mm, apex lobular truncate, upper surface echinate, base biauriculate, with two small depressions on either side of the ridges and a central ridge reaching a third of the length of the disk, thinly hinged to the column foot. *Column* short, c. 1.8 × 1 mm, stelidia expanded, obtusely 3-lobed. *Anther* oblong, c. 0.4 × 0.6 mm. *Pollinia* ovoid, c. 2 mm in diam. Figs 7, 8.

RECOGNITION. *Bulbophyllum geminiflorum* is recognised by its small bifoliate pseudobulbs, short inflorescence with almost invariably two small flowers, narrowly lanceolate leaves with the mid-vein elongated into a thorn-like extension, flowers borne back to back with narrowly lanceolate petals, a ventricose lip with an echinate surface, the apex lobular-truncate and biauriculate base, and obtusely three-lobed stelidia on the column.

DISTRIBUTION. Endemic to E Madagascar in the Andasibe area of Toamasina province.

SPECIMENS EXAMINED. MADAGASCAR. Toamasina prov., Moramanga, Andasibe, Maromizaha, humid evergreen forest, 928 m, 18 Jan. 2018, *Gamisch, Sieder, Prehsler & Andriantiana* 7358 (holotype WU!, isotype K!).

HABITAT. Epiphyte in humid evergreen forest, in part shade. 900 – 950 m.

CONSERVATION STATUS. This species is likely to be Critically Endangered (**CR**) according the Red List Categories and Criteria. It is only known from a single colony, at a single poorly protected locality, Maromizaha, Alaotra-Mangoro, Toamasina, in a forest fragment alongside a road — such fragments are known to be particularly at risk from human development. *Bulbophyllum geminiflorum* is CR based on Criterion D, number of mature individuals fewer than 50, under criterion B2ab(ii,iii) continuing decline in the value of AOO and the habitat quality.

ETYMOLOGY. The name refers to its paired flowers.

PHENOLOGY. January.

NOTES. It belongs in sect. *Ploiarium* Schltr. which is characterised by bifoliate pseudobulbs and flowers with fused lateral sepals. Only a few species of sect. *Ploiarium* are small and two-flowered with the flowers borne back to back. The thorn-like extension of the leaf tip is also rare in *Bulbophyllum* species from the Madagascan region but it is likely that this feature, together with the erose margin of the leaf, was missed and therefore usually not noted by authors working with dried material only. It has also been observed in *B. oenanthum*, described below but they share no other characteristics. There are a few other small species in the section with a few-flowered inflorescence shorter than the plant and a ventricose rounded lip but they all have a habit and leaves more or less twice the size of those of the new species. It shares a somewhat similar plant habit, lip and stelidia with *B. rubiginosum* Schltr. but that has oblong or lanceolate-ligulate leaves (vs narrowly lanceolate), the inflorescence has more than four flowers (vs two) and the dorsal sepal is oblong (vs ovate). It shares some features with *B. aggregatum* Bosser, especially the lip but that has more than six flowers (vs two) and the sepals are distinctly papillose (vs glabrous). The plant habit and small flowers might also be confused with *B. insolitum* Bosser but the latter's pseudobulbs are more flattened, the leaves oval to oblong (vs narrowly lanceolate), the lateral sepals serrate (vs entire), the lip three-lobed (vs subglobose) and the stelidia bidentate (vs tridentate).

Bulbophyllum oenanthum *Hermans, G.A.Fisch. & Andriant.* **sp. nov.** Type: Madagascar, Toamasina, Maroantsetra, Masoala, Tampolo, in mangrove swamp on old trees, rather shady, 2 m, Nov. 2007, *Fischer & Andriantiana* FS4418 (WU-Liqu.0063748) (holotype WU!).

http://www.ipni.org/urn:lsid:ipni.org:names:77214538-1

Epiphytic *plant* on a short branching rhizome 5 – 15 mm long in-between the pseudobulbs, c. 1 mm in diam., covered in sheaths; roots wiry, glabrous, c. 0.5 mm in diam. *Pseudobulbs* elliptic to ovoid, triangular in cross-section, somewhat winged, 6 – 20 × 4 – 12 mm, smooth with 2 – 3 rounded grooves, bifoliate, a few scarious acuminate bracts towards the base, green marked with brownish-red. *Leaves* flat, oblong, 15 – 49 × 5 – 10 mm, acuminate unequally bilobed at the tip, attenuate at the base towards a short 2 –

Fig. 7. *Bulbophyllum geminiflorum*. A inflorescence; B plant habit. PHOTOS: JOHAN HERMANS.

3 mm petiole, the prominent dorsal mid-vein ending in a thorn-like extension, green on the upper surface, red-purple underneath, mid-vein and margins darker. *Inflorescence* arching at first then pendent, extending as the flowers develop, up to 65 mm long, with up to 15 flowers. *Peduncle* round, substantially thickened towards the apex, with 2 – 3 nodes, peduncle sheaths short, thin amplexicaul, 1 – 3 mm long. *Rachis* densely-flowered, thickened, triangular in cross-section, about ¾ of the inflorescence length, hollowed beneath each flower and the floral bracts at first overlapping then forming a seamless series of hoods along the rachis as the flowers open, pale green, tinted red along the ridge of the floral bracts. *Floral bracts* fleshy, 3.4 – 7 × 1.9 – 3 mm, forming a hood over part of the flower, with a distinct dorsally keeled to almost sharply winged ridge, apiculate at the tip, triangular, roundly lobed at the base, forming a distinct zig-zag pattern in old inflorescences. *Flowers* flat against the rachis, c. 6 – 7.5 × 2.5 – 3 mm, ochre-yellow, the sepals densely suffused with brownish-pink, lip and petals yellow. *Pedicel* and *ovary* rounded, narrowing towards the base, 1.8 – 2 × 1.6 – 1.8 mm. *Dorsal sepal* lanceolate, attenuate, 4 – 4.2 × 1.3 – 1.8 mm, with a broad dorsal angular keel, forming a horizontal hood over the column and lip. *Lateral sepals* joined — fused in bud but separating when the flowers open then only joined at the base, broadly falcate, attenuate, 4.8 – 5.1 × 1.5 – 2 mm, the lateral margins thickened. *Petals* lanceolate-ovate, 2.3 – 3.1 × 0.8 – 1.1 mm, acute. *Lip* ovate-elliptic, 2.1 – 2.3 × 1 – 1.2 mm, base bi-lobular forming diverging ridges, disk concave, the surface verrucose, the margins thinning recurved sinuate, convex beneath, tip lobular-apiculate. *Column* fleshy, foot short, c. 0.6 mm, rounded, the anterior margin of the rostellum indented, the stelidia indistinctly bilobed, c. 0.8 mm long. *Anther* oblate-rounded c. 0.3 × 0.2 mm.

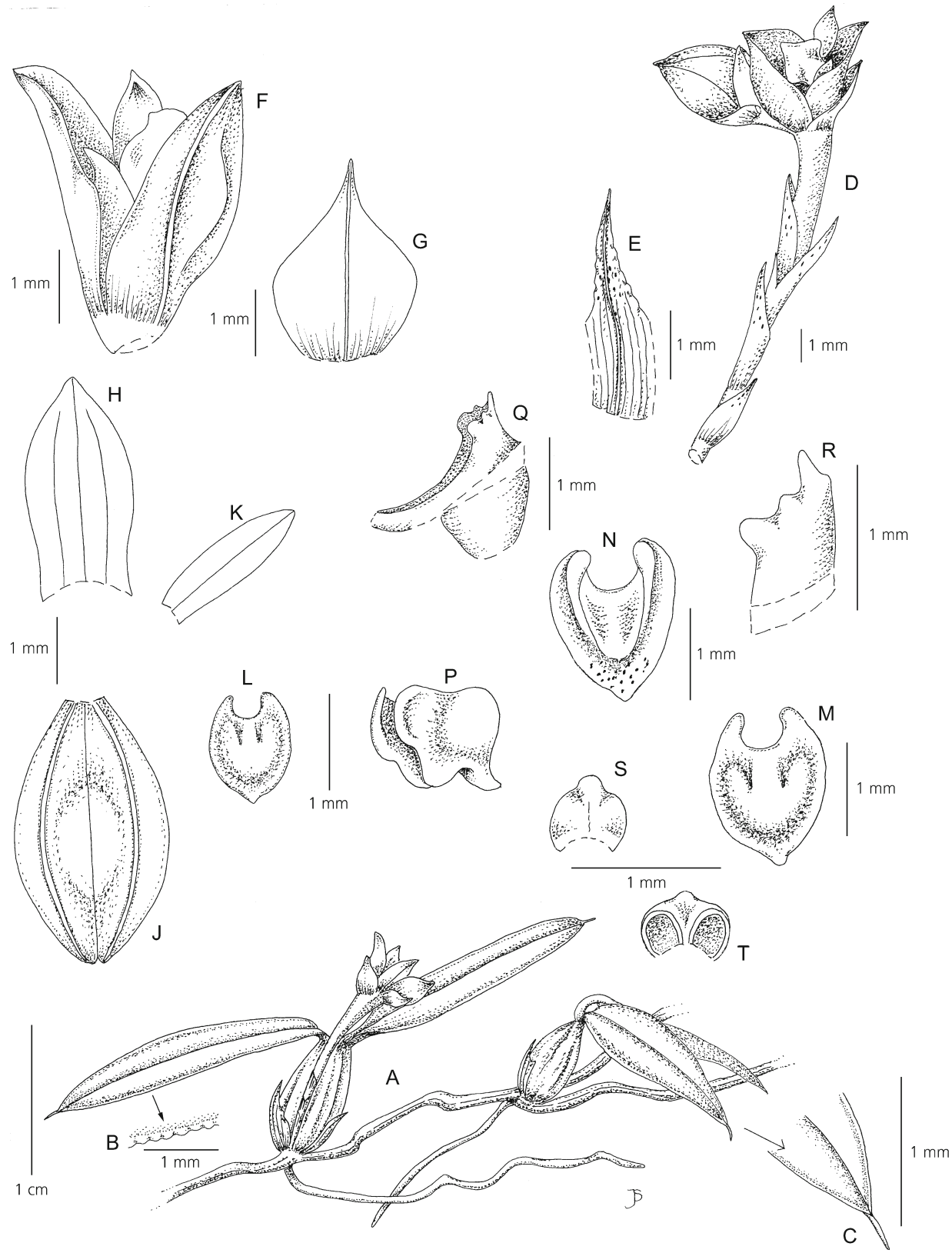

Fig. 8. *Bulbophyllum geminiflorum*. **A** habit; **B** close-up of leaf margin; **C** close-up of leaf tip; **D** inflorescence; **E** peduncle sheath; **F** flower; **G** floral bract; **H** dorsal sepal; **J** fused lateral sepals from below; **K** petal; **L** lip; **M** lip enlarged, from above; **N** lip enlarged, from below; **P** lip enlarged, side view; **Q** column side view; **R** column enlarged, foot removed; **S** anther from above; **T** anther from below. From *Gamisch et al.* 7358. DRAWN BY JUDI STONE.

Table 2. Comparison of similar species in *Bulbophyllum* sect. *Elasmatopus*.

	Bulbophyllum amphorimorphum	*Bulbophyllum aubrevillei*	*Bulbophyllum fierenanaense*	*Bulbophyllum kieneri*
Plant	< 5 cm	< 10 cm	< 15 cm	< 10 cm
Pseudobulb	amphora-shaped (turbinate) < 2.5 × 0.7 mm, unifoliate	conical – subcylindrical, < 6.5 × 0.7 mm, bifoliate	cylindrical, < 8.5 × 0.9 cm, bifoliate	cylindrical, < 4 cm, bifoliate
Leaves	ligulate-linear, < 6 × 1 cm	ligulate, < 9 × 0.8 cm	narrowly ligulate, < 7 × 1.2 cm	linear oblong, < 6.5 × 0.8 cm
Inflorescence	< 5 cm, < 5 flowers	< 6 cm, < 7 flowers	< 18 cm, < 16 flowers	< 4 cm, < 5 flowers
Dorsal sepal	oblong-lanceolate, < 8 × 4 mm	ovate, acute, < 5 × 3 mm	lanceolate, < 10 × 3 mm	ovate acute, < 4 × 2.3 mm
Lateral sepals	ovate acute, < 7 × 5 mm	obliquely ovate, < 6 × 4 mm	ovate-lanceolate, < 8 × 4 mm	oval acute, < 4 × 2.3 mm
Petals	spathulate (elliptic), < 3.5 × 2 mm	rectangular / elliptic, < 2 × 0.4 mm	elliptic, < 4 × 1.8 mm	oblong, obtuse, < 1.7 × 0.7 mm
Lip	sigmoid, apex convex, apex concave, < 3 × 1.5 mm	ovate, recurved, apex concave, < 3.8 × 2.1 mm	lingulate, tip concave, verrucose, < 6 × 2 mm	ovate, recurved, apex concave, < 2.5 × 2 mm
Anther	with obtuse beak	3-lobed, conical beak	globose, conical beak	semi-globose, small beak
Column	stelidia linear, acute, 0.6 mm	stelidia triangular-subulate, 1 mm	stelidia subulate, < 1.5 mm	stelidia linear, acute, < 0.5 mm
Distribution	Antsiranana (Marojejy), Toamasina prov. (Moramanga area)	Toamasina prov. (Moramanga area)	Toamasina prov. (Fierenana area)	Antsiranana (Marojejy?) Toamasina prov.
Altitude (m)	1000 – 1500	900 – 1200	1250	1300?
Flowering	Dec.	Nov. – Dec.	Dec.	?
Main characters	pseudobulbs amphora-shaped, unifoliate, sigmoid lip.	pseudobulbs subcylindrical, bifoliate, lip ovate, apex concave	pseudobulbs cylindrical, long, bifoliate, leaves long, lip lingulate	pseudobulbs cylindrical, bifoliate, short inflorescence, lip ovate, apex concave

Pollinia 2, ovoid, c. 0.2 × 0.2 mm. *Seed capsule* ovoid, c. 6 × 5 mm. Figs 9, 10.

RECOGNITION. *Bulbophyllum oenanthum* is characterised by the thorn-like extension of its leaf mid-vein, its arching-pendent inflorescence with a much thickened apex of the peduncle and rachis, the fleshy triangular floral bracts sharply keeled and apiculate, and its flowers with the lateral sepals joined then diverging as they develop, lanceolate-ovate petals, a lip with basal lobes, recurved sinuate margins, and a verrucose disk and a short column with indistinctly bilobed stelidia.

DISTRIBUTION. Endemic to the Masoala peninsula in Toamasina province of NE Madagascar.

SPECIMENS EXAMINED. MADAGASCAR. Toamasina, Maroantsetra, Masoala, Tampolo, 2 m, Nov. 2007, *Fischer & Andriantiana,* FS4418 (WU-Liqu.0063748) (holotype WU!); Madagascar, 2010, *Hartig* 20 (ORCH2000640) (WU!); Toamasina, Maroantstra, Tampolo, 2 m, Nov. 2007, *Sieder* 4414 (WU!).

HABITAT. In mangrove swamp, on mature trees, in shade. Sea level.

CONSERVATION STATUS. This species is likely to be Critically Endangered (**CR**) according to the Red List Categories and Criteria. It is endemic to Masoala protected area, in Madagascar, distributed in Analanjirofo, Toamasina. With only one threat location defined, the area of occupancy estimated to be less than 10 km^2, the habitat of this species is vulnerable to rising sea levels, forest logging and wood collecting. It is assessed as CR under criterion B2ab(iii) or under criterion D with number of mature individuals less than 50.

PHENOLOGY. November.

ETYMOLOGY. The epithet firstly refers to the wine-red colouration of the bracts and flowers and secondly to the bird genus *Oenanthe* (Wheatears), indirectly referring to the wheat-ear appearance of the rachis.

NOTES. The new species is best placed in sect. *Ploiarium*; a section defined morphologically by its bifoliate pseudobulbs and flowers with more or less fused lateral sepals forming a platform beneath the lip and with lateral keels. It largely conforms to these criteria except that the lateral sepals are only fused during the beginning of their development and become separate on maturity. Phylogenetically it is nested, as part of a well-supported yet poorly resolved subclade (comprising c. 34 species), in the strongly supported sect. *Ploiarium* (Gamisch *et al.* unpublished data).

With its thickened peduncle and prominent floral bracts it is similar to *Bulbophyllum pleiopterum* Schltr. from the same area but that species is much larger with the leaves and inflorescence at least double the size, and it has flowers with lateral sepals that are fused, linear-ligulate petals (vs lanceolate-ovate), a lip of a different shape and acuminate stelidia (vs

rounded). *Bulbophyllum platypodum* H.Perrier also has a thickened peduncle but has very different floral bracts and flowers. The flowers of *B. oenanthum* are similar to those of *B. coccinatum* H.Perrier, *B. myrmecochilum* Schltr. and *B. septatum* Schltr. but those do not have the thickened peduncle and rachis, the flowers are more distant with much less prominent floral bracts, the lateral sepals are fused, the petals more linear and the lip with different margins and surface.

Morphologically it is closest to the phylogenetically distantly related *Bulbophyllum labatii* Bosser, also from the Masoala peninsula: they are approximately of the same size, have prominent floral bracts and share the unusual way the lateral sepals become divergent. *Bulbophyllum labatii* has a longer rhizome, much longer inflorescence (40 – 60 cm vs 6 – 7 cm) with double the number of flowers, the floral bracts are obtuse (vs apiculate), the lip is convex (vs concave) and the stelidia are distinctly three-lobed (vs indistinctly lobed), and the flowers are yellow (vs ochre extensively suffused with red).

Even though the relationships of the new species are not fully resolved, unpublished research by Gamisch *et al.*, shows that the strongest genetic links seems to be with *Bulbophyllum toilliezae* Bosser and, to a lesser extent, with *B. leptochlamys* Schltr. With *B. toilliezae* it shares the small verrucose lip but the plant of this species is much more robust, the inflorescence longer, the floral bracts broader, the sepals and petals at least three times bigger, the lateral sepals are fused along their entire length and the stelidia have a different shape, the colour of the flowers is clear yellow (vs suffused with red). With *B. leptochlamys* it shares a small lip and general habit but differs by its shorter oblong leaves (vs linear-ligulate), the thick apiculate triangular floral bracts (vs thin oval) and the small bilobed stelidia (vs long subfalcate).

Bulbophyllum rudolphus *Hermans* **sp. nov.** Type: Madagascar, Toamasina prov., Andasibe area, 1150 m, May 2002, *Hermans* 8233 (holotype K!).

http://www.ipni.org/urn:lsid:ipni.org:names:77214539-1

Diminutive epiphytic *plant* on a thin ramose, repent rhizome c. 1 mm in diam., thickening towards the base of the pseudobulbs; roots smooth, rounded with a few short scales, c. 0.5 mm in diam. *Pseudobulbs* 2-leaved, a few millimetres apart, flattened, ovoid to globose, 3 – 4.5 mm long × 1.2 – 1.8 mm wide, green, ridged, the base with some membranous sheaths. *Leaves* ovate, apex acute, 3.5 – 5.2 × 2.1 – 2.8 mm, subsessile towards the base, shortly petiolate, set toward the end of the pseudobulb and within a slight depression, greyish-green with the central and lateral veins dark green. *Inflorescence* from the base of the pseudobulbs, descending, single-flowered at the apex, up to 33 mm long. *Peduncle* thin, rigid, 25 – 30 × 0.2 – 0.3 mm, thickening towards the base of the pedicellate ovary, with two membranous, imbricate sheaths 2.8 – 3.2 mm long, minutely verrucose all over. *Floral bract* membranous, broadly lanceolate, 1.4 – 1.6 × 0.9 – 1 mm, covering the ovary. *Flower* almost sessile, the segments divaricate, c. 6.5 × 7 mm, overall pale yellow, the dorsal sepal with broken red lines along the veins, the lateral sepals burgundy red at the base, fanning out along the veins, petal tips red, lip pale orange, burgundy at the base, column pale yellow, anther area bright red. *Pedicel* and *ovary* very short, slightly ridged, c. 1.3 × 1 mm. *Dorsal sepal* broadly lanceolate, attenuate, recurved towards the apex, 10 – 10.1 × 3.8 – 3.9 mm. *Lateral sepals* lanceolate-falcate, 9.1 – 9.3 × 2.9 – 3 mm, the margins involute. *Petals* elliptic, roundly retuse at the apex, 2.2 × 1.3 mm. *Lip* glabrous, broadly lingulate, 2.7 – 2.9 × 1.1 – 1.2 mm, thickened and rounded at the tip, roundly winged at the base, mobile on the column foot. *Column* short with a long tapering foot, stelidia shortly bidentate, triangular-acuminate, c. 2.2 × 1.1 mm. *Anther* bilobed, c. 0.4 × 0.5 mm. *Pollinia* ovoid c. 0.3 × 0.2 mm. Figs 11, 12.

RECOGNITION. *Bulbophyllum rudolphus* belongs in sect. *Lichenophylax* characterised by its tiny habit on a branching rhizome, small ovoid bifoliate pseudobulbs, thin single-flowered inflorescence, fleshy lip and short triangular stelidia. It is typical by the silvery leaves, long needle-like peduncle, sepals without a long acumen, blunt petals, the small lip (⅓ of the sepals) which is thickened lingulate and the short bidentate stelidia.

DISTRIBUTION. Toamasina province, E Madagascar. Known from the type only but there are photographic records from the Marojejy massif in Antsiranana province, N Madagascar (Hervouet 2018: 242).

HABITAT. Epiphyte amongst bryophytes in humid evergreen forest, 1150 m.

CONSERVATION STATUS. This species is endemic to Madagascar, distributed in Alaotra- Mangoro (Toamasina) and Sava (Antsiranana) regions. It is located in Zahamena Ankeniheny Corridor and may occur in Marojejy Protected Areas. It is known from one threat location. The habitat and the area of occupancy of this species are threatened and in continuing decline by logging, subsistence slash-and-burn farming, grazing and fires. Confirmation of its existence in northern Madagascar could alter its status. *Bulbophyllum rudolphus* is therefore assessed as Critically Endangered (**CR**) under criterion B2ab(ii,iii).

PHENOLOGY. May.

ETYMOLOGY. In reference to the bright red colour of the anther and tip of column reminding us of Rudolph the red-nosed reindeer.

NOTES. It is closest to the equally diminutive *Bulbophyllum neglectum* Bosser which comes from the same area: it has comparable pseudobulbs and some-

Fig. 9. *Bulbophyllum oenanthum*. **A** inflorescence; **B** inflorescence and flower. PHOTOS: JOHAN HERMANS.

what similar flowers but the leaves are narrower (linear lanceolate vs ovate), the peduncle shorter (17 mm vs 30 mm), and distinctively coloured flowers (overall yellow-orange with a bright red anther vs overall violet red with a white anther) with sepals about half the length and more longly acuminate, petals that are attenuate (vs blunt) and a triangular lip (vs bluntly lingulate).

It is somewhat similar to *Bulbophyllum pandurella* Schltr. but that differs by its smaller size and shape of the floral segments and the long, almost 1 mm stelidia (vs minutely triangular).

Bulbophyllum sect. Inversiflora

Bulbophyllum sect. **Inversiflora** *G.A.Fisch., Gamisch & P.J.Cribb* **sect. nov.** Type species: *Bulbophyllum cardiobulbum* Bosser (1965: 396). Madagascar, Ankeramadinika, *J.-P. Peyrot* 5 (holotype P!)

http://www.ipni.org/urn:lsid:ipni.org:names:77214540-1

Medium-sized epiphytes. *Rhizome* creeping. *Pseudobulbs* close together, distinctly laterally flattened, 2-leafed. Inflorescences heteranthous, a many-flowered, elongated raceme with spirally arranged flowers. *Rachis* thickened, somewhat spindle-shaped. *Flowers* reflexed, with the lip turned away from the rachis. *Sepals* free, glabrous abaxially. *Petal* margins entire, glabrous. *Lip* mobile, undivided, thick, margins entire, glabrous, verrucose or partly ciliate. *Column* stelidia rather short, triangular, acute, without a tooth along the lower margin. *Anther* with a rounded to conical protrusion which overtops the front margin.

NOTES. Three species, occurring in open or dwarf montane forests on poor soils (800 – 1400 m) in E Madagascar. Ants often live beneath the pseudobulbs, which are appressed to the substrate, not unlike the leaves of many *Dischidia* R.Br. species (Apocynaceae). Section *Inversiflora* shows features of sects *Alcistachys* Schltr., *Lupulina* G.A.Fisch. in prep. (comprising *Calamaria* sensu Perrier 1939: 406, *Humblotiorchis* sensu Schlechter 1924: 210 and *Kinethrix* Schltr. previously monographed by Bosser (2000: 167 – 182 as sect. *Kainochilus* Schltr.) such as an erect inflorescence, hairs on the lip and laterally flattened two-leaved pseudobulbs (Fischer *et al.* 2007b). However it differs in several respects: the inflorescence is erect and rigid (vs erect, pendulous or recurved in *Lupulina*), the pedicel apically droops up to 135 degrees (vs up to 180 degrees in *Alcistachys*), the flowers are large (vs comparatively small in

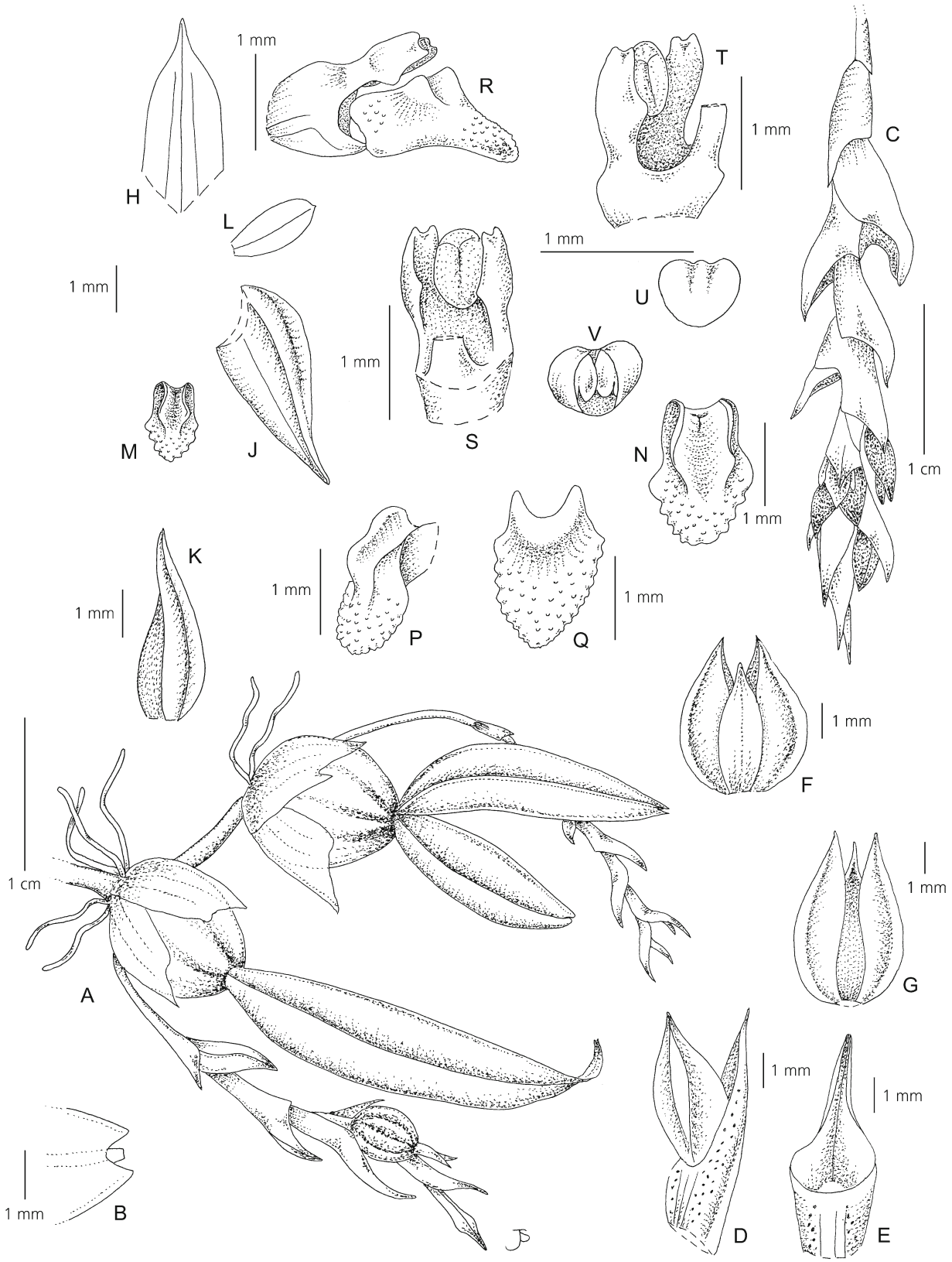

Fig. 10. *Bulbophyllum oenanthum*. **A** habit; **B** tip of leaf; **C** inflorescence; **D** flower & bract; **E** bract; **F** flower, partially opened from above; **G** flower partially opened, from below; **H** dorsal sepal; **J** lateral sepal, front view; **K** lateral sepal, side view, showing keel; **L** petal; **M** lip; **N** lip enlarged, from above; **P** lip, side view; **Q** lip from below; **R** column & lip, side view; **S** column, front view; **T** column, oblique view; **U** anther from above; **V** anther from below. From *Sieder* FS4418. DRAWN BY JUDI STONE.

Lupulina) and the stelidia have a small tooth along their upper margins (vs no tooth along their upper margins in *Alcistachys, Lupulina* and *Kinethrix*). Furthermore, the pseudobulbs of all species of sect. *Inversiflora* are more compressed and larger than those of species of sects *Kinethrix*, *Lupulina* and *Alcistachys* (with the exception of *Bulbophyllum hamelinii* W.Watson, which has larger but less compressed pseudobulbs). Phylogenetically, it forms a well-supported clade distinct from all the remaining sections of Madagascan *Bulbophyllum* (Gamisch *et al.* unpublished data). The combination of these properties uniquely identify this group of species; we therefore propose to place them in a section of their own.

During a recent field trip (2018), a first genus-level identification of a potential pollinator of *Bulbophyllum* in Madagascar was made (but see Gamisch *et al.* 2014 and references therein for respective reports from Réunion). *Bulbophyllum cardiobulbum* was observed (Gamisch, Sieder & Prehsler, pers. obs.) to attract several tiny (c 1.7 mm long) female flies (Fig. 13) of a hitherto unknown species of the genus *Arcuator* Sabrosky of the family Chloropidae (Dr. Michael von Tschirnhaus/Bielefeld University pers. comm.) remarkable for the lack of a terminal spur ("Endsporn") on the hind legs ("Hintertibia"), usually a diagnostic character of the genus *Arcuator* (Dr Michael von Tschirnhaus/Bielefeld University pers. comm.).

Key to the species of sect. Inversiflora

1a Peduncle compressed . . . . . **B. cardiobulbum** (Fig 3D).
1b Peduncle terete — circular in section 2
2a Length of peduncle 2 to 3 times the length of the leaves . . . . . **B. uroplatoides** (Fig 3C).
2b Length of peduncle at least 4 times the length of the leaves . . . . . **B. cochinealloides** (Fig. 4).

Nomenclatural Notes

Bulbophyllum aubrevillei *Bosser* (1965: 386); Du Puy *et al.* 1999: 64); Hermans *et al.* (2007: 82); Cribb & Hermans (2009: 190); Bosser & Lecoufle (2011: 196); Hervouet (2018: 179). Types: Madagascar, S of Moramanga, Moramanga to Anosibe road, Dec. 1962, *Bosser* 16458 (lectotype P (P00097600!); isolectotypes P ((P00097601!; P00097602!; P00334009!); BR (BR8810328!); TAN!).

Bulbophyllum kieneri Bosser (1971: 328) **synon. nov.**; Du Puy *et al.* (1999: 76); Hermans *et al.* (2007: 97); Cribb & Hermans (2009: 192). Type: Madagascar, Toamasina area, *Kiener* 526, hort. Jard. Bot. Tana. 526 (holotype P (P00097776!).

Small epiphytic *plant* up to 12 cm high excluding the inflorescence, scrambling on a long rhizome with the pseudobulbs 1 – 3.5 cm apart; rhizome 1 – 1.6 mm in diam., partly covered by membranous scales; roots wiry, c. 1 mm in diam. *Pseudobulbs* conical to cylindrical, 3 – 6.5 × 0.5 – 1.1 mm, more or less longitudinally grooved or furrowed, reddish-brown, with two apical leaves. *Leaves* sub-erect to divaricate, ligulate, 5 – 7 × 0.5 – 0.8 cm, subsessile to shortly petiolate, apex unequally bilobed, upper surface canaliculate, green to greenish-red, often purple underneath. *Inflorescence* thin, arching to pendent, with 3 – 5 scarious sheaths c. 3 mm long, up to 8 cm long, reddish-brown, with 3 – 9 flowers. *Peduncle* thickening slightly towards the apex, a little longer than the rachis, peduncle sheaths (scales), 3 – 4.5 mm long. *Rachis* a little thicker than the peduncle, loosely racemose, the flowers 2 – 5 mm apart. *Floral bracts* triangular, attenuate, 2 – 2.1 × 1.1 – 1.4 mm. *Flowers* opening basipetally, spreading, not opening very widely, c. 10 × 9 mm, dorsal sepal creamy-white more or less spotted with reddish-pink to purple, lateral sepals creamy-white spotted with red to purple, petals creamy-pink densely spotted, lip from whitish pink to yellow or purple red, the margins darker, column and anther cream. *Pedicel* and *ovary* ovoid-conical, slightly grooved, 1.1 – 2 × 1.1 – 1.4 mm. *Dorsal sepal* ovate, acute, 3.9 – 5 × 1.8 – 2.3 mm. *Lateral sepals* obliquely ovate with a dorsal keel, 3.5 – 5 × 2.3 – 2.5 mm. *Petals* flat, ovate, 1.7 – 2 × 0.5 – 0.8 mm, truncate. *Lip* loosely hinged to the column foot, fleshy, ovate, recurved, 2.1 – 3.6 × 1.5 – 2 mm, base roundly bilobed auriculate, the apex obtuse, hollowed, concave, finely papillose underneath. *Column* short (overall c. 2 × 0.8 mm) the stelidia triangular, subulate at the tip, c. 1 mm long. *Anther* galeate, with a conical papillose front lobe, c. 0.4 × 0.5 mm. *Pollinia* ovoid, c. 0.3 × 0.2 mm *Seed capsule* globose, strongly ridged, c. 8 × 8 mm. Figs 14, 15.

DISTRIBUTION. Endemic to Madagascar but widespread in Toamasina province (Moramanga area), Fianarantsoa province (Ranomafana) and Antsiranana province (Marojejy).

SPECIMENS EXAMINED. MADAGASCAR. S of Moramanga, Moramanga to Anosibe road, 900 m, Dec. 1962, *Bosser* 16458 (lectotype P00097600!); isolectotypes P00097601!; P00097602!; P00334009!); BR (BR8810328!); TAN!); Toamasina area, *Kiener* 526, hort. Jard. Bot. Tan. 526 (holotype P00097776!); Marojejy Massif, c. 1300 m, Nov. 1972, *Morat* 4148 (P01776753!); Antsiranana, Marojejy, N of Mandena, 1000 – 1200 m, Nov. 1989, *Miller & Randrianasolo* 4588 (MO3765968!), K!); Mantadia, Nov. 1997, 1100 m, *Hermans* 8180 (K!); Mantadia, Belakato, 1100 m, Nov. 2003, *D. Roberts et al.* TPPO9 (K!, P00024361!);

Fig. 11. *Bulbophyllum rudolphus*. **A** plant habit, Andasibe area; **B** inflorescence, Andasibe area; **C** flower, Marojejy. PHOTOS: **A, B** JOHAN HERMANS; **C** JEAN-MICHEL HERVOUET.

Mantadia, Belakato, 1200 m, Nov. 2003, *D. Roberts et al.* TPPO29 (K!); Ranomafana, 1220 m, Nov. 2003, *D. Roberts et al.* TPPO63 (K!, P!); Toamasina, Andasibe, Maromizaha, 1115 m, Nov. 2004, *Fischer et al.* FS1386 & 1388 (WU!); Toamasina, rd to Lakoto, 1009 m, Dec. 2005, *Fischer & Andriantiana* FS2811 (WU!); Brickaville, Maroseranana, Aneka, 294 m, Oct. 2005, Andriamihajarivo *et al.* 712 (TAN!); Mekaly, Manja, Beharoana, 86 m, Sept. 2007, *Rasoafaranaivo et al.* 281 (TAN!); Toamasina, Alaotra-Mangoro, Ambatovy, 1133 m, Dec. 2011, *Rasoazanany et al.* 43 (MO, P!, TAN!); Toamasina, Alaotra-Mangoro, Mantadia, 1094 m, Dec. 2013, *Ramandimbisoa et al.* 386 (BRLU, MO, P!, TAN!).

HABITAT. Evergreen forest, ridge forest, montane forest. On *Podocarpus*. In thick moss, amongst lichen. 90 – 1200 m

CONSERVATION STATUS. *Bulbophyllum aubrevillei* is endemic in Madagascar, distributed in Alaotra- Mangoro (Toamasina), Sava (Antsiranana) and Vatovavy-

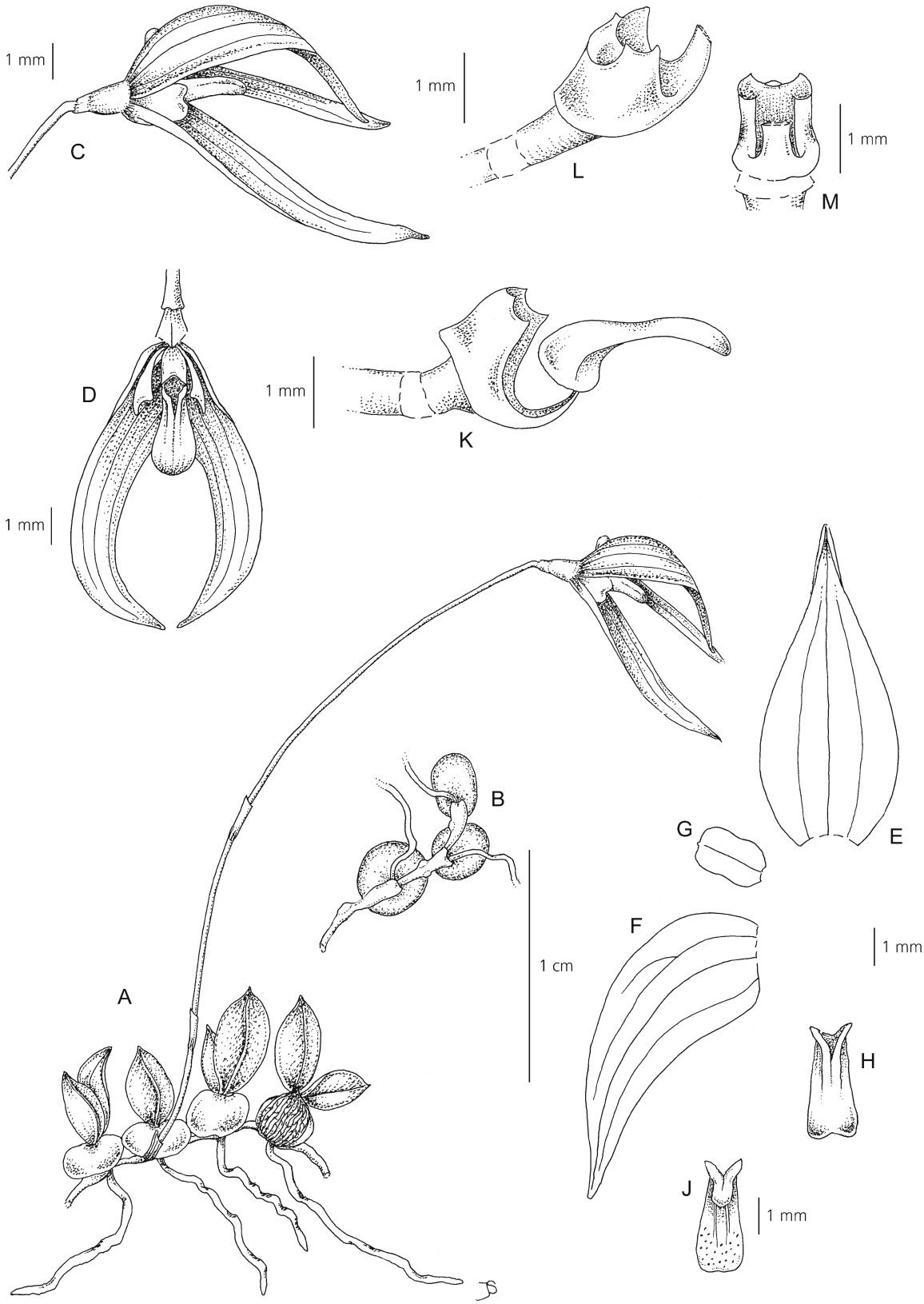

Fig. 12. *Bulbophyllum rudolphus*. **A** habit; **B** habit from below to show thickened rhizomes under pseudobulbs; **C** flower, side view; **D** flower from above, dorsal sepal removed; **E** dorsal sepal; **F** lateral sepal; **G** petal; **H** lip from above; **J** lip from below; **K** column and lip, side view; **L** column, from above; **M** column, front view. From *Hermans* 8233. DRAWN BY JUDI STONE.

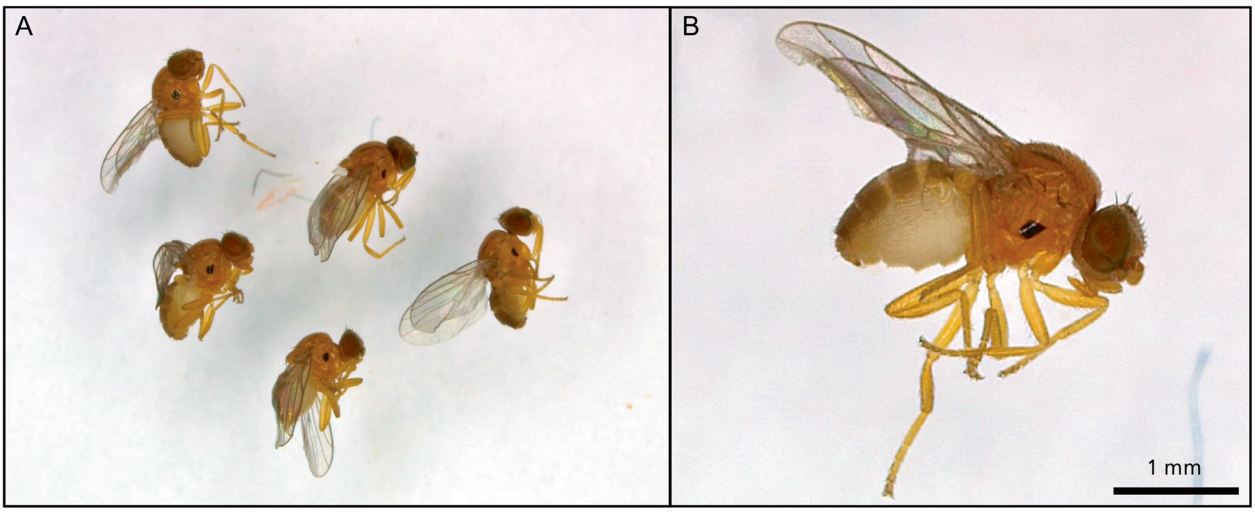

Fig. 13. Five female flies of the genus *Arcuator* of the family Chloropidae (Diptera) visiting flowers of *Bulbophyllum cardiobulbum* as observed during the Madagascar field trip 2018. **A** overview. **B** detail of a single fly. PHOTOS: ANNE-MARIE HEIDUK.

Fitovinany (Fianarantsoa) regions. The species is found in the Andasibe-Mantadia, Maromizaha, Marojejy and Ranomafana protected areas. However, it is threatened by habitat destruction due to mining activities, selective logging, wood collecting for small-scale subsistence and tavy (slash-and-burn agriculture). With nine threat locations defined, the area of occupancy AOO likely less than 2,000 km^2, the extent of occurrence EOO estimated to be less than 20,000 km^2 and a continuing decline on the EOO, AOO and the habitat quality, *Bulbophyllum aubrevillei* is therefore assessed as Vulnerable (**VU**) under criteria B1ab(i,ii,iii)+ B2ab(i,ii,iii).

PHENOLOGY. September to January.

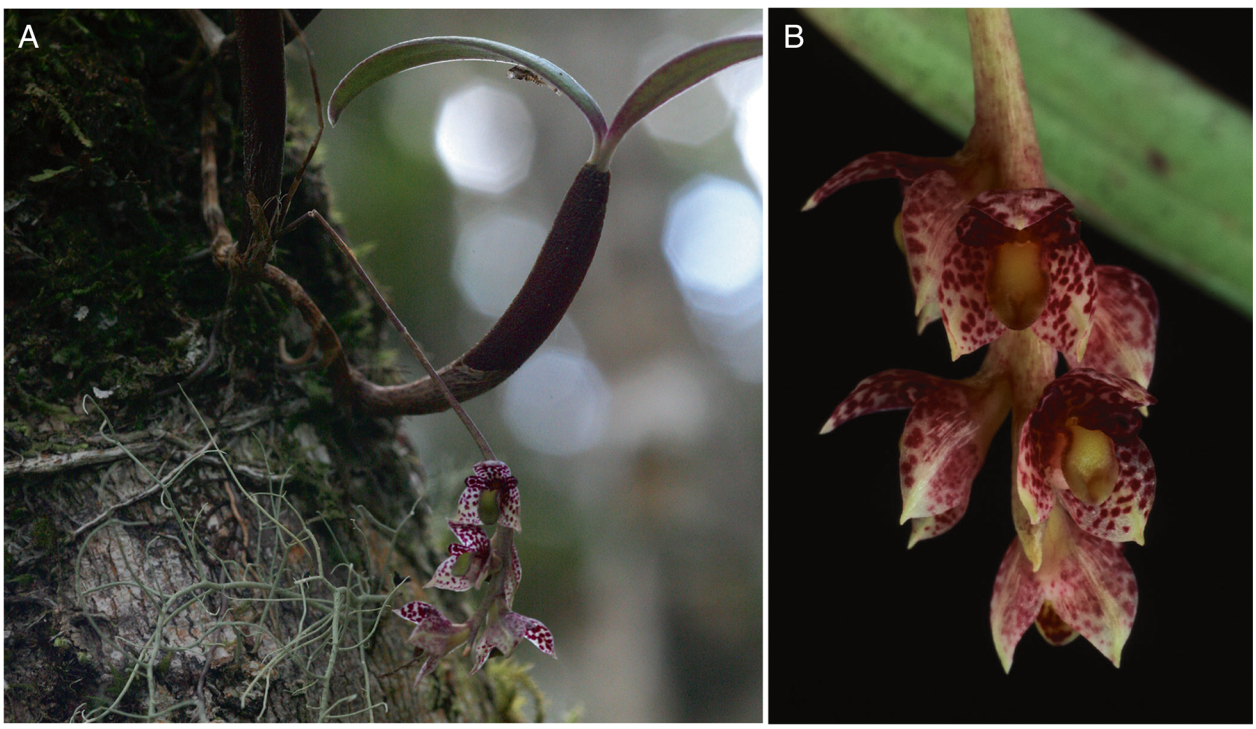

Fig. 14. *Bulbophyllum aubrevillei*. **A** plant habit; **B** inflorescence. PHOTOS: JOHAN HERMANS.

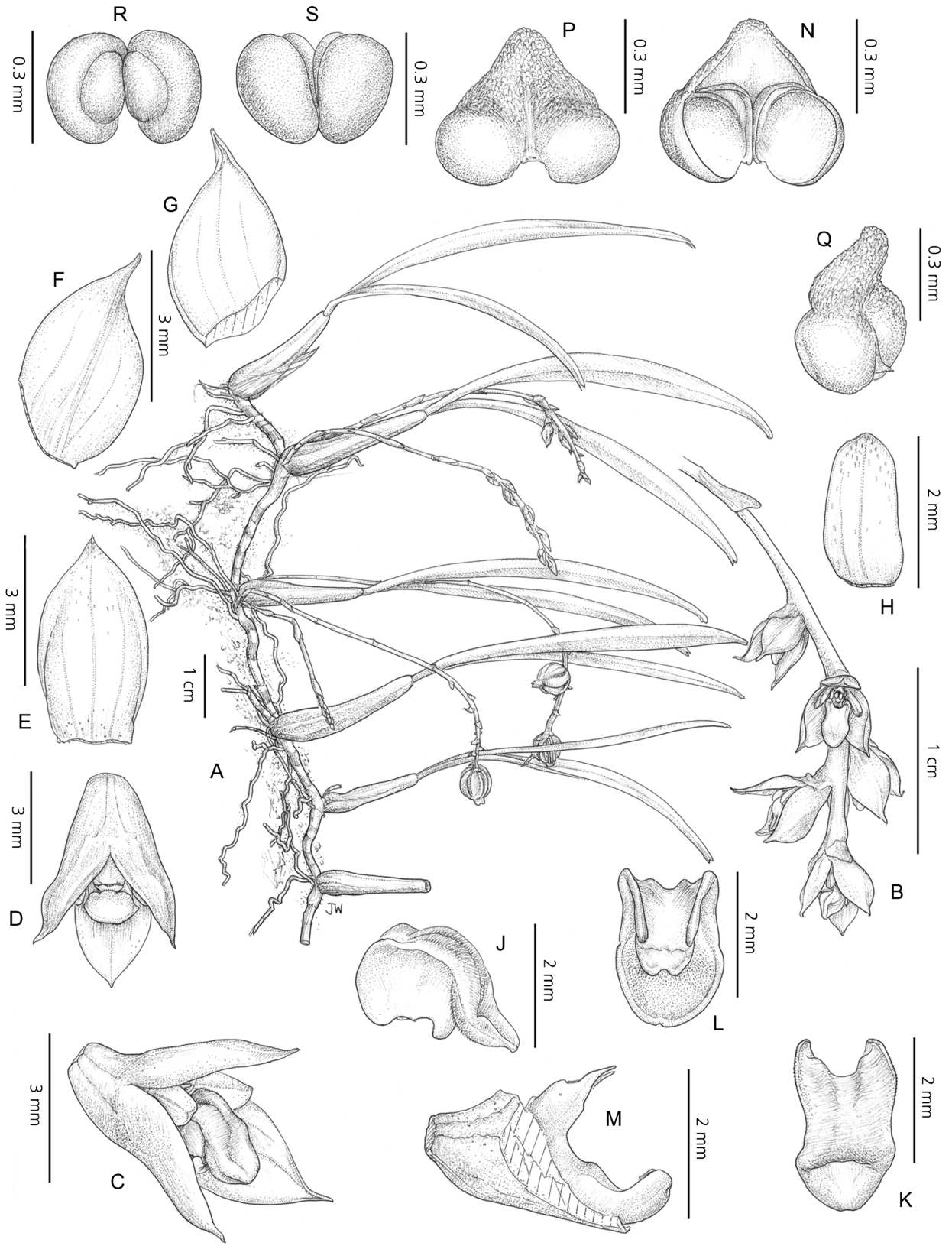

Fig. 15. *Bulbophyllum aubrevillei*. **A** habit; **B** inflorescence; **C** flower ¾ side view; **D** flower back view; **E** dorsal sepal abaxial; **F** lateral sepal, abaxial; **G** lateral sepal, adaxial; **H** petal; **J** lip, side view; **K** lip, front view; **L** lip back view; **M** column, side view; **N** anther, front view; **P** anther back; **Q** anther side; **R** pollinia, front view; **S** pollinia, back view. From *Fischer et al.* FS2779 & FS620. DRAWN BY JULIET BEENTJE.

ETYMOLOGY. *Bulbophyllum aubrevillei* was named for André Aubréville (1897 – 1982), a French botanist who worked in Madagascar at the same time as Jean Bosser and become the director of the Laboratoire de Phanérogamie at the Muséum national d'Histoire naturelle in Paris. *Bulbophyllum kieneri* was named for its collector André Kiener, a marine biologist who worked for the French colonial service in Madagascar in the 1950's.

VERNACULAR NAMES. *Fontsilahinjañahary kely* (*Miller & Randrianasolo* 4588, K); probably meaning 'small wild bananas' (pers. comm. J.-M. Hervouet).

NOTES. *Bulbophyllum aubrevillei* is readily recognised by its long and slender bifoliate pseudobulbs, its thin arching inflorescence, and flowers with free ovate sepals, a recurved lip with a hollowed epichile, a column with subulate stelidia and an anther with a distinct conical lobe. It belongs in sect. *Elasmatopus* of the genus because of its slender pseudobulbs and leaves, slightly thickened rachis, free sepals, long acicular stelidia and appendiculate anther. It is closest to *B. amphorimorphum* which has similar flowers but unifoliate pseudobulbs. It differs from *B. fierenanaense*, described above, by the shorter pseudobulbs, leaves and inflorescence, smaller flowers with sepals that are shorter and acute vs lanceolate-attenuate and the ovate lip (vs longly lingulate). The species are compared in Table 2.

Bulbophyllum aubrevillei, described and illustrated by Jean Bosser in 1965 from the Moramanga area in E Madagascar was compared with *B. amphorimorphum* H.Perrier which consistently has unifoliate pseudobulbs (vs bifoliate). Bosser differentiated the new species from the others in sect. *Elasmatopus* in his key because of its 4 mm long lip with the anterior part very concave and with raised margins. Six years later he described *B. kieneri*, based on a plant collected in the 'Tamatave' area by Kiener and cultivated at the Tzimbazaza Botanic Garden in Antananarivo. The single herbarium specimen in P comprises a small pseudobulb, a leaf and a few flowers; there also is a small anonymous drawing of the new species. Bosser wrote that it has the same morphology as the other species in sect. *Elasmatopus* but differed by its cylindrical canaliculate pseudobulbs with a short inflorescence at the base. There is no doubt that *B. kieneri* is the same as *B. aubrevillei*: the shape of the pseudobulbs is variable in *B. aubrevillei* and ranges from long-conical to cylindrical, the longitudinal grooves are not uncommon in desiccated or old pseudobulbs, while the length of the inflorescence is also very variable with those in immature plants being shorter. When comparing the floral detail, helped by the excellent drawing by Jaap Vermeulen of the type specimen (P), it is evident that all segments, including the hollowed lip and column structure are identical to those of *B. aubrevillei* but at the lower end of its size range. It is interesting to note that Bosser, in his description of *B. aubrevillei* gave the floral measurements almost a quarter larger than the actual size of those of the type. In his description Bosser had the sepal colour as whitish spotted red and the lip whitish: field observations and photographic records have shown that the colour of *B. aubrevillei* is very variable ranging from very pale and scarcely spotted with red to almost completely purple-red with various grades in-between. It is clear that *B. kieneri* is a small, poor and / or immature plant of *B. aubrevillei*.

Although not mentioned in his protologue of *Bulbophyllum aubrevillei*, Bosser marked one specimen (P00097600) as 'type' and others (P00107327) as 'isotype' but following McNeill (2014: 1112) a lectotype had to be chosen: sheet P00097600 is most representative and is designated here as the Lectotype and sheets P ((P00097601!; P00097602!; P00334009!); BR (BR8810328!); TAN!) as the isolectotypes of the species.

Bulbophyllum cylindrocarpum *Frapp.* in *Cordem.* (Cordemoy 1895: 174); Bosser (2000: 168); Bernet (2010: 56); Pailler *et al.* (2013: 30); Szelengowicz & Tamon (2013: 178). Type: Réunion, Bébour forest, *Bosser* 22232 (neotype P! designated by Bosser (2000: 168; isoneotype MAU!)). ex Boivin ms. Mus. Reun.

Bulbophyllum cylindrocarpum Frapp. (Frappier 1880: 16) **nom. nud.**

Bulbophyllum cylindrocarpum var. *olivaceum* Cordem. (Cordemoy 1895: 175) **nom. nud.**

Bulbophyllum cylindrocarpum var. *aurantiacum* Cordem. (Cordemoy 1895: 175) **nom. nud.**

Large erect epiphytic *plant* 9 – 18 cm tall, with a short woody cylindrical rhizome covered in brownish papery bracts, roots filiform, c. 2 mm in diam. *Pseudobulbs* ovoid to conical, more or less angular-tetragonal, 1.3 – 4.3 × 1 – 1.5 cm, yellowish-green, olive green or reddish-orange, with 2 apical leaves. *Leaves* erect to divergent, ligulate to narrowly lanceolate, 5 – 10 × 0.7 – 1.5 cm, contracted at the base into a 10 – 15 mm petiole, tip slightly emarginate, pale green to olive-green. *Inflorescence* erect, up to 20 cm long, 3 – 5 mm in diam., with 10 – 20 flowers. *Peduncle* about ⅔ the length of the inflorescence, 8 – 12 mm long, with 3 – 5 tubular peduncle sheaths at each internode. *Rachis* densely racemose, the flowers 3 – 7 mm apart. *Floral bracts* oval, 6.5 – 8 × 3 mm, obtuse to almost truncate, glandular on the exterior, reddish-brown towards the base. *Flowers* facing upwards with the lip erect and uppermost, 1.4 – 1.6 × 1.2 – 1.4 cm, greenish-yellow with the sepals more or less splashed with reddish-brown and darkly verrucose, the lip yellow with the

disk green, randomly spotted red, the marginal hairs brownish-yellow to white. *Pedicel* and *ovary* terete, 4 – 6.2 × 1.1 – 1.3 mm, slightly narrowed towards the base, green, brown to black verrucose-glandular. *Dorsal sepal* ovate to oblanceolate, semi-erect, concave, attenuate, 8.2 – 9.3 × 3.2 – 3.6 mm. *Lateral sepals* lanceolate falcate, recurved, 8.1 – 9.2 × 3.3 – 3.6 mm. *Petals* small, triangular, 0.4 – 0.5 × 0.4 – 0.5 mm, enclosing the sides of the column. *Lip* flexibly hinged, oblong-canaliculate, 6.3 – 6.9 × 1.4 – 1.6 mm, with two large lobes at the base, thickened towards the tip with the margins recurved, the disk with an elongate rounded ridge, the margins densely villose forming more or less branching tufts, the upper surface finely pilose to echinate. *Column* arching forward, acute, the stelidia prominent, linear, 2.1 – 2.3 × 1.8 – 2 mm, laterally flattened, wider towards the apex, with short angular wings below and a central tooth at the apex. *Anther* globose with a short blunt lobule at the front, c. 1 × 1 mm, filament with a conical protuberance. *Pollinia* 4, in 2 unequal pairs ovoid c. 0.4 × 0.4 mm. *Seed capsule* erect and persistent, cylindrical, c. 20 × 5 mm, initially orange-green becoming brown. Fig. 16.

DISTRIBUTION. Endemic to Réunion, mainly in Bébour forest.

SPECIMENS EXAMINED. RÉUNION: Bébour forest, *Bosser* 22232 (neotype P!; isoneotype MAU!); 1961, *Hort. Mason* 767 (K!); Coteau Maigre, Feb. 1971, *Bosser* 20477 (P!); Bébour forest, April 1971, *Guého* MAU14734 MAU, P!); Brûlé de St. Denis, 1000 m, Oct. 1972, *Bosser* 21337 (P!); Basse Vallée, Oct. 1972, *Bosser* 21304 (P!); Bébour, 1300 m, May 1973, *Th. Cadet* 4265 (P!); Basse Vallée, *Th. Cadet* 3104 (REU); Bébour, Piton Rond, 1400 m, *Th. Cadet* 3928 (REU); Brûlé de St. Denis, May 1974, *Bosser* 21921 (K!, P!); Bébour, May 1976, *Coode* 514 (K!); Bébour, Tacamaca, June 1978, *Friedmann* 3427 (P!); Forêt de Bébour, April 1989, *Bosser* 22587 (P!); Forêt de Bébour, April 1989, *J. Bosser* 22588 (P!); Piton Bébour, April 2004, *Grodin & Fontaine* 1098 (CBNM!) Plaine des Fougères, March 2004, *Ferard & Pausé* 1103 (CBNM!); s. loc. 1997, *J. Cadet* 15 (P!); s. loc. *Balfour* s.n. (K!); s. loc. *Cordemoy* s.n. (MARS!); s. loc. 1847 – 1852, *Boivin* s.n. (K!); Plaine des Palmistes, 1847 – 1852, *Boivin* 1041 (P!); s. loc. *M. Richard* 816 (P!); *Cordemoy* Photo of Cordemoy drawing (K!).

HABITAT. Wet evergreen forest, in shade or full sun, on *Dombeya* (Malvaceae), at medium altitude from 1200 – 2000 m.

CONSERVATION STATUS. The species was considered of Least Concern (LC) by Picot (2013: 10) on Réunion.

PHENOLOGY. February to July.

ETYMOLOGY. The name refers to the cylindrical seed capsules.

NOTES. *Bulbophyllum cylindrocarpum* clearly belongs in sect. *Kainochilus* Schltr., being a large plant with erect coriaceous leaves, flowers with tiny petals, a hinged lip with distinct hairs and basal lobes and well developed stelidia and. It is closest to *B. anjozorobeense* Bosser and *B. imerinense* Schltr. but it has a narrowly oblong lip, obtuse at the tip (vs spathulate and rounded) with a broad rounded longitudinal ridge on the disk (vs a narrow ridge). It is most similar to *B. jeanbosseri*, described below, which was considered a variety by Bosser (2000: 169) but there are significant differences: in *B. cylindrocarpum* the pseudobulbs are distinctly angular (vs grooved), the plant and inflorescence are generally shorter, the floral bract is oval, obtuse to almost truncate (vs lanceolate and attenuate), the sepals, petals and lip are smaller by a third, the lip is oblong (vs oblanceolate) with the median ridge on the blade rounded (vs oblong) the stelidia are linear-dentate (vs falcate) and the anther has a smaller lobule.

The species was first listed by Frappier in 1880 but was not described until 1895 in Cordemoy's *Flore de la Réunion*, based on Frappier's manuscripts. He added two varieties, var. *aurantiacum* and var. *olivaceum*, based on the colour of the pseudobulbs but did not add further detail. In his review of sect. *Kainochilus*, Bosser (2000) selected a neotype for the species since none of the Cordemoy specimens from MARS corresponded with the description with any certainty. There are three damaged specimens possibly corresponding to this species remaining in the Cordemoy herbarium (MARS). In the same paper Bosser also described var. *andringitrense* from Madagascar.

Bulbophyllum jeanbosseri *Gamisch & Hermans* **nom. nov.** Type: Madagascar, Andringitra massif, April 1964, *Bosser* 19510 (lectotype P00107328!, isolectoype P00107327!).

http://www.ipni.org/urn:lsid:ipni.org:names:77214541-1

Bulbophyllum cylindrocarpum var. *andringitrense* Bosser, *Adansonia* sér. 3, 22 (2): 169 (2000).

Bulbophyllum cylindrocarpum auct. non Frappier ex Cordem., referring to the Madagascan material.

Robust erect *epiphytic plant*, 15 – 20 cm tall, with a short ascending rhizome 5 – 20 mm long, 4 – 7 mm in diam., covered in brownish papery bracts; roots filiform, 1 – 2 mm in diam. *Pseudobulbs* conical, longitudinally deeply grooved, 3.5 – 5 × 1.5 – 2 cm, rounded at the apex, yellowish-green, olive green or reddish-orange, with 2 apical leaves. *Leaves* erect-spreading, ligulate to narrowly oblong, 8 – 15 × 1 – 1.5 cm, contracted at the base into a 15 – 23 mm petiole, tip slightly emarginate, pale green to olive-green. *Inflorescence* erect, rigid, 14 – 28 cm long, 4 – 7 mm in diam., with up to 30 flowers. *Peduncle* ½ to ⅔ the

Fig. 16. *Bulbophyllum cylindrocarpum*, Réunion. **A** plant in habitat; **B** part of inflorescence. PHOTOS: PATRICE BERNET.

length of the inflorescence, with 2 – 4 tubular peduncle sheaths, 7 – 14 mm long. *Rachis* thickened, sub-densely racemose, the flowers 6 – 12 mm apart, hollowed–angular beneath each flower. *Floral bracts* lanceolate attenuate, 8 – 11.5 × 2 – 2.3 mm, verrucose on the exterior, greenish-brown, dark red at the very base. *Flowers* facing upwards with the lip erect and uppermost, 2.1 – 2.4 × 1.4 – 1.9 cm, pale olive green to yellow with the sepals more or less splashed with reddish-brown and darkly verrucose on the exterior, the lip yellow with the margins and longitudinal ridge dark red, the marginal hairs yellow to white. *Pedicel* and *ovary* terete, 5 – 6.4 × 1.4 – 1.5 mm, a little narrowed towards the base, ridged, green, brown to black verrucose-glandular. *Dorsal sepal* lanceolate, erect, recurved from the middle, attenuate, 8.5 – 10 × 2.2 – 3 mm. *Lateral sepals* lanceolate falcate, recurved, 8.4 – 10 × 2.9 – 3.6 mm. *Petals* small, variable triangular to tridentate, broadened towards the base, 0.8 – 1.2 × 0.5 – 0.7 mm, enclosing the sides of the column. *Lip* oblanceolate, 7 – 8.4 × 2 – 2.3 mm, the margins strongly recurved, flexibly hinged, with two rounded basal lobes, with a longitudinal median ridge, roundly keeled at the base then widening into a rounded oblong cushion, the entire surface somewhat verrucose, the margins densely villose along the entire length but more bearded – fasciculate at the base and towards the tip. *Column* arching over the lip, on a short foot, with a cuspidate mid-lobe, the stelidia prominent, 2.9 – 4 × 1.8 – 2.5 mm, broadly falcate ending in a caudate hook, with long triangular to falcate wings below. *Anther* broadly ovoid, with a prominent lobule at the front, c. 1 × 0.8 mm. *Pollinia* 4, in 2 unequal pairs ovoid c. 0.6 mm × 0.5 mm. *Seed capsule* erect, persistent, cylindrical to fusiform, c. 25 × 8 mm. Figs 17, 18.

RECOGNITION. This is a large plant with erect coriaceous leaves, flowers with tiny petals, a hinged lip with distinct hairs around the margin and basal lobes and well developed stelidia that clearly belongs in sect. *Kainochilus* which has been confirmed by molecular phylogenetic data (Gamisch *et al.* unpublished data).

It is distinct by the deeply grooved conical pseudobulbs, long erect spreading leaves, erect inflorescence with up to 30 flowers, the thickened rachis hollowed beneath each flower, the lanceolate attenuate floral bracts, non-resupinate flowers with the lip uppermost, an oblanceolate lip with a rounded oblong cushion on the blade, distinct bearded fasciculate hairs around the margins, the prominent falcate stelidia with angular wings beneath and an anther with a prominent lobule. It is interesting to note that the shape of the petals is variable, ranging from triangular to tridentate, even differing between the left and right-hand of the same flower.

DISTRIBUTION. Endemic to E Madagascar in Fianarantsoa and Toamasina provinces.

SPECIMENS EXAMINED. MADAGASCAR. Andringitra massif, April 1964, *Bosser* 19510 (lectotype P00107328!, isolectotype P00107327!); Antoetra, forest remnants, 1727 m, Oct. 2015, *Sieder, Pertl & Andriantiana* 6857(WU!); Moramanga, Andasibe, Maromizaha, humid evergreen forest, 928 m, Jan. 2018, *Gamisch, Sieder, Prehsler & Andriantiana* 7342 (WU!).

HABITAT. High altitude forest remnants, humid evergreen forest, moss forest. 900 – 1700 m.

CONSERVATION STATUS. This species is endemic to Madagascar, in the Alaotra-Mangoro (Toamasina) and Haute-Matsiatra (Fianarantsoa) regions. It is known from three subpopulations partly in protected areas. This species is threatened by selective logging, charcoal production and tavy (slash-and-burn farming), resulting in habitat reduction. Regular fires in the Andringitra and Antoetra areas could affect several colonies of the species. With three defined threat locations, the habitat quality, the area of occupancy and the extent of occurrence in continuing decline, it is assessed as Vulnerable (**VU**) under criterion B2ab(i,ii,iii).

PHENOLOGY. October to January.

ETYMOLOGY. Named for the late Jean Bosser who first recognised this *Bulbophyllum* as distinct. The name *Bulbophyllum bosseri* was used, to the dedicatee's regret, by Lemcke in 1999 (p. 663) and is a *nom. superfl.* for *Bulbophyllum reflexiflorum* H.Perrier (1937: 93); also in the sect. *Kainochilus* and also with a bearded lip.

NOTES. Morphologically, it is close to *Bulbophyllum anjozorobeense* Bosser and *B. imerinense* Schltr. but it has shorter conical pseudobulbs (vs fusiform), a laxer inflorescence than the former and a denser one than the latter, a longer oblanceolate lip (vs spathulate) with an oblanceolate longitudinal ridge (vs narrow linear). Phylogenetically, the new species is clearly distinct from those two species (Gamisch *et al.* unpublished data). In all aspects the new species is most similar to but different from *B. cylindrocarpum* of which it was considered a var. by Bosser (2000: 169) but there are significant dissimilarities: in *B. cylindrocarpum* the pseudobulbs are distinctly angular (vs grooved), the plant and inflorescence are generally shorter, the floral bract oval, obtuse to almost truncate (vs lanceolate-attenuate), the sepals, petals and lip are smaller by ⅓, the lip is oblong (vs oblanceolate) with the median ridge on the blade rounded (vs oblong), the stelidia are linear-dentate (vs falcate) and the anther has a smaller lobule. Importantly, genetic evidence (unpublished data by Gamisch *et al.*) also shows that it is quite distinct from the Réunion species.

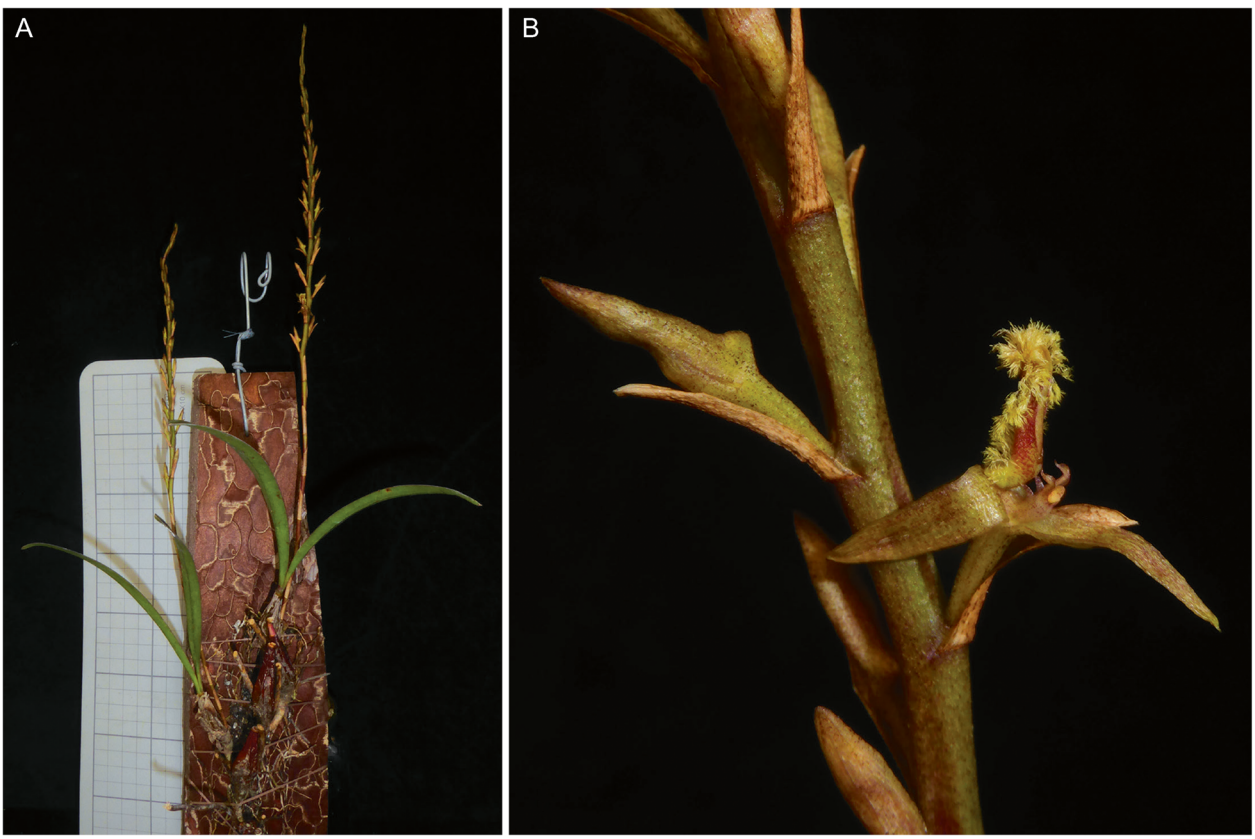

Fig. 17. *Bulbophyllum jeanbosseri*. A plant habit; B flower. PHOTOS: ANTON SIEDER.

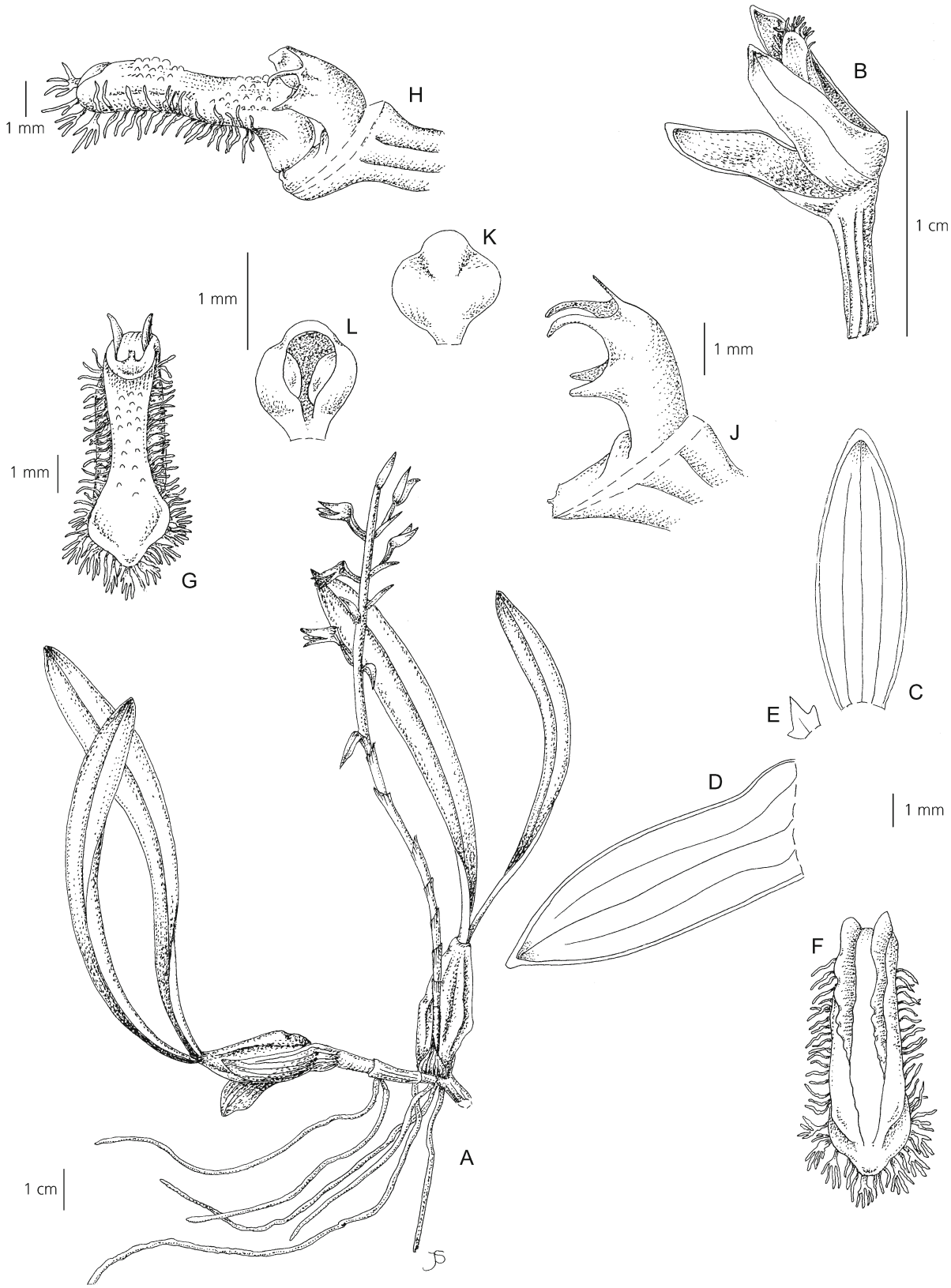

Fig. 18. *Bulbophyllum jeanbosseri*. **A** habit; **B** flower; **C** dorsal sepal; **D** lateral sepal; **E** petal; **F** lip from above; **G** lip from below; **H** column and lip, side view; **J** column with anther, side view; **K** anther from above; **L** anther with pollinia, from below. From *Bosser* 19510 & *Sieder et al.* 6857. DRAWN BY JUDI STONE.

The new species was inferred basal to the well-supported subclade containing *B. anjozorobeense, B. multiligulatum* H.Perrier, *B. horizontale* Bosser and *B. cylindrocarpum* making the new species and *B. cylindrocarpum* paraphyletic (Gamisch *et al.* unpublished data). Consequently, *B. cylindrocarpum* is more derived than the more basal new species, and probably diverged following ancestral colonisation of Réunion via long distance dispersal from Madagascar.

Bulbophyllum cylindrocarpum was described by Frappier in Cordemoy in 1895, a fairly common species in the central forests of Réunion. In his revision of the sect. *Kainochilus,* Bosser treated a similar plant from Andringitra in Madagascar as the new var. *andringitrense* (Bosser 2000: 169) based on his own collection (*Bosser* 18510). Although not mentioned in his protologue, he marked one specimen (P00107328) as 'type' and another (P00107327) as an 'isotype' but following McNeill (2014: 1112) a lectotype had to be chosen: sheet P00107328 is most representative and is designated here as the Lectotype and sheet P00107327 as the isolectotype of the variety. The main differences between the species and var. were considered to be the shape of the pseudobulbs, slightly bigger flowers and a different lip. Since then further collections have become available and, based on considerable morphological and genetic differences, the var. is now considered a species in its own right. As the name has no priority outside its rank and as *B. andringitranum* Schltr., based on *Perrier* 14389 (now *B. nutans* (Thouars) Thouars), has precedence anyway a new name had to be assigned.

Bulbophyllum pentastichum (*Pfitzer*) *Schltr.* (Schlechter 1915: 419). Types: all designated here: Madagascar, Fianarantsoa, between Ifanadiana and Kianjavato, Ankofafamalemy, fragments of lowland rainforest along ridge, rocky outcrops, 200 – 450 m, 16 Nov. 2002, *Fischer, Sieder & Andriantiana* FS826/2002 (Neotype designated here, K! spirit K6509.000; isoneotype designated here, SZU! spirit); Fianarantsoa, between Ifanadiana and Kianjavato, Ankofafamalemy, 200 – 450 m, 16 Nov. 2002, *Fischer, Sieder & Andriantiana* FS1051/2002 (clonotype SZU! spirit).

Bolbophyllaria pentasticha Pfitzer (1898: 542); (Kraenzlin 1908: 135 as *Bulbophyllaria*). Type: s. loc. hort. Hamburg Botanic Garden (syntypes B†, HBG†, HEID†).

Bolbophyllaria pentasticha Pfitzer ex Kraenzl. (Kraenzlin 1908: 135). **isonym** (as "*Bulbophyllaria*"). Type: As for *Bolbophyllaria pentasticha* Pfitzer.

Bulbophyllum pentastichum (Pfitzer) Rolfe (1915: 181, based on *Bolbophyllaria pentasticha* Pfitzer ex Kraenzl.) **isonym**.

Bulbophyllum quadrifarium Rolfe (1903: 126) **synon. nov.**; Rolfe (1905: 244); Hochreutiner (1908: 56); Perrier (1937: 117); Perrier (1939: 423): Cribb & Hermans (2009: 234). Types: Madagascar, s. loc., hort. Glasnevin B. G., *Peeters s.n.* (holotype (K000410156! & K000410155!); isotype BM (000516732!); s. loc. hort Glasnevin (paratype DBN!).

Bulbophyllum matitanense H.Perrier (1937: 85); Perrier (1939: 418); Hermans *et al.* (2007: 115). Type: Madagascar, lower Matitana, littoral forest, Oct. 1911, *H. Perrier* 8004 (holotype P00097485!)

Bulbophyllum matitanense subsp. *rostratum* H.Perrier (1939: 418) **nom. nud.**

Bulbophyllum pentastichum (Pfitzer) Schltr. subsp. *rostratum* H.Perrier ex Hermans (in Hermans *et al.* 2007: 288) **synon. nov.** Type: Madagascar, S, Fort Dauphin, Vinanibe, Oct. 1932, *Decary* 10865 (= *Decary* 10924) (holotype *Decary* 10865 P00097486!); isotype *Decary* 10865 P00097487!).

Large epiphytic *plant* 7 – 15 cm high excluding the inflorescence, on a short woody repent rhizome, c. 5 mm in diam., roots wiry, glabrous, forming a dense mass beneath the plant, c. 2 mm in diam. *Pseudobulbs* dense, partly overlapping, broadly oval, ovoid to tetragonal, more or less compressed, roundly grooved, 2 – 4.5 × 1.5 – 3 cm, yellowish-green becoming yellow when dried, often somewhat lustrous, with a few thin bracts at the base, with two (very rarely one) apical leaves. *Leaves* on a short (3 – 6 mm) petiole, elliptic-oblong to lanceolate, 5 – 11 × 1 – 2.5 cm, dorsally roundly keeled, coriaceous, pale green, lustrous. *Inflorescence* erect to divergent, curved at the rachis, up to 35 cm long, with up to 100 flowers. *Peduncle* terete, rigid, robust (3 – 5 mm in diam.), generally almost ⅔ the length of the inflorescence, green to reddish-brown, with 2 – 3 overlapping basal sheaths and up to 6 attenuate amplectant nodal sheaths c. 10 mm long. *Rachis* terete, thickened at the base to almost double that of the peduncle, narrowing towards the tip, more or less verrucose, with 5 rows of partly recessed flowers opening in succession over several weeks, 6 – 16 cm long, rows in an indistinct spiral with one starting higher than the others, pink to brownish-red. *Floral bracts* ligulate to oblong, acute, 7 – 8.5 × 2 – 3 mm, expanded at the base, scabrous to more or less verrucose on the exterior, covering the flower buds and arching over and surpassing the open flower, pale yellowish-pink to reddish-brown. *Flowers* relatively small for the section, set within a dimple in the rachis, only partly opening, c. 5 × 5 mm, sepals creamy-white splashed with red, petals white with the margins red-pink, lip pink the hairs white, column yellowish-white. *Pedicel* and *ovary* obconical, deeply grooved, 1.7 – 3.5 × 1 – 1.9 mm, scabrous to verrucose. *Dorsal sepal* concave, narrowly elliptic, acuminate, 3.5 – 4.1 × 0.9 – 1.8 mm, more or less verrucose on the exterior. *Lateral sepals* obliquely semi-orbicular to oval,

acuminate and incurved, 3 – 4 × 2 – 3 mm, more or less verrucose on the exterior. *Petals* linear, falcate, acuminate 1.9 – 2.8 × 0.3 – 0.5 mm. *Lip* thinly hinged to the column foot, cylindrical, geniculate, 1.5 – 2.4 × 0.8 – 1 mm, the margins strongly incurved, roundly winged and widely canaliculate towards the base, obtuse at the tip, the margins strongly fimbriate to villose, sometimes tufted. *Column* straight, 1.9 – 2.5 × 9 – 1.3 mm, slightly expanded below the stelidia, the stelidia linear, attenuate, slightly curved, 1 – 1.5 mm long. *Anther* with a prominent obtuse anterior lobe, c. 1 × 0.9 mm. *Pollinia* ovoid, c. 0.5 × 0.4 mm. *Seed capsule* broadly ovoid to almost globose, strongly ridged and often maturing whilst the lower flowers are still developing, reddish-brown, c. 6 × 5 mm. Figs 19, 20.

RECOGNITION. *Bulbophyllum pentastichum* has somewhat compressed ovoid pseudobulbs, a thickened rachis, the many flowers inserted into dimples in the rachis, a thick recurved lip and acicular stelidia, it fits well into sect. *Calamaria*. Molecular phylogenetic evidence confirms this (Fischer *et al.* 2007b; Gamisch *et al.* 2015). It is recognised by its long inflorescence with a substantially thickened rachis c. ⅓ of its length, the thick, almost scale-like, ligulate to oblong floral bracts that are at least ⅓ longer than the flower and completely cover the flower buds, and many small flowers that do not open widely and have a lip with a densely fimbriate margin.

Amongst the morphologically similar species in the section, it shares the hairy lip and flower shape with *Bulbophyllum bicoloratum* Schltr. and *B. occultum* Thouars but in those species the rachis is considerably thinner and the floral bracts are longer, thinner, wider and dorsally keeled. It is somewhat similar in habit, floral bracts and the verrucose exterior of its flowers to *B. cryptostachyum* Schltr. of which currently no phylogenetic data is available but that species has a much thinner rachis, a peduncle only ⅓ of the inflorescence (vs over ½), slightly longer and narrower floral bracts and a lip without hairs. It has similar flowers to the phylogenetically distantly related *B. elliotii* Rolfe (Gamisch *et al.* 2015; Gamisch unpublished data) but in *B. pentastichum* the plant is only half the size with much shorter leaves, a pendent inflorescence at least ¼ the length with a thinner rachis, and floral bracts at least ⅓ shorter and not surpassing the flower. Phylogenetically, *B. pentastichum* is part of a well-supported subclade of sect. *Calamaria* containing *B. rubrum* Jum. & H.Perrier and *B. senghasii* G.A.Fisch. & Sieder (Gamisch *et al.* 2015; Gamisch *et al.* unpublished data). *Bulbophyllum rubrum* has a similar plant habit but a much thinner rachis, the floral bracts are narrower and more acuminate, and the flowers are about $^{1}/_{3}$ larger and the lip has fewer and shorter hairs. *Bulbophyllum senghasii* has pseudobulbs that are not compressed, a thickened but shorter rachis, and the margins of the lip are erose (vs fimbriate).

Pfitzer (1898) described this species very well, referring to a robust plant with subglabrous pseudobulbs, fleshy leaves, long inflorescence with a thickened five-angled fleshy rachis, long broad floral bracts, and flowers with falcate petals and a geniculate lip with fimbriate margins. He referred to a single-leaved plant (*singulis*) but this may be an error or his specimen may have been immature (as in *Fischer et al.* 826). This description was elaborated by Kraenzlin (1908), who believed that Pfitzer had never published his *Bolbophyllaria pentasticha*, while changing the spelling of the genus name from *Bolbophyllaria* to

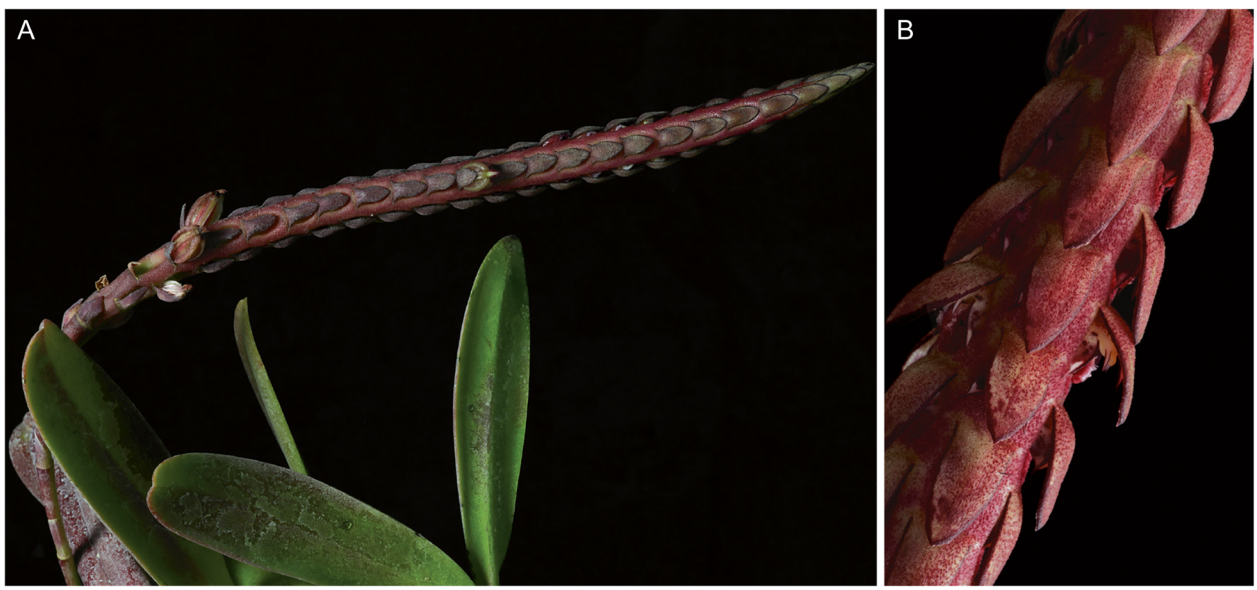

Fig. 19. *Bulbophyllum pentastichum*. **A** plant habit of the neotype; **B** flowers. PHOTOS: JOHAN HERMANS.

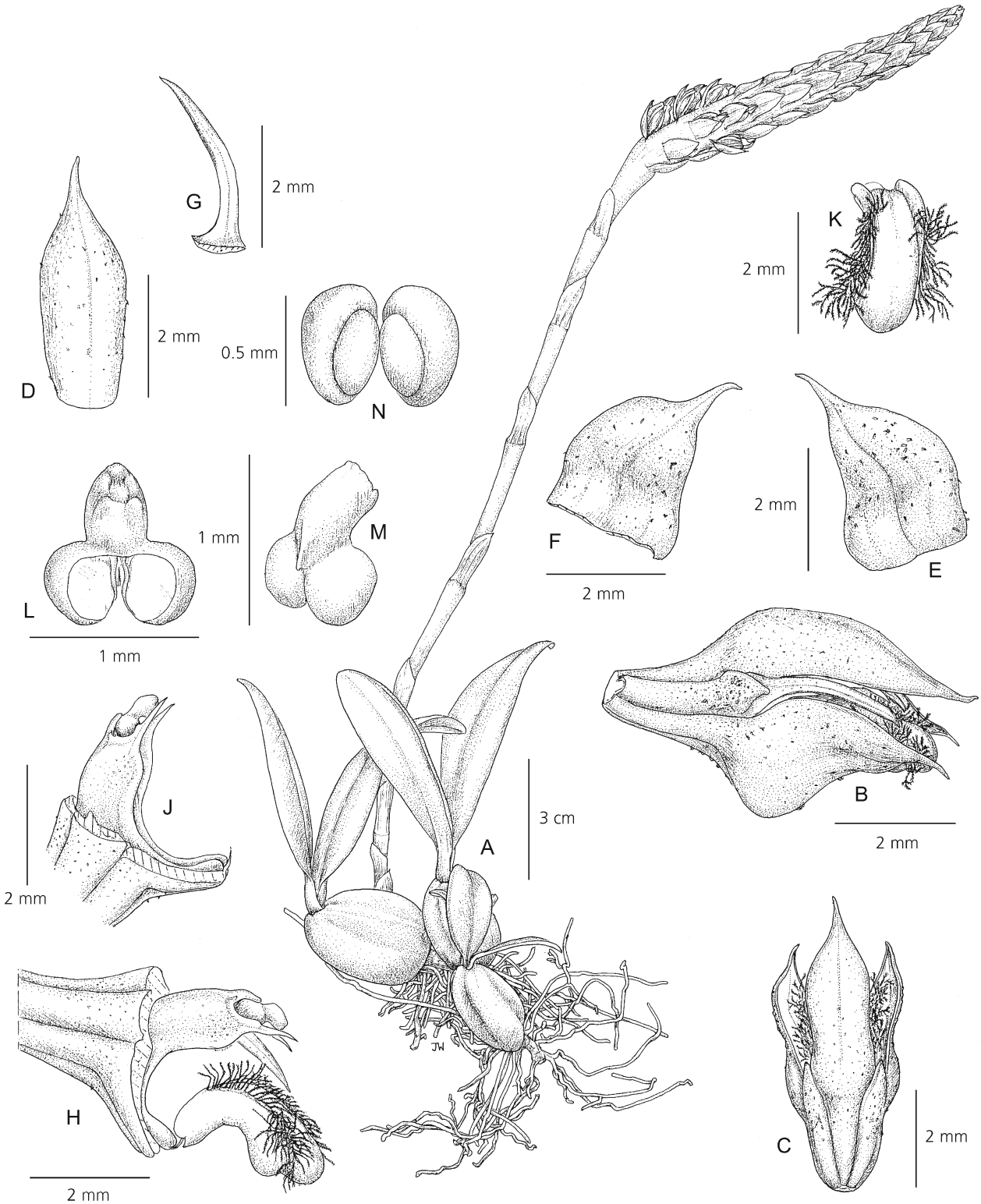

Fig. 20. *Bulbophyllum pentastichum*. A habit; B flower side; C. top view; D dorsal sepal, abaxial; E lateral sepal abaxial; F lateral sepal, adaxial; G petal; H column and lip, side view; J column; K lip front view; L anther, front view; M anther ¾ back view; N pollinia. From *Fischer et al.* 826-2002. DRAWN BY JULIET BEENTJE.

Bulbophyllaria, and it is clear that they refer to the same species. Nomenclaturally, *B. pentastichum* Pfitzer ex Kraenzl. must be regarded as an illegitimate name, and as both Schlechter and Rolfe based their combi-

nation in *Bulbophyllum* on Kraenzlin's name, these combinations should be treated as *nomina nova*, otherwise they would also be illegitimate. As explained below, the holotype material must be assumed lost or destroyed and there is no evidence of any other material directly relating to Pfitzer's protologue. Therefore a new type specimen had to be designated: the K and SZU spirit material (Fischer *et al.* FS826) was chosen because it represents the species very well and there is a further collection from the same locality and date at SZU (*Fischer et al.* FS1051). The Kew specimen (K6509.000) was chosen as the neotype because it consists of an entire plant and inflorescence, it was also the basis of the drawing by Juliet Beentje (Fig. 20).

Bulbophyllum quadrifarium Rolfe shares all the characteristics of Pfitzer's description and could well have been part of the same importation from Madagascar by Peeters' nursery in Belgium: when comparing the inflorescence and floral detail with Pfitzer's description there is no doubt that they are the same species, with *B. pentastichum* being the earlier name. The complex development of its nomenclature is explained below.

Perrier's *Bulbophyllum matitanense* is also identical as was explained by Hermans *et al.* (2007: 115). *Bulbophyllum matitanense* subsp. *rostratum* described by Perrier (1939: 418) was said to be different by its more curved and longer raceme and verrucose flowers with an anther with a distinct verrucose rostrum. All specimens dissected (*Commerson* s.n. P; *Peeters* s.n. K; DBN; *Colman* s.n. K; *Dumetz* 1285 K; *Fischer* OR241/2003 SZU; *Fischer et al.* FS826/2002; *Hermans* 509; *Hermans* 5031) had a long curved raceme, flowers verrucose on the exterior and an anther with a verrucose rostrum. Thus, there is no reason to recognise this subsp. as distinct.

DISTRIBUTION. Endemic to the southern part of Madagascar, mainly in the far S and E in Fianarantsoa, Toliara and Toamasina provinces.

SPECIMENS EXAMINED. MADAGASCAR. s. loc. hort. Hamburg Botanic Garden (holotypes or syntypes B?†, HBG?†, HEID?†); Madagascar, Fianarantsoa, between Ifanadiana and Kianjavato, Ankofafamalemy, fragments of lowland rainforest along ridge, rocky outcrops, 200 – 450m, 16 Nov. 2002, *Fischer, Sieder & Andriantiana* FS826/2002 (neotype K! spirit K6509.000; isoneotype SZU! spirit); Fianarantsoa, between Ifanadiana and Kianjavato, Ankofafamalemy, 200 – 450 m, 16 Nov. 2002, *Fischer, Sieder & Andriantiana* FS1051/2002 clonotype SZU! spirit; s. loc., hort. Glasnevin B. G., *Peeters* s.n. (holotype K000410156! & K000410155!; isotype BM000516732!); s. loc. hort. Glasnevin (paratype DBN!); lower Matitana, littoral forest, Oct. 1911, *H. Perrier* 8004 (holotype P00097485!); S, Fort Dauphin, Vinanibe, Oct. 1932, *Decary* 10865 (= *Decary* 10924) (holotype *Decary* 10865 P00097486!; isotype *Decary* 10865 P00097487!); s. loc. Herbier Vaillant, 1650's, *Flacourt* s.n (P00569537!); s. loc., *Commerson*, Herb. Jussieu 3861 (P-JU!) (P00673084)); s. loc, May 1904, Hort. Glasnevin (K000410157!); Hort. Glasnevin (BM000516732!); Hort. Glasnevin ex Peeters (DBN!); Vatomandry distr., Sept. 1903 *Guillot* 12 (P); Hort. Colman, Gatton Park, May 1915 (K000410100!); Fort Dauphin area, Oct. 1932, *Decary* 10924 (P00097487!); Toliara, Manampana, Soanierana Ivongo, Sept. 1959, *Rauh* M397 (HEID!) (spirit 250484)); Fort Dauphin, Nov. 1967, *Bernardi* 11525 (G045036!); Fort Dauphin, Mandena area, Oct. 1990, *Dumetz* 1285 (K!, MO!, TAN!); Toliara, Anosy, Mandena, Oct. 1993, *Bourgeois* 28 (MO0498808!); Toliara, between Fort Dauphin and Evatra, 63 m, 1996, *Hermans* 5031 (K!) & spirit K73339!; Toliara prov., from Ranohira to Tulear, Zombitsi forest edge, 750 m, Jan. 1996, *Hermans* 509 (K!); Fianarantsoa, Atsimo-Atsinanana, Farafangana, Ankarana, 11 m, Sept. 2005, *Rakotonirina, Razakamalala, Rambo, Bika & Randrianantoanina* 445 (MO!, TAN); Toliara, Ansoy, St Luce, 20 m, Nov. 2011, *Ratovoson* 1794 (MO!, TAN!); Toamasina, Mahavelona, Jan. 2014, *Sieder, Knirsch & Andriantiana* 6630 (*Hermans* 8147) (K!, WU!); hort. *Mason* 2429 spirit (K!).

HABITAT. Mainly in low altitude forest, coastal forest, white sands and littoral forest. 10 – 750 m.

CONSERVATION STATUS. *Bulbophyllum pentastichum* is endemic to Madagascar, distributed in Atsinanana, Analanjirofo (Toamasina), Vatovavy-Fitovinany, Atsimo-Atsinana (Fianarantsoa), Anosy, Atsimo-Andrefana (Toliara) regions. The species is only found in three protected areas: Mandena, Manombo and Zombitsy- Vohibasia. With ten threat locations, most of the habitat and the area of occupancy are in continuing decline because of subsistence slash-and-burn agriculture, logging forest, wood collection, anthropogenic fires and mining. It is therefore assessed as Vulnerable (**VU**) under B2ab(ii,iii).

PHENOLOGY. September to January.

ETYMOLOGY. The epithet refers to the five rows of flowers of the rachis. Of the other epithets: '*quadrifarium*' refers to the angular shape of the rachis or its four rows of flowers; '*matitanense*' to the Matitanana river (also known as the Matitana river) in E Madagascar; '*rostratum*' to the beaked anther.

NOTES. The history of the species is complex but interesting. The earliest evidence can be found in the historical collections of the Muséum national d'Histoire naturelle in Paris (P) where there is a specimen collected by Étienne de Flacourt in southern Madagascar in the 1650s (P00569537) (Fig. 21). The sheet has two sterile plants with broadly ovoid, somewhat compressed pseudobulbs, oblong leaves and remnants of a thick peduncle base that are unmistakably this species. It is labelled '*Ahatsendre*' and was, like others of his collections, integrated in the herbarium of the botanist

Sébastien Vaillant in 1715 and later into the main Paris herbarium (Allorge & Ikor 2003: 121). It was later identified as an unknown species of *Phyllorkis* (*Bulbophyllum* nom. cons.) by Du Petit-Thouars (1822). Although of no taxonomic value, this specimen is interesting in that it is undoubtedly one of the oldest surviving orchids brought to Europe from Madagascar. Earlier herbaria contain European plants only.

Flacourt (Fig. 22), was born in Orléans in 1607 and appointed the second French governor of Madagascar from 1648 to 1655 under the auspices of the French East India Company (Allibert 1995). He was confined to a fortified area near Fort Dauphin [Tôlanaro] in the far SE of the island and dedicated his time to science and in particular, botany (Kay 2004: 253). On his return to Paris he compiled the information he had gathered in the island and produced the first history of Madagascar (Flacourt 1658) including chapters on its civilisation, geography, minerals, and on its fauna and flora. He illustrated a number of plants, including a few that resemble orchids but he made no specific mention of them; he gave Malagasy names to many of the plants but there is no reference to '*Ahatsendre*', used on the Paris herbarium sheet, it is a word now not known in the language. One of Flacourt's illustrations of the local plants (Flacourt 1661: 115 fig. 61) represents a bulbous plant with two leaves which could be a *Bulbophyllum* but it is not referred to in the text (Fig. 23). Flacourt was killed by pirates on the return journey to Madagascar in 1660.

A flowering specimen of the species, collected by Philibert Commerson in Madagascar, in the de Jussieu herbarium in P (P00673084) is labelled as a *Bulbophyllum*. Commerson travelled and collected mainly on the Mascarenes but also in Madagascar in the early 1770s where he visited the E coast and also Fort Dauphin area in the S. He sent large quantities of plants to Paris where they were described by Lamarck, Poiret and Willdenow (Dorr 1997: 93) but this particular plant appears not to have been described. A number of his collections, including the *Bulbophyllum*, were incorporated into the de Jussieu's herbarium.

Pfitzer (1898) described the species as '*Bolbophyllaria pentasticha n. sp.*' based on a cultivated plant sent to him by Eduard Zacharias, curator of the botanical garden in Hamburg. Soon after, Zacharias (1899a: 189 & 1899b: 13) mentioned the new species and showed an inflorescence to the Naturwissenschaftlichen Vereins of Hamburg. He placed it in Reichenbach's genus *Bolbophyllaria* Rchb.f. (Reichenbach 1852: col. 934). This description was expanded by Kraenzlin in 1908, two years after Pfitzer's death. Perhaps confusingly Kraenzlin wrote of: '*Bulbophyllaria pentasticha n. sp. Pfitz*' with a slightly changed orthography, he used Pfitzer's 1898 text as a basis but included an expanded description and additional information, mentioning that the plant came from the Hamburg botanic garden 'where it now does not exist' but that he had seen additional inflorescences himself. Subsequent authors (Schlechter 1915: 419; Perrier 1939: 412; Du Puy *et al.* 1999: 90; Hermans *et al.* 2007: 115 etc) interpreted this as the original description and Schlechter's combination *Bulbophyllum pentastichum* (Pfitzer ex Kraenzl.) Schltr. 1915 was generally accepted. It is clear that Kraenzlin merely meant to add more information to Pfitzer's description and that Pfitzer's description has precedence. The type of Pfitzer's species is problematic: logically it would have been kept in Pfitzer's home herbarium in Heidelberg (HEID), Kraenzlin mentioned that the original Hamburg Botanic Garden plant had already disappeared by 1908, we do not know the origin or whereabouts of the inflorescences he had seen for his enhanced description but one can assume that they would have been kept in Berlin or in Kraenzlin's private collection. It is known that most of Kraenzlin and Pfitzer' s herbaria were destroyed (Christenson 1994) and the *Bulbophyllum* has not been found in either HEID or HBG (Schultz 2013, 2015), it therefore must be assumed that the type is missing and a neotype had therefore to be designated.

Meanwhile, Rolfe (1903: 126), at Kew, described *Bulbophyllum quadrifarium* in a short note in *The Orchid Review*, adding a little more information in 1905 (p. 244). Whilst the description was somewhat limited (Summerhayes referred to it as 'scarcely adequately described' in manuscript, on the species folder at K), there are several good inflorescences of Rolfe's new species at Kew. The inflorescences had been sent to Rolfe by Frederick Moore, keeper of the Glasnevin Botanic Garden, Dublin, Ireland, where it had flowered. Moore had obtained the plant from Ets. A. A. Peeters in St. Gilles, Belgium. A note from Peeters confirmed that the plant came from Madagascar and asked for it to be recorded as their introduction. The holotype material at K is on one sheet but barcoded K000410156 and K000410155, together they are the material used by Rolfe for his limited protologue. It is interesting to note that Rolfe uses the epithet *quadrifarium* possibly referring to four rows of flowers vs Pfitzer's *pentastichum* referring to five rows of flowers; the spiralling rows are often deceptive, when counting at the base there appear to be four rows, but a little higher on the rachis a fifth row starts. On the same sheet is an additional inflorescence from Glasnevin received in 1904 (K0004101157). Another specimen at BM with a label written by Moore indicating it as from the type and a specimen at DBN may be of the same origin. As explained above, there is no doubt that this is the same as Pfitzer's species that flowered in Hamburg. It is not known who supplied the plant to Peeters, who was a large importer of orchids and used several collectors, including Albert

Fig. 21. *Bulbophyllum pentastichum* collected by Étienne de Flacourt in southern Madagascar in the 1650s, Herb. Vaillant. Courtesy of the Muséum national d'Histoire naturelle, Paris, MNHN -Recolnat network.

Fig. 22. Portrait of Étienne de Flacourt. Engraving by Corneille from *Éloge de Feu Monsieur de Flacourt*, c. 1661.

Fig. 23. A Flacourt illustration of Madagascan plants resembling an orchid (Flacourt 1661: 115 fig. 61).

Mocquerys who travelled in Madagascar (Dorr 1997: 336) but there is no evidence of a specific origin. A number of plants seem to have found their way into botanic gardens and other collections around Europe; there are records of it flowering at Kew (1904: 29) and in the collection of Jeremiah Colman (a specimen and a watercolour by Matilda Smith of his plant is at K). Rolfe (1915: 181) mentioned this Colman *Bulbophyllum* as remarkable 'with a long reddish spike having the flowers concealed under five rows of bracts (*B. pentastichum*, Rolfe)'. It is puzzling why he used Pfitzer's epithet but attached it to his own name.

Perrier (1937: 85), in his paper on the *Bulbophyllum* of Madagascar, described *B. matitanense* from the eastern littoral forest but did not include *B. pentastichum* in his text and had *B. quadrifarium* (p. 116) listed as an incompletely known species. In his orchid flora of Madagascar he included *B. pentastichum* (1939: 412), *B. matitanense* and its subsp. *rostratum* without Latin diagnosis (p. 418) and *B. quadrifarium* (p. 423) as incompletely known and undescribed.

Hermans *et al.* (2007) treated *Bulbophyllum matitanese* as a synonym of *B. pentastichum*, the subsp. *rostratum* was validated (p. 115) and it was noted that *B. quadrifarium* might be the same as *B. pentastichum* (p. 119).

This species has an interesting reproductive strategy and appears to be self-compatible. Rolfe (1905: 244) noted that it appeared to be highly self-fertile. However it has been recently shown that outcrossing individuals are also found. The outcrossing and selfing plants differ slightly in gynostemium structure, namely in the presence and absence of a rostellum. In outcrossing individuals the rostellum acts as a barrier preventing the pollinia falling onto the stigma. No individuals exhibiting both outcrossing and selfing have been observed. Other gross morphological differences in vegetative or floral phenotype between outcrossing and selfing individuals have not been observed indicating that selfing morphs probably arose only recently.

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his advice and help. We would like to thank the anonymous reviewers for their constructive suggestions and corrections, Judi Stone and Juliet Beentje for the detailed drawings. We are also very grateful to Solo Rapanarivo, head of the flora department at *PBZT* Antananarivo, for his permission to use the collection at the *PBZT* herbarium and for providing the necessary collecting authorisation. We extend special thanks to Michael von Tschirnhaus (Bielefeld University) for fly specimen identification and Annemarie Heiduck (Salzburg University) for preparing photographs of the latter. The work at the University of Salzburg was supported by the FWF (Austrian Science Fund) grant P20726 and P29371 to Hans Peter Comes and grants P17124 to Michael Kiehn, University of Vienna, P20906 to Gunter Fischer.

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