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Two new threatened species of *Benstonea* Callm. & Buerki (Pandanaaceae) from Sabah (Borneo, Malaysia)

Martin W. Callmander & Sven Buerki

Abstract

CALLMANDER, M.W. & S. BUERKI (2016). Two new threatened species of *Benstonea* Callm. & Buerki (Pandanaaceae) from Sabah (Borneo, Malaysia). *Candollea* 71: 257–263. In English, English abstract. DOI: <http://dx.doi.org/10.15553/c2016v712a10>

Two new species of *Benstonea* Callm. & Buerki (Pandanaaceae) are described from Sabah (Borneo, Malaysia). *Benstonea fortuita* Callm. & Buerki is only known from a small patch of forest in the southern tip of Crocker Range in the southwest of the state. It is diagnosed by its subcaulescent habit, its leaves abruptly attenuate at the apex and narrowing towards the base, and its solitary globose syncarp on a short peduncle. *Benstonea serpentinica* Callm. & Buerki is endemic to the ultramafic substrate of Mt. Silam in eastern part of the state; it is diagnosed by its lateral plurisyncarpic infructescence, its peduncle covered with prophylls at base, and its stout acuminate style. Discussions on the morphological and molecular phylogenetic affinities of the new species are provided. Finally, both new species are assessed as “Critically Endangered” following IUCN Red List Categories and Criteria.

Keywords

PANDANACEAE – *Benstonea* – Malaysia – Borneo – Taxonomy – IUCN Red List

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Introduction

Benstonea Callm. & Buerki (Pandanaeae) has been segregated from *Pandanus* Parkinson based on morphological and molecular phylogenetic evidence (BUERKI et al., 2012; CALLMANDER et al., 2012). This screw-pine genus includes all species with stigmatic grooves consistently placed on the abaxial side of the style (vs. always adaxial in *Pandanus*) (CALLMANDER et al., 2012, 2013). *Benstonea* includes 60 species (incl. the two new species described here) spanning from India to Fiji with centres of diversity in Borneo, Peninsular Malaysia and New Guinea (see BUERKI et al., 2016 and references therein).

Borneo (the third largest island of the world and a biodiversity hotspot) hosts the highest species diversity of *Benstonea* with currently 22 accepted species (82% endemic) representing 37% of the generic diversity (CALLMANDER et al., 2012). Several other plant families unveil high level of endemism in Borneo, i.e. *Arecaeae* (see DRANSFIELD et al., 2008; BAKER & COUVREUR, 2012). The unique floristic diversity of Borneo can be mainly explained by its stable climate sustaining tropical humid forests (SLIK et al., 2011) and complex geological history (HALL, 2009). A recent biogeographical study on *Benstonea* demonstrated that the Bornean species community resulted from multiple independent dispersals from other parts of the Sunda shelf (especially Peninsular Malaysia) taking place from the Miocene onwards (see Fig. 3–4 in BUERKI et al., 2016). In most cases, dispersal events seem to have been associated with increases of diversification rates, especially in clade IIIc (BUERKI et al., 2016). The biogeographical analysis inferred an origin of this latter clade in Borneo, which was followed by an apparent increase of diversification rate giving birth to 13 species (including the new species *B. serpentinica* Callm. & Buerki described here) occurring in most ecosystems available on the island. In addition, some of the species of clade IIIc subsequently expanded their range across the Sunda shelf and even the Philippines (e.g. *B. affinis* (Kurz) Callm. & Buerki) (BUERKI et al., 2016).

The authors accompanied by Chris Davidson, Sharon Christoph and a team from SAN conducted fieldwork in Sabah in 2012 and 2014. We targeted areas of high species endemism: Crocker Range, Mt Kinabalu and two ultramafic outcrops (Mt Silam and Mt Tawai) (WONG, 1998; VAN WELZEN, 2005; RAES et al., 2009; VAN DER ENT et al., 2014). These field missions have led to the publication of a new species of *Trigonachras* Radlk. (*Sapindaceae*) endemic to Mt. Tawai (BUERKI et al., 2013) and the discovery of two new species of *Benstonea* described below. *Benstonea fortuita* Callm. & Buerki is only known from a small patch of forest in the southern tip of Crocker Range (southwestern Sabah), whereas *B. serpentinica* is currently restricted to Mt Silam (eastern Sabah) (Fig. 1). Discussions on the morphological and molecular phylogenetic affinities of the new species are provided below along with their preliminary IUCN Red List assessments (IUCN, 2012).

New species

Benstonea fortuita Callm. & Buerki, **spec. nova** (Fig. 2).

Typus: MALAYSIA [BORNEO]. **State Sabah:** Tenom Dist., 21 km from Tenom on road to Sipittang, Lumako FR, 5°00'22"N 115°51'53"E, 620 m, 9.X.2014, fr., Callmander et al. 1197 (holo-: G [G00341180]!; iso-: BM!, SING!, SAN!)

Benstonea fortuita Callm. & Buerki is distinguished among the genus by its subcaulescent habit, its leaf abruptly attenuate at the apex with a short apicule (0.5–1 cm), its ventral pleats armed, its stout acuminate style (3–4 mm), slightly curved proximally, and its solitary globose syncarp.

Subcaulescent *shrub* <1m tall. *Leaves* glaucous, white below, 100–120 cm long, 4–5 cm wide in the middle, 3.5 cm wide near the sheath, abruptly attenuate in the upper part, shortly apiculate (c. 0.5–1 cm long), narrowing towards the base, subcoriaceous; marginal prickles beginning at 6–9 cm above the base and extending to the apex, antrorse, c. 2 mm in the lower third, 2–6 mm apart, to c. 1 mm in the mid third, 5–10 mm apart; minute in the distal third, c. 2 mm apart; ventral pleats armed in the last 25–28 cm of the leaf with minute prickles; sheath not auriculate, whitish. *Infructescence* terminal, monosyncarpic, erect at maturity; syncarp in the middle of the clump of leaves, pale green, subglobose, c. 6 cm in diam.; peduncle straight, 10 cm long, 0.7 cm wide at apex, trigonous, white *in vivo*, longitudinal veins visible, covered with 4–5 bracts scars. *Drupes* c. 150, 23–25 mm high, 4–6 mm wide, c. 6 mm in depth, 5–6-angled; pileus pyramidal, pale to dark green *in vivo*, shrunk when dried, 8–10 mm high (excluding style). *Style* unique, stout acuminate, 3–4 mm long, slightly curved proximally; stigmatic groove brown *in vivo*, linear, positioned on abaxial side; endocarp c. 6 mm long, walls c. 0.4 mm thick; seed locule elliptic, 4 × 3 mm; apical mesocarp fibrous, discrete, c. 4 mm long; lower mesocarp fibrous. *Staminate plant* unknown.

Etymology. – This species is only known from a single population where only one fruiting individual was observed. We were very fortunate to come across this rare and discrete taxon and the species epithet reflects our feeling when we discovered this new *Benstonea*.

Distribution and ecology. – *Benstonea fortuita* is only known by few individuals in southwestern Sabah in the lowland Dipterocarp forest at an altitude of 600 m (Fig. 1).

Conservation status. – Despite being known from a Forest Reserve [FR], this species is considered rare and seriously threatened. The only known population is located in the southern tip of the Lumako FR in a secondary Dipterocarp forest where few dominant trees still protect the understorey due



Fig. 1. – Distribution of *Benstonea fortuita* Callm. & Buerki (white star) and *B. serpentanica* Callm. & Buerki (white circle) in Borneo. Abbreviations: 1. Crocker Range National Park; 2. Kinabalu Park.

to past logging. *Benstonea fortuita* is assigned a preliminary status of “Critically Endangered” [CR B1ab(i,iii,iv,v)] following IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – The overall morphology of the new species can be compared to: *B. glaucophylla* (Ridl.) Callm. & Buerki, *B. parva* (Ridl.) Callm. & Buerki, and *B. undulifolia* (Ridl.) Callm. & Buerki. All three species share wide, abruptly attenuate leaves and a solitary syncarp with *B. fortuita*. Nevertheless, the new species can easily be discriminated from these species by the combination of characters presented in Table 1.

In their phylogeny, BUERKI et al. (2016) showed that the new species *B. fortuita* belongs to clade I together with the endemic Bornean *B. platystigma* (Martelli) Callm. & Buerki. Although both species have the same ecology (lowland humid forest), *B. fortuita* can easily be distinguished from *B. platystigma* by its habit (subacaulescent shrub <1 m tall vs. low shrub), leaves (wide, 4.5 cm and apex abruptly attenuate vs. narrow, 1.5 cm and apex gradually attenuate), style and stigmatic groove (stout acuminate, slightly curved proximally with a linear stigmatic groove vs. antrorsely bent down, flattened proximally with a subreniform groove) and fruits (pale green syncarp when ripe vs. bright red syncarp when ripe).

***Benstonea serpentanica* Callm. & Buerki, spec. nova** (Fig. 3).

Typus: MALAYSIA [BORNEO]. State Sabah: Lahad Datu Distr., Gunung Silam, 4°58'14"N 118°10'44"E, 365 m, 3.X.2014, Callmänder, Buerki & Jumian 1187 (holo-: G [G00341664]; iso-: BM!, MO!, SING!, SAN!).

Benstonea serpentanica Callm. & Buerki is distinguished among the genus by its lateral infructescence, its peduncle covered with prophylls at base, its pileus peeling at maturity, its short stout style (2–3 mm), and the pale green fruit colour of its syncarp when ripe.

Treelet to 5–8 m tall, 10 cm dbh, with wide cones of proproots at the base. Each clump of leaves with several lateral erect infructescences. Leaves 300–400 cm long, 5–5.5 cm wide in the middle, 6–6.5 cm wide near the sheath, gradually attenuate in the upper part, flagellate (flagellum 22–25 cm long), coriaceous; prickles white *in vivo*; marginal prickles beginning at 10–12 cm above the base and extending to the apex, antrorse (rarely retrorse in the lower 1/3), 2.5–3 mm in the lower third, (3–)4–6(–7) mm apart, strong, to c. 2 mm in the mid third; (3–)4–8(–10) mm apart, to <1 mm in the distal third, 3–6 mm apart; midrib armed at 10–15 cm above base, prickles strong in the lower part, c. 5 mm long, getting smaller through the apex, c. <1 mm long in the apical part; ventral pleats armed at the distal part of the leaf, prickles discrete, c. <1 mm long, irregularly spaced; sheath 8–10 cm long, c. 7 cm wide at apex c. 10–12 cm large at base. Infructescence lateral, with 7–9 syncarps pending at maturity; syncarp 5–7 × 6–8 cm, ovoid, compressed dorso-ventrally, the distal syncarps globose and smaller (not compressed); peduncle curved (rarely straight), 20–25 cm long, 1.3–1.5 cm wide at apex, slightly flattened, veins and bracts scars visible, covered with several prophylls at base; the latter 2–4 × 14–20(–26) cm long, coriaceous, attached at the base of the peduncle. Drupes >300 per syncarp, 15–20 mm high, 4–5 mm wide, 2–4 mm in depth, 5–angled; pileus pyramidal, pale green *in vivo*, 3 mm high (excluding style), covered with a white waxy surface, remaining attached and peeling at maturity, revealing the connate part of the drupes. Style unique, brown *in vivo*, stout, straight, shortly acuminate, slightly curved at apex, 2–3 mm long; stigmatic groove linear, positioned on abaxial side; endocarp c. 5 mm long, walls c. 0.2 mm thick; seed locule elliptic, 2–3 × 3–3.5 mm; apical mesocarp chamber large, ovoid, c. 5.5 mm long; lower mesocarp fibrous. Staminate plant unknown.

Etymology. – The species epithet refers to the ultramafic rocks of Mt. Silam where the species was collected and is confined. Serpentine outcrops cover c. 3,500 km² across the Sabah state (PROCTOR et al., 1988). These patches of ultrabasic rock are home to several endemic species (see VAN DER ENT, 2014 for more details on the plant taxa and their distributions).



Fig. 2. – *Benstonea fortuita* Callm. & Buerki. **A.** Habit; **B.** Inflorescence; **C.** Close up of styles and stigmas. [Callmander et al. 1197] [Photos: M. Callmander]

Table 1. – Key morphological differences between *Benstonea fortuita* Callm & Buerki, *B. glaucophylla* (Ridl.) Callm. & Buerki, *B. parva* (Ridl.) Callm. & Buerki, and *B. undulifolia* (Ridl.) Callm. & Buerki.

	<i>B. fortuita</i>	<i>B. glaucophylla</i>	<i>B. parva</i>	<i>B. undulifolia</i>
Habit [m]	subcaulescent shrub, <1 tall	shrub, 1-4 tall	slender shrub, 0.5-3 tall	shrub, 1-4 tall
Leaf [cm]	glaucous, white below, 100-120 × 4-5, apex abruptly caudate and apiculate; apicule 0.5-1	glaucous, 52-75 × 3.9-6.5, apex abruptly caudate and apiculate; apicule 1-1.2	dark green above, pale glaucous below, 18-60 × 1-4.8, apex abruptly caudate and flagellate; flagellum 2-9	light green, 45-85 × 6-9.5, abruptly caudate and flagellate; flagellum 4.5-5
Ventral pleats	armed	unarmed	unarmed	unarmed
Syncarp [cm]	subglobose, c. 6 in diam.	broadly ellipsoid, 5.7 × 4.5	globose to broadly ovoid, 1.8-5.5 × 1.7-4	cylindrical-ellipsoid, 6-7 × 4.1-1.7
Style [mm]	stout acuminate, 3-4, slightly curved proximally	stout subulate, 5-6.5, strongly curved proximally	horn-like, 2.5-6, sharply curved upwards	fine linear, 4-5.5, curved

Distribution and ecology. – *Benstonea serpentinitica* is endemic from Mt. Silam on ultramafic soil in the eastern region of Sabah (Fig. 1). This mountain, which culminates at 884 m, is home to several endemic species including the recently described *Ardisia silamensis* Utteridge, Julius & Suzana (UTTERIDGE et al., 2014).

Conservation status. – Populations of *Benstonea serpentinitica* are only known from 350 to 600 m on Mt. Silam. This patch of forest on ultramafic substrate represents c. 10 km² and is part of the Sapagaya FR. Logged forest, palm oil plantations and roads surround nevertheless this mountain, which is under serious human pressure. The new species is therefore preliminary assessed here as “Critically Endangered” [CR B1ab(iii)] following IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – *Benstonea serpentinitica* is most similar to *B. affinis*, but differs by its peduncle (short, 20-25 cm, covered with several prophylls at base vs. long, 40-45 cm, with no prophylls), its smaller drupes (15-20 × 4-5 mm vs. 30 × 8 mm) and style (2-3 vs. 7 mm), style morphology (stout, shortly acuminate, slightly curved proximally vs. spiniform, curved proximally) and fruit colour when ripe (pale green vs. red).

In their phylogeny of *Benstonea*, BUERKI et al. (2016) showed that the new species *B. serpentinitica* belongs to clade IIIc together with *B. affinis*, which is widespread across the Sunda shelf (including the Philippines).

Paratypus. – MALAYSIA [BORNEO]. State Sabah: Lahad Datu Distr., Gunung Silam, 4°58'01"N 118°10'28"E, 620 m, 1.X.2014, Buerki et al. 342 (BM, G, PH, SAN).

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References

- BAKER, W.J. & T.L.P. COUVREUR (2012). Biogeography and distribution patterns of Southeast Asian palms. In: GOWER, D.J. et al. (ed.), *Biotic Evolution and Environmental Change in Southeast: 164-190*. Cambridge University Press.
- BUERKI, S., M.W. CALLMANDER, D.S. DEVEY, L. CHAPPELL, T. GALLAHER, J. MUNZINGER, T. HAEVERMANS & F. FOREST (2012). Straightening out the screw-pines: a first step in understanding phylogenetic relationships within Pandanaceae. *Taxon* 61: 1010-1020.
- BUERKI, S., C. DAVIDSON, J.T. PEREIRA & M.W. CALLMANDER (2013). A new endemic species of *Trigonachras* (Sapindaceae) from Sabah, Malaysia (Borneo). *Phytotaxa* 88: 19-23. DOI: <http://dx.doi.org/10.11646/phytotaxa.88.2.1>
- BUERKI, S., T. GALLAHER, T. BOOTH, G. BREWER, F. FOREST, J.T. PEREIRA & M.W. CALLMANDER (2016). Biogeography and evolution of the screw-pine genus *Benstonea* Callm & Buerki (Pandanaceae). *Candollea* 71: 211-223. DOI: <http://dx.doi.org/10.15553/c2016v712a7>



Fig. 3. – *Benstonea serpentinica* Callm. & Buerki. **A.** Habit; **B-C.** Inflorescences; **D.** Syncarp; **E.** Close up of styles and stigmas. [A-B: Buerki et al. 342; C-D: Callmander et al. 1187] [Photos: M. Callmander]

- CALLMANDER, M.W., T. BOOTH, H. BEENTJE & S. BUERKI (2013). Update on the systematics of *Benstonea* (Pandanaceae): when a visionary taxonomist foresees phylogenetic relationships. *Phytotaxa* 112: 57-60. DOI: <http://dx.doi.org/10.11646/phytotaxa.112.2.4>
- CALLMANDER, M.W., S. BUERKI, A.P. KEIM & P.B. PHILLIPSON (2014). Notes on *Benstonea* (Pandanaceae) from the islands of Halmahera, New Guinea and Sulawesi. *Phytotaxa* 175: 161-165. DOI: <http://dx.doi.org/10.11646/phytotaxa.175.3.6>
- CALLMANDER, M.W., P.P. LOWRY II, F. FOREST, D.S. DEVEY, H. BEENTJE & S. BUERKI (2012). *Benstonea* Callm. & Buerki (Pandanaceae): characterization, circumscription, and distribution of a new genus of screw-pines, with a synopsis of accepted species. *Candollea* 67: 323-345.
- DRANSFIELD, J., N.W. UHL, C.B. ASMUSSEN, W.J. BAKER, M.M. HARLEY & C.E. LEWIS (2008). *Genera Palmarum. Evolution and Classification of the Palms*. 2nd ed. Kew Publishing, Royal Botanic Gardens, Kew.
- HALL, R. (2009). Southeast Asia's changing paleogeography. *Blumea* 54: 148-161.
- IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1*. 2nd ed. IUCN Species Survival Commission, Gland & Cambridge.
- PROCTOR, J., Y.F. LEE, A.M. LANGLEY, W.R.C. MUNRO & T. NELSON (1988). Ecological Studies on Gunung Silam, A Small Ultrabasic Mountain in Sabah, Malaysia. I. Environment, Forest Structure and Floristics. *J. Ecol.* 76: 320-340.
- RAES, N., M.C. ROOS, J.W.F. SLIK, E.E. VAN LOON & H. TER STEEGE (2009). Botanical richness and endemism patterns of Borneo derived from species distribution models. *Ecography* 32: 180-192.
- SLIK, J.W.F., S.I. AIBA, M. BASTIAN, F.Q. BREARLEY, C.H. CANNON, K.A.O. EICHHORN, G. FREDRIKSSON, K. KARTAWINATA, Y. LAUMONIER, A. MANSOR, A. MARJOKORPI et al. (2011). Soils on exposed Sunda Shelf shaped biogeographic patterns in the equatorial forests of Southeast Asia. *Proc. Natl. Acad. Sci. U.S.A.* 108: 12343-12347.
- UTTERIDGE, T.M.A., A. JULIUS & S. SABRAN (2014). *Ardisia silamensis*, a new ultrabasic species from Borneo; studies in Malaysian Myrsinaceae II. *Kew Bull.* 69: 9510.
- VAN DER ENT, A., R. REPIN, J. SUGAU & K.M. WONG (2014). *The Ultrabasic Flora of Sabah. An introduction to the plant diversity on ultrabasic soils*. Sabah Parks & Natural History Publications (Borneo), Kota Kinabalu.
- VAN WELZEN, P.C., J.W.F. SLIK & J. ALAHUHTA (2005). Plant distribution patterns and plate tectonics in Malesia. *Biol. Skr.* 55: 199-217.
- WONG, K.M. (1998). Patterns in plant endemism and rarity in Borneo and the Malay Peninsula. In: PENG, C.-I. & P.P. LOWRY II (ed.), *Rare, threatened and endangered floras of Asia and the Pacific rim. Acad. Sin. Monogra. Ser.* 16: 139-169.