



## Notes on *Benstonea* (Pandanaceae) from the islands of Halmahera, New Guinea and Sulawesi

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### Abstract

*Benstonea* (Pandanaceae) was circumscribed to include 57 species formerly placed in the genus *Pandanus*. Field observations, accompanied by the study of available herbarium material have brought new insights for the delimitation of certain problematic species, especially in the difficult group of species characterized by an axillary infructescence on a short peduncle covered by prophylls and the abscission of the basal portion of the drupe at maturity. New combinations, based on names in *Pandanus* previously treated as synonyms of *Benstonea stenocarpa*, are proposed for three distinct species of this group from Halmahera (Indonesia) and Papua New Guinea. The identity of *Benstonea celebica*, endemic to Sulawesi (Indonesia), is also elucidated and an epitype is designated for this species.

### Introduction

While formally describing the genus *Benstonea* Callmander & Buerki in Callmander & al. (2012: 328) following the study of Buerki & al. (2012), a synopsis of the new genus with the new name combinations for the 50 accepted species was provided. This synopsis was primarily based on observations of herbarium specimens deposited at key herbaria [Berlin (B), Berkeley (UC), Geneva (G), Firenze (FI), Harvard (A), Honolulu (BISH), Kew (K), Kuala Lumpur (KLU), Leiden (L), Sabah (SAN), Sarawak (SAR), St. Louis (MO), Singapore (SING) and Washington (US)] and the relevant literature, in addition to field observations made in Borneo (Sabah, Sarawak), Fiji and Singapore in 2011 and 2012. A further seven new species combinations were added to the genus by Callmander & al. (2013) following further morphological and molecular studies (Booth & al. unpubl. data).

During 2013 and 2014, MWC had the opportunity to visit the Herbarium Bogoriense (BO) on two occasions and the Philadelphia Herbarium (PH), both of which house many types and other important collections of Pandanaceae from south-east Asia, and to spend one month on Halmahera (North Maluku Province, Indonesia). Those visits, and fruitful discussion with AK in BO have provided us with new insights that permit us to refine the taxonomy of certain *Benstonea* species in the region, especially in the difficult 'Dimissistyli' group of species characterized by an axillary infructescence on a short peduncle covered by prophylls and the abscission of the basal portion of the drupe at maturity [previously recognized at the subsectional level by Stone (1969, 1974) as *Pandanus* section *Acrostigma* (Kurz 1867: 100) subsection *Dimissistyli* Stone (1969: 12), but not currently formally recognised in *Benstonea*] (Fig. 1A–G).

Stone (1978) suggested that too many species had been described in the 'Dimissistyli' group, but he nevertheless maintained six distinct species: *Pandanus danckelmannianus* Schumman in Schumman & Hollrung (1899: 18), *P. erinaceus* Stone (1965: 1), *P. lictor* Stone (1965: 2), *P. misimaensis* St. John ex Stone (1978: 54), *P. stenocarpus* Solms (1883: 91) and *P. verruculosus* Backer ex Stone (1978: 55). A broader species concept was proposed by Jebb (1992) who accepted only two species in this group, and one of these with doubt. Jebb (1992) considered *Pandanus danckelmannianus* as probably different from the holotype of *P. stenocarpus* (Beccari s.n. [F12723]! from the Arfak Mts. in West Papua Prov., Indonesia) and reduced all the other eleven species of the 'Dimissistyli' group to

*P. danckelmannianus*. He underlined the rather different pileus of *P. stenocarpus* with an abrupt style instead of the gradually tapering style of *P. danckelmannianus*. Confronted with this inconclusive situation and the relative paucity of available collections, Keim (2012) subsequently recognised only a single species in the group, *P. stenocarpus*, extending from the Moluccas through New Guinea and the Bismarck Archipelago to the Solomon Islands. This concept was followed by Callmander & al. (2012) who provided the necessary new combination for this species in their new genus *Benstonea*. Clearly more fieldwork will be needed throughout the range of the group before its taxonomy can be fully resolved. However our new field observations and careful review of herbarium collections have now shown that this broad species concept of *Benstonea stenocarpa* (Solms-Laubach 1883: 91) Callmander & Buerki in Callmander & al. (2012: 339) must be amended, and that at least three species can be easily distinguished from *B. stenocarpa*.

In this article we propose three new combinations for species that were previously placed in synonymies under *Benstonea stenocarpa* by Callmander & al. (2012): *B. jacobsii* (B.C. Stone) Callm., Buerki & A.P. Keim, *comb. nov.*, *B. misimaensis* (H. St. John ex B.C. Stone) Callm., Buerki & A.P. Keim, *comb. nov.* and *B. verruculosa* (Backer ex B.C. Stone) Callm., Buerki & Phillipson, *comb. nov.* In addition, the true identity of *Benstonea celebica* (Warburg 1900: 80) Callmander & Buerki in Callmander & al. (2012: 332) is elucidated and a new synonym is proposed: *Pandanus gladiator* Stone (1984: 209). The latter species was erroneously synonymized under *B. stenocarpa* by Callmander & al. (2012). An epitype is designated for *B. celebica*. Taxonomic notes on the three newly recognized species and *B. celebica* are presented below in alphabetical order.

## Taxonomy

***Benstonea celebica*** (Warburg 1900: 80) Callmander & Buerki in Callmander & al. (2012: 332).

Basionym: *Pandanus celebicus* Warburg (1900: 80). **Type:**—INDONESIA. Sulawesi: s.d., *Warburg s.n.* (holotype, B [B100279969] image seen; isotype, FI [FI003942]!). **Epitype (designated here):**—INDONESIA. Central Sulawesi Province: Sulawesi, Mt Roroka Timbu, W slope, 80 km SSE of Palu, 1°16'S, 120°18'E, c. 1050 m, 11.V.1979, *Vogel 5287* (epitype, L [L0332713] image seen; isoeptype, KLU-36404 [2 sheets] images seen, PH [PH00018268]!).

Syn.: *Pandanus gladiator* Stone (1984: 209). **Type:**—INDONESIA. Central Sulawesi Province: Sulawesi, Mt Roroka Timbu, W slope, 80 km SSE of Palu, 1°16'S, 120°18'E, c. 1050 m, 11.V.1979, *Vogel 5287* (holotype, L [L0332713] image seen; isotype, KLU-36404 [2 sheets] images seen, PH [PH00018268]!).

**Notes:**—*Benstonea celebica* was regarded as an enigmatic species before its rediscovery by AK in 2005 (Keim 558) in Sulawesi at Pontolotua Hill during a survey of the Lore-Lindu National Park (Keim, 2005). The delimitation of this taxon has remained challenging for a century due to the very fragmentary material of the type (*Warburg s.n.*). The fruiting material deposited at B was apparently destroyed during World War II, but a photograph exists at FI. Stone (1978) has even suggested that *B. celebica* and *B. pachyphylla* (Merrill 1922: 154) Callmander & al. (2012: 337) may be conspecific. *Benstonea celebica* is in reality very different from *B. pachyphylla*, which is a slender acaulescent shrub bearing a small syncarp with a small infrafoliar near-ground solitary syncarp (see Keim & al. 2011: 52, Fig. 12; Callmander & al. 2012: 331, Fig. 4D). *Benstonea celebica* is a tree up to 5 m with a large spicate pendulous infructescence comprising up to 10 subspherical syncarps (c. 10–11 cm in diam) (Fig. 1G). In the absence of adequate material of *B. celebica* and apparently unaware of the presence of the photograph at FI, Stone (1984) was evidently oblivious to its highly distinctive morphology, and he described *Pandanus gladiator* Stone (1984: 209) based on a specimen collected from the same island, Sulawesi, *Vogel 5287*. The latter species was erroneously considered to be a synonym of *Benstonea stenocarpa* by Callmander & al. (2012) and this error is corrected here. Original material of *B. celebica* comprises only Warburg's type gathering from Sulawesi, which is highly fragmentary - consisting now of only of two incomplete leaf portions (at B and FI). The only known syncarp of this collection is believed to have been destroyed (at B), although fortunately a photograph is conserved at FI. *Vogel 5287* (the type of *Pandanus gladiator*) is an excellent fertile collection from Central Sulawesi with duplicates in L, KLU and PH, each with leaves and representative portions of the infructescence. We consider this specimen to represent the same species as the type of *B. celebica*, and we therefore designate it as an epitype for the species. *Benstonea celebica* has also been collected recently elsewhere on Sulawesi: Central Sulawesi Province, Pontolotua Hill and Sedoa in the vicinity of the Lore-Lindu National Park (Keim, 2005; Keim & Rustiami, 2007) and in Northern Sulawesi Province, Ambang Hill in the vicinity of Boganinani Wartabone National Park and Bolaang Mongondow, Minahassa (Polosakan & al. 2009; Purwanto & al. 2009) and is considered to be endemic to the island.

**Additional specimens seen:**—INDONESIA. Central Sulawesi Province: Sulawesi, Toro, Pono (Pontolotua) Hill, 900 m, 31 May 2005, *Keim 558* (WAL); Poso, Sedoa, Siboala Hill, 11 September 2005, *Keim 683* (BO). North Sulawesi Province: Sulawesi, Mount Ambang Nature Reserve, near Kotulidak River, 00°47'29"N, 124°22'39"E, 23 November 2009, *Kinho 267* (WAL); Bolaang Mongondow, Kolangkangon, around Ambang mountain, Modayag, 00°44'45"N, 124°26'07"E, 1271 m, 27 March 2006, *Purwanto & al. PSU42* (BO).

***Benstonea jacobsii*** (Stone 1984: 210) Callm., Buerki & A.P. Keim, *comb. nov.*

Basionym: *Pandanus jacobsii* Stone (1984: 210). **Type:**—PAPUA NEW GUINEA. Hela Province: Near Waro airstrip, 20 km SSW of Kutubu, 6°31'S 143°10'E, 500–600 m, 15 October 1973, *Jacobs 9281* (holotype, L [L0050543, L0050544] images seen).

**Notes:**—*Benstonea jacobsii* was described by Stone (1984) in the genus *Pandanus* based on the small dimensions of its leaves (220 x 5 cm) and fruits (c. 10–11 cm in diam.) and the relatively smooth coarsely verruculose pileus. It is a small treelet (2–3 m) growing on limestone in the southeastern region of Papua New Guinea. *Benstonea jacobsii* can be easily distinguished from *B. stenocarpa*, by its habit (tall slender tree up to 10 m) and morphology (long and broad leaves, 400 x 11 cm) (Fig. 1F). *Benstonea jacobsii* is only known by the type specimen and is apparently restricted to limestone.

***Benstonea misimaensis*** (St. John ex Stone 1978: 54) Callm., Buerki & A.P. Keim, *comb. nov.*

Basionym: *Pandanus misimaensis* St. John ex Stone (1978: 54). **Type:**—PAPUA NEW GUINEA. Milne Bay Province: Misima Island, Mt Sisa, N slopes, 300 m, 19 July 1956, fr., *Brass 27401* (holotype, L [L0050582] image seen; isotype, A [A00020059] image seen, LAE, S [S-G-406] image seen)

**Notes:**—*Benstonea misimaensis* is the smallest species in the 'Dimissistyli' group. The species is almost acaulescent, with the stem only attaining approximately 20 cm in height and grows in understory forest. This habit and habitat are similar to those of *Benstonea ornithocephala* (Stone 1978: 64) Callmander & Buerki in Callmander & al. (2013: 59). The two species are nevertheless very easily to distinguish, *B. ornithocephala* having a terminal syncarp and the upper styler part of drupe not deciduous at maturity is not a member of the 'Dimissistyli' group. *Benstonea misimaensis* is endemic to the Island of Misima, 120 km to the east of mainland Papua New Guinea, in the Louisiade Archipelago, whereas *B. ornithocephala* is endemic to Bird's Head Peninsula in West Papua Province (Indonesia). Both species are only known from the type collection.

***Benstonea verruculosa*** (Backer ex Stone 1978: 55) Callm., Buerki & Phillipson, *comb. nov.*

Basionym: *Pandanus verruculosus* Backer ex Stone (1978: 55). **Type:**—INDONESIA. North Maluku Province: Halmahera, Galileo, Sao Tobaroe, *Beguín 1920* (holotype, BO [2 sheets]!, isotype, L [L0050725] image seen).

**Notes:**—*Benstonea verruculosa* was described based on a fragmentary collection from Halmahera dating back to 1921 (*Beguín 1920*). Its overall morphology bears a strong resemblance to *B. stenocarpa* but its recent rediscovery on the island and collection of more adequate material (*Callmander & Lasut 1151*) provides a clarification of its delimitation and ample justification for its recognition at species level. *Benstonea verruculosa* is characterized by larger and broader leaves (c. 450 x 14 cm) (400 x 11 cm in *B. stenocarpa*), but more significant is the distinct morphology of its drupes. The style of *B. verruculosa* are short (Fig. 1A–G), and not elongated and gradually tapering as in *B. stenocarpa*. The stigmatic groove is also accordingly much shorter in *B. verruculosa*. Furthermore, the pileus of *B. verruculosa* is conspicuously verrucate contrasting with the rather smooth pileus (rarely roughly granular) of *B. stenocarpa*. The type of *B. verruculosa* is fragmentary, consisting of only leaf portions and separate drupes. *Callmander & Lasut 1151* is the first complete collection of *B. verruculosa*, a species endemic to Halmahera where it grows along streams.

**Additional specimens seen:**—INDONESIA. North Maluku Province: Halmahera, Lolea Poeloe Rao, 40 m, 12 October 1921, *Beguín 1816* (BO, L); Soa Tobaroe, 60 m, 2 June 1922, *Beguín 1933* (BO); Soa Tobaroe, 60 m, 13 August 1922, *Beguín 2119* (BO); Soa Tobaroe, 60 m, 13 August 1922, *Beguín 2120* (BO, L); Central Halmahera, Doromesmesan, Loy Poloy, 00°30'29"N, 127°54'21"E, 15 m, 9 February 2013, *Callmander & Lasut 1151* (BO, G, L, MO).



**FIGURE 1.** A–D. *Benstonea verruculosa*. E–G. *Benstonea stenocarpa*. H. *Benstonea celebica*. A, E. Axillary syncarp. B. Peduncle covered by prophylls. C, D, F. Details of pileus and stigmas. G. Habit. H. Polysyncarpic pending infructescence. A–C: From Callmander & Lasut 1551 (Photos: M. Callmander). F: Munzinger & Bau 6745 (Photo: J. Munzinger). E, G. Bau s.n. (Photos: B. Bau). H. Purwanto & al. PSU42 (Photo: Y. Purwanto & R. Polosakan).

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