



## *Sabal lougheediana* (Arecaceae), a critically endangered, endemic palm species from Bonaire

M. PATRICK GRIFFITH<sup>1</sup>, QUIRIJN COOLEN<sup>2</sup>, MICHELLE BARROS<sup>1</sup> & LARRY R. NOBLICK<sup>1</sup>

<sup>1</sup>Montgomery Botanical Center, Coral Gables, Florida, United States of America.

<sup>2</sup>BonBèrdè, Tras 'I Montaña 45, Bonaire. Dutch Caribbean.

Email: [patrick@montgomerybotanical.org](mailto:patrick@montgomerybotanical.org), [bonberde@gmail.com](mailto:bonberde@gmail.com), [michelleb@montgomerybotanical.org](mailto:michelleb@montgomerybotanical.org), [larryn@montgomerybotanical.org](mailto:larryn@montgomerybotanical.org).

### Abstract

A new palm species, *Sabal lougheediana*, is described and illustrated. This critically endangered island endemic, native solely to Bonaire, is characterized by a compact crown of leaves, erect leaf segments, distinctive leaf scars, and frequently vascularized fiber bundles in leaflet transection. Detail on history, morphology, range, habitat, and conservation status is presented, along with a diagnostic key.

**Key words:** anatomy, Coryphoideae, critically endangered, single-island endemic, Palmae, palms, Southern Caribbean

### Introduction

*Sabal* Adans.—the palmetto—is a New World genus with 17 recognized species (Zona, 1990, Goldman *et al.* 2012, Griffith *et al.* 2017). Boldingh's Florae (1913, 1914) did not include any *Sabal* in the Leeward Antilles. The first collection of *Sabal* on these islands (M. Arnoldo 1030, U!) was made in 1948 on Curaçao, and thereafter Stoffers (1956) wrote of “an unidentified species of *Sabal*” on both Curaçao and Bonaire. More than two decades later, a dedicated and detailed study of these palms on both islands (Winkelman, 1979) considered them endemic, but continued to list them as “*Sabal* spec.”

Despite being a prominent, emergent feature of the Bonaire vegetation, review of herbaria suggests that the native palm on Bonaire was not collected until 2017 (Griffith 392, NY!). Conservation concern over the native Bonaire palm population—first mentioned by Winkelman (1979), and continued through de Freitas *et al.* (2005) and Griffith *et al.* (2017)—prompted further study of these little-known plants. Following in the steps of Winkelman's work, a detailed re-assessment of the palms on both Bonaire and Curaçao was conducted, mapping and documenting every native palm on both islands (de Freitas *et al.* 2019), comparing these data to the record from 40 years prior. Significant morphological, anatomical, and ecological differences were noted during the course of both the 1979 and 2018 surveys: the palms on Bonaire share a number of morphologically cohesive features not seen elsewhere, and are also distinct from *Sabal antillensis* M.P.Griff. (2017:56) on Curacao. We therefore describe the *Sabal* on Bonaire as a new species.

### Taxonomic Treatment

*Sabal lougheediana* M.P.Griff. & Coolen, *sp. nov.* (Figures 1, 2, 3A, 4A, 5A).

Type:—BONAIRE. Lima, limestone terrace pavement west of Lac Bay, north of the solar salt works, and south of Kaya Rudolph Stadius von Eps. 5 m elev., 12° 6' 1.098" N, 68° 15' 30.603" W, 11 January 2017, Griffith 392 (holotype NY!, isotype FTG!).

**Diagnosis:**—This new species is most similar to *Sabal antillensis* in leaf morphology and inflorescence structure, but differs by the much taller overall height (7 m vs. 5 m) and more slender-trunked (less than 40 cm vs. greater than 40 cm) habit, the conspicuous, textured trunk scars, the uniformly erect leaf segments unlike the pendent segments in *S. antillensis*, and the more frequently vascularized fiber bundles.

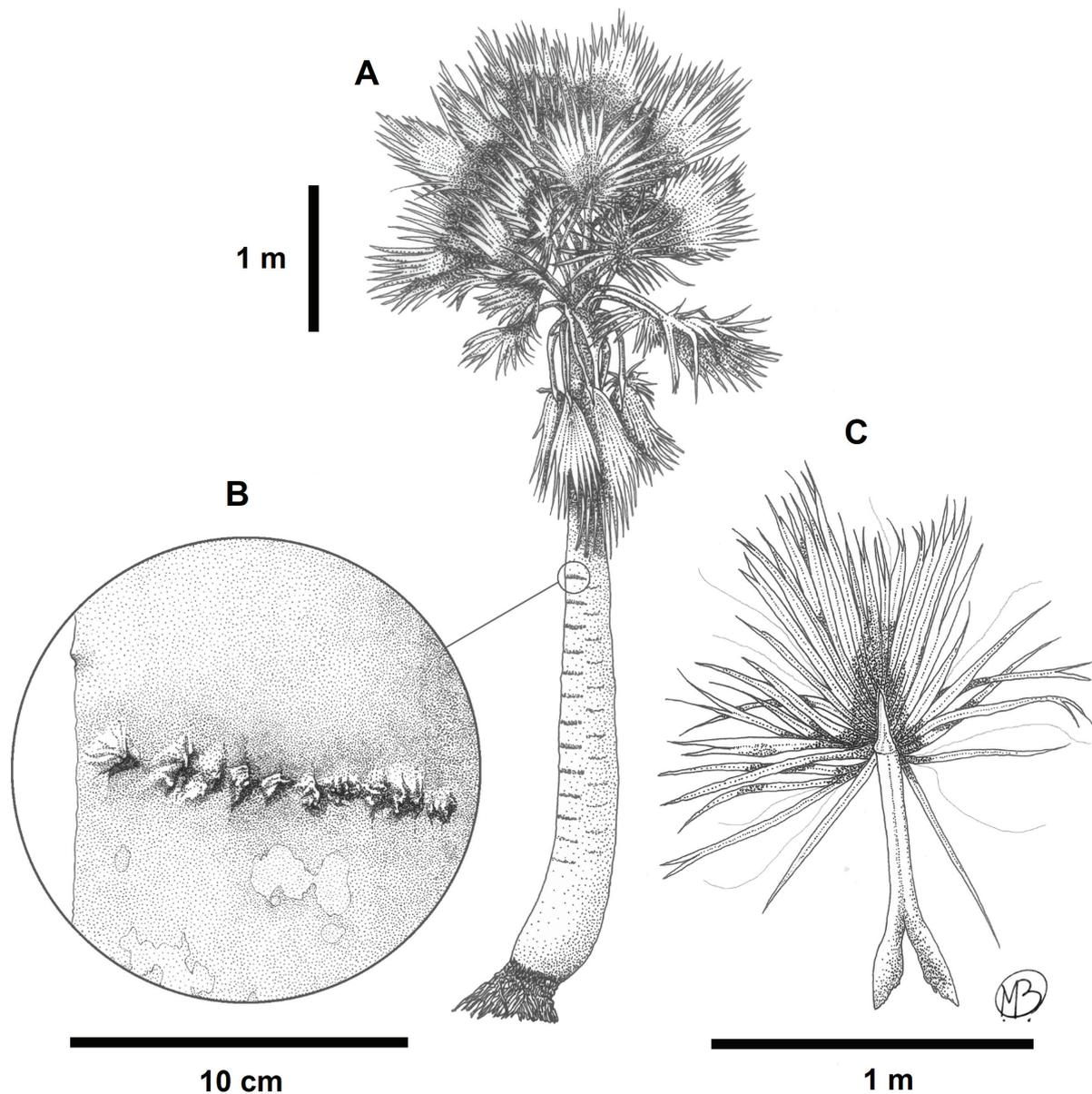


FIGURE 1. *Sabal lougheediana* (illustration: Barros). A. Habit. B. Detail of leaf scar. C. Leaf.

*Habit* as a solitary palm, overall height to 7 m, with a compact crown of leaves, mostly ascending from the trunk axis, and inflorescences held within and mostly occluded by the crown of leaves. *Trunk* to 5.5 m high, 30–37 cm diameter at widest point, gently narrowing near the crown, with prominent regular raised leaf scars (Figure 1B), holding up to 35 leaves. *Leaf* 120 to 200 cm long overall (longer in immature plants), strongly costapalmate, grass-green, the palman strongly sinuous with more than one arch when viewed from the side, filiferous between the leaflets. *Petiole* half or less of the total leaf length, less than 1 m, often 60–100 cm long, up to 6 cm wide, 2 cm thick, the proximal portion split to nearly 35% of its length, with papyraceous ligules to 22 cm long and 5 cm wide, persistent on newest leaves and rarely seen on older leaves. *Hastula* adaxial, acute, 10 to 17 cm long. *Costa* linear, 30–55 cm long. *Leaf segments* up to 80, strongly induplicate at insertion to hastula and proximally undivided for up to 25% of their length, with the apex divided for up to 35% of the segment length. *Basal leaf segment* 45–70 cm long hastula to tip, up to 1.8 cm wide. *Median leaf segment* to 90 cm long, 5 cm wide, undivided up to 50% of its length. *Apical leaf segment* to 70 cm long, 1.8 cm wide. *Inflorescence* arcuate, held within the crown of leaves and not pendant below it, very rarely exerted beyond the leaf tips, mostly occluded by the foliage unless senescent, branched to three orders, to 150 cm long. *Peduncle* proximally to 2 cm wide and 1 cm thick with an average of 5 sheathing bracts. *First order branches* up to 15. *Flowers* sessile, 3–4.5 mm long, bisexual. *Sepals* 3, green, glabrous, tubular to cupulate, 2–3 mm long, 2 mm wide. *Petals* 3, glabrous, white, obovate, 1.2–1.5 mm long, anthers 1–1.2 mm long, cream white to pale

yellow, style 1.4–1.5 mm long, 0.5 mm wide. *Fruit* glabrous, maturing to black, spherical, 9–12 mm high, 11–13 mm wide. *Seed* oblate-spherical to slightly pyriform, brown to black, 5–8 mm high, 7–11 mm wide.

**Distribution:**—This species is currently limited to a very small range on the island of Bonaire (de Freitas *et al.* 2019) in the Southern Caribbean. The plants are found in the southern part of the island (Lima), west of Lac Bay and north of the solar salt factory.

**Habitat:**—The plants are found in the *Coccoloba–Melocactus* Middle Terrace landscape type (de Freitas *et al.* 2005), on flat limestone pavements, at elevations near 5 m. Vegetation cover in the range of *S. lougheediana* is very sparse, and there is evidence that the current vegetation is greatly reduced from its potential density via introduced herbivores (Coolen, 2015; Roberts *et al.* 2018).

**Etymology:**—The name honors Dr. Lin Lougheed, author, explorer, and patron of botanic gardens.

**Common Names:**—The plant is called Sabalpalm on Bonaire. We also propose an additional common name “Bonaire Palm” to highlight its single-island endemism, and distinguish from its nearest geographic neighbor on Curaçao also called Sabalpalm.

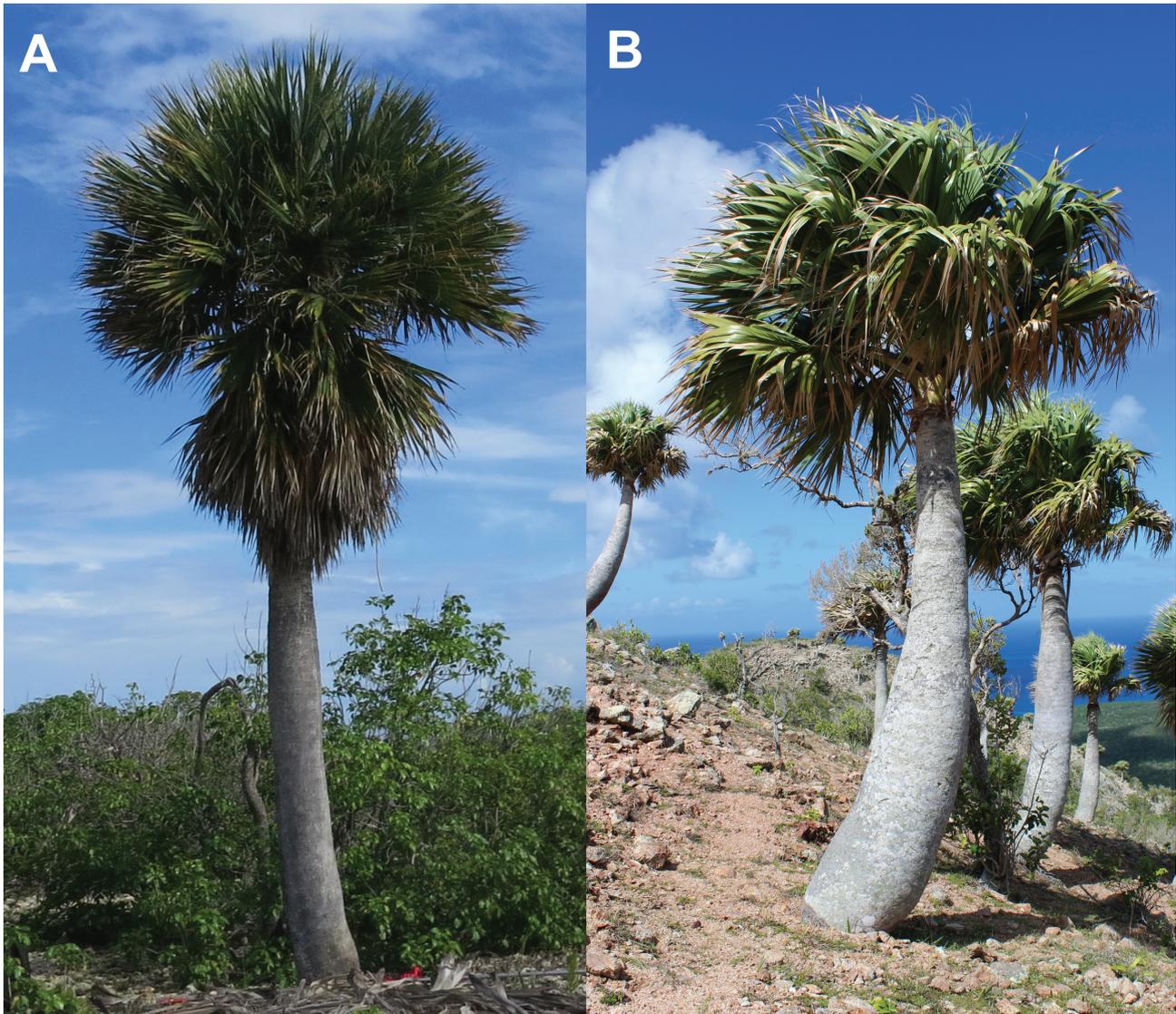


**FIGURE 2.** *Sabal lougheediana*, Bonaire, showing uniformly erect leaf segments and infructescence (white arrow) occluded by foliage (photograph: Coolen).

**Conservation Status:**—Under the IUCN (2012) Red List criteria, *Sabal lougheediana* is considered Critically Endangered (criteria B1ab(v), B2ab(v), C2a(ii), D), owing to its single, very restricted population of very few mature individuals. Complete survey in 2018 located only 25 reproductively mature palms in the wild (de Freitas *et al.*, 2019), compared to 31 adults located during the Winkelman (1979) survey. Furthermore, the range of these palms fell from near 5 km<sup>2</sup> to less than 1 km<sup>2</sup> over the same period. Winkelman detailed an extractive harvest of these palm leaves with over a dozen individuals—at least 40% of the mature population—completely defoliated and showing cuts on the trunks. Extant palms in 2018 still show these “steps” (Figure 4A) to facilitate climbing, which may date

to Winkelman's era. However, no palms in 2018 showed signs of cut leaves. A single dead palm was noted during recent field survey, but the loss of this single plant represents 4% of the total reproductive population. Very limited recruitment of seedlings into more mature palms—likely due to herbivore pressure—suggests that the population will continue to decline without intervention (de Freitas *et al.* 2019).

De Freitas *et al.* (2019) presented recommendations to improve the conservation status of this highly imperiled island endemic, primarily dependent upon excluding herbivores from the very limited native range. Cultivation of Bonaire Palm in offsite reserves and other managed landscapes on Bonaire and elsewhere is also essential to assure against extinction, given the small number and tiny range of extant wild plants.



**FIGURE 3.** Comparison of habit and leaf segments of *Sabal lougheediana* and *S. antillensis* (photographs: Griffith). **A.** *Sabal lougheediana* showing typical slender trunk and erect leaf segments, Bonaire; overall height of this plant is just over 7m. **B.** *Sabal antillensis* showing pachycaulous trunks and pendescent leaf segments, Christoffelpark, Curaçao; overall heights of these plants are 4–5m.

**Discussion:**—The leaf, leaflet anatomy, inflorescence, flowers and seeds all place this species in *Sabal*, and these plants were once considered close to *Sabal causiarrum* Beccari (1907:71), as reviewed in Griffith *et al.* (2017). As detailed above, a record of the indigenous Bonaire Palm exists in the literature for over sixty years, yet apparently no specimen was collected before 2017. *Sabal lougheediana* appears most similar to *S. antillensis*, also described in 2017; until now *S. antillensis* applied to palms from both Curaçao and Bonaire. Winkelman (1979) first noted the much taller height of the Bonaire palms (Figure 3). The pronounced stem thickening seen in *S. antillensis* is also not present in *S. lougheediana* (Figure 3). *S. lougheediana* shows distinctive persistent raised leaf scars that do not appear on *S. antillensis* (Figure 4). Both species show a characteristically dense crown resulting from short petiole length relative to lamina length, but also show a difference in foliage, with sharply erect “spiky” leaf segments distinctive for *S.*

*lougheediana*, and a more pendulous, flexible leaf segment habit in *S. antillensis* (Figure 3). Separating Bonaire’s *S. lougheediana* from the previous broader circumscription of *S. antillensis* also tightens the concept of *S. antillensis* to solely comprise the short, stout palms of western Christoffelberg.

Anatomical differences also support distinction between *Sabal lougheediana* and *S. antillensis*. (Figure 5). In leaflet transection, *S. antillensis* shows a characteristic alternation between vascularized fiber bundles and unvascularized fiber strands (Griffith *et al.* 2017). *S. lougheediana* instead shows more frequent large vascularized fiber bundles without consistent intercalary, smaller unvascularized fiber bundles. This results in a greater density of vascularized fiber bundles per width of lamina in *S. lougheediana* than in *S. antillensis*, and perhaps this anatomy supports the more rigid leaflet habit in *S. lougheediana*.



**FIGURE 4.** Comparison of trunk leaf scars of *Sabal lougheediana* and *S. antillensis* (photographs: Griffith) **A.** *Sabal lougheediana* showing typical conspicuous regular leaf scars (black arrows), presenting as linear rows of small (< 10mm) protuberances, Bonaire. This distinctive character is observed on all trunked plants on Bonaire. Note also the carved “steps” (white arrows) originally observed by Winkleman (1979). **B.** *Sabal antillensis* showing typical annular leaf scars with no raised texture, Christoffelpark, Curaçao.

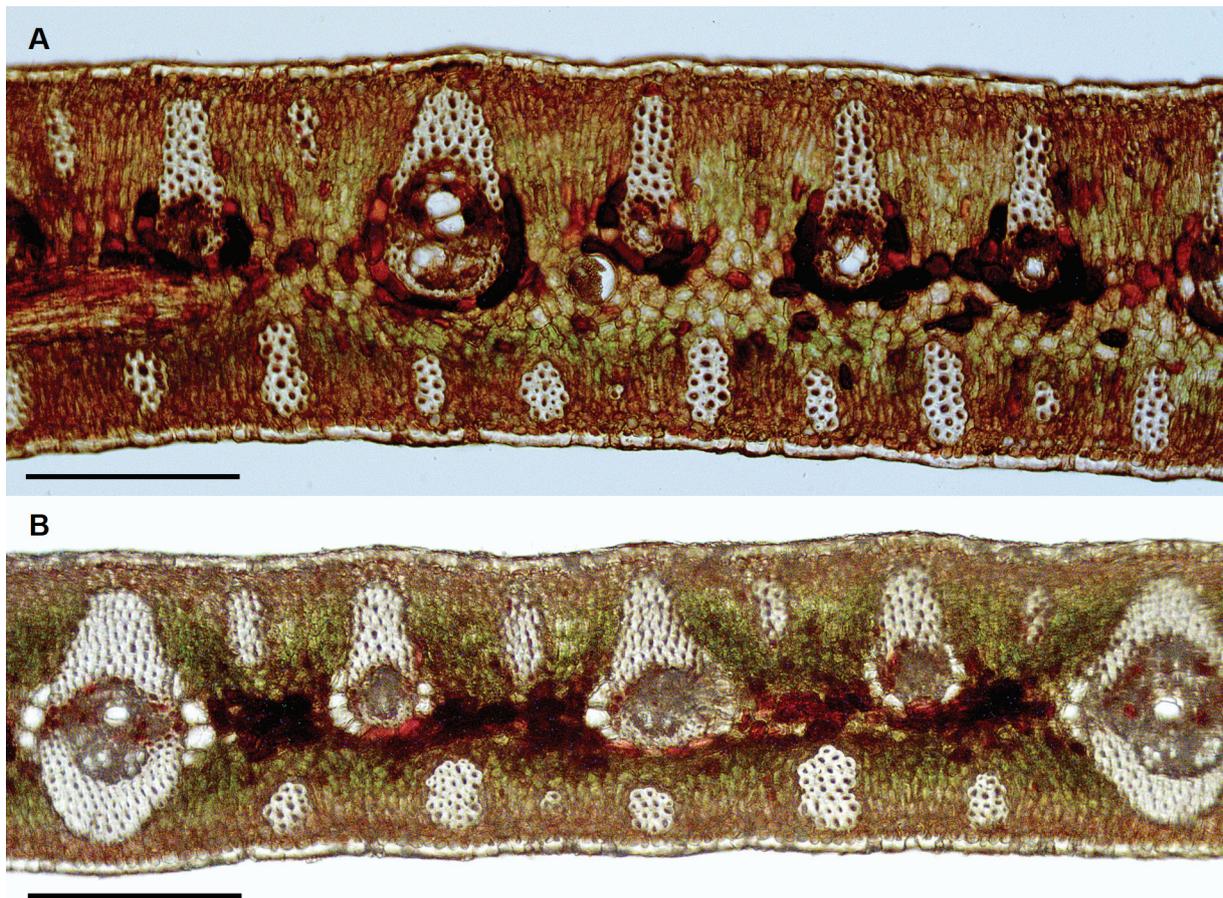
Beyond the structural differences that separate these two species, they are also separated by 100 km of open water and a mountain ridge, and occur in very different habitats. As noted above, *Sabal lougheediana* grows on limestone flats near sea level, while *S. antillensis* grows on cherty mudstone hills only above 140m elevation. Overall vegetation

type differs sharply between these habitats (Beers *et al.* 1997, de Freitas *et al.* 2005). Conservation status also differs between these two taxa. The *S. antillensis* population is trending upward as a result of conservation management, while *S. lougheediana* is declining (de Freitas *et al.* 2019).

Given the very significant differences in morphology, anatomy, habitat, ecology, and geography detailed above, recognizing *Sabal lougheediana* as separate from *S. antillensis* best characterizes both the distinctiveness of each taxon, as well as the morphological cohesiveness of each. In addition to improved taxonomic clarity, recognition of two separate taxa may further galvanize conservation action for these iconic plants.

### Diagnostic key to the *Sabal* of the Leeward Antilles

- 1 Plants to 7 m overall height; trunk diameters 40 cm or less, showing prominent leaf scars of raised protuberances; with uniformly erect leaf segments; Bonaire.....*Sabal lougheediana*
- 1\* Plants to 5 m overall height; mature trunk diameters above 40 cm at widest point, showing faint annular leaf scars with no texture, or no leaf scars, with pendescent leaf segments; Curaçao.....*Sabal antillensis*



**FIGURE 5.** Leaf segment lamina transections of *Sabal lougheediana* and *S. antillensis*, methods follow Noblick (2013), scale bar = 0.25 mm (micrographs: Noblick). **A.** *Sabal lougheediana* (Griffith 392, NY!). **B.** *Sabal antillensis* (Griffith 385, NY!). **A** shows secondary minor veins with few intercalary fiber bundles, while **B** shows adaxial fiber bundles intercalated between all secondary minor veins.

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