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**Front Cover**

*Arisaema macrospathum* from Parque Nacional El Tepozteca, Morelos, Mexico. Note the many leaflets and the very large, open spathe from which the long, attenuate spadix emerges symmetrically © Robert Wyatt and Ann Stoneburner

**Back Cover**

*Philodendron* 'Bette Waterbury'. Inflorescence in frontal view at anthesis (*Croat 69686*).

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### ***Voucher Materials***

Descriptions of new species require deposit of type materials in a recognized herbarium.

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# AROIDEANA

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***Philodendron* × *joepii*, a new nothospecies in section  
*Schizophyllum* (Araceae) from French Guiana, and  
*Philodendron* ‘Bette Waterbury’, a new cultivar name  
for a similar hybrid of unknown original provenance**

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**ABSTRACT**

*Philodendron* × *joepii* is a hybrid found in the forests of eastern French Guiana with parentage presumed to be members of *Philodendron* sect. *Schizophyllum* (Schott) Engl. *Philodendron* × *joepii* is further compared with another putative hybrid from Brazil.

**Keywords:** *Philodendron*, new species, French Guiana, new cultivar.

**INTRODUCTION**

The genus *Philodendron* with 564 described species is the second largest genus in the family and remains one of the most poorly known, especially at the sectional level. Recent attempts at a molecular phylogeny (Vasconcelos et al., 2018; Canal, et al. 2019) indicate molecular phylogeny is certainly at odds with the classification by Krause (1913), so it is hoped that breeding studies and reports of wild hybridizations as in the case of this report, might have a bearing on the sectional classification. The person that this species was named after is a keen observer of nature and has spent many years in the forests of the Guianas. An earlier publication reported another natural hybridization event that is between *Philodendron melinonii* Brongn. ex Regel and *P. linnaei* Kunth (Croat & Moonen, 2020). *Philodendron* species are typically not easily cross-pollinated in the wild, and most are known to be pollinated by specific beetles that are cued to visit the inflorescence at a specific time owing to the timing of scent production. Moreover, many species also have different scents that have apparently evolved to attract specific pollinators (Pereira et. al., 2014; Florian Etl, pers. com.). Thus, the discovery of wild hybrids is not a particularly common event and therefore very exciting.



Figure 1. *Philodendron × joepii* Croat. Habit.

*Philodendron × joepii*, described in this paper, was discovered in an area where several putative parents coexist. Two members of sect. *Schizophyllum*, *Philodendron bipennifolium* Schott and *P. pedatum* (Hook.) Kunth are present in the region. Owing to the shape of the blades, the hybrid appears to be a cross between these two pinnately lobed plants. *Philodendron × joepii*, which shows an dissected leaf not in any way similar to any known species of *Philodendron* or to any other known hybrid.



**Figure 2.** *Philodendron × joepii* Croat. Leaf blade, adaxial surface.





**Figure 3.** *Philodendron × joepii* Croat. Stem showing internodes, roots, and base of petioles.

A cross between *Philodendron pedatum* and *P. bipennifolium* appears logical since they are both members of sect. *Schizophyllum* and the shape of the blades of the two species with the characteristic posterior lobes typical of *P. pedatum* as well as the slender shape of the leaf of *P. bipennifolium* (see images of proposed parents in **Figures 1** and **2**). On the other hand, the shape and coloration of the inflorescence is most like *Philodendron pedatum*.

*Philodendron × joepii* Croat, nothosp. nov. — TYPE: French Guiana. Rivière Mataroni, Bassin de l'Approuague, 04°17'N, 52°10'W, 5 m, 23 Mar. 2000, J.J. de Granville 14049 (holotype, CAY; isotypes, MO, P, U, US). **Figures 1–4** & **7**.

Nomadic vines; internodes longer than broad on younger plants, as broad as long or broader than long on adult plants, 2–3 cm long, 2.5–3 cm diam., dark green, weakly glossy to semi-



**Figure 4.** *Philodendron × joepii* Croat. Inflorescence.

glossy; cataphylls reddish or pinkish outside, whitish inside, 2-ribbed, apical part coiled after opening, ca. 30 cm long, deciduous. Leaves with petioles erect-spreading, 40 cm long, 1 cm diam., densely pale raised-lineate; blades deeply 3-lobed, 30–50 cm long, 25–40 cm wide, 1.1–1.2 times longer than wide, equal to or up to 1.3 times longer than petioles, subcoriaceous, dark green and weakly glossy above, paler and semiglossy below, drying gray-brown and matte above, medium yellowish brown and semiglossy below; medial lobe 27–52 cm long, (8.5)14.7–22.7 cm wide at broadest point, 2.6–3.1 times longer than lateral lobes, sometimes attenuated to near the petiolar plexus and confluent onto the posterior lobes (confluent area 1.3–4 cm broad), sometimes markedly constricted slightly below middle then broadened to form a second lower more or less ovate segment near the base 8–12 cm long, 4–8 cm wide, the





**Figure 5.** *Philodendron bipennifolium*, putative parent of *P.* × *joepii*.



**Figure 6.** *Philodendron pedatum*, putative parent of *P.* × *joepii*





**Figure 7.** Collector Joep Moonen holding cultivated plant of *Philodendron × joepii*.



Figure 8. *Philodendron* 'Bette Waterbury'. Habit of cultivated plant at Missouri Botanical Garden (Croat 69686)

base of this lobe then confluent onto posterior lobes, the terminal portion of the medial lobe 14.5–22 cm wide, narrowly ovate and attenuate onto the constricted area, the lower portion of the anterior lobe, narrowly ovate to elliptic, 8–14 cm long, 4.5–11.7 cm wide, sometimes somewhat sinuate on margins, the constricted area 1.3–4.5 cm wide; posterior lobes spreading-reflexed at a 110–135° angle, often asymmetrical, (5.5) 9–16.5 cm long, (1.3) 3–3.8 cm wide in broadest area, somewhat constricted in one or more areas along its length; upper margin 1–1.8 cm wide; lower margin 1–3 cm wide; basal veins united into a posterior rib that extends to the tip of the posterior lobes, 3–4 pairs of the veins in lateral lobes acroscopic, 5–6 pairs basisopic, only the lowermost pair of acroscopic veins free to the base; midrib rounded above, narrowly rounded below, drying sunken and darker above, narrowly rounded, several-ribbed and nearly concolorous below; primary lateral veins 12–14 pairs, arising at a 60° angle, sunken and concolorous above, narrowly rounded and paler below; minor veins moderately obscure on both surfaces on dried leaves. *Inflorescences* 1–3 per axil; peduncle greenish, matte, (4–6)10–15 cm long; spathe 18 cm long, scarcely constricted when furled, tinged pinkish outside in lower ½ post-anthesis; tube 5–8.5 cm long, 2.5–3 cm diam. at anthesis, opening to within 2 cm from the base, medium green weakly glossy outside (the margins whitish, flaring out), reddish in tube; blade whitish, markedly curved forward at anthesis, inner surface white, except tinged pinkish near its base; spadix 12–17 cm long, protruding forward moderately; staminate portion 9.5 cm long, 1 cm diam. at 1 cm from tip, 1.2 cm diam. in middle and at base; fertile portion 8 cm long, 1.2 cm diam. in distal 2/3, 1.6 mm diam. midway, 1.5 cm diam. at base, narrowly rounded at apex; sterile staminate portion 1.5 cm long, 1.2 cm diam., lowermost row of staminodia enlarged, to 1 mm diam., the remaining staminodia prismatic, 0.5–1 mm diam.; pistillate portion 7.2 cm long, 1.3 cm diam. at apex and middle, to 1 cm diam. near base; pistils 2.8 mm long; stigma 1–1.2 mm diam. with a deep medial pore and the stigmatic papillae in a narrow fringe around margin; ovary 2.1 mm long, 1.8 mm diam., 5–7-locular; placentation basal; ovules 3–5 per locule, borne in a transparent envelope to 1 mm long, 0.2 mm diam., funicles as long as or up to two times longer than ovule proper. *Infructescences* not seen.

**Distribution and ecology** — *Philodendron × joepii* is known only from French Guiana, from the type locality around the Mataroni River at less than 50 m elevation in an area of *tropical moist forest* life zone.

**Etymology** — The presumed hybrid is named in honor of Mr. Joep Moonen who discovered it in 1990 and has had it in cultivation for many years. Moonen, a professional photographer and naturalist, is one of the best authorities on the Araceae of the Guianas, having studied and traveled widely in the region. He is the owner of Emerald Jungle Village, tourist facility in French Guiana. Joep is also a Volunteer Research Associate of the Missouri Botanical Garden's Aroid Research Program

**Discussion** — The plant is believed to be a natural hybrid between *Philodendron pedatum* (Hook.) Kunth and *P. bipennifolium* Schott, both of which occur in the area. They are both members of subgenus *Philodendron* section *Schizophyllum* (Schott) Engl., a small group of species with pinnately lobed leaf blades. *Philodendron × joepii* is very rare in nature. Plants in culture in the wet tropics regularly flower but there is no evidence that mature and viable fruits are developed. This adds to the theory that it is a natural hybrid. Since the presumed hybrid is a part of the Amazonian flora and has been collected several times, it is deemed worthy of a name.

The plant is by now somewhat widespread in cultivation and can be seen at the Botanic Gardens in Brest (France), the Jean Marie Pelt Botanical Garden in Nancy; Tonate (French Guiana), Utrecht (Holland), Sitio Burle Marx (Rio de Janeiro State, Brazil), and The Kampong in Miami, Florida (USA).

The introduced clone of this hybrid already has the cultivar name *Philodendron* ‘Joep’, formally established in *Aroideana* 33: 267. 2010. The cultivar name is often seen as “*Philodendron* ‘Joepii’” (e.g., Moonen, 2014, 2017). However, this is incorrect as *joepii* is prohibited as a cultivar epithet under the International Code of Nomenclature for Cultivated Plants because it is Latin, which is almost entirely reserved for botanical names. The plant should now be referred to as *Philodendron × joepii* when the botanical name is applied, or *Philodendron* ‘Joep’ when the cultivar name is applied. Both are correct under their respective nomenclatural Codes.

*Paratypes*: French Guiana. Rivière Mataroni, Bassin de l’Approuague, 04°17’N, 52°10’W, 0 m, 27 Feb. 1998, J. Moonen 2 (CAY); 04°17’N, 52°10’W, 5 m, 16 May 1991, J. J. de Granville 11625 (CAY); 10 m, 11 Mar. 2006, J. J. de Granville 17319 (CAY); Mataroni River, collected in 1990, vouchered 26 May 2000, J. Moonen 266 (MO); Mataroni River, collected November 1990, J. Moonen JM0418 (MO).

*Cultivated Plants*: ca. 26 km S of Cayenne, Property of J. Moonen at jct. of Route de Tonnegrande and Route de l’Est, S. Mori, C. Gracie, J. Moonen, R. Rishel, D. Russell & F. Wright 22139 (CAY, MO, NY).

### A new cultivar name for a similar hybrid

The plant named and described below was found in the collection of the late Roberto Burle Marx (1909–1994) and introduced into cultivation in the U.S. by the late Bette Waterbury (died 4 Nov. 1986), the first President of the International Aroid Society. The collection at





**Figure 9.** *Philodendron* 'Bette Waterbury'. Habit of cultivated plant at Missouri Botanical Garden (Croat 69686).



**Figure 10.** *Philodendron* 'Bette Waterbury'. Inflorescence in frontal view at anthesis (Croat 69686).



**Figure 11.** *Philodendron* 'Bette Waterbury'. Inflorescence in side view at anthesis (Croat 69686).



**Figure 12.** *Philodendron* 'Bette Waterbury'. Inflorescence with part of spathe removed, showing pistillate greenish spadix, sterile staminate portion and part of fertile staminate portion of spadix (Croat 69686).

the Missouri Botanical Garden was obtained from Waterbury and it is now relatively widespread in cultivation. The plant was vouchered at MO with the number Croat 69686 and appears to be a hybrid much like *Philodendron* × *joepii*. It has been in circulation for many years under that voucher and recently under the informal trade designation *Philodendron* BIG EARS. However, neither has been formally established. It remains without a formal botanical name owing to its lack of provenance, but for the convenience for those who grow it, the plant is described and formally given a cultivar name here, commemorating Bette Waterbury.

***Philodendron* ‘Bette Waterbury’, new cultivar.** — Nomenclatural standard: Cultivated, Missouri Botanical Garden, voucher of plant received from Bette Waterbury ex Brazil, Rio de Janeiro, collection of Roberto Burle Marx, 26 September 1988, T.B. Croat 69686 (MO). **Figures 8–12.**

Vine; internodes 1–5 cm long, 1.5–2 cm diam.; cataphylls 18 cm long, slender and long-tapered, deciduous; petioles terete, dark green, weakly glossy, weakly ribbed circumferentially, the ribs weakly and densely warty, 35 cm long, 7 mm diam. at base, 6 mm diam. midway, 5 mm diam. at apex; blades deeply 3-lobed; anterior lobe 32.5 cm long, 10 cm wide toward apex, markedly constricted toward the base to 2 cm wide at the junction with the lateral lobes, narrowly acuminate, subcoriaceous, dark green and semiglossy above, slightly paler and semiglossy below; primary lateral veins 4 pairs; lateral lobes directed at a 120° angle, markedly constricted to 1.7 cm wide at base, inequilateral, 4 cm wide on upper edge, 4.7 cm wide on lower side; primary lateral veins 4 pairs on upper side, 5 pairs on lower side; sinus nearly spatulate, 1 cm wide, acute to narrowly rounded at apex; inflorescence solitary; peduncle 10.5 cm long, 6 mm diam., medium green, densely short darker green lineate; spathe 16 cm long, narrowly long acuminate-apiculate, 1.8 × 1.5 cm diam., semiglossy outside, medium green on tube, whitish on blade; inner surface of spathe whitish throughout; resin canals weakly visible in lower half of tube; spadix 11 cm long; pistillate portion 4.6 cm long, 1 cm diam., weakly curved; staminate spadix 7.5 cm long, 1 cm diam. in distal 2/3; sterile staminate spadix 1.5 cm long, 1 cm diam., slightly paler, narrowly rounded at apex; pistils 1.8 mm long, 0.8–1 mm diam.; stigma depressed-globose, 0.6 mm thick, 1–1.2 mm diam.; ovary 6-locular; locules 0.6 mm long, ovules enveloped in a translucent envelope, 1–2 per locule, basal, the funicle ca. ½ as long as ovule proper.

**Comments** — *Philodendron* ‘Bette Waterbury’ is like *Philodendron* × *joepii* but with a somewhat less complexly lobed leaf blade and the lateral lobes are always smooth, not possessing the somewhat irregular margins so typical of the posterior lobes of *P.* × *joepii*. *Philodendron* ‘Bette Waterbury’ also differs in having only two ovules per locule instead of 2–5 ovules per locule.

It is characterized by its scandent habit, deeply 3-lobed blades with the lobed prominently attenuated at the base with the lateral lobes spreading and markedly constricted near the base and with the lamina inequilateral. Its parentage, though unknown, perhaps involved different species from the presumed parents of *Philodendron × joepii*.

### Acknowledgements

The author is indebted to Joep Moonen who provided much of the information in this report.

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## New species of *Philodendron* subgen. *Philodendron* (Araceae) from Central America

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### ABSTRACT

Three new species of *Philodendron* subgen. *Philodendron* are described as new from Central America: *P. marcarlsoniae* Croat, *P. monroi* Croat & O.Ortiz and *P. trisectifolium* Croat. These remain the balance of the undescribed species of *Philodendron* in Central America needed to complete the treatment of the Araceae for the Flora of Mesoamerica.

**Keywords:** Araceae, *Philodendron*, subgen. *Philodendron*, New Species.

### INTRODUCTION

The genus *Philodendron* with 487 published species and an estimated total of 1500 species (Boyce & Croat, 2011), has 128 species which occur in Central America and Mexico, including those described here and one additional species to be published by Pedro Diaz in Mexico. Of this total, 21 species are members of subgen. *Pteromischum* and the remainder are members of subgen. *Philodendron*. Both groups were revised in the late 1990's with the revision of those species from Pacific and Caribbean Tropical America in subgen. *Pteromischum* being published in 1996 (Grayum, 1996) and subgen. *Philodendron* of Mexico and Central America published in 1997 (Croat, 1997). Since the time of those revisions, seven other new species were published (Ortiz et al., 2022). Four additional species, including the three in this paper and one to be published soon by Pedro Diaz of Mexico.

### Methods and Materials

New species confirmation was made using the author's 50-year experience with work in Central America and confirmation was affirmed with the Lucid *Philodendron* Key which contains a detailed database on all new species in the genus. Collections were studied in most

Mexican and Central American herbaria including CHIP, CSAT, ENCB, MEXU and UJAT in Mexico, AGUAT, BIGU, GUAT and UVAL in Guatemala, EAP and TEFH in Honduras, HNMN and HULE in Nicaragua, CR in Costa Rica and PMA, SCZ and UCH in Panama. Descriptions were made according to standards established by Croat & Bunting (1979). Ecological parameters were based on the Holdridge life zone system (Holdridge, 1979). Conservation status was based on Redbook values (IUCN-2021)].

### Taxonomy

*Philodendron marcarlsoniae* Croat, **sp. nov.** — Type: MEXICO Chiapas: Los Lagos, 8 miles NW of Rancho San José, [34 mi. SE of Comitán,] 1648 m, 15–20 Apr. 1949, M.C. Carlson 1846 (holotype, EAP-52848). **Figure 1.**

*Diagnosis:* *Philodendron marcarlsoniae* is a member of *Philodendron* series *Macrobelyum* and it is characterized by its hemiepiphytic vining habit, elongate internodes, deciduous cataphylls long-petiolate leaves, subterete petioles, narrowly ovate-sagittate brown-drying, narrowly acuminate leaf blades with broadly concave lateral margins, slightly spreading posterior lobes, a parabolic sinus, four pairs of basal veins, a short posterior rib which is naked for 1–1.5 cm, as well as by a single inflorescence per axil, a short peduncle and a green unconstructed spathe which is crimson inner surface of the tube.

Hemiepiphytic vine; internodes longer than broad, probably less than 2 cm diam. *Leaves* with petioles 31.5 cm long, drying light brown, 3.5 mm diam.; blades narrowly ovate-triangular-sagittate, 29.5–31.5 cm long, 16.3–17.5 cm wide, 1.68–1.93 times longer than wide, broadest across the posterior lobes or near petiole attachment, about as long as the petioles, narrowly long-acuminate at apex, deeply lobed at base, drying medium yellowish brown and weakly glossy above, slightly paler and weakly glossy below; anterior lobe 22.7–24.5 cm long, broadly concave to nearly straight along margins; posterior lobes 9–10.5 cm long, 5.8–7.2 cm wide, narrowly rounded at apex; sinus parabolic, 6.5–7 cm deep, 3.3–4.3 cm wide; basal veins 4–5 pairs; 1st pair sometimes free to base; 2nd pair fused 1.3–1.7; 3rd pair fused 2.5–2.8 cm; 4th–5th pairs fused 2.5–3.8–5 cm; posterior ribs 3.5–4 cm long, naked 1–1.5 cm; midrib broadly rounded and concolorous above, narrowly rounded and slightly paler below; primary lateral veins 3–5 pairs, arising at 50–55°, drying weakly raised and slightly paler above; upper surface smooth with minor veins weakly and irregularly ridged, the intervening area close and minutely areolate-ridged; lower surface with the minor veins as above but more widely spaced with the intervening area somewhat blistered and minutely reddish brown-speckled; laticifers not apparent. *Inflorescences* two per axil; peduncle 10–14 cm long, 0.75–1.4 times longer than spathe, 7 mm diam.; spathe 15 cm long, 1.5 cm diam., lacking a constriction



**Figure 1.** *Philodendron marcarlsoniae* Croat, Herbarium type specimen, Margery C. Carlson 1846.

above the tube, green outside; tube crimson on inner surface; spadix (one only studied) to 7.5 cm long; staminate portion 1 cm long, 1 cm diam.; sterile staminate portion 4.5 cm long, 1.3 cm diam.; fertile staminate portion 4.2 cm long, 1.3 cm diam. at widest portion; pistillate spadix 3.5 cm long, 1.7 cm diam.; pistils 2 mm long, 0.8–1 mm diam.; ovary 5-locular; placentation basal; ovules 1–2 per locule, 0.5 mm long, the funicle shorter than ovule. Inflorescence not known.

**Distribution and ecology** — *Philodendron marcarlsoniae* is known only from the type locality in Mexico, in Chiapas at 1648 m at Los Lagos in a Subtropical montane dry forest life zone. Flowering is known only from April.

**Etymology** — The species was named in honor of America botanist Margery Claire Carlson (1892–1985) who collected the only specimen of the species. She was the first woman to receive a degree in botany at Northwestern University and went on to teach there for more than 30 years. She was a plant anatomist, morphogeneticist and taxonomist (specializing in the genus *Russelia* Jacq.) and was also an adjunct staff member at the Field Museum. She was a frequent correspondent with Thomas B. MacDougall (1895–1964), another well-known collector of Mexican plants. In addition to her collections from Southern Mexico (1922–1924), she also collected plants in Illinois and Wisconsin.

**Comments** — In Central America, the species would be most easily confused with *Philodendron verapazense* Croat which is also a vine with blades of similar size and shape. That species differs in having prominently longitudinally ribbed stems, a proportionately narrower blades (2.7 times longer than broad versus 1.68–1.93 times longer than broad for *A. marcarlsoniae*) with a narrower sinus, proportionately narrower posterior lobes, as well as by having more obscure primary lateral veins, an upper blade surface which is conspicuously granular and the lower blade surface with the minor veins more conspicuous and paler with the intervening area finely ridged (in contrast the upper surface of *P. marcarlsoniae* has a blade which is smooth, aside from being irregularly ridged and the lower surface has more widely and more irregularly spaced minor veins with the intervening area somewhat blistered and minutely dark-speckled).

In addition to the differences in vegetative parts of the plant, the inflorescences are different with *Philodendron marcarlsoniae* having 2 inflorescences per axil, proportionately longer peduncles which are 0.75 to 1.4 times longer than the spathe and a non-constricted spathe, in contrast *P. verapazense* has only 1 inflorescence per axil, has proportionately shorter peduncles (spathe 2.3 times longer than peduncle) and the spathe is constricted above the tube.



**Figure 2.** *Philodendron monroi* Croat & O.Ortiz, Monro et al. 5922.  
Habit of flowering plant (displaced from tree and laying on ground).





Figure 3. *Philodendron monroi* Croat & O.Ortiz, Monro et al. 5922. Stem showing two inflorescences, one at anthesis. Photo credit: P. Monro.



Since the species is known from only a single specimen, its classification in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species should be DD (Data Deficient) (IUCN, 2021).

*Philodendron monroi* Croat & O.Ortiz, **sp. nov.** — Type: PANAMA. Bocas del Toro: Changuinola, PILA, Point 12, ca. 3 km from estación de Alto Urí, ridgetop, canopy 25 m, dbh range 30–60 cm, large outcrops, very steep slopes, 09°04'13"N, 82°42'11.8"W, 1700 m, 15 Apr. 2008, A.K. Monro, D. Santamaria & J. Lezcano 5922 (holotype, PMA-70533; barcode, 68455). Figures 2 & 3.

*Diagnosis:* The species is member of *Philodendron* ser. *Glossophyllum* and is characterized by its epiphytic climbing habit, short internodes, weakly 2-ribbed promptly deciduous cataphylls, subterete, obtusely flattened petioles with a dark green ring at the apex, oblong-ovate cordate-sagittate acuminate blades which are deeply lobed at base with short rounded posterior lobes, a narrowly triangular or narrowly parabolic sinus, 5–6 pairs of basal veins, two pairs of which are free to the base with a short or obsolete posterior rib, 12–15 weakly quilted-sunken primary lateral veins, as well as by a pair of inflorescences, a short-pedunculate spathe which is violet-purple on tube outside, maroon inside and the blade medium green outside, cream-maroon inside towards the apex.

Epiphytic climber; flowering at 2 m above ground, the stem pendulous; internodes 5–5.5 cm long, 4–4.5 cm diam., greenish gray and semiglossy; cataphylls weakly 2-ribbed, 39 cm long, green, promptly deciduous. Leaves erect-spreading, 8–10 clustered toward apex of stem; petioles 58–60 cm long, 1.3–1.5 cm diam., subterete, obtusely flattened towards the apex, broadly and deeply sulcate toward the middle and base, dark green, weakly glossy; geniculum not apparent; blades narrowly ovate cordate-sagittate, 58–60 cm long, 22.5–33.7 cm wide, (0.82)1.1–2.5 times longer than petioles, acuminate at apex, deeply lobed at base, subcoriaceous, dark green and weakly glossy above, slightly paler below; anterior lobes 49–50 cm long, broadly rounded on margins; posterior lobes short and rounded, 9–10.3 cm long, 9–11.2 cm wide; sinus 5.4–8 cm deep, 2.2–3 cm wide, narrowly triangular or narrowly parabolic; basal veins 5–6 pairs, all but the lowermost free to base; posterior rib lacking or short, to ca. 1 cm long, not at all naked; primary lateral veins 12–15 pairs, arising at 0–80°, weakly quilted-sunken and concolorous above. *Inflorescences* two per axil; peduncle 6 cm long, 2.5 cm diam., cylindrical cream-green, turning dark green, clearly demarcated from colored spathe tube; spathe 22.5–34.6 cm long, 6.5 cm diam. across tube, tube violet-purple at base and white-pink where exposed along margins, semiglossy outside with darker striations, moderately constricted above tube, maroon inside; blade medium green and semiglossy outside, inside cream-maroon towards the apex, releasing latex when cut, fragrant; spadix slightly shorter than spathe; staminate portion white; pistillate portion pale green, no further details determinable. Infructescence not known.

**Distribution and ecology** — *Philodendron monroi* is known only from the type locality in Panama in Bocas del Toro at 1700 m in a Premontane rain forest life zone. The type locality is very near large regions of a Lower montane rain forest life zone so the species might occur there as well. Flowering is known only for mid-April.

**Etymology** — The species was named for British botanist Alex Monro from the Royal Botanic Gardens, Kew. Alex formerly worked at the Natural History Museum, London, and was responsible for collecting the type specimen. He is a specialist on the family Urticaceae.

**Comments** — The species is close to *Philodendron auriculatum* Standl. that differs in having conspicuous two-ribbed thick spongy petioles, proportionately longer yellow-green-drying blades that are auriculate or cordate, not subcordate, at base.

*Philodendron monroi* can be confused with *P. brenesii* Standl. with which it shares a V-shaped sinus with little or no development of the posterior rib and moderately close and numerous primary lateral veins, but that species differs in drying more greenish and in having the major veins on the upper surface sunken on drying, as well as having a green spathe in contrast to a maroon spathe for *P. monroi*.

In the Lucid *Philodendron* Key, the species also tracks to *Philodendron cotonense* Croat & Grayum, differing by having thinner leaf blades with a naked posterior rib, more prominently spreading posterior lobes with a parabolic sinus, the posterior rib naked at least near the base and by having longer peduncles (to more than 10 cm long); to *P. grayumii* Croat, differing by prominently persistent cataphylls, larger and more prominently ovate-sagittate blades with a naked posterior rib and up to 5 inflorescences per axil; to *P. morii* Croat, differing by having leaf blades thinner and greenish drying with leaf blade sinus that is arcuate and somewhat decurrent on petiole; and to *P. panamense* K.Krause, differing by having persistent cataphyll fibers, much larger leaf blades with a prominent naked posterior rib, and a much longer peduncle that is markedly curved just below the spathe tube. Since the species is known from only a single specimen, the Red Book status (IUCN, 2021) of the species is DD (Data Deficient).



**Figure 4.** *Philodendron trisectifolium* Croat. Habit with leaves, adaxial surface, Croat 56108.



**Figure 5.** *Philodendron trisectifolium* Croat. Stem, leaf bases & cataphylls, *Croat 56108*.



**Figure 6.** *Philodendron trisectifolium* Croat. Close up of leaves, adaxial surface, Croat 56108



***Philodendron trisectifolium*** Croat, **sp. nov.** — Type: COLOMBIA. Chocó: 4 km S of Quibdó, 50 m, 9 Jan. 1979, A. H. Gentry & E. Renteria 23858 (holotype, MO-2714293!; isotypes, CHOCO, HUA). Figures 4–8.

*Diagnosis:* The species belongs to subgen. *Philodendron* sect. *Tritomophyllum* and is characterized by its long stems, long internodes, deeply 3-lobed blades which are divided nearly to the base and weakly confluent at the base with prominently quilted major veins mostly aggregated near the base of the lateral lobes, markedly asymmetrical posterior lobes with a parabolic or hippocrepiform sinus and with the base of the blade decurrent on the petiole, as well as having by 1–6 inflorescences per axil with the spathe tube pinkish to light magenta on both surfaces and the spathe blade light green to whitish outside, white inside.

Appressed-climbing hemiepiphyte or sometimes terrestrial on steep road banks, stem often very elongated, sap watery, with a strong odor to turpentine; internodes (3–)6–15 cm long, 1.6–3.5(–5) cm diam., shorter toward the apex of stem, somewhat glossy, promptly grayish green; cataphylls 16–28(45) cm long, unribbed to 1-ribbed, thin, light green to whitish, semi-glossy, deciduous; roots 2–10 per node, yellow or brown. Leaves spreading; petioles 37–74 cm long, 0.5–0.9 cm diam. at apex, 1.4 cm at base, cylindrical to subcylindrical, somewhat firm and fleshy, obtusely angular adaxially, medium green, with dark purple ring at apex, semiglossy; blades deeply 3-lobed, almost to the base (ca. 1 cm of the base), weakly coriaceous, somewhat bicolorous, to glossy above, glossy below, drying brown above and olive-green below; median lobe 24–48(63) cm long, 10–18 (26.5) cm wide, elliptic to obovate-elliptic, gradually long-acuminate at apex, prominently constricted at the base, the area of confluence less than 1 cm wide; lateral lobes 20–34(–43.5) cm long, 8–16(–21) cm wide, conspicuously inequilateral, acute at the apex, the inner margin always narrower than the outer margin and weakly confluent with medial lobe, the outer margin rounded at the base and forming a parabolic to hippocrepiform sinus, base of the blade decurrent on the petiole; sinus (2.5)6–13 cm deep, 1–2.3(6) cm wide midway; midrib of the lobes narrowly raised in valleys and paler than surface above, thicker than broad and more or less concolorous below; primary lateral veins of the anterior lobe (6–)10–16 pairs, departing midrib at 50–65°, quilted-sunken and paler than surface above, narrowly raised and concolorous below, sometimes giving the base of the blade a pleated appearance; primary lateral veins of the lateral lobes up to 17 pairs, closely aggregated toward the base near the petioles; minor veins visible, drying moderately fine and distinct, densely and minutely granular on the upper surface (under magnification). *Inflorescences* 1–6 per axil; peduncle 4–9(15) cm long, 0.9–1.0 cm diam., light green; spathe (11)14–21 cm long weakly constricted above tube; blade light green with purple mottling and whitish margins outside, whitish, glossy, with orange resin canals inside; tube 2–3.8 cm diam., light green tinged pinkish to light magenta outside, dark magenta to rosy red inside; spadix 9.5–17 cm long, sessile or shortly stipitate, more or less erect; staminate portion 5.5–10.5 cm long;

fertile portion 1.3 cm diam., broadest at the middle, white to cream; sterile staminate portion ca 1.2 cm diam., usually broader than pistillate portion; pistillate portion 4–6.5 × 0.8 cm diam., greenish, pistils 6–8-locular with sub-basal placentation; locules to 2.3 mm long; ovules 1–2 per locule contained within a gelatinous matrix, longer than the funicle; stigma subdis-coid, truncate, covering center of style apex. *Infructescence* with whitish fruits 4 mm × 2–2.7 mm diam.; seeds ca. 1.5 mm long, usually 6–8 per fruit, cylindrical, sticky.

**Distribution and ecology** — *Philodendron trisectifolium* occurs along the Pacific Coast of Darién Province in Panama and in Colombia in the Department of Choc to considerably south of Quibó from sea level to 200 m in *Tropical wet forest* and *Tropical rain forest* life zones. In the Cabo Corrientes region of Chocó Department, it is very abundant in the forest and it is usually found climbing on trees less than 3 m above the ground. Flowers December to February, June and August. Fruiting Dec.-Feb., June, August.

**Etymology** — The specific epithet refers to the deeply three-lobed leaf blades appearing to be trisect.

**Comments** — *Philodendron trisectifolium* was confused with *P. tripartitum* (Jacq.) Schott in the Revision of *Philodendron* subgen. *Philodendron* for Mexico and Central America (Croat, 1999) but has since proven to be quite distinct. In that publication, the species was represented by Figures 412 and 424 (Croat 56108).

*Philodendron trisectifolium* is similar to *P. tripartitum* but that species has appreciably smaller leaves and usually a solitary inflorescence that is green on the tube (vs. pinkish to light magenta).

Four collections (Croat 35342, Croat 35248, Croat 43438 and Morales & Abarca 6371) determined as *Philodendron tripartitum* from Costa Rica in the San José Province, are morphologically very similar to material of *P. trisectifolium* from Chocó, Colombia. However, these collections differ by having leaf blades with a narrower anterior lobe with primary lateral veins that depart midrib at a narrower angle (<65° vs. >70°), a spathe predominantly green (vs. pinkish to maroon or light magenta on the tube), and they occur in higher elevations (680–1650 m vs. 0–100 m).

The species is also similar to *Philodendron cotobrusense* Croat & Grayum, a species endemic from Costa Rica, but the later species has leaf blades that are deeply lobed (vs. almost, trisect) with the area of confluence usually more than 1.5 cm wide (vs. less than 1 cm), a





**Figure 7.** *Philodendron trisectifolium* Croat. Cataphyll with new emerging leaf, Croat 56108. All photos: Croat.



**Figure 8.** *Philodendron trisetifolium* Croat. Herbarium specimen, Juncosa 1596 (MO-125898).

higher number of primary lateral veins, and more conspicuous interprimary and secondary veins.

*Philodendron trisectifolium* was first discovered by Al Gentry and Enrique Renteria in the Chocó Department of Colombia on January 9, 1979 and again on Jan. 12th (Gentry & Renteria 23858 & 24078, respectively). It was first collected in Panama along the Río Cocalito on the Pacific coast near the Colombian border by Caroline Whitefoord and Alan Eddy (223) in February 1982.

The Red Book status (IUCN, 2021) of the species is LC (Least Concern) since it has a broad range extending from southern Panama to at least as far south as southern Chocó Department in Colombia.

*Paratypes*: COLOMBIA. **Chocó**: Serranía de Baudó, along road between Las Animas and Pato, on Río Pato ca. 1 km from Pato, 05°32'N, 76°48'W, 150 m, T. B. Croat 56108 (COL, MEXU, MO, SEL). PANAMA. **Darién**: Río Cocalito, 17 Feb. 1982, Caroline Whitefoord & Alan Eddy 223 (BM, MEXU, MO); 4 km S. Quibdó, 9 Jan. 1979, A. H. Gentry & E. Renteria 23858 (CHOCO, MO); 5 km W of Istmo de San Pablo (Río San Pablo = Río Quito) on Pan American Highway (under construction), ca. 25 km W of Las Animas. 12 Jan. 1979, A. H. Gentry & E. Renteria 24078 (CHOCO, MO).

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# A new species of *Philodendron* subgenus *Philodendron* (Araceae) from Costa Rica

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## ABSTRACT

*Philodendron florianetlii* is published as a new species of series *Macrobium* from Puntarenas Province, Costa Rica, and distinguished from *P. sagittifolium* Liebm.

**Keywords:** Araceae, Costa Rica, new species, *Macrobium*, *Philodendron*.

## INTRODUCTION

The genus *Philodendron*, with 564 described and accepted species and an estimated total of 1500 species (Boyce & Croat, 2011 onwards), is the second largest genus of Araceae. It ranges from Mexico to Argentina but is absent from Chile. Most species are known only from South America, and while the genus ranges from sea level to at least 2600 m, it is most species-rich at lower elevations. In the most recent revisions of the only two subgenera of *Philodendron* occurring naturally in Central America and Mexico, Croat (1997) reported 95 species of subgenus *Philodendron* and Grayum (1996) reported 21 species of subgenus *Pteromischum* from the same region.

Recently seven new species of *Philodendron* from Panama were recognized as new (Ortiz et al., 2022), and another new species was published from Mexico (Díaz Jiménez et al., 2020). In addition to the species proposed here, four others will soon be published. Thus, the total number of species of the genus *Philodendron* for Mexico and Central America will be 128.

In this paper, we describe and illustrate *Philodendron florianetlii*, a new species of subgenus *Philodendron* series *Macrobium* from Province Puntarenas Province in Costa Rica. During



fieldwork on the pollination biology of Araceae at the La Gamba Field Station in the Golfo Dulce area in Puntarenas Province, Austrian botanist Florian Etl conducted ecological studies which involved detailed analyses of scents and the timing of scent production. These studies showed conclusively that the new species described below is distinct from *Philodendron sagittifolium* Liebm., to which it had been previously referred.

### Materials and Methods

The species was described from both living and dried material using terminology following Croat (1997), and the IUCN Red Categories and Criteria were consulted for potential Red Book Listing (IUCN, 2020). Ecological characterization was based on the Holdridge Life Zone map (Tosi, 1971).

***Philodendron florianetlii*** Croat & Grayum, **sp. nov.** — Type: COSTA RICA. Puntarenas: Golfo Dulce Region, La Gamba field station next to Esquinas Rainforest Lodge, 08°42'02"N, 83°12'07"W, 77 m, 16 Mar 2019, F. Etl 13 (holotype, WU0120157–59; isotypes, CR, K, MO, US). **Figures 1–9.**

*Diagnosis:* *Philodendron florianetlii* is distinguished from *P. sagittifolium* Liebm. by the lack of purplish violet blotches on the former's petioles, inflorescences only one per axil, spathes that are orange-red in the tube and only tinged reddish on the medial portion of the blade inside, and a spadix that remains essentially erect (not much protruded forward from the spathe), as well as sap with a different scent, and a unique floral scent at anthesis. In contrast, *Philodendron sagittifolium* has purplish violet blotches on its petioles, inflorescences usually two or three per axil, spathes that are solid dark red to violet-purple inside and heavily suffused onto the blade as a solid color, and spadix that is protruded forward. In addition, *P. florianetlii* differs in having the primary lateral veins paler, rather than darker on the lower surface as is the case with *P. sagittifolium*.

High-climbing robust hemiepiphyte, appressed or loosely attached; roots several per node, becoming very elongate and pendent, extending down in a curtain as much as 10 m from the ground; sap smelling of citrus (grapefruit); internodes 4–6 cm long, 2–5 cm diam., green to medium dark green, matte (or nearly so), soon tan-brown or brown, drying conspicuously and often acutely wrinkled-ridged, medium yellow-brown; cataphylls light green to green, sharply 2-ribbed or -keeled, 35–40 cm long, tinged reddish on margins, deciduous intact. Leaves many; petioles erect-spreading, medium dark green to dark green, terete or subterete, obtusely and weakly flattened adaxially, 39–52 cm long, 1.0–1.7 wide midway, drying 7–10 mm diam. midway, matte; blades mostly pendent, narrowly ovate-cordate-sagittate,

(43.5–)48–77 cm long, (15–)18–36 cm wide, 2.7–3.1 × longer than wide, about at long aspetioles (0.92–1.06 × longer than petioles), broadest (5–)10–20 cm above petiolar plexus, subcordate at base, narrowly long-acuminate at apex, subcoriaceous, weakly bicolored, dark green and semiglossy above, drying greenish brown and matte to weakly glossy, brownish grey-green and weakly glossy to semiglossy below; margins somewhat undulate; anterior lobe 37.8–48.2 cm long, broadly convex; posterior lobes 5.5–7.1 cm long, sometimes unequal, narrowly rounded; sinus V-shaped, 3.3–5.7 cm deep; basal veins 4 or 5(–6) pairs, 1<sup>st</sup> & 2<sup>nd</sup> pair free to the base, 3<sup>rd</sup> & 4<sup>th</sup> (5<sup>th</sup>) fused 5–12 mm; midrib flattened, broadly sulcate to broadly rounded and concolorous or paler above, narrowly rounded and paler, dark short-lineate below, drying broadly rounded, minutely many-ridged, slightly paler above, bluntly acute or narrowly rounded and moderately paler (whitish) below with a blunt medial rib and 5 or 6 smaller acute ridges below; primary lateral veins (8–)10–11 per side, arising at a (50–)65–70° angle, concolorous or slightly paler and quilted-sunken above, narrowly rounded and paler (whitish or cream-colored) below; minor veins moderately obscure to visible, weakly raised above (the larger of these drying weakly undulate), obscure to more clearly distinct but scarcely more raised below; upper surface drying sparsely pale-speckled; lower surface densely pale-speckled; laticifers not apparent. Inflorescence erect, one per axil; peduncle ca. 10 cm long, ca. 2 cm diam., medium green, tinged reddish near apex; spathe ca. 20.3 cm long, medium green, semiglossy, nearly white along the margins of the open edge; tube ca. 9.5 cm long, 4–5 cm diam., orange-red to red or maroon and glossy inside, tinged reddish on the medial portion of the blade inside (mostly owing to the reddish resin canals, these prominent, extending to ca. 5 cm from apex in middle, to ca. 7 cm from apex on sides); blade white to pale green inside, 3.3–3.8 cm wide, ca. 5 mm thick; spadix ca. 20.3 cm long, the axis reddish, remaining within the spathe (not protruded forward); pistillate portion ca. 7 cm long, ca. 3.7 cm long on back side; sterile staminate portion whiter than the fertile spadix, 1 cm long, as wide as apex of pistillate portion; fertile staminate portion creamy white, ca. 12.5 cm long, ca. 2.6 cm diam. at base, ca. 2.2 cm diam. at constricted area, ca. 2.4 cm diam. in middle; female flowers pale green, the pistil ca. 5 mm long; ovary ca. 2 mm long, ca. 1.5 mm diam., constricted slightly to ca. 1.2 mm diam. between ovary and style; locules 6 per ovary, each containing a single transparent basally attached envelope (ca. 0.8 mm long, pointed at apex); ovules 1 or 2 per locule, 0.2–0.3 mm long, with funicles about as long as ovules; style ca. 1 mm long; stigma thickly disc-shaped, ca. 0.6 mm thick, ca. 1.6 mm diam.; male flowers creamy white, drying irregularly prismatic, 4–6-sided, tan, 1.2–2 mm wide in both directions. Infructescence berries becoming whitish.

**Distribution and ecology** — *Philodendron florianetlii* is endemic to Costa Rica, known only from the type locality in the southwestern part of the country, on the Pacific slope, at 70 – 260 (1200) m elevation in a *Tropical wet forest* life zone, generally in or near the crowns of canopy trees.



**Figure 1.** *Philodendron florianetlii*. Habit of flowering plant.



**Figure 2.** *Philodendron florianetlii*. Leaf blade, adaxial surface.





**Figure 3.** *Philodendron florianetlii*. Leaf blade, abaxial surface.



**Figure 4.** *Philodendron florianetlii*. Spathe showing resin canals on inner surface and apical portion of spadix.



**Figure 5.** *Philodendron florianetlii*. Herbarium sheet, sheet 1 of 3. WU0120157.





**Figure 6.** *Philodendron florianetlii*. Herbarium sheet, sheet 2 of 3. WU0120158.





**Figure 7.** *Philodendron florianetlii*. Herbarium sheet, sheet 3 of 3. WU0120159.



**Figure 8.** *Philodendron florianetlii*. Roots forming curtain to the ground.





**Figure 9.** *Philodendron florianetlii*. Florian Etl in canopy.

**Etymology** — The species is named in honor of Austrian botanist, Florian Etl, of the University of Vienna, whose work with pollination biology in Costa Rica helped to define and distinguish this species. Florian has made many discoveries such as this during his years of work at the La Gamba Field Station in Puntarenas Province.

**Comments** — The new species is a member of *Philodendron* subgenus *Philodendron* section *Macrobelum* subsection *Macrobelum* series *Macrobelum* and is characterized by its hemiepiphytic habit, numerous pendent roots, short internodes, subterete petioles about as long as the blades, and oblong-elliptic, subcordate-sagittate, narrowly long-acuminate leaf-blades with a V-shaped sinus, usually four or five basal veins, two of which are free to the base, and pale-speckled surfaces, as well as by its solitary moderately short-pedunculate inflorescences with a pale green spathe that is orange-red on the tube inside with similarly colored resin canals extending far up the interior surface of the blade.

The species has been associated with *Philodendron sagittifolium* and, indeed, was included provisionally in that species by both Croat (1997) and Grayum (2003). Each author discussed material here included in *Philodendron florianetlii* as aberrant within *P. sagittifolium* and possibly representing a distinct species. Note that in the case of both the upper and lower leaf blade surfaces of dried specimens, the pale speckling appears to be owing to minute, presumably crystalline cellular inclusions.

The Redbook status for this species is LC (Least Concern) since the species is known from only from a number of well-preserved areas (IUCN, 2020).

*Paratypes*: COSTA RICA. **Puntarenas**: Cantón of Coto Brus, Las Cruces Tropical Botanical Garden, 6 km SW of San Vito de Java, 8°49'N, 82°58'W, 1200 m, Accession #65–215, 6–7 Mar. 1984 (st), collected originally in Costa Rica, Puntarenas, vicinity of Golfito near TV transmission tower, 2000 ft., T. B. Croat 57243 (MO-932385–88); Along road from Pan-American Hwy. at Piedras Blancas to Rincón (on Osa Peninsula), 3.7 mi W of Panamerican Hwy., 8°46'N, 83°18'W, 90–195 m, 16 Sep. 1987 (fl), T. B. Croat 67697 (CR; MO-9322379–83); Golfito Canton, R. N. Fauna Silv. Golfito Cantón, along crest of Fila Gamba to ca. 0.7 km N, 8°40'12"N, 83°12'00"W, 160–260 m, 27 Jan. 1992 (fr), M. H. Grayum & B. Hammel 10066 (CR, MO-932384).

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# The current status of *Anthurium* sect. *Porphyrochitonium* (Araceae) and allies, with many new species from Central and South America

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## ABSTRACT

One hundred twenty taxa of *Anthurium*, mostly belonging to *Anthurium* sect. *Porphyrochitonium*, are described as new. Of these, 76 taxa (75 species and one variety) are from Central America:

*A. abelardoi* Croat, *A. alatipetiolum* Croat, *A. albifructum* (Croat) O. Ortiz & Croat, *A. alex-espinosae* Croat, *A. ariztutense* Croat, *A. attenuatifolium* Croat, *A. aurantiifructum* Croat, *A. bajobonitense* O. Ortiz & Croat, *A. belenense* Croat & O. Ortiz, *A. bergii* Croat, *A. berguidoi* Croat & O. Ortiz, *A. billdarcy* Croat, *A. billhahnii* Croat, *A. boqueronense* Croat, *A. botijaense* Croat, *A. bratsiense* Croat, *A. brunneum* Croat, *A. carrionii* Croat & O. Ortiz, *A. chaconii* Croat, *A. churchillii* Croat, *A. comincoense* Croat, *A. cuadrosii* Croat, *A. deneversii* Croat, *A. diversurensense* Croat, *A. doroteryense* Croat, *A. duocostatum* Croat, *A. edtysonii* Croat, *A. flagellum* Croat, *A. floresii* Croat & O. Ortiz, *A. gerardoi* Croat, *A. glandulicostum* Croat & O. Ortiz, *A. granditepalum* Croat, *A. gregneversii* Croat, *A. guaboense* Croat, *A. guadalupae* Croat & O. Ortiz, *A. heraclioanum* Croat, *A. hughchurchillii* Croat, *A. iguanitense* Croat, *A. insolitum* Croat & O. Ortiz, *A. jicoteense* Croat, *A. jimfolsomii* Croat, *A. kensytsmae* Croat, *A. kittredgeanum* Croat, *A. lellingeri* Croat, *A. loratum* Croat, *A. mercadoi* Croat & O. Ortiz, *A. minimum* Croat, *A. monroi* Croat, *A. morrisii* Croat & O. Ortiz, *A. muscidiradix* Croat & O. Ortiz, *A. neei* Croat, *A. nutans* Croat, *A. orosiense* Croat, *A. paulmaasii* Croat, *A. perangustum* Croat, *A. polancoi* Croat, *A. robertii* Croat, *A. sabanitense* Croat, *A. scottmorii* Croat, *A. sknappiae* Croat, *A. stockwellii* Croat, *A. sueae* Croat, *A. sukutense* Croat, *A. tarrazuense* Croat, *A. tayuticense* Croat & O. Ortiz, *A. toroense* Croat, *A. tsaiiae* Croat, *A. tscuiense* Croat & O. Ortiz, *A. tuquesense* Croat, *A. van-ninii* Croat, *A. veraguense* Croat & O. Ortiz, *A. wendlingeri* G.M. Barroso var. *horichii* Croat,

*A. wiehleri* Croat, *A. zachdufranianum* Croat & O.Ortiz, *A. zapatae* Croat, *A. zhui* Croat.

A further 44 new species are described from South America:

*A. acaimense* Croat & W.Vargas, *A. alejandroi* Croat, *A. barfodii* Croat, *A. bueyense* Croat, *A. certeguense* Croat, *A. chiriacoense* Croat, *A. claudiae* Croat, *A. cojimiesense* Croat, *A. coquiense* Croat, *A. davidneillii* Croat, *A. friedrichii* Croat, *A. gladysmartineziae* Croat, *A. gruesoi* Croat, *A. habitense* Croat, *A. jimgribianum* Croat, *A. jimwestii* Croat, *A. juanguillermoi* Croat, *A. koesteri* Croat, *A. lamanense* Croat, *A. lobinii* Croat, *A. luzmariae* Croat, *A. mercedesense* Croat, *A. micosense* Croat, *A. minutiareolum* Croat, *A. minutiglandulum* Croat, *A. miriamiae* Croat, *A. nonoense* Croat, *A. oblitum* Croat, *A. omarescobarii* Croat, *A. orellanense* Croat, *A. ortizii* Croat, *A. pacevedoi* Croat, *A. pallidifibrum* Croat, *A. palmitasense* Croat, *A. pedernalense* Croat, *A. prominor* Croat, *A. purpuribacca* Croat, *A. sursumtepalum* Croat, *A. tarapiuense* Croat, *A. unguiense* Croat, *A. victoriense* Croat, *A. vlastimilii* Croat, *A. yatuense* Croat, *A. zakii* Croat.

**Keywords:** *Anthurium*, sect. *Porphyrochitonium*, sect. *Decurrentia*, new species, Neotropics.

## INTRODUCTION

*Anthurium* sect. *Porphyrochitonium* is one of the largest sections of *Anthurium* with between 350–400 species. Already 357 species have been named (but not all published) and 333 species have been entered into the Lucid *Anthurium* Key. This paper will be the first in a series that will formally publish these species. The section is perhaps the most well-defined section in the genus, yet it remains unrevised, largely owing to the large number of unresolved species. The section is characterized by being relatively small plants, typically with short stems, short internodes, usually persistent, fibrous cataphyll fibers, and blades that are usually much longer than broad and rarely cordate or even subcordate at the base, with the lower surface and sometimes the upper surface glandular-punctate. Another distinctive feature is the usual presence of more than one ovule per locule (usually 2–4 per locule) and berries that are depressed medially, often somewhat quadrangular or rectangular in cross-section and broader in one dimension than in the other dimension. Chromosomally the section is based on  $2n=30$  (Croat & Sheffer, 1983). Aneuploids have been reported in *Anthurium bakeri* Hook.f., *A. bicollectivum* Croat, *A. lancifolium* Schott and *A. scherzerianum* Schott (Croat & Sheffer, *ibid.*). Gene flow throughout the group is demonstrated to be common (Croat & Sheffer, *ibid.*).

**Footnote:** A few species which are not classified as sect. *Porphyrochitonium* but which can easily be confused with this section are included here because they will otherwise be construed as members of the sect. *Porphyrochitonium*. These are mostly members of sect. *Decurrentia* but can easily be confused with sect. *Porphyrochitonium*. These are *Anthurium aurantiifructum* Croat, *A. boqueronense* Croat, *A. chaconii* Croat, *A. doroteryense* Croat and *A. vlastimilii* Croat. In addition, one new species, *A. gerardoii* Croat, is in sect. *Calomystrium* series *Rupicola*, another group which can be confused with sect. *Porphyrochitonium*. (See Appendix).

Species of *Anthurium* sect. *Porphyrochitonium* are an important component of most humid to wet neotropical forests (Croat, 1988). While the relatively small size of the plants ensure that they are never the dominant group in any local area, their ubiquitous presence and their small size (making them easy to collect) ensure that they are very common in the collections from nearly any Andean aroid flora within the altitudinal and elevational range of the section. The large numbers of similar species in given localities means that it is not uncommon to find several species mixed by inexperienced collectors under a single collection number. In parts of northwestern South America, such as in the Departments of Chocó and Valle del Cauca of Colombia, members of *Anthurium* sect. *Porphyrochitonium* are so common as to exceed all other *Anthurium* sections combined in terms of numbers of individuals. The section is particularly common in lowland areas but remains an important element of the vegetation up to 1500 m. It is probable that areas of high species diversity for *Anthurium* sect. *Porphyrochitonium* will be found to correlate with areas of high amounts of rainfall (Gentry, 1988; Croat, 1992).

While the section vaguely resembles members of sect. *Urospadix* from eastern South America (and were seemingly confused with them by Engler) most *Urospadix* do not have glandular punctations and when black-dotted, the black area is typically not button shaped with distinct margins as is the case in *Porphyrochitonium*. Moreover, sect. *Urospadix* have typical *Anthurium* berries that are rounded in cross-section and usually obovoid as well as by having only 1 ovule per locule. Berry color is also less diverse, largely being red to purple at maturity while the berry color of sect. *Porphyrochitonium* is more diverse, ranging from red, yellow, or orange to violet-purple to lavender-blue or white. In addition to the above, the two sections are seemingly not overlapping in range, most being separated by as much as 3000 kilometers.

*Anthurium bakeri*, the only widespread species in the section (occurring from Central America to the West Indies and South America) occurs in far Western Acre State of Brazil (73° W) and in southern Venezuela (Amazonas) at 65° W as well as in Guyana (Essequibo) at 58° W but both of the latter localities are in a region where no *Urospadix* occur. Finally, molecular studies have shown the two groups to be consistently and significantly distinct (Temponi, 2006).

*Anthurium* grex *Porphyrochitonium* was first described in 1860 by H.W. Schott, who recognized 28 nomenclaturally valid but rankless 'greges' (flocks) of *Anthurium* species (Schott, 1860), and it was later raised to formal sectional status by Engler (1878: 55). Schott based it on a single species, *Anthurium scherzerianum* Schott. He included two other species currently recognized as members of sect. *Porphyrochitonium* in other greges (Croat & Sheffer, 1983). *Anthurium lancifolium* Schott was placed in grex *Acamptophyllum* along with three other species all of which are now considered members of sect. *Urospadix*, a group which typically lacks glandular punctations. *Anthurium friedrichsthali* Schott, was placed in grex *Leptanthurium* Schott, a small but natural group (Croat, 1975; Delannay & Croat, 2020) with few flowers per spiral, uniovulate ovaries, and a base chromosome number of 10. It does not easily accommodate *Anthurium friedrichsthali* despite its superficial resemblance to *A. gracile* (Rudge) Schott (Croat, 1975).

Engler's 1905 revision of *Anthurium* recognized *A. scherzerianum* as the only member of sect. *Porphyrochitonium*, but he included a number of species of typical *Porphyrochitonium* (as re-defined by Croat & Sheffer, 1983) in sect. *Urospadix*, including *A. andinum* Engl., *A. aureum* Engl., *A. barbacoasense* Engl., *A. curvatum* Sodiro, *A. durandii* Engl., *A. firmum* Engl., *A. glanduligerum* Engl., *A. julospadix* Sodiro, *A. lancifolium* Engl., *A. littorale* Engl., *A. myosurus* Sodiro, *A. paludosum* Engl., *A. punctatum* N.E.Br., *A. silvicola* Engl., *A. sulcatum* Engl., *A. tenuispica* Sodiro, *A. trianae* Engl., *A. tenuifolium* Engl., *A. turrialbense* Engl. (currently a synonym of *A. bakeri*), *A. umbricola* Engl., and *A. umbricola* var. *rupicola* Engl. In addition, he included a few other typical members of *Anthurium* sect. *Porphyrochitonium* in sect. *Xialophyllum* (*A. angosturense* Engl. *A. filiforme* Engl. and *A. tenuinerve* Sodiro), sect. *Polyneurium* Engl. (*A. densinervium* Engl.), sect. *Tetraspermium* (*A. margaricarpum* Sodiro), sect. *Pachyneurium* (Schott) Engl. (*A. hacumense* Engl.), and sect. *Episeiostenium* (*A. bakeri*). He also followed Schott in erroneously placing *A. friedrichsthalii* in sect. *Leptanthurium*, then added another species, *A. acutangulum* Engl. as well. All of these species that Engler placed in other sections are not unusual or different in any way from the other members of sect. *Porphyrochitonium* and it is difficult to imagine why they were placed where they were. Engler did not seem to recognize the importance of the glandular punctations on the blades in defining this group. Engler usually did not even mention the dark glandular punctations in his descriptions of most of the species and yet these glandular punctations are the easiest character to observe and the most reliable character for identifying the section. At the time of the completion of Engler's 1905 revision of *Anthurium* there were 28 currently valid names already described in *Anthurium* sect. *Porphyrochitonium* either by Engler himself or by earlier authors. Sodiro described an additional ten species of *Anthurium* sect. *Porphyrochitonium* (Sodiro, 1905), which were not included in Engler's revision. These were *Anthurium cachabianum* Sodiro, *A. fuscopunctatum* Sodiro, *A. navasii* Sodiro, *A. pedunculare* Sodiro, *A. pellucidopunctatum* Sodiro, *A. plantagineum* Sodiro, *A. quinquesulcatum* Sodiro, *A. rhizophorum* Sodiro, *A. spathulifolium* Sodiro and *A. tenuispica* Sodiro.

No modern revision exists for *Anthurium* sect. *Porphyrochitonium*. The last revision, in Das Pflanzenreich (Engler, 1905), treated only one species in the section, whereas my (T.B.C.) estimates put the total at well over 500 species, many of which are new to science. Engler did include 30 species clearly belonging to *Anthurium* sect. *Porphyrochitonium* elsewhere in his revision, mostly in sect. *Urospadix* (Schott) Engl., but also in sect. *Episeiostenium* (Schott) Engl., sect. *Tetraspermium* (Schott) Engl., and sect. *Xialophyllum* (Schott) Engl. Thus, the last revision is completely out of date, and it is very important that this species-rich ornamentally important group be revised. One would have to investigate groups of invertebrates to encounter similar statistics regarding new species.



A few additional species were described before the senior author's own involvement with *Anthurium*. Kurt Krause published *Anthurium porschianum* K.Krause and *A. ramonense* Engl. ex K.Krause in 1932 (Krause, 1932). Other species of *Anthurium* sect. *Porphyrochitonium* published after the turn of the century include *A. chiriquiense* Standl. (Standley, 1940) and *A. terryae* from Panama (Standley & Williams, 1952), *A. apaporanum* R.E.Schult. from the Amazon basin (Schultes, 1958) and *A. wendlingeri* G.M.Barroso (Barroso, 1965). In addition, there were two species described by Bunting during his work with the Araceae for the Flora of Venezuela, *A. angelorum* G.S.Bunting (Bunting, 1975) and *A. subscriptum* G.S.Bunting (Bunting, 1986).

Thus, 18 species were described after the last revision by Engler and before the senior author's involvement with *Anthurium* sect. *Porphyrochitonium*. This left a total of 44 species in the section. One of these, *Anthurium porschianum* Burret ex K.Krause, proved to be synonymous with *A. acutangulum* bringing the total number of recognized species to 43 by the time the senior author began work on sect. *Porphyrochitonium*.

The senior author's own taxonomic efforts with *Anthurium* sect. *Porphyrochitonium* included describing four new species, *A. alatipedunculatum* Croat & R.A.Baker, *A. austinsmithii* Croat & R.A.Baker, *A. louisii* Croat & R.A.Baker and *A. utleyorum* Croat & R.A.Baker from Costa Rica with Richard Baker at the Field Museum (Croat & Baker, 1979). This was followed by a revision of *Anthurium* from Central America, first for Middle America (Croat, 1983) then for Panama (Croat, 1986). While the Middle American revision generated no additional new species in sect. *Porphyrochitonium* at the time, the Panama Revision yielded 36 new species in sect. *Porphyrochitonium* mostly known only from Panama at the time but now in some cases also found to be ranging into Costa Rica or Colombia. The total number of species in Central America was 40 before the species in this paper are considered.

Recent studies on material collected in Panama and Costa Rica since the senior author's last revisions in the 1990s have shown that many additional new species occur there. This paper describes 11 new species for Costa Rica and 62 new species for Panama. Thus, the total number of known species of sect. *Porphyrochitonium* for Central America is 127 with an additional two varieties. Costa Rica has 30 taxa (29 species and 1 variety) whereas Panama has 113 taxa (111 species and 2 varieties). Only 15 species are presently known to occur in both countries. The fact that so many species have turned up in Central America in the past 25 years despite the Missouri Botanical Garden's current emphasis on South America is an indication of the complexity and diversity of sect. *Porphyrochitonium*. The plants are often small and owing to their generally similar leaves are overlooked by collectors. Areas that have already been studied, such as Central America, give an indication of the degree to which the group has been overlooked. The earlier floristic accounts for the Araceae of Central America including Panama (Standley, 1928, 1944), Costa Rica (Standley, 1937) and Guatemala (Standley & Steyermark, 1958) included few species of *Anthurium* sect. *Porphyrochitonium*. In addition to being inaccurate by including many synonyms, the treatments also grossly undercounted the number of existing species. Standley included only four species in his Flora of the Canal Zone (Standley,

1928). The Flora of Costa Rica (Standley, 1937) included an additional seven names representing eight species for the country. The Flora of Panama, which included only seven species of *Anthurium* sect. *Porphyrochitonium* (Standley, 1944) was particularly unrepresentative. Thus, Standley, the principal compiler of Araceae in Central America treated only 11 species of sect. *Porphyrochitonium* for Central America while there are at least 126 species known from Central America today. While Standley treated only seven species in *Anthurium* sect. *Porphyrochitonium*, in Panama alone there are 111 species plus 2 varieties known in the section today. While Costa Rica has 12 new species, only one of them also occur in Panama.

The discrepancy between the number of species reported by Standley and the number reported here was in part due to a poor understanding of the collections that existed at the time (many were simply misdetermined), but also to the fact that most collections of Araceae have been made since I began my work with the family in the late 1960's (and especially between 1968 and 1986 when I began working principally in South America). During this time, the Missouri Botanical Garden still had a regular full time collecting program in Panama and there were vast increases in the number of species collected and identified. Since the treatment of Araceae in the Flora of Panama (Standley, 1944), some genera, such as *Philodendron* have increased from 12 species to 115 species known today or a ninefold increase since 1944. *Anthurium* was as dramatic with a sevenfold increase from 37 known species to 289.

### South America

No meaningful floristic studies have been made for *Anthurium* sect. *Porphyrochitonium* in South America, excepting Venezuela which is now relatively well-known floristically (Bunting, 1979; Croat, 1985; Croat & Lambert, 1987). Few species are known from this part of South America and only *A. apaporanum*, *A. bakeri* (from Amazonas in southern Venezuela) and *A. angelorum*, *A. bernardii* Croat, *A. fernandezii* Croat, *A. gebrigeri* Croat, *A. gonzalezii* Croat and *A. smithii* Croat from the Cordillera de la Costa and the Cordillera de Mérida are known. The senior author's own efforts with South American *Porphyrochitonium* began with Croat & Lambert (1987).

The Guianas are even weaker than northern Venezuela in representation of sect. *Porphyrochitonium*, with only two species, *A. apaporanum* and *A. bakeri*, known in all three of the countries of the Guianas, and in the Venezuelan Guyana.

Even on the eastern slopes of the Andes and in western Amazonia, only a few species were known until recently. The effort to study the area of northern Peru in the Department of Amazonas between the Río Santiago and the Río Cenepa brought the discovery of the greatest concentration of sect. *Porphyrochitonium* in the Amazon drainage. This area was explored by Dr Brent Berlin who was conducting anthropological studies and hired a series of local collectors between the years 1972 and 1980. They turned up several new *Porphyrochitonium*. Rodolfo Vásquez of the Missouri Botanical Garden began working in the area as early as 1981.

Working with Camilo Díaz and others, Vásquez made a concerted effort to collect in the region between 1993 and 1999. This resulted in the Flora of the Río Cenepa (Croat et al. 2005). This work has 15 species of sect. *Porphyrochitonium* all of which were new to science except *A. apaporanum*. The new species were *A. apanui* Croat, *A. atamainii* Croat, *A. baguense* Croat, *A. chinimense* Croat, *A. diazii* Croat, *A. huashikatii* Croat, *A. rubiokayapii* Croat, *A. leveauii* Croat, *A. ligulare* Croat, *A. mostaceroi* Croat, *A. penae* Croat, *A. quipuscoae* Croat, *A. tsamajainii* Croat, *A. tunquii* Croat and *A. yamayakatense* Croat.

The only species known in the section from Bolivia, *Anthurium beckii* Croat & Acebey was published in preparation for the Araceae for the Bolivian Checklist (Croat & Acebey, 2005).

A later publication (Croat et al., 2010b) included additional species of sect. *Porphyrochitonium* from the related region in the Cordillera del Cóndor (Delannay & Croat, 2021) and in an area to the north at the base of the Cordillera de Cutucú. *Anthurium collettianum* Croat was described from the Amazon lowlands of eastern Ecuador near the border with Peru and *A. nangaritense* Croat was from southeastern Ecuador in the Cordillera del Cóndor.

A paper (Croat et al., 2013) describing 11 new species from Latin America included a single *Porphyrochitonium* species, *Anthurium betsyae* Croat, from the region between Tarapoto and Yurimaguas — known for lots of endemic species, as well as one from the Chocó region, *A. quinonesiae* Croat, where new species of sect. *Porphyrochitonium* are abundant.

There are only 16 species in Peru that are endemic to the region of northern Peru in Amazonas State. *Anthurium apaporanum* and *A. bakeri* are the only widespread *Porphyrochitonium* in the Amazon Basin.

Although it is probable that additional new species will be found on the eastern slopes of the Andes between Colombia and Bolivia, the fact is that, despite considerable collecting in the region, the total number of species in sect. *Porphyrochitonium* from the eastern slopes of the Andes in the Amazon drainage and the slopes of the Cordillera de la Costa in Venezuela appears to be only 30. Except for those from the Cordillera de la Costa, the drainage of all these species is into the Amazon Basin.

The distribution of *Anthurium* sect. *Porphyrochitonium* is richest on the western slopes of the Andes from central Ecuador to northern Colombia and Panama. Perhaps the greatest concentration is in the Chocó region. Only a few studies have been concluded in this vast stretch south of Panama

In Ecuador, there is considerable richness, but few definitive studies have yet been completed. A study of the ENDESA reserve in Pichincha Province of Ecuador at 650–800 m elevation in a Premontane wet forest life zone (Croat & Rodríguez, 1995) turned up only four species, *A. aureum* Engl., *A. cabuyalense* Croat & J. Rodr., *A. margaricarpum* Sodiro and *A. rodrigueziae* Croat, two of them described there for the first time.

The richest assemblage of species of sect. *Porphyrochitonium* in Ecuador is in the northwest corner of the country in Esmeraldas and Carchi Provinces (especially the former). A study of the Araceae of Esmeraldas Province, especially the Lita-San Lorenzo region has been ongoing for the past 22 years with revisions for *Philodendron* (Croat et al., 2016) and for *Anthurium* sect. *Polyneurium* (Croat et al., 2019) having been published. An ongoing investigation of sect. *Porphyrochitonium* by the senior author and REU (NSF Research Experiences for Undergraduate) student Anna Dmitreiva with more than 100 species for the region will be ignored for purposes of this paper because that project is not finished.

In Colombia, the richest area thus far surveyed is a region in the lowlands of the Pacific slope near Buenaventura in Valle del Cauca Department. The region called Bajo Calima located between the Bajia de Málaga and the Río Calima was surveyed by Tom Croat & Dorothy C. Bay, a student who did her Ph.D. thesis on the Araceae of the region (Croat et al., 2006). The area is in a transitional zone between Tropical wet forest and Tropical rain forest life zones. This small region turned up 17 species of *Anthurium* sect. *Porphyrochitonium* with eleven new species: *Anthurium calimense* Croat & D.C.Bay, *A. cordobense* Croat & D.C.Bay, *A. cylindratum* Croat & D.C.Bay, *A. joaquinense* Croat & D.C.Bay, *A. langendoenii* Croat & D.C.Bay, *A. lautum* Croat & D.C.Bay, *A. malaguense* Croat & D.C.Bay, *A. oxyanthum* Croat & D.C.Bay, *A. perviride* Croat & D.C.Bay, *A. verrucosum* Croat & D.C.Bay and *A. wattii* Croat & D.C.Bay. In addition, another new species was found sterile, and was left undescribed, but is included in this paper (*Anthurium miriamiae* Croat). The Bajo Calima region had five other species that had already been described from the region or were described from elsewhere (Central America). These were *Anthurium barbacoasense* Engl., *A. filiforme* Engl., *A. friedrichsthalii* Schott, *A. paludosum* Engl. and *A. vallense* Croat.

A floristic survey from another area on the western slope of Colombia in Chocó in the area of Cabo Corrientes (Mora et al., 2006) yielded only 12 species of sect. *Porphyrochitonium*, five of which were new (and one not published owing to being sterile) (Croat & Mora, 2004). The El Amargal Reserve in this area where the study was carried out by Marcela Mora for her undergraduate thesis, is a region in a *Tropical wet forest* life zone. Species occurring there are *A. acutangulum* Engl., *A. acutibacca* Croat & M.M.Mora, *A. amargalense*, *A. arusiense* Croat & M.M.Mora, *A. dwyeri* Croat, *A. friedrichsthalii* Schott, *A. grandicataphyllum* Croat & M.M.Mora, *A. hacumense* Engl., *A. lancifolium* Schott, *A. paludosum* Engl. and *A. ramonense* Engl. ex K.Krause.

Only one montane site in western South America has been studied, that of La Planada in Nariño Department in Colombia. Most of the 10 species in sect. *Porphyrochitonium* found there were new to science and five out of six were described as new (Croat et al., 2009). One sterile collection was not published. The published species were *Anthurium chucunesense* Croat, *A. keatingi* Croat, *A. lakei* Croat & Pu Huang, *A. pazii* Croat and *A. restrepoae* Croat. Engler (1898) published *Anthurium umbricola* Engl. which also occurs there. Four additional new species that were sterile were not published. This study is important in that it shows how much less rich the distribution is at high elevations in contrast to lower elevations.



In northwestern Colombia, for the area believed to be the richest region for *Anthurium* sect. *Porphyrochitonium*, all that exists is a provisional checklist containing only a small fraction of the Araceae from the Chocó (Forero & Gentry, 1989). That list contained 91 species of Araceae with only 15 members of sect. *Porphyrochitonium* out of 53 species of *Anthurium*. A conservative estimate of the number of species of *Anthurium* in sect. *Porphyrochitonium* in the Chocó Department would be at least 150 species. In another paper, where 35 new species of Araceae were published from Colombia (Croat et al., 2010a), another new member of sect. *Porphyrochitonium*, *Anthurium dylanii* Croat was published from Chocó Department. Since such a small portion of the area of greatest richness for the group has been explored, it is assumed that the total number of published species will more than double, which is typical for other groups of Araceae that have been revised. Thus, the estimate for the total number of species in sect. *Porphyrochitonium* is well over 500 species. Finally, two of the species included in the *Anthurium* of Panama (Croat, 1986), *A. amnicola* Dressler and *A. sytsmae* Croat which had been reported as members of *Anthurium* sect. *Porphyrochitonium* have proven to be unusual members of a new subsection (Rupicola Croat) of *Anthurium* sect. *Calomystrum* (Croat, Whitehill & Yates, 2007). These species, part of a small group of lanceolate-leaved rheophytes which also include *A. antioquiense* Engl., *A. antrophyoides* Killip, *A. callejasiii* Croat, *A. chocoense* Croat, *A. palacioanum* Croat, *A. vanderknaapii* Croat and *A. werffii* Croat, are much like sect. *Porphyrochitonium* in having short internodes and small lanceolate leaves but they lack the typical glandular punctations. They will not cross with other members of sect. *Porphyrochitonium* but will cross with more typical members of sect. *Calomystrum* such as *Anthurium andreanum* Linden. This has allowed many interesting hybrids, especially the introduction of a lilac-colored flower into the typical cut-flower breeding program owing to the lilac-colored spathe in *A. amnicola* Dressler.

## Materials and Methods

Herbarium specimens were studied from nearly all herbaria devoted to neotropical studies but especially major herbaria in Europe, North America, western South America and Central America, specifically AAU, AGUAT, B, BH, BIGU, BM, BR, C, CAS, CHAP, CHOCO, COL, CR, CUV, DUKE, E, EAP, ENCB, F, FMB, GH, GOET, GUAT, HUA, HNMN, HULE, HUT, INPA, IAN, JAUM, K, L, LE, LOJA, LPB, M, MEXU, MG, MOL, NY, P, PMA, PSO, Q, QCNE, QPA, R, RJ, S, SEL, TEFH, QPA and VEN. While most herbaria have been visited repeatedly all but those in Venezuela were revisited in the past 5 years.

The Lucid *Anthurium* Key is an unpublished multi-entry key that contains 1640 species of known *Anthurium* which have been fully described, including all published species and others described and pending publication. It is used as a means of assuring the novelty of any new entity. It is a multi-entry key designed to eliminate any species which does not contain the specified set of characters chosen (those attributed to the species in question). Thus, it works to eliminate from a list all species that lack the characteristics of the plant in question.

Descriptions are based on a model published by Croat & Bunting (1979) that attempts to standardize descriptions to make them more easily comparable. An attempt has been made to include the features of both fresh vegetative material and the appearance of dried leaves where appropriate. Certain features of living plants are predictably modified, eg. a narrowly rounded vein rarely retains that shape but is invariably made narrower and often acute on drying. Other features such as soft and peaked epidermal cells on understory plants become predictably areolate on drying as the soft cells and epidermis collapse inward. Petioles which are frequently subterete and weakly sulcate in life are invariably narrowed adaxially and the sulcus becomes deeper with sharper margins. Thus, a petiole described as sharply and deeply sulcate might in life be only subterete and weakly to moderately sulcate. The senior author has cultivated and prepared specimens from thousands of plants and some information can be extrapolated based on this experience.

## TAXONOMY

### *Anthurium* sect. *Porphyrochitonium* (Schott) Engl.

*Anthurium* sect. *Porphyrochitonium* (Schott) Engl. in Martius, Fl. Bras. 3(2): 55 (1878).

*Anthurium* grex *Porphyrochitonium* Schott, Prodr. Syst. Aroid.: 438. 1860

Type: *Anthurium scherzerianum* Schott.

Typically epiphytic to hemiephytic but frequently terrestrial; internodes short or rarely elongated; typically 1 cm diam. or less, sometimes to 3 cm diam.; roots typically moderately dense with more than one root per internode, commonly moderately short but not typically clustered and directed upward, rarely flattened and forming a subglobose root mass; cataphylls typically persistent and fibrous, most frequently erect, sometimes disheveled and spreading, frequently with fragments of epidermis, rarely persisting intact. Leaves usually clustered near apex; petioles typically subterete but at least weakly sulcate adaxially, narrowly rounded abaxially, sometimes sharply 3-sided or 3-sided-winged, about as long as the blade or shorter than blade, rarely longer than blades; blades longer than broad, most commonly narrowly ovate to elliptic or oblanceolate, rarely ovate, usually acuminate at apex, usually acute at the base, rarely subcordate at base, usually subcoriaceous, rarely thin or coriaceous, usually moderately bicolorous; major veins typically prominent; midrib always raised on both surfaces, convex, narrowly rounded to acute above, convex, narrowly rounded, acute or 3 or more ribbed or winged below; primary lateral veins usually more prominent than collective veins, sometimes with the collective veins more prominently sunken; collective veins usually 1 pair, sometimes with 2 pairs, rarely with 3 pairs, the inner pair arising from near the base, the 2<sup>nd</sup> pair usually from near the base, usually not ending at the apex, the 3<sup>rd</sup> pair usually margining out in lower 1/3 of the blades; glandular punctations on at least the lower surface, often also on the upper surface; tertiary veins typically not prominent. *Inflorescence* typically erect, typically moderately

long-pedunculate, frequently short-pedunculate, rarely long-pedunculate; peduncle terete, triangular to quadrangular, sometimes winged-ribbed; spathe typically lanceolate and spreading to reflexed, sometimes erect, less frequently ovate, rarely ovate-cordate, not typically ensheathing spadix, usually green, rarely reddish or purplish to yellow or bright red; spadix typically oblong to short-tapered, often long-tapered, frequently green, often colored, reddish, orange, purplish, purplish violet to lavender. Inflorescence typically erect, often pendent; berries typically sub-quadrangular at apex with a deep depression, commonly red, yellow, orange, violet-purple to lavender-blue or white; seeds typically 4 per berry, sometimes 6-seeded; mesocarp juicy and sweet. Chromosomes usually  $2n=32$ , but also  $2n=30$ ,  $2n=31$ ,  $2n=29$  (Croat & Sheffer, 1983).

### **Geographical distribution of *Anthurium* sect. *Porphyrochitonium***

*Anthurium* sect. *Porphyrochitonium* ranges from Mexico (Chiapas) to Colombia and Ecuador on the Pacific slope of the Andes and to Venezuela and the Guianas, south to the northern rim of the Amazon Basin in Peru and Ecuador, with lesser areas of diversity in the Andes of Venezuela (Croat & Lambert, 1987). Distribution of species is uneven across the range, with centers of diversity apparent in Panama, Colombia, and Ecuador, especially at lower to middle elevations in the western Andes of Colombia and Ecuador. The most widespread species, *A. bakeri*, ranges from Mexico to southern Venezuela and the Guianas. The group is particularly diverse at or near sea level in rain forests in northwestern Colombia in the Departments of Chocó and Valle.

In Central America species diversity in general increases approaching northwestern Colombia, (see Appendix). Only a single species in the section occurs in Mexico, Guatemala, and Belize (*A. bakeri*), two species in Honduras, none in El Salvador, five species in Nicaragua, 31 in Costa Rica, 112 in Panama and an unknown but likely very much higher number for Colombia. In all, there are only 31 species for all Middle American countries (Belize, Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica).

As is true for many other genera (Croat, 1992), the northwestern part of South America, especially on the Pacific slope in Colombia and adjacent Ecuador, is rich in species of *Anthurium* sect. *Porphyrochitonium*. It is currently difficult to predict the actual number since most of the collections remain unstudied, especially material at the herbarium in Bogotá, Colombia (COL), where all the unicate collections of A. H. Gentry and E. Forero are deposited for their studies on the floristics of the Chocó (Forero & Gentry, 1989). The region of Bajo Calima (Croat et al., 2006) and the area around Quibdó in Chocó Department remain the only areas reasonably well studied. Yet this represents a minuscule part of the region where the section is richest.

In contrast to the richness in the northern part of South America, few species of sect. *Porphyrochitonium* occur in the Amazon Basin and no species occur in the Southern Cone (Zuloaga & Belgrano, 2015) or even in the southern part of the Amazon basin except for one species in Bolivia. Until recently only *Anthurium apaporanum* and *A. bakeri* were known to occur at

lower elevations in the Amazon basin. Even on the Pacific slope, species are most abundant at lower elevations and diminish as elevation increases. For example, at Bajo Calima at less than 150 m (Valle Department of Colombia) there are at least 30 species, while at the ENDESA Reserve (Pichincha Province, Ecuador) at 650 m there are only four species and at the La Planada Reserve (Nariño Department, Colombia) at 1900 m there are only eleven species.

## NEW SPECIES DESCRIBED HERE

### 1. Species from Central America

*Anthurium abelardoi* Croat, **sp. nov.** — Type: COSTA RICA. Limón Province: Limón Cantón, El Progreso, area of inundated soils, Fila Matama, Valle de La Estrella, 09°47'20"N, 83°07'30"W, 1600 m, 24 Apr. 1989, G. Herrera & A. Chachón 2765 (holotype, MO-4371692).

#### Figure 1.

*Diagnosis:* *Anthurium abelardoi* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short, slender internodes, stiffly erect, reddish brown cataphyll fibers, the weakly sulcate petioles about 1/3 as long as the blades, the oblong-lanceolate long-acuminate blades glandular-punctate on both surfaces, narrowly rounded at the base and with the collective veins increasingly more remote from the margin above the middle (except near the very tip).

Epiphytic; internodes short, 1.4 cm diam.; cataphylls 3.7 cm long, stiffly erect, drying reddish brown, fibrous with fragments of brown epidermis, the fibers eventually manila. Leaves with petioles 10.5–17.5 cm long, 2–3 mm diam., terete, weakly sulcate with petiolar punctations, drying yellowish brown; geniculum 0.7–1.2 cm long, drying darker than petioles; blades oblong-lanceolate, 24.7–35.8 cm long, 3.9–6.0 cm wide (averaging 30 × 5), 6.0–6.3 (averaging 6.15) times longer than broad, broadest midway, 2.0–2.4 (averaging 2.2) times as long as petioles, long-acuminate with last 1.5 cm less than 1 mm wide, narrowly rounded at the base, subcoriaceous, weakly bicolorous, drying brown and weakly glossy above, grayish brown and weakly glossy below; midrib with sparse glandular punctations or with no punctations, drying narrowly rounded, finely ribbed and concolorous above, narrowly rounded, ribbed and concolorous below; primary lateral veins 15 or 16 per side, departing midrib at 55–60°, scarcely more prominent than interprimary veins, drying weakly and narrowly rounded and concolorous above, narrowly rounded and concolorous below; collective veins only one in number, arising from the 1<sup>st</sup> pair of primary lateral veins, 2–7 mm from margin, more prominent than primary lateral veins; antemarginal vein present; basal veins 1 pair; upper surface sparsely dark glandular-punctate and minutely granular-ridged and pustular upon magnification; lower surface densely dark glandular-punctate and minutely and irregularly granular-ridged upon magnification. *Inflorescence* with peduncle ca 20 cm long, drying subterete, weakly sulcate; spathe reddish, drying ca 4.5 cm long, ca 0.8 cm wide, lanceolate with no punctations, coriaceous and reddish brown; spadix green when immature, uniform and weakly tapered, 5.3 cm long, 0.6

cm diam.; flowers about 3 visible per spiral, drying 1.7–1.8 mm long and 1.4–1.7 mm wide; tepals minutely granular and sparsely pustular on drying; lateral tepals 1.2–1.3 mm wide, the outer margins 2-sided, inner margin rounded; stamens not observed. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium abelardoi* is known only from the type locality in Costa Rica in Limón Province at 1500 m elevation in a Tropical wet forest life zone.

**Etymology** — *Anthurium abelardoi* is for Abelardo Chachón Gamboa who was a parataxonomist for a now abandoned program to collect insect and plant collections for the Department of Natural History of the National Museum of Costa Rica. He collected many interesting and new species, including this one.

**Comments** — *Anthurium abelardoi* is similar to both *A. lancifolium* Schott and *A. austin-smithii* Croat & R. A. Baker, both of which differ in having lanceolate or ovate-lanceolate blades clearly broadest below the middle and in having the collective veins less than 2 mm from the margin in the upper 8 cm of the blade. *Anthurium lancifolium* also differs by having the blades lanceolate to ovate-lanceolate and broadest clearly below the middle.

In the Lucid *Anthurium* Key, *Anthurium abelardoi* tracks to *Anthurium cuasicanum* Croat from Darién Province in Panama, *A. gracilispadix* Croat from Cerro Colorado in Chiriquí Province and *A. pageanum* Sodiro. *Anthurium cuasicanum* differs by having much smaller lanceolate leaf blades less than 16 cm long with the leaf base acute and the collective veins closer to the margins (especially toward the apex (1–5 mm from margin). In contrast, the leaf blades of *A. abelardoi* have a rounded leaf base and the collective veins rather remote from the margins (2–7 mm) even approaching the apex. *Anthurium gracilispadix* differs by having blades lanceolate to lanceolate-elliptic with attenuate bases. *Anthurium pageanum* differs by having a triangular petiole and typically grayish drying blades.

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***Anthurium alatipetiolum*** Croat, **sp. nov.** — Type: PANAMA. San Blas (Kunayala): El Llano-Cartí Road, 7 miles N of Interamerican Highway, ca. 09°15'N, 79°00'W, ca. 550 m, 14 Mar. 1985, G. McPherson & T. B. Croat 6852 (holotype, MO-3208937). **Figure 2.**

*Diagnosis:* *Anthurium alatipetiolum* is a member of sect. *Porphyrochitonium* characterized by its epiphytic habit, short internodes, reddish brown, more or less parallel cataphyll fibers, long-petiolate leaves, 5-winged petioles, elliptic-oblancheolate, weakly acuminate blades drying grayish with glandular punctations on both surfaces, the collective veins arising from one of the lower primary lateral veins as well as by its long-pedunculate inflorescence, 4-winged peduncles, linear-lanceolate green spathe and a long-tapered green spadix.

Epiphytic; internodes short, 1.3 cm diam.; cataphylls 5.3–5.5, cm long, persisting as red-brown, more or less parallel fibers with reddish brown epidermis. *Leaves* long-petiolate; petioles 5.5–14.4 cm long, 3 mm diam., 5-winged, broadly and sharply sulcate adaxially, sharply 3-ribbed abaxially, drying yellowish brown; geniculum 5 mm long, drying darker than pet-





Figure 1. *Anthurium abelardoi* Croat. Holotype: Herrera 2765.



**Figure 2.** *Anthurium alatipetiolum* Croat. Holotype: McPherson & Croat 6852.

ioles; blades elliptic-oblongate, 14.2–26.4 cm long, 4.7–8.1 cm wide (averaging  $21 \times 7$ ), 3.0–3.3 (averaging 3.2) times longer than broad, 1.9–2.6 (averaging 2.1) times as long as petioles, gradually acuminate at apex, attenuate at base, subcoriaceous, drying moderately glossy on both surfaces, dark green above, drying greenish gray above, paler and gray below; midrib glandular-punctate on both surfaces, narrowly raised and concolorous above, narrowly raised below, drying acute, slightly darker than surface; primary lateral veins 14 per side, departing midrib at  $45^\circ$  near middle, drying narrowly rounded, slightly paler above, narrowly rounded and slightly darker below; tertiary veins drying weakly raised above and below; collective veins arising from 3rd primary lateral vein, 4 mm from margin; basal veins 1 pair; antemarginal vein present; ; upper surface densely granular, glandular-punctate; lower surface sparsely granular, glandular-punctate. Inflorescence with peduncle 39.2–40.4 cm long, 4-winged; spathe green, reflexed-spreading, 4.8–4.9 cm long, 5–6 mm wide, linear-lanceolate, drying moderately coriaceous, yellowish brown; spadix green, sessile, long-tapered, 9.4–11.1 cm long, 4–5 mm diam.; flowers 3 visible per spiral, drying 3.2–3.5 mm long and 2.5–2.8 cm wide; tepals minutely granular on drying; lateral tepals 2.4 mm wide, the outer margins 2-sided, inner margin rounded; stamens not exerted. Infructescence not seen.

**Distribution and ecology** — *Anthurium alatipetiolum* is endemic to Panama, known only from the type locality in San Blas (Kunayala) Province at 550 m elevation in a Tropical moist forest life zone.

**Etymology** — The species epithet is derived from the Latin ‘*alatus*’ (meaning winged) and ‘*petiolus*’ (petiole) referring to the winged petioles.

**Comments** — *Anthurium alatipetiolum* is seemingly most closely related to *A. pageanum* Sodi-ro which differs by having a merely 3-angled petiole. It also differs by lacking the brownish speckling on the lower blade surfaces. *Anthurium alatipetiolum* is also similar to both *A. acutangulum* Engl. and *A. ramonense* Engl. ex K.Krause but both differ in having a subterete, not 5-winged petiole and by having blades typically more than 30 cm long.

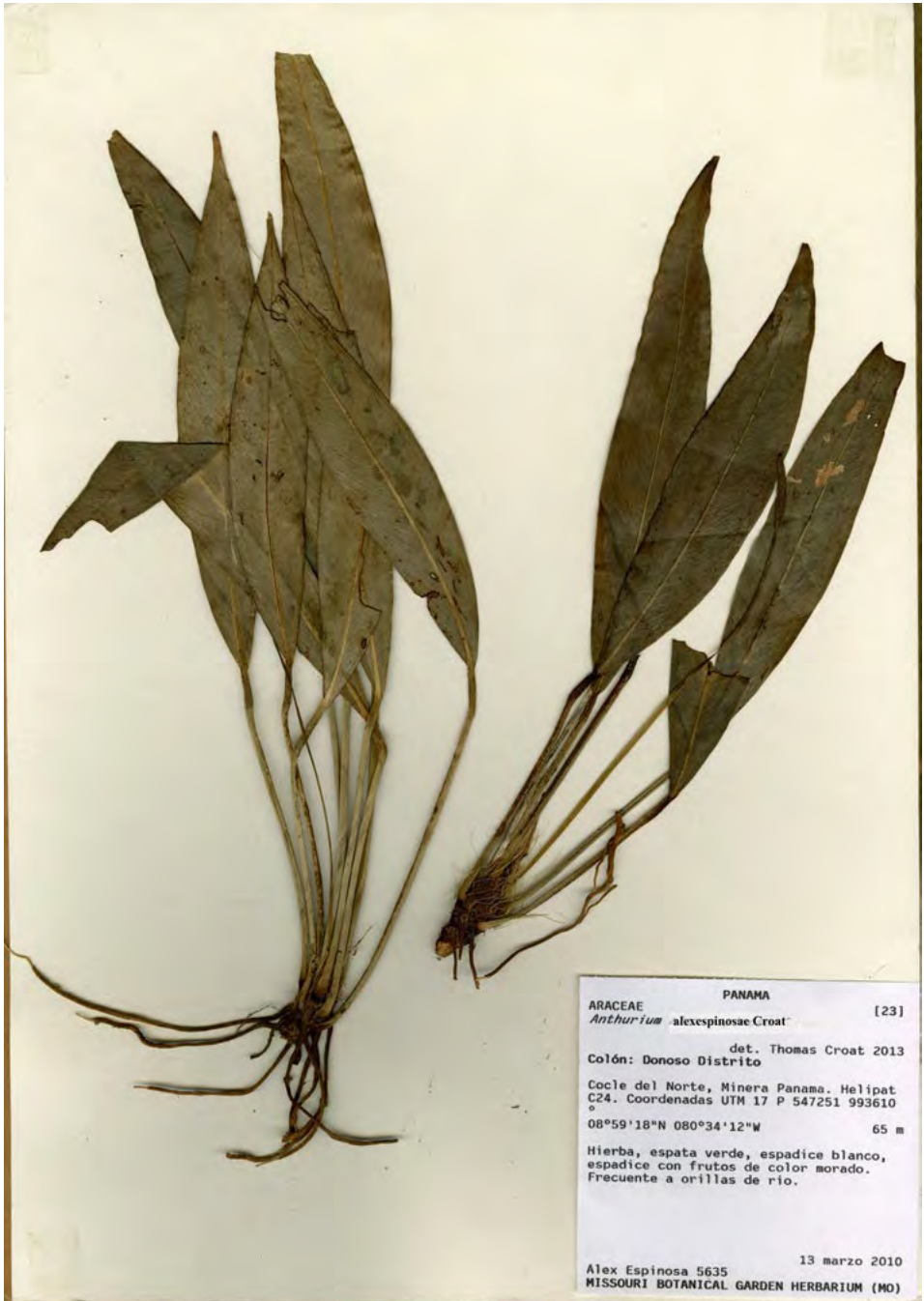
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***Anthurium albifructum*** (Croat) O.Ortiz & Croat, **comb. et stat. nov.** — *Anthurium lancifolium* Schott var. *albifructum* Croat, Monogr. Syst. Bot., Missouri Bot. Gard. 14: 125–126. F. 92. 1986. — Type: PANAMA. Chiriquí: N of San Félix, along mining road 18–27 mi N of Pan-American Hwy. (above turn-off to Chame or Escopeta), 1200–1500 m, ca.  $08^\circ 34'N$ ,  $81^\circ 52'W$ , T.B. Croat 33099 (holotype, MO-2381151). **Figure 3.**

**Diagnosis:** *Anthurium albifructum* is a member of sect. *Porphyrochitonium* characterized by an epiphytic habit, short internodes, persistent cataphyll fibers, long-petiolate leaves, subterete petioles which are equal to or longer than the blades, the elliptic, gray-green-drying blades with moderately indistinct primary lateral veins, glandular punctations on both surfaces and a long-pedunculate inflorescence with a green spathe, a spadix that is green at anthesis and greenish white berries.



**Figure 3.** *Anthurium albifructum* (Croat) O.Ortiz & Croat. Holotype: Croat 33099.



**Figure 4.** *Anthurium alexespinosae* Croat. Holotype: *Espinosa 5635*.



Epiphyte or terrestrial; internodes short, to 1.5 cm diam.; cataphylls to 3.0 cm long, intact, reddish brown, fibrous with fragments of brown epidermis. Leaves with petioles 22.7–28.6 cm long, 1.0–1.5 mm diam., subterete, drying acutely sulcate, greenish brown; geniculum 1.2 cm long, drying darker than petioles; blades elliptic, 12.8–27.3 cm long, 4.6–8.1 cm wide (averaging  $21 \times 7$ ), 2.6–3.5 (averaging 3.0) times longer than broad, broadest midway, 0.7–1.1 (averaging 0.9) times as long as petioles, abruptly acuminate at apex (acumen to 2.5 cm), base acute, subcoriaceous, moderately bicolorous, dark green and matte-subvelvety above, moderately paler and semiglossy below, drying gray-green, matte above, yellowish green-brown to grayish green-brown, semiglossy below; midrib drying narrowly acute, and slightly darker above, narrowly raised, short linear-granulate and slightly paler below; primary lateral veins 18–20 per side, departing midrib at  $45\text{--}50^\circ$  drying narrowly rounded, and concolorous above, narrowly raised and concolorous below; collective veins arising from only one pair of basal veins, 3–4 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface glandular-punctate (glands dark brown and weakly raised); lower surface glandular-punctate, entirely areolate upon magnification, matte-subvelvety surface, finely textured, minutely subgranular with ridges sometimes evident. Inflorescence erect, long-pedunculate with peduncle to 40 cm long, drying brown; spathe lanceolate, 2.7–5.0 cm long, 3–10 mm wide, green, reflexed-spreading, drying coriaceous and yellowish brown; spadix sessile, white to greenish white, uniformly and weakly tapered, 2.7–5.2 cm long, 3–5 mm diam., drying yellowish brown; flowers 4 visible per spiral, drying 2.2 mm long, 2.7 mm wide; tepals drying minutely granular; lateral tepals 1.5 mm wide, outer margins 2- or 3-sided, inner margin rounded; stamens not emergent. *Infructescence* erect, spathe persistent; berries obovoid, white before maturity, becoming tinged with purple-violet at base at maturity, all the berries emerged throughout spadix at full maturity, obovoid, rounded at apex, with punctiform raphide cells in upper three-fourths of berry; seeds (boiled up)  $3.5\text{--}4.0 \times 2.4\text{--}2.6 \times 1.5$  mm thick, 2 per berry, oblong-obovoid, rounded at base, truncate or oblique at apex, flattened on one side, lacking any apparent appendage.

**Distribution and ecology** — *Anthurium albifructum* is known only from Panama at the type locality in Bocas del Toro on Cerro Fábrega at 1300 m in a Premontane rain forest life zone.

**Etymology** — The species epithet is from the Latin ‘*albus*’ (white) and ‘*fructus*’ (fruit) referring to its white berries.

**Comments** — *Anthurium albifructum* is probably closest to *A. lancifolium* Schott but that species differs by having blades that are typically thicker, broadest below the middle and with much more prominent primary lateral veins. In the Lucid Anthurium Key, *Anthurium albifructum* tracks to *A. crassitepalum* Croat from Darién Province in Panama which differs by having blades that dry brownish, having the upper midrib more nearly convex, not narrowly rounded and drying more or less acute on upper surface, having the upper blade surface more conspicuously glandular-punctate and by having the tepals markedly thickened in dry condition. *Anthurium cuasicanum* Croat, also from Darién Province, differs by having smaller (less than  $16.5 \times 5.3$  cm), lanceolate leaf blades that are more nearly rounded at the base.

Paratypes: PANAMA. Chiriqui, vicinity of Boquete, SW slope of Cerro Pate de Macho, virgin forest, 1630–1780 m, 08°46'N, 82°25'W, 18 June 1987, T.B. Croat 66394 (MO); Bocas del Toro: Caribbean slope of Cerro Fábrega at foot of 'Falso Fábrega' in Palo Seco Reserve, second NW tributary (on map) of Río Culebre Pavón Camp, 09°09'51"N, 82°39'41"W, 1300 m, 22 Mar. 2005, A.K. Munro & S. Cafferty 4857 (BM, INB, MEXU, MO, PMA).

*Anthurium alexespinosae* Croat, **sp. nov.** — Type: PANAMA. Colón: Coclé del Norte, Minera Panamá, Donoso, helipad C24, UTM 547251 993610, 65 m, 13 Mar. 2010, *A. Espinosa* & *L. Kelvin* 5635 (holotype, MO-6414024; isotype, PMA). **Figure 4.**

*Diagnosis:* *Anthurium alexespinosae* is a member of sect. *Porphyrochitonium* and characterized by its terrestrial habit, short internodes, cataphylls with short, parallel, pale fibers, subterete petioles drying grayish green and weakly and narrowly sulcate, 0.4–0.7 times as long as blades on the larger leaves, the narrowly lanceolate and oblong-lanceolate, narrowly acuminate blades which dry grayish green, with bases acute, midrib narrowly and prominently raised above, primary lateral veins moderately obscure, a single pair of collective veins about as prominent as the primary lateral veins, glandular punctations on both surfaces but moderately obscure above, as well as by the long-pedunculate inflorescence with a reflexed green spathe, the moderately stipitate, white, short, weakly tapered spadix and violet-purple berries.

Terrestrial; internodes short, 7–10 mm diam.; cataphylls (3.7)4.1–4.3 cm long, persisting as a dense mass of fine, mostly erect, pale grayish brown fibers. Leaves with petioles 2.7–11.8 cm long, 2 mm diam., subterete, weakly and narrowly sulcate, sparsely glandular-punctate, drying grayish green; geniculum 6–7 mm long, drying darker than petioles; blades narrowly lanceolate to oblong-lanceolate, 10.6–21.1 cm long, 2.7–4.3 cm wide (averaging  $16 \times 3$ ), 3.6–6.1 (averaging 4.8) times longer than broad, 1.4–3.9 (averaging 2.5) times as long as petioles, narrowly acuminate but the tip abruptly rounded with a weak apiculum at apex, acute at base, drying subcoriaceous, grayish green and weakly glossy above, grayish green and weakly glossy below; midrib drying narrowly raised, sparsely glandular-punctate and paler above, narrowly convex, finely ribbed and paler below; primary lateral veins 10(11) per side, departing midrib at 35–40°, drying weakly and narrowly rounded, paler above, weakly and narrowly rounded and paler below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from the only pair of basal veins, 3–4 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface sparsely glandular-punctate, moderately smooth on magnification; lower surface consciously glandular-punctate, moderately smooth on magnification. *Inflorescence* with peduncle sparsely glandular-punctate, 15.1 cm long; spathe green, reflexed, 3.1 cm long, 1.2 cm wide, oblong-lanceolate, drying moderately coriaceous, grayish green; spadix white, stipitate 5 mm, short and cylindroid-tapered, 3.4 cm long, 4 mm diam., drying yellowish brown; flowers 5 visible per spiral, drying 2.0 mm long and 1.9 wide; tepals smooth, very minutely granular on drying; lateral tepals 1.9 mm wide, inner margin rounded, outer margins 3-sided; stamens not exerted. Infructescence with berries violet-purple.

**Distribution and ecology** — *Anthurium alexespinosae* is endemic to Panama, known only from the type locality in Colón Province at 65 m in a Tropical wet forest life zone.

**Etymology** — *Anthurium alexespinosae* is named in honor of Panamanian botanist, Alex Espinosa who, along with Kelvin Lorenzo collected the type specimen. Alex has contributed to the knowledge of the traditional use of plants, especially medicinal plants. He worked for many years at the University of Panama, Faculty of Pharmacy, at the Centro de Investigaciones Farmacognósticas de la Flora Panameña (CIFLORPAN) and has participated in many floristic studies throughout Panama, making many important collections.

**Comments** — *Anthurium alexespinosae* is most similar to *A. lancifolium* Schott which differs by having typically much larger blades with more prominent primary lateral veins and a much more long-tapered acumen with the upper surface very weakly glandular-punctate as well as by having a usually more stipitate spadix. It is also similar to *A. rupicola* Croat that differs by having leaf blades more than 7 times longer than wide.

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***Anthurium ariztutense* Croat, sp. nov.** — Type: PANAMA. Veraguas: vicinity of Cerro Arizona-Cerro Tute, above Santa Fé and Altos de Piedra, along trail to summit; 08°30'N, 81°10'W; 1000–1200 m, 28 July 1988, G. McPherson 12803 (holotype, MO-3584284). **Figure 5.**

**Diagnosis:** *Anthurium ariztutense* is a member of sect. *Porphyrochitonium* recognized by its epiphytic habit, short internodes, fibrous cataphylls, long-petiolate leaves, subterete, weakly sulcate petioles, narrowly ovate-elliptic and prominently acuminate blades with downturned tips, prominently sunken collective veins, glandular punctations on both surfaces and especially by its long-pedunculate inflorescences with the peduncles longer than the petioles and by the stamens which remain emergent throughout the spadix.

Epiphyte; internodes short, 1 cm diam.; cataphylls 4 cm long, dark brown, soon pale fibrous with fragments of epidermis. *Leaves* with petioles 5.0–24.5 (38.5) cm long, drying 1.5– 2.0 (2.5) mm diam., subterete, weakly sulcate, drying deeply and sharply sulcate, semiglossy, densely glandular punctate; geniculum 1.2–1.3 cm long, terete, drying darker, closely and acutely longitudinally ridged, sometimes transversely ridged; blades narrowly ovate-elliptic, 9.0–12.7(16.8) cm long, 2.1–4.6(6) cm wide, 2.1–2.6 times longer than wide, (0.5)0.8–1.4 times longer than petioles, narrowly and sharply long-acuminate and downturned at apex, rounded at base, drying moderately coriaceous, yellowish gray and matte above, greenish gray to yellowish gray, matte below; midrib usually drying narrowly rounded to much thicker than broad in a deep valley, concolorous, sparsely glandular-punctate above, narrowly rounded, in part with an acute medial rib, glandular-punctate below; primary lateral veins 5 or 6 per side, departing midrib at 30–40°, drying deeply sunken and concolorous above, narrowly concolorous and glandular-punctate below; tertiary veins obscure; collective veins arising from near the base, spreading at nearly a 90° angle at the base, 3–6 mm from the margins, deeply sunken above, much more so than the primary veins; upper surface densely glandular-punctate, longitudinally wrinkled-ribbed; lower surface dark glandular-punctate, granular and

areolate-ridged. *Inflorescence* erect; peduncle 18.3–29.7(41.0) cm long, drying 2 mm diam., yellowish green, finely and irregularly ribbed; spathe lanceolate, 1.7–2.3 cm long, 0.8–1.1 cm wide, spreading; spadix sessile or stipitate 3–4 mm, 2.1–3.0 cm long, 4–5 mm diam., pink to brown; flowers (4)5–6 visible per spiral, 2.5–3.1 mm long and wide; tepals densely granular, matte, lateral tepals 1.0–1.8 mm wide, inner margin rounded, outer margin 2-sided; stamens held at surface of tepals, remaining emergent throughout spadix; anther 0.3 mm long, 0.6 mm wide; thecae narrowly ovoid, weakly divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium ariztutense* is endemic to Panama, known only from the type locality in Veraguas Province at 1000–1200 m in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium ariztutense* is named for the type locality on the massif that comprises Cerro Arizona and Cerro Tute located in Veraguas Department near Santiago.

**Comments** — *Anthurium ariztutense* is closest to *A. tutense* Croat, a species with which it has been confused but that species, while also occurring in the same area and having long-pedunculate inflorescences, has proportionately much shorter petioles, rarely up to 10 cm long and have leaf blades usually acute at the base.

*Paratype*: PANAMA. **Veraguas**: Parque Nacional Santa Fé, La Sabaneta, bosque achaparrado, vertiente caribe, 08°40'34"N.80°59'31"W, 2140 m, 30 Sept., 2014, *Batista, J.A. Camp. M. Perret. & S. Rodríguez* 1191 (MO-6600601).

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***Anthurium attenuatifolium*** Croat, **sp. nov.** — Type: PANAMA. Veraguas: Vicinity Santa Fé, along road between Santa Fé and Calovebora, 1.7 mi past Alto Piedra School, 1.5 mi beyond Quebrada Cosilla (previously referred to as Río Primero Braso), 08°31'28"N, 81°07'50"W, 570 m, 13 July 1994, T.B. *Croat & G. Zhu* 76852 (holotype, MO-04612789).

**Figure 6.**

*Diagnosis*: *Anthurium attenuatifolium* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, more or less parallel cataphyll fibers, glandular-punctate petioles sharply flattened adaxially with medial rib and acute abaxially, oblong-elliptic, acuminate blades which dry greenish with glandular punctations on both surfaces, the collective veins arising from basal veins as well as the spreading-reflexed green spathe and long-tapered green spadix.

Epiphyte; internodes short, 1 cm diam.; cataphylls 3.2–3.7 cm long, acute, persisting, fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. Leaves with petioles 4.5–23.4 cm long, 3–4 mm diam., glandular-punctate, more or less 3-sided, sharply flattened adaxially with medial rib, acute abaxially, drying yellowish brown; geniculum 5–13 mm cm long, drying darker than petioles; blades oblong-elliptic, 21.6–36.6 cm long, 5.8–9.6 cm wide (averaging 28 × 7), 3.6–4.5 (averaging 4.0) times longer than broad, broadest at midpoint, 1.3–5.0 (averaging 3.2) times as long as petioles, gradually acuminate at apex, (acumen to 1.8 cm long), attenuate at base, subcoriaceous, drying olive-brown



Figure 5. *Anthurium ariztutense* Croat. Holotype: McPherson 12803.





Figure 6. *Anthurium attenuatifolium* Croat. Holotype: Croat 76852.

and matte above, yellowish olive-brown and semiglossy below; midrib drying narrowly raised, finely ribbed, sparsely glandular-punctate and darker above, narrowly rounded, some acute, ribbed, sparsely glandular-punctate and darker below; primary lateral veins 11 or 12 per side with moderately prominent interprimary veins, departing midrib at 60°, drying weakly and narrowly rounded, paler above, narrowly raised and darker below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from only pair of basal veins, 5 mm from margin, moderately loop-connected; basal veins one pair; antimarginal vein present; upper surface conspicuously glandular-punctate, uniformly and minutely granular; lower surface conspicuously glandular-punctate, smooth and irregularly dark speckled on magnification. Inflorescence with peduncle 13.6–22.4 cm long; spathe green, 5.1–7.8 cm long, 5–10 mm wide, spreading-reflexed, narrowly elliptic, drying moderately coriaceous, yellowish olive-brown; spadix medium green, stipitate 3 mm, very long and weakly tapered, 9.9–13.9 cm long, 3–5 mm diam., drying yellowish brown; flowers 2 (3) visible per spiral, drying 2.4 mm long and 1.6 mm wide; tepals matte, minutely granular on drying; lateral tepals 1.7 mm wide, the outer margins 2-sided, inner margin rounded; stamens not exerted. *Infructescence* with berries pale red-orange, flat at apex with a minute depression.

**Distribution and ecology** — *Anthurium attenuatifolium* is endemic to Panama, known only from the type locality in Santa Fé Province at 570 m elevation in a Premontane wet forest life zone.

**Etymology** — The species epithet is derived from the Latin ‘*attenuatus*’ (meaning attenuate) and ‘*folium*’ (meaning leaf), referring to the attenuate leaf blade.

**Comments** — *Anthurium attenuatifolium* is seemingly most closely related to *A. pageanum* Croat which differs by having a merely 3-angled petiole. It also differs by lacking the brownish speckling on the lower blade surfaces; *A. zhui* Croat that differs by having dark purplish, sharply triangular petioles and narrower dark brown drying blades

*Paratypes*: PANAMA. **Veraguas**: Valley of Río Dos Bocas on road between Alto Piedra (above Santa Fé) and Calovebora, along road, 08°33'03"N, 081°10'17"W, 350–400 m, 29 Aug 1974, T.B. Croat 27442 (MO); Valley of Río Tercero Braso beyond Escuela Agrícola Alto Piedra above Santa Fé, 08°32'45"N, 81°09'58"W, 500–600 m, 29 Aug 1974, T.B. Croat 27323 (MO).

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***Anthurium aurantiifructum*** Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Oleoducto Road near Continental Divide, Fortuna Dam area, 1000 m, 8°48'N, 82°12'W, 5 Feb. 1984, W.W. Churchill, G. de Nevers & H. Stockwell 4217 (holotype, MO-3210677). **Figure 7.**

**Diagnosis:** *Anthurium aurantiifructum* is a member of sect. *Decurrentia* and is characterized by its small size, epiphytic habit, short, slender internodes, persistent cataphyll fibers, elongated, bluntly C-shaped to sharply flattened petioles almost as long as or longer than the blades, the linear-oblong epunctate long-attenuated dark grayish-brown eglandular blades with the collective veins arising from the base and and more prominent than primary lateral veins as well,

a long-pedunculate brownish inflorescence which equals or exceeds the length of the leaves as well as by a green tapered spadix with 2 flowers visible per spiral.

Epiphytic; stem more than 11 cm long, the lower internodes short or to more than 1 cm long, 4–6 mm diam.; roots sparse and slender, some to 15 cm long; cataphylls 3–4 cm long, becoming fibrous and sub-parallel. *Leaves* more or less erect; petioles 12.5–16 cm long, 2.5–3.0 mm diam., bluntly C-shaped, sulcate, drying dark grayish brown; geniculum 0.6–1 cm long, drying slightly thicker and darker than petioles; blades linear-oblong, 12.7–16.5 cm long, 1.2–2.2 cm wide (averaging  $16 \times 2$ ), 6.3–10.5 times longer than broad, broadest midway, 0.6–1.0 times as long as petioles, long-attenuated to narrowly long-acuminate at apex, narrowly acute at base, subcoriaceous, slightly bicolorous, drying dark grayish brown and matte, grayish brown, matte below; midrib weakly raised and eglandular on both surfaces, concolorous, drying bluntly acute and paler above, narrowly rounded and concolorous below; primary lateral veins 9–10 per side, departing midrib at 25–30°, scarcely more visible than upper surface, granular on both surfaces, drying bluntly acute and paler above, narrowly convex and concolorous below; collective veins arising from base or the lower pairs of basal veins, 1–2 mm from margin, more prominent than primary lateral veins; basal veins 2 pairs; upper surface eglandular, weakly and minutely granular; lower surface eglandular, conspicuously granular and granular ridged. Inflorescence erect with peduncle 15–17.5 cm long, drying reddish brown; spathe oblong, green, reflexed, drying 1.8–2.1 cm long, 3–5 mm wide, coriaceous, green to reddish brown; spadix green, tinged brownish, scarcely tapered to apex semiglossy, 4.2–6.6 cm long, 4–5 mm diam., drying reddish brown, bluntly rounded at apex; flowers 2 visible per spiral, drying 3.2 mm long, 1 mm wide; tepals granular on drying; lateral tepals 2.5 mm wide, inner margin rounded, outer margins 3-sided; stamens not emergent; pistils darker green; Infructescence with berries orange, more or less globose, 6 mm diam.

**Distribution and ecology** — *Anthurium aurantiifructum* is known only from Bocas del Toro and Coclé Province at 900–1000 m in a *Premontane rain forest* or *Tropical wet forest* life zones.

**Etymology** — The species epithet is from the Latin ‘*aurantiacus*’ (orange) and ‘*fructus*’ (fruit).

**Comments** — *Anthurium aurantiifructum* is most similar to *A. tuquesense* Croat in general appearance because it has similarly long, narrow blades and a long-pedunculate inflorescence with a long-tapered spadix but that species is a member of sect. *Porphyrochitonium* with glandular-punctate lower blade surfaces and proportionately much shorter petioles. *Anthurium aurantiifructum* may also be confused with *A. chacoense* Croat which differs by having the inflorescences shorter than the leaves and a spadix that is less than 4 cm long.

In the Lucid *Anthurium* Key, *Anthurium aurantiifructum* tracks to two other members of sect. Decurrentia, *A. boqueronense* Croat, which differs by having proportionately shorter petioles and more elliptic leaf blades as well as a proportionately shorter peduncle as well as *A. carrasquillanum* Croat, which differs by having proportionately longer petioles and peduncle as well as by having only a single pair of basal veins. It might also be confused with similar members of sect. *Porphyrochitonium*, namely *A. crassiradix* Croat which differs by having a V-shaped



**Figure 7.** *Anthurium aurantiifructum* Croat. Holotype: Churchill et al. 4217.



**Figure 8.** *Anthurium bajobonitense* O.Ortiz & Croat. Holotype: Ortiz et al. 1570.



petiole, blades which are generally broadest below the middle with a rounded leaf base and a well-developed secondary collective vein; *A. crassitepalum* Croat, which differs by having thinner, more elliptic, acuminate blades with a single pair of collective veins; *A. friedrichstahl* Schott, which differs by having much longer, more linear blades and proportionately much shorter petioles and *A. oxystachyum* Croat, which differs by having thinner leaves with lanceolate blades with a single pair of rather remote collective veins.

Paratype: PANAMA. Coclé: Vicinity of La Mesa, N of El Valle de Antón, along east edge of Cerro Gaital, on hogback ridge leading to summit, 08°37'N, 80°08'W, 900–1000 m, 13 July 1987, T.B. Croat 67231 (MO).

***Anthurium bajobonitense*** O.Ortiz & Croat, **sp. nov.** — Type: PANAMA. Colón: Parque Nacional Portobelo, Cascajal. Área boscosa al los alrededores de Bajo Bonito, bosque húmedo con presencia de muchos cuerpos de agua. 09°30'55"N, 79°31'56"W, 165 m, 17 Aug. 2013, O.Ortiz, L.Martínez, A.Cubilla, J.I.Dojirama & J.Dojirama 1570 (holotype, PMA-107460).

**Figure 8.**

*Diagnosis:* *Anthurium bajobonitense* is a member of sect. *Porphyrochitonium* and is characterized by its lithophytic habit, short internodes, persistent short fibrous cataphylls, moderately long-petiolate leaves, sulcate petioles, elliptic-lanceolate prominently acuminate moderately bicolorous blades which are acute at the base with 1 pair of essentially straight collective veins that are moderately close to the margins and with glandular punctations on both surfaces as well as by the moderately long-pedunculate inflorescences with a small lanceolate erect-spreading spathe, and a prominently stipitate pale yellowish green spadix.

Growing among stones on rocky stream bank; internodes short, 1.0–1.5 cm diam.; cataphylls 4.0–4.5 cm long, weathering to moderately straight red-brown fibers, persisting. Leaves with petioles 23–25 cm diam., drying deeply sulcate adaxially, dark brown, finely many-ribbed circumferentially; geniculum 2.0–2.3 cm long, drying blackened; blades elliptic-lanceolate, 32.3–37.4 cm long, 9.9–10.6 cm wide, 3.2–3.5 times longer than wide, 1.4 times longer than petioles, acuminate at apex, acute at base, subcoriaceous drying medium gray-brown above, moderately paler, pale to medium yellow-brown and semiglossy below; midrib drying narrowly rounded, concolorous, finely narrow-ribbed, glandular-punctate above, narrowly rounded, slightly darker, finely many-ribbed, sparsely glandular-punctate below; primary lateral veins 10 or 11 per side, departing midrib at 40–45°, drying narrowly rounded, scarcely discernible above, narrowly rounded, sometimes glandular-punctate below; collective veins 1 pair, arising from near base, 5–6 mm from margin, sunken above, narrowly raised below, more prominent than primaries; upper surface finely areolate-granular and weakly glossy sparsely glandular-punctate; lower surface finely granular-striate, conspicuously round glandular-punctate. *Inflorescence* erect, much shorter than leaves; peduncle 31.5 cm long, terete; spathe drying 5 cm long, 6 mm wide, dark green, erect-spreading with the margins turned up; spadix prominently stipitate (stipe 9 mm long, 7 mm diam.) drying 7.4 cm long, 4 mm diam., pale yellowish green (slightly yellowish in distal 2 cm), matte; flowers 4–5 per spiral, 2.2–2.4 mm long,

2.0–2.3 mm wide; tepals drying yellow-brown, matte, weakly granular; lateral tepals 1.2–1.4 mm wide, inner margin rounded, outer margin 2- or 3-sided; stamens included, anthers 0.3 mm long, 0.6 mm wide, thecae ovoid, moderately divaricate. Infructescence not seen.

**Distribution and ecology** — *Anthurium bajobonitense* is endemic to Panama, known only from about 160 m on the Caribbean coast in Colón Province in a Tropical wet forest life zone.

**Etymology** — The species is named for the type locality at Bajo Bonita in the Portobelo National Park.

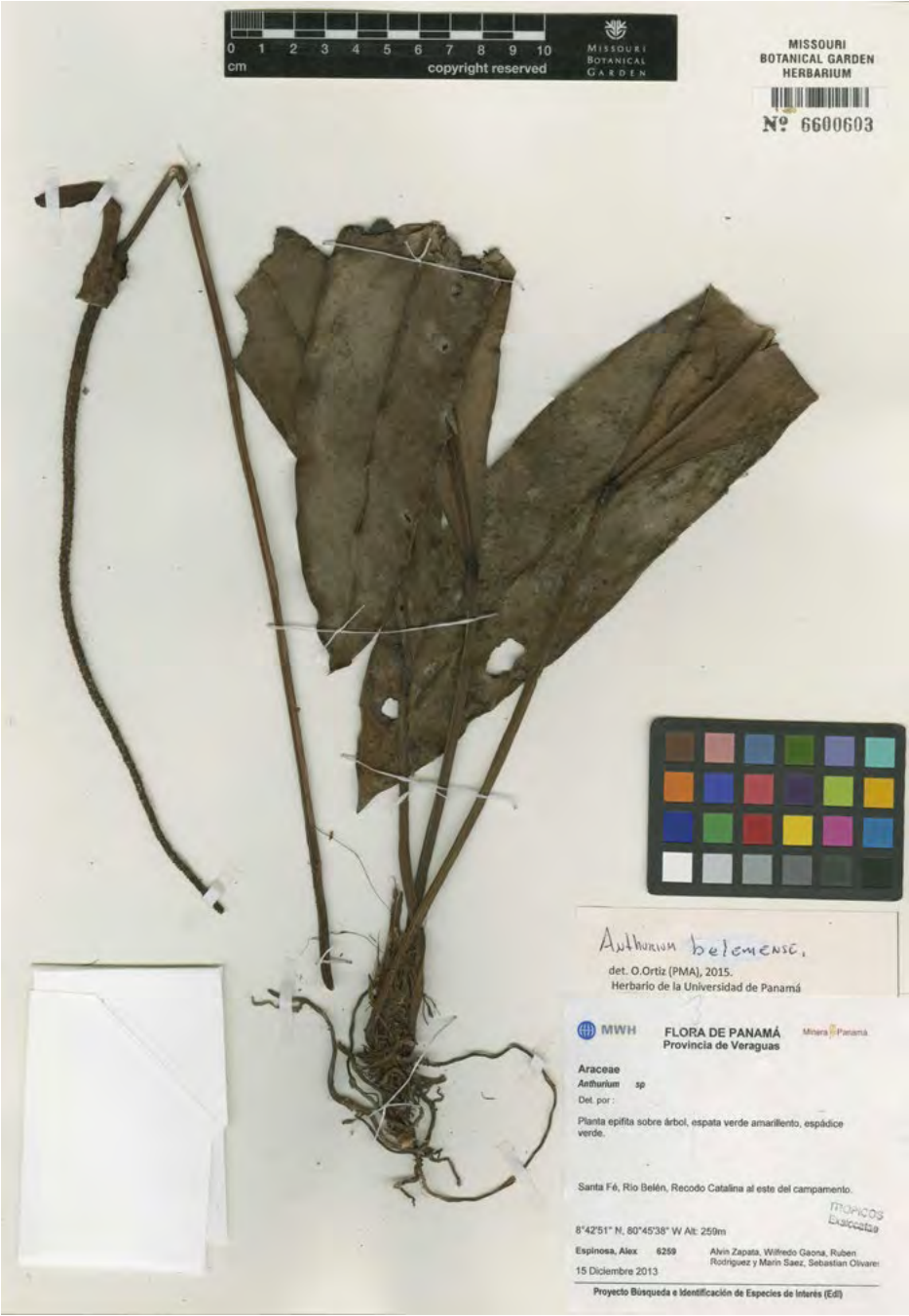
**Comments** — *Anthurium bajobonitense* is seemingly closest to *A. friedrichsthali* Schott in its general appearance (leaves of similar size and shape) but that species differs by having a thicker, usually whitish, sessile spadix. In the as yet unpublished key to the species of *Anthurium* from Central America *Anthurium bajobonitense* is closest to *A. albifructum* Croat which differs by having petioles longer than the blades with elliptic leaf blades and a sessile spadix.

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***Anthurium belenense*** Croat & O.Ortiz, **sp. nov.** — Type: PANAMA: Veraguas: Río Belén, Recodo Catalina, al este del campamento, 08°48'51"N, 80°45'38"W, 259 m, 15 Dec. 2013, *A. Espinosa*, *A. Zapata*, *W. Gaona*, *R. Rodríguez*, *M. Saez* & *S. Olivare* 6259 (holotype, MO-6600603; isotype, PMA). **Figure 9.**

**Diagnosis:** *Anthurium belenense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent reddish brown cataphyll fibers, sharply 3-sided petioles, oblanceolate-elliptic, short-acuminate, moderately coriaceous blades which dry brownish and are glandular-punctate only on the lower surface with the midrib acute below and with moderately obscure primary lateral veins, a single pair of collective veins 3–5 mm from the margin as well as distinct antemarginal veins; also by the moderately long-pedunculate inflorescence, angular-winged peduncles, green, lanceolate, erect-spreading spathe and very long-tapered, green spadix 50–100 times longer than wide.

Epiphytic; internodes short, 1.5–2.0 cm diam.; cataphylls 3–5 cm long, dark reddish brown, fibrous. Leaves with petioles 8.4–19.8 cm long, 4–5 mm wide, sharply triangular, broadly sulcate adaxially with sharply erect margins, faintly ribbed medially, acutely angular abaxially; geniculum 1.0–1.3 cm long, drying darker than petiole shaft; blades oblanceolate-elliptic, 21.7–28.5 cm long, 5.8–8.1 cm wide (averaging 25 × 6.4 cm), 3.4–4.7 times longer than wide, 0.4–0.7 times as long as petioles, acute to obtuse and weakly acuminate at apex, acute to cuneate at base, moderately coriaceous, drying dark gray-brown and matte above, weakly glossy and medium brown below; midrib acute and concolorous above, narrowly rounded to acute and darker below; primary lateral veins 10–12 per side, departing midrib at 50–65°, inconspicuous and sometimes minutely undulate on upper surface, weakly raised, concolorous and sometimes minutely undulate below; collective veins one principal pair arising from the base, straight and 3–5 mm from margin but with a distinct antemarginal pair of veins; upper surface minutely wrinkled, eglandular, often purplish speckled; lower surface diffusely and weakly pale-speckled, conspicuously dark-glandular. *Inflorescence* erect; peduncle 16–34 cm, longer



**Figure 9.** *Anthurium belenense* Croat & O.Ortiz. Holotype: Espinoza et al. 6259.



**Figure 10.** *Anthurium bergii* Croat. Holotype: Croat 81377.



**Figure 11.** *Anthurium bergii* Croat. Croat 81377. Habit of living plant.



than petioles, usually acutely angular, sometimes angular-winged, drying reddish brown; spathe yellowish green, 8.5–9.0 cm long, 7–10 mm wide, erect-spreading; spadix green, narrowly long-tapered, 22.5–31.0 cm long, 4 mm diam., 50–100 times longer than wide; flowers 3 visible per spiral, 4.6–5.2 mm long, 1.7–2.1 mm wide; tepals drying dark brown, moderately smooth; lateral tepals 1.8–2.1 mm long, very broadly rounded on inner margin, very broadly 2-sided on outside margin; stamens barely visible above tepals, 0.2 mm long, 0.8 mm wide. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium belenense* is endemic to Panama, known only from Veraguas and Coclé Provinces at 200–259 m in a *Tropical wet forest* or *Premontane rainforest* life zone.

**Etymology** — *Anthurium belenense* is named for the type locality near Belén in Veraguas Province in the Parque Nacional Santa Fé.

**Comments** — *Anthurium belenense* most closely resembles darker drying specimens of *A. pageanum* Croat but that species differs by having upper blade surfaces glandular-punctate and by having a much shorter, less long-tapered spadix, typically 15–25 times longer than wide. *A. belenense* is also similar to *A. gracilispadix* Croat, *A. crassiradix* Croat and *A. paludosum* Engl. *Anthurium gracilispadix* differs by having petioles flattened adaxially with erect margins, leaf blades glandular-punctate on both surfaces and inflorescences with shorter spadices (5–10 cm vs. 22–31 cm); *A. crassiradix* differs by having leaf blades narrowly ovate-oblong, inflorescences with 5–6 flowers visible in the principal spiral and 8–10 flowers in the alternate spiral; *A. paludosum* differs by having coriaceous, persisting intact cataphylls, petioles D-shaped to subterete and inflorescences with cylindrical spadices scarcely tapered at apex.

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*Anthurium bergii* Croat, **sp. nov.** — Type: Cultivated at Selby Gardens 2002–259 ex PAN-AMA. Kunayala Province: El-Llano Carti Road, originally collected by Wally Berg, Sarasota, vouchered 15 Oct 1997, T.B. Croat 81377 (*holotype*, MO-05098524; isotypes, K, PMA, SEL, US). **Figures 10 & 11.**

**Diagnosis:** *Anthurium bergii* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, cataphyll fibers persisting in a more or less intact reticulum, sharply sulcate petioles, the oblong-lanceolate blades with 2 pairs of basal veins and glandular punctuations on both surfaces as well as by its green, reflexed spathe and the faintly violet-purple, weakly glossy, uniformly and weakly tapered spadix.

Epiphytic; internodes short, ca. 5 mm diam.; roots 5 mm diam., descending, green becoming light brown, elongate; cataphylls existing intact, reddish brown, finally deciduous. Leaves with petioles subterete, 15–18 cm long, drying 3–4 mm wide, sharply sulcate, drying grayish brown; geniculum 1.5–2.2 cm long, drying transversely fissured, darker than petioles; blades oblong-lanceolate, 24.5–37.4 cm long, 8.8–13.5 cm wide (averaging 31 × 11), 2.5–3.3 (averaging 3.0) times longer than wide, 2.3–3.6 (averaging 2.7) times longer than petioles, broadest below middle, gradually acuminate at apex, acute at base, subcoriaceous, drying weakly glossy

to matte, slightly bicolorous and gray; midrib bluntly acute above (drying acute at least above middle), convex and paler below, drying yellowish brown, narrowly ribbed; primary lateral veins 17 or 18 per side, departing midrib at 50°, flat above when fresh, drying weakly raised on both surfaces but scarcely more prominent than the interprimary and tertiary veins; collective veins arising from 1st pair of basal veins (innermost basal vein) slightly more prominent than primary lateral veins, drying weakly raised both surfaces, 4–7 mm from margin; antemarginal veins present; basal veins 2 pairs; upper surface smooth, glandular-punctate; lower surface glandular-punctate, densely granular on magnification. *Inflorescence* erect-spreading at anthesis, later pendent; peduncle tinged reddish, 35.7–58.2 cm long, drying sharply sulcate; spathe linear-lanceolate, green, reflexed, drying 4.6–14.3 cm long, 5–6 mm wide, yellowish brown; spadix faintly violet-purple, weakly glossy, uniformly cylindroid and weakly tapered, drying 11.2–41.9 cm long, 4–5 mm wide, brown; flowers 6–7 per spiral, drying 2.5–2.6 mm long, 1.4–1.5 mm wide; tepals minutely granular on drying; lateral tepals 1.4 mm wide, the outer margins 2-sided, inner margin rounded. *Inflorescence* not seen.

**Distribution and ecology** — *Anthurium bergii* is endemic to Panama, known only from the type locality on the El Llano-Cartí Road in Panamá Province at 350 m elevation in a *Premon-tane wet forest* life zone.

**Etymology** — *Anthurium bergii* is named in honor of the late Wally Berg, a collector of Bromeliaceae from Sarasota, Florida who collected the type. Wally was a collaborator with the staff at Selby Gardens, especially with the late Harry Luther, a Bromeliaceae specialist then at Selby Gardens.

**Comments** — *Anthurium bergii* perhaps most closely resembles *A. bicollectivum* Croat based on the size and shape of its blades but that species differs by having a second pair of collective veins that usually extend to the apex of the blades whereas the second pair of collective veins for *A. bergii* merge promptly with the margin near the base. In the Lucid Anthurium Key, *Anthurium bergii* keys out with two other species, *A. curvilaminum* Croat and *A. crassilaminum* Croat, both of which it resembles because of its markedly arching blades in live condition and by having the collective veins rather remote from the margins. Both of those species differ by having blades 3.0–5.6 times longer than wide, the collective veins arising from the base of the blade and by lacking a short second collective vein.

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*Anthurium berguidoi* Croat & O.Ortiz, **sp. nov.** — Type: PANAMA. Darién: Serranía de Cañasas, Reserva Privada Chucantí, Cascada Chucantí, 08°37'41"N, 78°26'51"W, 699 m, 28 Aug. 2014, O.O.Ortiz 2435 (holotype, MO-660592; isotype, PMA). **Figures 12–15.**

*Diagnosis:* *Anthurium berguidoi* is a member of sect. *Porphyrochitonium* and is characterized by its terrestrial or rupicolous habit, short internodes, persistent fibrous cataphylls, sulcate petioles which dry circumferentially ribbed, more or less oblong–elliptic, narrowly acuminate blades that are glandular dotted only on the lower surface, are acute at the base and have only a single pair of basal veins as well as by its green, lanceolate, reflexed spathe and scarcely tapered spadix



**Figure 12.** *Anthurium berguidoi* Croat & O.Ortiz. Holotype: Ortiz 2435.



**Figure 13.** *Anthurium berguidoi* Croat & O.Ortiz. Ortiz 2435. Habit of living plant.





**Figure 14.** *Anthurium berguidoi* Croat & O.Ortiz. Ortiz 2435. Inflorescence.





**Figure 15.** *Anthurium berguidoi* Croat & O.Ortiz. Ortiz 2435. Infructescence.



**Figure 16.** *Anthurium billdarcyi* Croat. Holotype: D'Arcy 11259.

that ranges from lilac to rose and finally orange during flowering and becomes cream-colored in fruit with red berries.

Terrestrial or rupicolous herb; internodes short, 1.1–1.4 cm diam.; cataphylls 6.0– 6.5 cm long, persisting as grayish fibrous with tiny narrow fragments of dark brown epidermis. *Leaves* with petioles 4–9 cm long, 3.0–4.6 mm diam., terete, sulcate adaxially, drying narrowly sulcate, multi-ribbed circumferentially, medium orange-brown on drying; geniculum 6–17 mm long, drying blackened; blades oblong-ob lanceolate to oblong-elliptic, 15.6–45.7 cm long, 3.3–8.1 cm wide (averaging 29 x 5), 3.6–8.1 (averaging 5.5) times longer than wide, 3.6–8.6 (averaging 6.2) times longer than petiole, broadest at middle or slightly above middle, narrowly acuminate at apex, narrowly acute at base, moderately coriaceous, weakly bicolorous, dark green above, light green below, drying dark greenish brown, matte above, yellowish brown and weakly glossy below; midrib narrowly round-raised above, triangular below; primary lateral veins to ca. 20 per side, only weakly apparent above, easily visible below, drying weakly visible above, weakly raised, narrowly rounded and concolorous, moderately granular below; collective veins 1 pair, arising from the base, 3–7 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface smooth, eglandular; lower surface densely and weakly thick pale granular, densely and conspicuously dark glandular-punctate. *Inflorescence* erect, shorter than leaves; peduncle 16.5–28.0 cm long, terete, drying ca. 1 mm diam., several-ribbed; spathe green, lanceolate, reflexed, 3.4–3.6 cm long, 8–9 mm wide, drying, lanceolate, drying coriaceous and reddish brown; spadix sessile (stipe to 10 mm long in life), 4.0–5.5 cm long, 4–5 mm diameter, rose-colored with lavender during anthesis, orange after anthesis, becoming cream-colored in fruit, drying narrowly rounded at apex, dark brown. flowers 6 visible per spiral, drying 1.7–2.5 mm long, 1.5–2.3 mm wide; tepals drying minutely granular; lateral tepals 1.3 mm wide, inner margin rounded, outer margins 2-sided; stamens withdrawing beneath the margin of the tepals leaving the pollen on surface of tepals. *Infructescence* with tepals cream and berries red, drying 5–7 mm long, beaked at apex; seed 1 per berry, whitish.

**Distribution and ecology** — *Anthurium berguidoi* is endemic to Panama, known from the type locality in Darién Province in the Serranía de Cañasas near the border of Panama Province at about 700 m and in Panama Province near Chepo in *Tropical wet*, *Premontane wet* or *Tropical moist forest* life zones.

**Etymology** — *Anthurium berguidoi* is named in honor of biologist and conservationist Guido Berguido who has made great efforts to preserve the forests of Chucantí, located in the last section of uplifted hills in the range of the Majé Mountains.

**Comments** — *Anthurium berguidoi* is similar to *A. curvilaminum* Croat but that species differs by having primarily lateral veins less closely spaced and not prominently raised on drying and by having a dark burgundy spadix (versus violet-purple (B & K blue-purple 5/2.5) (Berlin & Kay, 1969). In the Lucid Anthurium Key, *Anthurium berguidoi* tracks to *Anthurium acutibacca* Croat & M.M.Mora which differs by having a much longer stipe on the spadix and by its red berries; *A. belemense* Croat & O.Ortiz, which differs by its very long-tapered, green spadix

which is 50–100 times longer than wide; *A. juanguillermoi* Croat, which differs by having much longer, proportionately narrower leaf blades and longer peduncle with a narrowly linear-lanceolate spathe 4.2–13.6 cm long and *A. marginellum* Sodiro which differs by its much longer petioles being about as long or longer than the blades and blades that are only about 3 times longer than broad.

*Paratypes*: PANAMA. Panamá: Distrito Chepo; Río Serrano, 4.7.18, Z. Mijango, K. Vega, C. Pineda, J. Guerra 596 and 507 (both MO, PMA); Serranía de Majé forest along small streams near the headwaters of Río Pirati, 09°00'N, 78°35'W, 100–150 m, S. Knapp & J. Mallet 5150 (MO).

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***Anthurium billdarcy*** Croat, **sp. nov.** — Type: PANAMA. Colón: Along road to Iguanita from main Colón to Portobello Highway, 09°28'N, 79°39'W, 390 m, 7 Apr. 1977, W.G. D'Arcy 11259 (holotype, MO-2589173). **Figure 16.**

*Diagnosis*: *Anthurium billdarcy* is a member of sect. *Porphyrochitonium* and is characterized by its short stem, short internodes, short cataphylls persisting more or less intact, long-petiolate leaves, petioles which are sulcate adaxially with a medial rib and slightly shorter than blades, narrowly oblong-elliptic, narrowly long-acuminate blades which dry dark brown above and moderately paler grayish yellow-brown below with a single pair of collective veins arising from the base and moderately more prominent than the primary lateral veins as well as by the long-pedunculate inflorescence with a short, green, erect-spreading spathe and short, weakly tapered, brown, stipitate spadix.

Terrestrial (fide W. D'Arcy, pers. comm.); internodes short, 4 mm diam.; cataphylls 1.8 cm long, acute at apex, persisting intact, with reddish brown epidermis. *Leaves* with petioles 16.2–18.2 cm long, 2 mm diam., sulcate adaxially with a medial rib, drying yellowish brown; geniculum 3 mm long, drying darker than petioles; blades narrowly oblong-elliptic, 20.6–21.9 cm long, 4.0–4.2 cm wide (averaging  $21 \times 4$ ), 5.0–5.5 (averaging 5.2) times longer than broad, broadest about midway, 1.2–1.3 (averaging 1.25) times as long as petioles, gradually long-acuminate at apex, (acumen 1.0–1.5 cm long), acute at base, drying subcoriaceous, dark brown and matte above, grayish yellow-brown and weakly glossy below; midrib drying narrowly raised, finely ribbed throughout and darker above, narrowly convex, finely ribbed throughout and paler below; primary lateral veins 12–14 per side, but scarcely more conspicuous than the interprimary veins, departing midrib at 45°, drying weakly and narrowly rounded, concolorous above, weakly and narrowly raised and concolorous below; collective veins arising from 1st pair of basal veins, 2.5–3.5 mm from margin; basal veins 1 pair; upper surface eglandular, densely and markedly pale-granular above; lower surface irregular at high magnifications but not markedly granular, conspicuously glandular-punctate. *Inflorescence* with peduncle 15.7 cm long; spathe green, erect-spreading, 2.5 cm long, 5 mm wide, lanceolate, drying moderately coriaceous, yellowish brown; spadix brown, stipitate 5 mm, weakly tapered, 4.2 cm long, 3 mm diam., drying yellowish brown; flowers 4 visible per spiral, drying 2.1 mm long and 1.9 mm wide; tepals minutely granular on drying; lateral tepals 1.1 mm wide, the inner margin rounded, outer margins 2-sided; stamens retracting below tepals, 0.15 mm long, 0.6 mm wide, thecae weakly divaricate. Infructescence not seen.

**Distribution and ecology** — *Anthurium billdarcyi* is endemic to Panama, known only from the type locality in Colón Province near the Río Iguanita on eastern slopes of the hills leading up to the Santa Rita Ridge, NE of Portobello at 390 m in a Montane rain forest life zone.

**Etymology** — *Anthurium billdarcyi* is named in honor of the late Dr William G. D'Arcy (1931–1999), who worked at the Missouri Botanical Garden and collected the type specimen. Bill was a specialist on the Solanaceae and was in charge of the Flora of Panama when it was finally completed in April 1980. D'Arcy was a polymath of sorts at the Garden, the guy you went to for questions about nomenclature, Latin and other languages, the history of botany and many other things. Originally an economist, Bill came to botany late in life after becoming interested while living in Tortola in the British Virgin Islands.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium billdarcyi* tracks to *A. jefense* Croat at that differs by having the leaf blades usually obtuse and short-acuminate to narrowly short-acuminate, usually drying coriaceous and somewhat grayish rather than having the leaf blades narrowly long-acuminate at apex and drying subcoriaceous, dark brown above with the cataphylls mostly drying intact as in *A. billdarcyi*. *Anthurium billdarcyi* may also be confused with *A. longistipitatum* Croat and *A. nutans* Croat, both of which differ by having more coriaceous blades which are rounded at the base as well as by having petioles much shorter than the blades.

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***Anthurium billhahnii*** Croat, **sp. nov.** — Type: PANAMA. Coclé: Between Continental Divide above El Copé (Alto Calvario) and Río Blanco, a 5-hour walk to the north, 08°38'N, 80°36'W, 1000 m, 13 Dec. 1980, K. Sytsma, W. Hahn & T. Antonio 2424 (holotype, MO-29003272). **Figure 17.**

**Diagnosis:** *Anthurium billhahnii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short densely rooted stem, fibrous persistent cataphylls, short-petiolate leaves, petioles drying narrowly and sharply sulcate adaxially and prominently several ribbed abaxially, oblong-elliptic, brown drying leaf blades acute to weakly short-acuminate at apex and attenuate at base, with a single pair of basal veins, a rather prominent antemarginal vein, many primary lateral veins which dry much less conspicuous than the collective veins as well as by the erect inflorescence held among the leaves, an erect yellowish spathe and a purple cylindroid spadix which is 7–10 times longer than wide.

Epiphyte; internodes short, 1.4 cm diam.; cataphylls 2.1–2.3 cm long, acute, persisting semi-intact at apex, becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. Leaves with petioles 2.7–4.1 cm long, 2–3 mm diam., narrowly and sharply sulcate adaxially and prominently several ribbed abaxially, drying reddish brown; geniculum 4–6 mm long, drying slightly darker than petioles; blades oblong-elliptic, 10.5–18.7 cm long, 2.9–4.4 cm wide, (averaging  $14 \times 4$ ), 3.4–4.4 (averaging 3.8) times longer than broad, broadest midway, 3.4–4.8 (averaging 4.2) times as long as petioles, weakly short-acuminate at apex, attenuate at base, drying subcoriaceous, brown and matte above, reddish brown



and weakly glossy below; midrib drying narrowly acutely ribbed to irregularly acute-ribbed, and paler above, acute, glandular-punctate, finely ribbed and darker below; primary lateral veins 8 per side, departing midrib at 60°, drying narrowly rounded, slightly paler above, finely ribbed and slightly darker below; secondary veins scarcely more visible than surface above, prominent below; collective veins arising from the only pair of basal veins, 5 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface epunctate with conspicuous, small, mound-like, concolorous bumps; lower surface conspicuously glandular-punctate, smooth; Inflorescence erect; peduncle 10.7–10.9 cm long; spathe yellowish, erect, 3.2–4.3 cm long, 1.0–1.2 cm wide, oblong-lanceolate, drying coriaceous, reddish brown; spadix purple, stipitate 6–11 mm, cylindroid, 3.6–4.1 cm long, 4–6 mm diam., drying reddish dark brown; stipe drying 3–4 mm long, 2.7 mm diam.; flowers 7 visible per spiral, drying 2 mm long and 1.7 mm wide; tepals minutely granular on drying; lateral tepals 1.2 mm wide, inner margin narrowly rounded; outer margins 3-sided; stamens not exerted. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium billbahnii* is endemic to Panama, known only from the type locality in Coclé Province at 300 m in a *Premontane wet forest* life zone (not distant from *Premontane rain forest* life zone).

**Etymology** — *Anthurium billbahnii* is named in honor of William Hahn, who is currently associate dean and associate research professor of biology at Georgetown University, Washington, D.C. His research focuses on plant molecular systematics, conservation genetics, and the evolution of monocots, particularly Arecaceae, and systematics of Oenothera and diatoms. He received his B.S. in biology from Washington University, St Louis (1985), his M.S. in botany from Cornell University (1990) and his Ph.D. from the University of Wisconsin (1993). His Guyanan collections date from his service as resident collector for the Biological Diversity of the Guiana Shield Program (1988–1989).

**Comments** — *Anthurium billbahnii* is similar to *A. scottmorii* Croat from the Cerro Jefe region which occurs at about the same elevation but that species differs by having more grayish drying blades (often with a proportionately much longer petiole), the inflorescence much longer than the leaves with the spathe reflexed.



Figure 17. *Anthurium billbahnii* Croat. Holotype: Sytsma et al. 2424.



**Figure 18.** *Anthurium boqueronense* Croat. Holotype: Knapp & Sytsma 2411.

***Anthurium boqueronense*** Croat, **sp. nov.** — Type: PANAMA. Colón: Ridges and drainage NW of Mina Boquerón #1 (manganese mine), near end of road past Salamanca; Río Boquerón drainage, 09°20'N, 79°35'W, 12 Dec. 1981, S. Knapp & K. Sytsma 2411 (holotype, MO-3041699). **Figure 18.**

*Diagnosis:* *Anthurium boqueronense* is a member of sect. *Decurrentia* and is characterized by its small size, epiphytic habit, short internodes, mostly fibrous cataphylls, short, sulcate petioles, oblong-elliptic blades which dry grayish, the long-pedunculate inflorescence with a green linear-lanceolate spathe and a slender green spadix.

Epiphyte; internodes short, 3–4 mm diam; cataphylls 3.0 cm long, mostly intact, reddish brown, becoming fibrous with fragments of brown epidermis. Leaves with petioles 4.7–5.1 cm long, 2–3 mm diam, terete, sulcate, drying grayish brown; geniculum 0.5 cm long, drying darker than petioles; blades oblong-elliptic to narrowly elliptic, 15.0–18.8 cm long, 4.7–5.1 cm wide (averaging 16 × 5), 3.1–3.7 (averaging 3.4) times longer than broad, broadest midway, 4.2–4.4 (averaging 4.3) times longer than petioles, acuminate, acute at base, drying subcoriaceous, gray-brown and weakly glossy above, gray-green-brown and semiglossy below; midrib drying narrowly rounded, short-linear-granulate and slightly darker above, narrowly raised, ribbed adaxially and concolorous below; primary lateral veins 17 per side, departing midrib at 55–60°, drying narrowly rounded, densely and minutely granular and concolorous above, bluntly acute and concolorous below; collective veins arising from the only pair of basal veins, 3–5 mm from margin; basal veins 1 pair; antimarginal veins present; upper surface eglandular, densely and minutely granular with deep-red speckles upon magnification; lower surface eglandular, densely dark reddish brown speckled (speckles irregular). *Inflorescence* with peduncle 14 cm long, drying terete and brown; spathe 2.7 cm long, 2 mm wide, green, spreading horizontal, drying coriaceous and reddish brown; spadix green, long, uniform and weakly tapered, 3.6 cm long, 3 mm diam., drying dark brown; flowers about 3 visible per spiral, drying 2.8 mm long and 2.3 mm wide; tepals minutely granular and sparsely pustular on drying; lateral tepals 1.8 mm wide, the outer margins 2- or 3-sided, inner margin rounded; stamens not emerged, anther born on the narrow filament, ca. 1 mm long and wide. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium boqueronense* is known only from the type locality in Colón Province of Panama at 300–400 m in a *Tropical moist forest* life zone.

**Etymology** — The species is named for the type locality at the mine at Boquerón and the Río Boquerón.

**Comments** — *Anthurium boqueronense* keys out with *A. glandulicostum* Croat, a species in sect. *Porphyrochitonium*, which has larger, glandular-punctate blades which are broadest well above the middle as well as an inflorescence which is much shorter than the leaves and a shorter peduncle.

*Anthurium botijaense* Croat, **sp. nov.** — Type: PANAMA. Colón: bajando el río Botija, recorrido en dirección 87° SE hacia la comunidad de San Benito, 11 June 1996, A. Zapata, J. Polanco, D. Mosquera & W. Martínez 1180 (holotype, MO-5548505; isotype, PMA (not seen). **Figure 19.**

*Diagnosis:* *Anthurium botijaense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphyte habit, conspicuous red-brown persistent cataphyll fibers, short-petiolate leaves, narrowly oblong-linear, semi-erect blades which dry grayish above and yellow-brown and glandular-punctate beneath with a conspicuously sunken collective veins and obscure primary lateral veins as well as by the long, sessile, scarcely tapered, pale green spadix with 10–12 flowers visible per spiral.

Epiphytic; internodes short, 2 cm diam.; cataphylls 6.5–13.0 cm long, drying red-brown, persisting as closely parallel, mostly pale fibers. *Leaves* with petioles 13 cm long, drying gray-brown, matte, sharply and deeply sulcate adaxially, sharply 1 low-ribbed abaxially, several weak-ribbed on sides, densely granular, lacking glandular punctations; geniculum 1.5 cm long, darker and more shrunken than petiole, blades narrowly elliptic-linear, 91 cm long, 7.3 cm wide, 12.4 times longer than wide, 7 times longer than petioles, acuminate at apex, acute at base, moderately coriaceous, dark green above, much paler below, drying gray-brown, matte above, grayish yellow-brown, weakly glossy below; midrib drying convex in valley, finely ribbed, paler, minutely glandular-punctate above, much thicker, narrowly round-raised, matte, finely and acutely ribbed, eglandular, slightly darker than surface below, primary lateral veins 30–40 per side, departing midrib at 30–40°, scarcely apparent above, drying weakly raised and scarcely more apparent than interprimary veins below; collective veins arising from base, 6–9 mm from margins, more deeply sunken than primary lateral veins above, narrowly raised below; upper surface eglandular, ridged-granular at higher magnifications; lower surface finely ridged, conspicuously dark glandular-punctate, the glands mostly raised, blackish, often sunken medially. *Inflorescence* erect; peduncle 27 cm long, 2 mm diam.; spathe linear-lanceolate, 16 cm long, 1.7 cm wide, green, reflexed; spadix pale green, 16 cm long, 4 mm diam., 40 times longer than broad; flowers 10–12 visible per spiral, 1.4 mm long, 7–9 mm wide; tepals moderately smooth, dark brown; lateral tepals 8–9 mm wide, inner margin broadly rounded, outer margin 3-sided; stamens not seen. *Infructescence* not seen.





Figure 19. *Anthurium botijaense* Croat. Holotype: Zapata et al. 1180.



Figure 20. *Anthurium bratsiense* Croat. Holotype: Herrera 5195.

**Distribution and ecology** — *Anthurium botijaense* is endemic to Panama, known only from the type locality in Colón Province at ca. 100 m elevation in Tropical wet forest life zone.

**Etymology** — The species is named for the type locality along the Río Botija in Colón Province.

**Comments** — *Anthurium botijaense* is seemingly most closely related to *A. kittredgeanum* Croat with which it shares many flowers visible per spiral. That species from the mountains of Darién at 450–500 m elevation differs by having broader, less narrowly elongated leaf blades to only 7.2 times longer than wide, more distinct primary lateral veins and a stipitate, pale yellow spadix. *Anthurium botijaense* has been confused with *A. redolens* Croat, a species which differs by having shorter and proportionately broader leaf blades, mostly 45–60 cm long that range from 4.5–8.2 times longer than wide with a typically stipitate, usually lavender spadix with 10–13 flowers per spiral.

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***Anthurium bratsiense*** Croat, **sp. nov.** — Type: COSTA RICA. Limón: Cantón de Talamanca: Bratsi, Amubri, Alto Lari, Kivut, 09°24'15"N, 83°05'16"W, 1300 m, 6 Mar. 1992, G. Herrera 5195 (holotype, MO-4352078; isotype, INB). **Figure 20.**

**Diagnosis:** *Anthurium bratsiense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, short, dark brown cataphyll fibers, short sulcate petioles, oblong-oblancoate, acuminate blades which are eglandular on the upper surface and dry dark grayish brown and 3.3–6.2 times longer than the petioles as well as by the long pedunculate inflorescence which exceeds the length of the blades.

Epiphytic; internodes short, 3–5 mm long; cataphylls 2.5–3.0 cm long, mostly intact, reddish brown, becoming fibrous with fragments of brown epidermis with reddish brown speckles and punctiform on inside of cataphylls. *Leaves* with petioles 4.0–6.6 cm long, 1–2 mm diam, terete, short sulcate, drying brown; geniculum 0.4–0.7 cm long, drying slightly darker than petioles; blades narrowly oblong-oblancoate, 21.8–24.8 cm long, 3.6–3.7 cm wide, 5.9–6.7 times longer than broad, broadest midway, 3.3–6.2 times longer than petioles, long-acuminate, acute at base, drying papyraceous, brown and weakly glossy above, yellowish brown, and weakly glossy below; midrib drying narrowly rounded to round-raised, short linear-granulate and slightly paler above, narrowly rounded, linear-granulate, pustular and darker below; primary lateral veins 6–8 per side, departing midrib at 30–35°, drying weakly and narrowly rounded and concolorous above, narrowly rounded and concolorous below; collective veins arising from the only pair of basal veins, 2–4 mm from margin; basal veins 1 pair; antemarginal veins present, upper surface eglandular, densely granular, sometimes pustular; lower surface densely glandular-punctate, weakly granular, sometimes dark spotted, sparsely pustular. *Inflorescence* with peduncle 29.2 cm long, red-green, drying terete, weakly sulcate; spathe 2.8–5.0 cm long, 4–5 mm wide, reddish green, drying coriaceous and reddish brown; spadix reddish green, uniformly and weakly tapered, 6.2 cm long, 0.3 cm diam., drying brown; flowers about 3 visible per spiral, drying 2.0 mm long and 1.7 mm wide; tepals minutely granular on drying; lateral tepals 1.0 mm wide, the outer margins 2-sided, inner margin rounded. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium bratsiense* is known only from the type locality in Costa Rica in the Cantón de Talamanca at 1300 m in a *Lower montane rainforest* life zone.

**Etymology** — The species epithet refers to the type locality at Bratsi in the Cantón de Talamanca in Limón Province.

**Comments** — *Anthurium bratsiense* is closest to *A. austinsmithii* Croat & R.A. Baker which differs by having proportionately longer petioles, and proportionately shorter peduncles. *A. bratsiense* has oblong-oblongate leaf blades broadest above the middle and 3.3–6.2 times longer than petioles whereas *A. austinsmithii* has blades broadest below the middle and 1.8–1.9 (–2.4) times longer than petioles.

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***Anthurium brunneum* Croat, sp. nov.** — Type: PANAMA. Panama: El Llano-Cartí road, 5 mi from Pan American Hwy., virgin forest on steep slopes; along trail through forest (west side of road), 350 m, 16 July 1987, *T. B. Croat 67347* (holotype, MO-3609894). **Figure 21.**

*Diagnosis:* *Anthurium brunneum* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, semi-intact network of cataphyll fibers, sharply V-sulcate petioles, brown-drying blades and moderately long-tapered greenish spadix.

Epiphyte; internodes short, 1.7 cm diam.; cataphyll fibers persisting semi-intact. *Leaves* with petioles narrowly rounded to acute abaxially, sharply V-sulcate adaxially; blades oblong-elliptic to oblong-oblongate, 30–40 cm long, 9–11 cm wide, 3.3–3.5 times longer than wide, 3.3–4.6 times longer than petioles, short-acuminate at apex, acute at base, moderately coriaceous, moderately bicolorous, dark green and semiglossy above, paler and semiglossy below, drying moderately dark brown on both surfaces; midrib convex and slightly paler above, sharply acute and paler below, drying darker than surface below; primary lateral veins 16–20 per side, arising at 50–65°, narrowly quilted-sunken above, pleated-raised below, darker than surface; tertiary veins moderately obscure; collective veins arising from the base, 4–7 mm from margin, weakly sunken and about as conspicuous as primary lateral veins above; upper surface moderately smooth, eglandular; lower surface moderately granular, glandular-punctate. *Inflorescence* erect-spreading; peduncle 25–30 cm long, 1-ribbed (opposite spathe); spathe linear-lanceolate, green, spreading, 8–10 cm long, 1.5–2.2 cm wide; spadix moderately long-tapered, 10–12 cm long, 6–8 mm diam., greenish; pistils square-raised; flowers 6–7 visible per spiral, 2.3–3 mm wide in both directions; lateral tepals 1.5 mm wide, inner margin rounded, outer margin 2-sided; stamens not seen. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium brunneum* is endemic to Panama, known only from the type locality in the Isthmus of Panama in Panama Province at 350 m elevation in a *Pre-montane wet forest* life zone.

**Etymology** — The species epithet is from the Latin ‘*brunneus*’ (meaning brown) referring to the color of the dried leaf blades.



**Figure 21.** *Anthurium brunneum* Croat. Holotype: Croat 67347. Habit of potted plant.



*Comments* — *Anthurium brunneum* is most similar to *A. iguanitense* Croat which has blades of similar shape and size with a long peduncle but that species differs by having proportionately much shorter petioles, blades that dry gray with the primary lateral veins scarcely visible on the upper surface.

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***Anthurium carrionii*** Croat & O.Ortiz, **sp. nov.** — Type: PANAMA. Colón: Coclé del Norte, 08°50'14"N, 080°38'32"W, Botija Pit, area 3, 30 Sep. 2012, *J.F. Carrión, K. Viquez & R. Flores* 873 (holotype, PMA-0108507). Figures 22–25.

*Diagnosis:* *Anthurium carrionii* is a member of sect. *Porphyrochitonium* and is distinguished by its epiphytic habit, short brown loose cataphyll fibers, sharply acutely C-shaped petioles with an obtuse medial adaxial rib and a much thickened pulvinus, narrowly elliptic short-acuminate blades which are weakly glandular-punctate and minutely areolate on upper surface as well as by the short-pedunculate inflorescence with a slender green reflexed spathe and 3 flowers visible per spiral on the short spadix which is about 1 mm diam.; spathe 5 mm wide, reflexed, green, drying dark brown; spadix 3 visible per spiral with the stamens retracted below the level of the tepals.

Epiphyte; stem short, slender; internodes short, less than 1 cm diam.; cataphylls 1.5 cm long, persisting as few dark brown, moderately coarse, loose fibers. Leaves with petioles 1.0–1.3 cm long, sharply C-shaped with margins drying acute with an obtuse medial rib, irregularly and folded-ridged adaxially with a much-thickened pulvinus at base, this more finely ridged than the remainder of petiole; blades narrowly elliptic, 7.2–10.7 cm long, 2.2–2.5 cm wide, 3.1–4.8 times longer than wide, 6.5–8.9 times longer than petioles, short-acuminate at apex (acumen 5–6 mm long), narrowly acute at base, subcoriaceous, scarcely bicolorous, drying dark gray-brown; midrib drying narrowly raised with the dried epidermis easily flaked off, concolorous in apical half, paler in lower half above, drying weakly raised and finely ribbed, slightly paler below; primary lateral veins (4)5(6) per side, departing midrib at 20–25°, weakly visible on both surfaces; tertiary veins not visible; upper surface sparsely and weakly glandular-punctate, minutely areolate, with thin epidermis, this capable of flaking free, the epidermis exposing deep hole under the dark glandular punctations; lower surface drying finely ridged, conspicuously dark glandular-punctate. *Inflorescence* erect; peduncle 5.5 cm long, drying dark brown, 1 mm diam.; spathe 5 mm wide, reflexed, green, drying dark brown; spadix 4.6 cm long, 3.5–3.8 mm diam.; flowers 3 visible per spiral, 2.0–3.0 mm long and wide; tepals 1.3 mm wide, broadly rounded on inner margin, 2-sided on outside; stamens retracted below the level of the tepals. *Infructescence* not seen.



**Figure 22.** *Anthurium carrionii* Croat & O.Ortiz. Holotype: *Carrion et al.* 873



**Figure 23.** *Anthurium carrionii* Croat & O.Ortiz. *Carrion et al.* 873. Flowering hand-held plant in field.



**Figure 24.** *Anthurium carrionii* Croat & O.Ortiz. *Carrion et al.* 873. Both surfaces of blade and juvenile infructescence.



**Figure 25.** *Anthurium carrionii* Croat & O.Ortiz. *Carrion et al.* 873. Flowering plant in field.



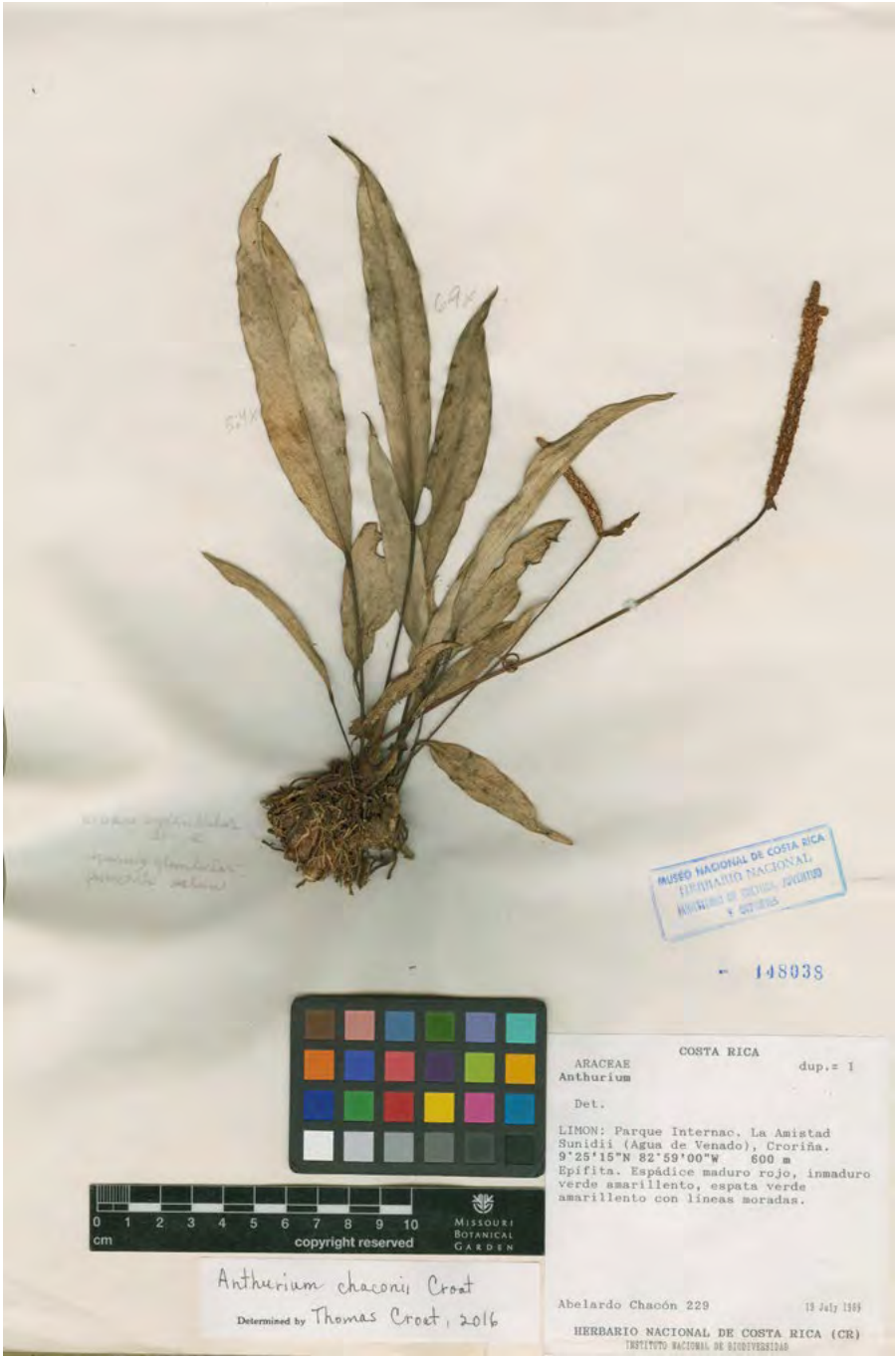


Figure 26. *Anthurium chaconii* Croat. Holotype: Chacon 229.



Figure 27. *Anthurium chaconii* Croat. Paratype: Rodriguez 11667.

**Distribution and ecology** — *Anthurium carrionii* is endemic to Panama, known only from the type locality in Coclé Province at near sea level in a *Tropical moist forest* life zone.

**Etymology** — *Anthurium carrionii* is named in honor of Juan Fernando Carrión who collected the type specimen.

**Comments** — In the Lucid Anthurium Key, *Anthurium carrionii* tracks to *Anthurium cuasicanum* Croat, which differs by having proportionately longer petioles (almost as long as blades), more brownish-drying more long-acuminate blade and a much longer peduncle. It also keyed to *Anthurium oxystachyum* Croat which differs by having leaf blades broadest well below the middle and by having petioles equal to or longer than the blade.

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***Anthurium chaconii*** Croat, **sp. nov.** — Type: COSTA RICA. Limón: Parque Internacional La Amistad Sunidii (Agua de Venado), Croriña, 09°25'15"N, 82°59'00"W, 600 m, 19 July 1989, A. Chacón 229 (holotype, INB-148038). Figures 26 & 27.

**Diagnosis:** *Anthurium chaconii* is provisionally placed in sect. *Decurrentia* and is characterized by its epiphytic habit, short internodes, dense cluster of roots, persistent cataphyll fibers, long-petiolate leaves, moderately long, very slender petioles, narrowly oblong-elliptic to narrowly lanceolate, greenish drying, epunctate, long-acuminate blades with weakly developed primary lateral veins, as well as the long-pedunculate inflorescence with a short greenish yellow spadix and red berries.

Epiphyte; internodes short, 2.5 cm long; cataphylls 2.0–3.8 cm long, stiffly erect, acute, persisting intact at apex, becoming fibrous with fragments of brown epidermis drying reddish brown. Leaves with petioles 2.4–19.7 cm long, 1–2 mm diam, terete, narrowly and acutely sulcate, drying reddish brown; geniculum 4–5 mm long, drying darker than petioles; blades narrowly oblong-elliptic, 6.2–20.8 cm long, 1.4–3.7 cm wide (averaging  $14 \times 3$ ), 3.5–6.5 (averaging 5.4) times longer than broad, 0.7–2.7 (averaging 1.5) times longer than petioles, abruptly acuminate at apex, acute at base, drying subcoriaceous, drying yellowish brown and weakly glossy above, grayish brown, and weakly glossy below; midrib drying narrowly rounded and paler above, narrowly raised, glandular-punctate and darker below; primary lateral veins (8)10 per side, departing midrib at 35–45°, drying weakly and narrowly raised, paler above, weakly narrowly raised, glandular-punctate and darker below; collective veins arising from the only pair of basal veins 2–3 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface densely granular but not glandular-punctate, sometimes with removable black dots (probably insect eggs); lower surface minutely granular-ridged, lacking glandular punctations, conspicuously pustular on both surfaces.

*Inflorescence* with peduncle 10.1–24.7 cm long; spathe green with purple lineations, 1.5–1.7 cm long, 3 mm wide, drying moderately coriaceous, reddish brown; spadix greenish yellow, sessile, cylindrical, 3.6–7.0 cm long, 3–5 mm diam., drying yellowish red-brown; flowers 2 visible per spiral, drying 2.8 mm long and 2.2 mm wide; tepals granular on drying; lateral tepals 1.9 mm wide, the outer margins 2-sided, inner margin rounded; stamens not exerted. *Infructescence* with red berries.

**Distribution and ecology** — *Anthurium chaconii* is known only from the eastern slopes of the Cordillera de Talamanca in Limón Province at 600–700 m in *Tropical wet forest* and *Lower montane rain forest* life zones.

**Etymology** — *Anthurium chaconii* is named in honor of Costa Rican biologist, Abelardo Marcial Chacón Gamboa who was trained, beginning in 1980, to collect both plants and insects for the Costa Rican biodiversity program. He collected many plants including the type specimen of this species.

**Comments** — *Anthurium chaconii* is unique in Costa Rica in looking like a member of sect. *Porphyrochitonium* but lacking well-developed glandular punctations. Most species which resemble *A. chaconii* have proven to be members of *Anthurium* sect. *Calomystrium* series *Rupicola* but all of the members of this group (so far as is known) were collected in or along streams and usually were growing on rocks in or near flowing water. The Herrera collection was described as an epiphyte so there is some doubt about its sectional placement.

*Anthurium chaconii* is unusual in having strange brown rounded to ellipsoid gland-like structures on the lower surface that can easily be removed but they are apparently not real glandular punctations. *Anthurium chaconii* is very similar to *A. carrasquillanum* Croat & O. Ortiz from western Panama although that species differs by having larger leaf blades with the collective veins further from the margin, lacking antemarginal veins and by having the primarily lateral veins further apart.

Other species which are similar to *Anthurium chaconii* in terms of its blade shape, size and coloration are *A. rupicola* Croat which differs by having leaf blades glandular-punctate on both surfaces and has the petiole to blade ratio more nearly equal and *A. angustispadix* Croat & R.A. Baker which differs by having broader leaf blades with more primary lateral veins, much longer pale fibrous cataphylls and in having a much more long-tapered spathe and a longer spadix and pale yellow-green berries.

*Paratype*: COSTA RICA. Limón: Cantón de Talamanca, Fila de exploracion minera; area between Río Sukut and Río Carbri, Muragubishi, 09°22'50"N, 82°56'50"W, 700 m, 14 July 1989, G. Herrera 3287 (CR, MO).

*Anthurium churchillii* Croat, **sp. nov.** — Type: PANAMA. Chiriquí: Fortuna Dam area. Along Quebrada Bonito to E of road, 08°45'N, 82°13'W, 1100 m, 8 Feb. 1984, *H.W. Churchill, G. de Nevers & H. Stockwell* 4827 Holotype, (MO-3670512). **Figure 28.**

*Diagnosis:* *Anthurium churchillii* is a member of section *Porphyrochitonium* and is distinguished by its narrowly oblong, long-attenuated blades which dry reddish brown, the long, acutely tapered, greenish spadix and the berries which are yellowish, orange or red.

Epiphyte; internodes short, to 5 mm diam.; cataphylls to 2.7 cm long, persisting as reddish brown fibers. Leaves with petioles 2.0–8.4 cm long, 10 mm diam., subtriangular, broadly and acutely sulcate, drying medium brown; geniculum 4–5 mm, drying darker than petioles; blades narrowly oblong, 6.6–17.0 cm long, 1.6–4.6 cm wide (averaging  $11 \times 3$ ), 3.4–4.8 (averaging 4.1) times longer than broad, broadest above middle, 2.3–3.9 (averaging 3.1) times longer than petioles, abruptly acuminate at apex, narrowly acute at base, coriaceous, weakly to moderately bicolorous, drying slightly reddish brown and weakly glossy above, medium brown and semiglossy below; midrib sparsely glandular, narrowly rounded and slightly darker above, sparsely glandular, narrowly acute and concolorous below; primary lateral veins 9 or 10 per side, departing midrib at 40–50°, drying convex and concolorous above, narrowly rounded and slightly darker below; tertiary veins prominulous on upper surface; collective veins arising from basal vein, to 5 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface conspicuously glandular-punctate, smoother with very small brownish speckles upon magnification; lower surface with conspicuous, raised, reddish brown glandular punctations, granular. *Inflorescence* erect with peduncle greenish maroon, drying 10.6–23.6 cm long, medium brown; spathe lanceolate, yellow-green, drying 1–3 cm long, 3–7 mm wide, coriaceous, yellowish to reddish brown; spadix sessile, green, acutely tapered, drying 2.7–6.0 cm long, 2–3 mm diam., slightly reddish brown; flowers 3 visible per spiral, drying 3.6–3.7 mm long, 3.1–3.2 mm wide (2.1–2.3 mm long and wide pre-anthesis); tepals minutely granular on drying; lateral tepals 2.5–2.7 mm wide, the outer margins 2-sided, the inner margins rounded; stamens not seen. *Infructescence* with berries yellowish orange or red.

**Distribution and ecology** — *Figure 28.* *Anthurium churchillii* Croat. is endemic to Panama, known only from the type locality around the Fortuna Dam in Chiriquí and Bocas del Toro Provinces at 970–1150 m in *Premontane rain forest* life zones.





**Figure 28.** *Anthurium churchillii* Croat. Holotype: Churchill et al. 4827.



**Figure 29.** *Anthurium comincoense* Croat. Holotype: McPherson 20668.

**Etymology** — *Anthurium churchillii* is named in honor of the late Hugh W. Churchill (1946–1993) who worked on the Flora of Panama Project for the Missouri Botanical Garden during 1983 and 1984 and who made most of the collections of this species. Churchill made many fine aroid collections and for a non-specialist, his descriptions were more detailed than any other collector we have known. After working in Panama, he taught at the University of Vermont until the time of his death in 1993.

**Comments** — *Anthurium churchillii* is closest to *A. gracililaminum* Croat in appearance but that species has a spadix that is proportionately shorter and is bluntly rounded at apex and has berries which are white to pinkish white. In the Lucid Anthurium Key, *Anthurium churchillii* tracks to *Anthurium brevipes* Sodiro from Ecuador, *A. kallunkii* Croat and *A. pageanum* Croat (the two latter species from Panama) all of which differ by having the inflorescences shorter than the leaves. Another similar species is *A. oxystachyum* Croat from central Panama, which differs by having lanceolate, greenish drying leaves which are glandular-punctate only on the lower surface as well as by having a more narrowly long and pointed spadix.

**Paratypes:** PANAMA. Chiriquí: Fortuna Dam area. Along Quebrada Bonito to E of road, 08°45'N, 82°13'W, 1100 m, 8 Feb 1984, H.W. Churchill, G. de Nevers & H. Stockwell 4826, 4820 and 4924 (all MO); North fork of Quebrada de Arena, near Continental Divide, 08°46'N, 82°12'W, 1100 m, 8 Feb. 1984, H.W. Churchill et al. 4855 (MO).

***Anthurium comincoense* Croat, sp. nov.** — Type: PANAMA: Colón: Teck Cominco Petaquilla mining concession, forested slopes, 08°51'25"N, 80°41'47"W, 100 m, 25 June 2008, G. McPherson 20668 (holotype, MO-6103348; isotypes, COL, K, PMA, US). **Figure 29.**

**Diagnosis:** *Anthurium comincoense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, loose, pale, persisting cataphyll fibers, long, obscurely D-shaped petioles (shorter than blades), narrowly oblong-elliptic, narrowly acuminate leaf blades which dry gray on the upper surface, yellowish green on the lower surface and glandular-punctate on both surfaces as well as by the long-pedunculate inflorescence (much longer than petioles) with a green, lanceolate, spreading spathe and a white spadix as well as white berries.

Epiphyte; internodes short, 4–5 mm diam.; cataphylls 4.2 cm long, acute, persisting as loose pale fibers with fragments of reddish brown epidermis, the fibers pale brown, the uppermost mostly closely parallel. *Leaves* with petioles 7.2–14.7 cm long, 2 mm diam., obscurely D-shaped, drying greenish yellow-brown; geniculum 1.1–1.6 cm long, drying darker than petioles; blades narrowly oblong-elliptic, 11.2–24.1 cm long, 2.4–4.6 cm wide (averaging 16 × 3), 4.2–5.4 (averaging 4.7) times longer than broad, broadest at middle or slightly below middle, 1.2–1.7 (averaging 1.2) times longer than petioles, gradually and narrowly acuminate at apex, (acumen 1.0–1.5 cm long), acute at base, drying subcoriaceous, gray and weakly glossy above, yellowish green and weakly glossy below; midrib drying narrowly acute and slightly paler above, narrowly rounded, finely ribbed, sparsely glandular-punctate and paler below;

primary lateral veins 14(16) per side, difficult to discern and not markedly more conspicuous than interprimary veins, departing midrib at 35–40°, drying weakly and narrowly rounded, slightly paler above, narrowly raised and slightly darker below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from the basal veins 3–4 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface sparsely glandular-punctate, minutely granular-ridged on magnification; lower surface moderately smooth, conspicuously and densely glandular-punctate. *Inflorescence* with peduncle 21.7–29.1 cm long; spathe green, spreading, 3.1–4.2 cm long, 9–12 mm wide, lanceolate, drying coriaceous, greenish yellow-brown; spadix white, stipitate 5 mm, weakly tapered, 3.2–4.1 cm long, 3–4 mm diam., drying reddish brown; flowers 3 visible per spiral, drying 2.3 mm long and 2.3–2.5 mm wide; tepals minutely granular on drying; lateral tepals mostly shield-shaped, 1.2–1.3 mm wide, inner margin rounded, outer margins 3- or 4-sided; stamens at first weakly exerted, then mostly withdrawn beneath tepals; anthers 0.2 mm long, 0.6 mm wide, thecae somewhat divaricate. *Infructescence* with berries white.

**Distribution and ecology** — *Anthurium comincoense* is endemic to Panamá, known only from the type locality in Colón Province at 100 m in a Tropical wet forest life zone.

**Etymology** — *Anthurium comincoense* is named for the type locality at the Teck Cominco Petaquilla mining area in Colón Province.

**Comments** — In the key to *Anthurium* of Central America, *Anthurium comincoense* comes out near *A. lancifolium* Schott, a species that differs by having leaf blades broadest below the middle and with prominent primary lateral veins.

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***Anthurium cuadrosii* Croat, sp. nov.** — Type: PANAMA, Parque Nacional del Darién, slopes of Cerro Mali, head waters of S branch of Río Pucuro, ca. 22 km E of Pucuro, 08°04'30"N, 77°14'00"W, 1300–1400 m., 23 Oct. 1987, H. Cuadros, B. Hammel, G. de Nevers & H. Herrera 3965 (holotype, MO-3581748). **Figure 30.**

*Diagnosis:* *Anthurium cuadrosii* is a member of sect. *Porphyrochitonium* and is characterized by its oblong-elliptic, narrowly acuminate blades which are eglandular on the upper surface, have a narrowly (but not acutely) raised midrib on the upper surface and dry somewhat grayish, by its short inflorescence scarcely longer than the petiole, the sharply 2- or 3-ribbed-winged peduncle shorter than the petiole and by the green, narrowly cylindric, green spadix. The spathe on the type specimen is only 7 mm long and appears to be normal otherwise.

Epiphyte; internodes short, 5 mm diam.; cataphylls 2.8 cm long, persisting semi-intact, reddish brown with fragments of reddish brown epidermis. Leaves erect; petioles 12.0–13.7 cm long, 3 mm diam., sharply 2- or 3-ribbed-winged, drying dark yellowish brown; geniculum winged, to 1 cm long, drying darker than petioles; blades oblong-elliptic, 23–27 cm long, 6.0–7.1 cm wide (averaging 24 × 7), 3.8–4.0 (averaging 3.9) times longer than broad, broad-

est at middle, 1.7–2.2 (averaging 2.0) times longer than petioles, narrowly acuminate at apex, acute at base, subcoriaceous, drying grayish brown and matte above, dark yellowish brown and weakly glossy below; midrib eglandular above, drying narrowly raised and darker above, sparsely glandular below, drying narrowly raised to narrowly acute and darker below; primary lateral veins 13 or 14 per side, departing midrib at 45–50°, drying narrowly convex in sunken valleys and concolorous above, narrowly rounded, etched and slightly darker below; collective veins narrowly sunken above, as prominulous as primary lateral veins below, arising from the basal veins, to 5 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface eglandular, densely and minutely granular with minute ridging parallel to margins upon magnification; lower surface densely glandular-punctate and granular-ridged upon magnification, the glands dark brown and rounded with occasional central depression. *Inflorescence* with peduncle 7.5 cm long, 2 mm diam., sharply 2- or 3-ribbed-winged, drying yellowish medium brown; spathe green, not seen on specimen; spadix green, cylindrical, drying 9.2 cm long, 4 mm wide, medium brown; flowers 3 visible per spiral, drying 3.6 mm long, 1.6 mm wide; tepals minutely granular on drying; lateral tepals 2.1 mm wide, the outer margins 2-sided, the inner margins rounded; stamens not emergent. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium cuadrosii* is known only from the type locality in the Parque Nacional del Darién at 1300–1400 m elevation in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium cuadrosii* is named in honor of Colombian botanist, Hermes Cuadros, Curator at the Universidad de Atlantica in Baranquilla, Colombia. Hermes has spent much of his career collecting in the north of Colombia. For several years he worked at the Cartajena Botanical Gardens.

**Comments** — *Anthurium cuadrosii* is closest to *A. granditepalum* Croat, another species from Cerro Pirre, in having blades of similar shape and size and with a short spathe. That species differs however in having the upper blade surface conspicuously glandular-punctate, a long, slender subterete peduncle that is more than twice as long as the longest petiole, the upper midrib drying narrowly acute and large fruiting tepals (2.8–3.4 mm long).





Figure 30. *Anthurium cuadrosii* Croat. Holotype: Cuadros et al. 3965.



**Figure 31.** *Anthurium deneversii* Croat. Holotype: Denevers et al. 6526.

*Anthurium deneversii* Croat, **sp. nov.** — Type: PANAMA. Comarca de San Blas: Cangandí, hills NW of village toward Río Nergala, 09°24' N, 79°24' W, 50 m, 16 Dec. 1985, *G. de Nevers, H. Herrera & S. Charnley* 6526 (holotype, MO-3320670). **Figure 31.**

*Diagnosis:* *Anthurium deneversii* is a member of sect. *Porphyrochitonium* and is characterized by its moderately small size, short internodes, persistent cataphyll fibers, triangular petiole, elliptic gray-drying blades with nearly rounded apices and short, abrupt acumens with primary lateral veins that are weakly developed, scarcely visible on the dried upper blade surface as well as by the slender, cylindroid, green spadix with the stamens mostly visible.

Epiphyte; internodes short, 1 cm diam.; cataphylls 1.7 cm long, persisting at upper nodes, the fibers reddish brown, erect; leaves forming rosettes. *Leaves* with petioles 2.5–8.3 cm long, triangular, drying 2.5–3.0 mm wide, sharply sulcate adaxially, blackened to yellow-brown with 3 or more ridges on the sides, 0.2–0.5 times as long as the blades; geniculum 0.6–1.0 cm long, not markedly different from petiole shaft; blades narrowly elliptic, 12.9–17.5 cm long, 5.3–7.0 cm wide (averaging  $16 \times 6$ ), 2.4–2.6 (averaging 2.5) times longer than wide, 2.4–5.4 (averaging 4.8) times longer than petioles, narrowly rounded and weakly and abruptly short-acuminate at apex, acute to narrowly rounded at base, subcoriaceous, drying gray above, brownish gray below; midrib narrowly raised and concolorous above, narrowly rounded and slightly paler below, drying several-ridged and concolorous to darker than surface above, several ridged and darker or paler than surface; primary lateral veins 8 or 9 per side, departing midrib at 50–55°, only weakly visible and weakly undulate on drying and equaling the collective veins on the dried upper blade surface, along with the collective veins weakly raised on drying below; collective veins arising from the base, 3–5 mm from margin; upper surface eglandular, appearing smooth, closely areolate with pale punctations on magnification; lower surface conspicuously glandular-punctate, closely areolate on magnification, the whitish punctations not apparent. *Inflorescence* much shorter than leaves; peduncle 11 cm long, drying 1 mm wide, several ribbed, semiglossy, dark brown; spathe green, linear-lanceolate, 3.6 cm long, 4 mm wide, abruptly short-acuminate at apex, reflexed-spreading; spadix narrowly oblong, sessile, 5.5 cm long, 3 mm diam., green, rounded at apex; flowers 3 visible per spiral, 2.5–2.8 mm long, 1.6–1.8 mm wide; lateral tepals 1.1–1.3 mm wide, the inner margin broadly rounded, the outer margin 2-sided; stamens remaining exposed or at least with some stamens visible along the entire length of the spadix; anthers 4–5 mm long, only slightly longer than wide, held at the level of the tepals. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium deneversii* is known only from the type locality in the Comarca de San Blas near the Caribbean coast at 50 m elevation in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium deneversii* is named in honor of American botanist, Gregory Clark de Nevers, who collected the species while working as the Curator of Summit Herbarium in Panama City, Panama. Greg lived in Panama and collected for the Missouri Botanical Garden's Flora of Panama Project for three years. Greg worked closely with Kuna Indians and collected widely throughout Panama. Later he served as the resident biologist at the 1200 hectare Pepperwood Preserve in Sonoma County, CA, as well as at the Bolinas Lagoon Preserve of Audubon Canyon Ranch. Greg served in the Peace Corps in Guinea (West Africa) from 2018 through 2020, and is now a botanist with the U.S. Forest Service in Happy Camp, CA.

**Comments** — *Anthurium deneversii* may be closest to *A. jefense* Croat mostly known from the vicinity of Cerro Jefe and mostly above 900 m elevation but that species differs by having leaf blades oblong-elliptic and less than 5 cm wide, 3.5–4.0 times longer than wide with the lower surface drying usually brownish, upon magnification densely brownish maculate and irregularly short-ridged-granular. In contrast, *A. deneversii* has leaf blades narrowly elliptic, 2.4–2.6 times longer than wide with the lower surface drying grayish and upon magnification densely areolate, not brownish maculate, not short-ridged nor granular. *A. deneversii* may also be confused with *A. lactifructum* Croat owing to the size and shape of its blades but that species differs by having glandular punctations on the upper surfaces.

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*Anthurium diversurense* Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Along Continental Divide from road branching N off main Fortuna-Chiriquí Grande Highway near Continental Divide; 1.1 mi from main highway, 08°44'N, 82°17'W, 1200 m, 11 Mar. 1985, T.B. Croat & M.H. Grayum 60341A (holotype, MO-3237538). **Figure 32.**

**Diagnosis:** *Anthurium diversurense* is a member of sect. *Porphyrochitonium* distinguished by its epiphytic habit, short internodes, persistent reddish brown cataphyll fibers, sharply 3-sided petioles; elliptic, brown-drying blades with etched primary lateral veins and collective veins as well as the long-pedunculate inflorescences with green spathe and spadix.

Epiphyte; stems 6 cm long; internodes short, 4 mm diam.; cataphylls 3.5 cm long, persistent, reddish brown, fibrous with fragments of medium brown epidermis. *Leaves* with petioles 7.7–13.2 cm long, to 4 mm diam., sharply C-shaped, flat adaxially with erect margins, drying grayish brown; geniculum 8 mm long, drying darker than petioles; blades elliptic, 17.5–21.8



Figure 32. *Anthurium diversurense* Croat. Holotype: Croat 60341A.





Figure 33. *Anthurium doroteryense* Croat. Holotype: Rodriguez et al. 11247.

cm long, 6.2–7.9 cm wide (averaging  $20 \times 7$ ), 2.6–2.8 (averaging 2.7) times longer than broad, broadest midway, 1.7–2.3 (averaging 1.9) times longer than petioles, abruptly acuminate at apex (acumen to 8 mm long), attenuate at base, subcoriaceous, moderately glossy, dark green above, moderately paler below, drying slight reddish brown and semiglossy above, grayish brown and weakly glossy below; midrib sparsely glandular, narrowly raised and darker above, sparsely glandular, narrowly raised to sharply acute, concolorous below; primary lateral veins 14 or 15 per side, departing midrib at  $55\text{--}60^\circ$ , etched, narrowly raised and concolorous above, narrowly rounded and paler below; collective veins arising from the basal veins, to 5 mm from margin, etched above, scarcely visible below; basal veins 1 pair; antemarginal vein present; upper surface densely and minutely granular, densely glandular-punctate, the glands larger than on lower surface and appearing flat; lower surface equally glandular-punctate and weakly brown-speckled. *Inflorescence* with peduncle 15.7–22.5 cm long, green or tinged reddish, V-shaped, flattened adaxially with a medial rib, drying medium brown; spathe narrowly ovate-elliptic, green, tinged reddish, drying 5.2 cm long, 5 mm wide, coriaceous, slightly reddish brown; spadix medium green, cylindrical, weakly tapered, drying 5.7–8.0 cm long, 3 mm diam., medium brown; flowers 3 visible per spiral, drying 3 mm long, 2.2 mm wide; tepals weakly glossy, granular on drying; lateral tepals 2 mm wide, the outer margins 3-sided, the inner margins rounded; stamens not emerged. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium diversurense* is known only from the type locality in Panama in Bocas del Toro Province near the Continental Divide at 1200 m in a *Premontane wet forest* life zone.

**Etymology** — The epithet comes from the Latin ‘*diversurus*’ (meaning about to divert or separate) and ‘-ensis’ (indicating origin) referring here to the Continental Divide (commonly called La Divisura) where the species was collected.

**Comments** — *Anthurium diversurense* is similar to *A. paulmaasii* Croat but that species differs by having a peduncle shorter than the petioles and a narrowly ovate-elliptic spathe that is 2.8 times longer than wide.

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***Anthurium doroteryense*** Croat, **sp. nov.** — Type: COSTA RICA. Limón: Talamanca. Parque Nacional La Amistad. Cuenca de Sixaola, Talamanca. Bratsi. Alrededores de Laguna Dorotery. Bosque primario,  $09^\circ 37' 04.7''\text{N}$ ,  $83^\circ 16' 05.1''\text{W}$ , 900–910 m, 23 July, 2007, A. Rodríguez, D. Santamaría, D. Solano, S. Bridgewater, A. Solís, M. Moraga & W. Ga 11247 (holotype, CR). **Figure 33.**

**Diagnosis:** *Anthurium doroteryense* is a member of sect. *Decurrentia* and is characterized by its epiphytic habit, persistent fibrous cataphylls, elongate terete petioles, oblong-linear, greenish brown, narrowly acute, epunctate blades with obscure primary lateral veins, collective veins arising from one of the lowermost primary lateral veins and running close the margin as well as by its long-pedunculate inflorescence with a linear-lanceolate green spathe and long-stipitate, narrowly oblong reddish burgundy spadix.

Epiphytic. stems short; internodes short, ca. 1 cm diam.; cataphylls 12 cm long, rounded at apex, persisting as slender, much shorter fibers. *Leaves* with petioles 15.5–16.5 cm long, drying deeply sulcate adaxially, medium yellow-brown; geniculum 1 cm long, drying darker, weakly sulcate, transversely fissured; blades linear, 33.0–38.5 cm long, 2.8–4.0 cm wide, 9.6–10.7 times longer than wide, 0.5–0.6 times as long as blades, narrowly acute at apex, slightly less acute at base, drying moderately coriaceous, yellowish brown and slightly glossy above, slightly paler and semiglossy below, epunctate on both surfaces; midrib narrowly and acutely raised and concolorous above, narrowly and bluntly raised and slightly paler below; primary lateral veins 40–45 per side, departing midrib at 35–45°, scarcely more conspicuous than interprimary veins, narrowly rounded and concolorous on both surfaces; collective veins arising from one of the lower primary lateral veins near the base, 1–2 mm from margin, scarcely or not at all loop-connected; upper surface eglandular, minutely and densely areolate-granular; lower surface eglandular, minutely granular-ridged. *Inflorescence* erect, long-pedunculate; peduncle 21 cm long, 1.5 mm diam.; spathe green, linear-lanceolate, 5.5 cm long, 7 mm wide, acute and narrowly rounded at apex, rounded at base, drying densely granular on both surfaces; spadix narrowly oblong, reddish violet, 16.2 cm long, stipitate 2.2 cm (stipe 1.5 mm diam.); flowers 6 visible per spiral, 1.8–2.1 mm long, 1.4–1.5 mm wide; tepals weakly granular, inner margin rounded, outer margins 2-sided; stamens clustered around the style at the level of the tepals; anthers 0.4 mm long and wide; thecae somewhat divaricate, persisting exserted. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium doroteryense* is endemic to Costa Rica, known only from the type locality in Limón Province at 900–910 m in a *Premontane rain forest* life zone.

**Etymology** — The species is named for the type locality at the Laguna Dorotery in the Parque Nacional La Amistad in Limón Province, Talamanca Cantón.

**Comments** — *Anthurium doroteryense* has been confused with *A. bakeri* but that species differs by having much broader blades with glandular punctations and deeply sunken collective veins with a stubby whitish spadix. In the key to the species of Central American

*Anthurium doroteryense* tracks to *Anthurium eximium* Engl., a member of sect. *Pachyneurium* with an ovate spathe and a short somewhat clavate spadix.

***Anthurium duocostatum*** Croat, sp. nov. — Type: PANAMA. San Blas (Kunayala): 7 mi. N of Interamerican Highway on El Llano-Cartí Road, ca. 09°15'N, 79°00'W, 550 m, 14 Mar. 1985, G. McPherson 6854 (holotype, MO-3208939). **Figure 34.**

*Diagnosis:* *Anthurium duocostatum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, internodes which are sometimes longer than broad, long, sharply C- to D-shaped petioles, more or less elliptic grayish-drying blades which are matte on the lower surface and glandular-punctate on both surfaces as well as by the long-pedunculate inflorescence with a long-tapered, sharply pointed green spadix.

Epiphyte; internodes short, 7 mm diam.; cataphylls 4 cm long, semi-intact, reddish brown becoming fibrous with fragments of reddish brown epidermis, the fibers manilla. [Leaves](#) with petioles 8.1–13.7 cm long, drying 3 mm diam., C-shaped (nearly D-shaped), drying grayish brown; geniculum 0.7 cm long, drying slightly darker than petioles; blades oblong-elliptic, 13.1–18.3 cm long, 4.7–6.2 cm wide (averaging  $16 \times 5$ ), 2.8–3.0 (averaging 2.9) times longer than broad, broadest midway, 1.3–1.6 (averaging 1.4) times longer than petioles, abruptly acuminate, attenuate at base, subcoriaceous, bicolorous, drying gray-brown and weakly glossy above, grayish brown and semiglossy below; midrib drying narrowly rounded, sparsely pustular and slightly darker above, narrowly raised, sparsely pustular and concolorous below; primary lateral veins 9 or 10 per side, departing midrib at 55–60°, drying narrowly rounded and concolorous above, narrowly rounded to narrowly raised and concolorous below; collective veins arising from the basal veins, 2 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface conspicuously granular, glandular-punctate (glands dark brown, weakly raised with center concave); lower surface moderately smooth, somewhat pustular in places, glandular-punctate (glands dark brown, weakly raised with concave center) with fine ridging upon magnification below. *Inflorescence* long-pedunculate, erect-spreading; peduncle 2-ridged, 27 cm long, drying narrowly and obtusely sulcate and brown; spathe perhaps white, 4 cm long, 2 mm wide, drying coriaceous and reddish brown; spadix green, long-tapered, sharply pointed, 7.7 cm long, 3 mm diam., drying dark reddish brown; flowers about 2–3 visible per spiral, drying 2.2–2.4 mm long, 1.8–2.0 mm wide; tepals minutely granular and sparsely pustular on drying; lateral tepals 1.2 mm wide, the outer margins 2-sided, inner margin rounded. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium duocostatum* is endemic to Panama, known only from the type locality in central Panama at ca. 550 m in a *Premontane wet forest* life zone.



Figure 34. *Anthurium duocostatum* Croat. Holotype: *McPherson 6854*.





Figure 35. *Anthurium edtysonii* Croat. Holotype: Nee & Tyson 10897.

**Etymology** — The species epithet derives from ‘*duo*’ (two) and ‘*costatus*’ (ribbed) and refers to the two-ribbed state of the adaxial surface of the petioles.

**Comments** — *Anthurium duocostatum* is perhaps closest to *A. zhui* Croat which differs by having shorter internodes, darker reddish brown cataphyll fibers, sharply 3-sided petioles, proportionately longer, brown-drying more narrowly long-acuminate blades.

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***Anthurium edtysonii*** Croat, **sp. nov.** — Type: PANAMA. Colón: Colón to Portobello, vic. of bridge over Río Viejo, 9 m, 4 km NE of Puerto Pilón, 09°23'30"N, 79°46'15"W, 9 m, 27 Mar. 1974, *M. Nee & E. Tyson* 10897 (holotype, MO-2251621). Figure 35.

**Diagnosis:** *Anthurium edtysonii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, pale loosely organized cataphyll fibers, short-petioleate leaves, sulcate petioles, narrowly oblong-ob lanceolate grayish-green-drying long-acuminate leaves with a single pair of basal veins, upper surface with an acutely raised midrib, short pale-lineate and epunctate, lower surface elineate and densely glandular-punctate as well as by the moderately long-pedunculate inflorescence with a green spathe and spadix.

Epiphyte; stem short, less than 10 cm long; internodes short, 0.5–1.0 cm diam.; cataphylls 4.5–5.2 cm long, persisting as a loose network of pale fibers, becoming fibrous with fragments of yellowish-brown epidermis, the fibers manila. *Leaves* with petioles 6.2–9.8 cm long, 3 mm diam., drying sharply sulcate, light yellowish brown; geniculum 4–6 mm long, drying darker than petiole; blades narrowly oblong-ob lanceolate, 38–46 cm long, 4.2–5.4 cm wide (averaging 42 × 5), 8.5–9.1 (averaging 8.9) times longer than broad, broadest at midpoint, 4.4–4.9 (averaging 4.7) times longer than petioles, gradually acuminate at apex, acute at base, subcoriaceous, drying grayish green and matte above, grayish yellow-brown and weakly glossy below; midrib drying narrowly raised to acute, irregularly several ribbed and paler above, narrowly raised to acute, sparsely glandular-punctate and paler below; primary lateral veins 14–20 per side, departing midrib at 25–30°, drying narrowly raised to acute, concolorous above, narrowly acute, and slightly darker below; secondary veins drying as prominent as primary lateral veins above and below; collective veins arising from basal veins, 3–5 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface short pale-lineate and epunctate; lower surface elineate and densely glandular-punctate. *Inflorescence* erect, much longer than petioles but much shorter than leaves with peduncle 20.3 cm long; spathe green, erect-spreading, 2.5 cm long, 3 mm wide, linear-lanceolate, drying moderately coriaceous, medium reddish brown; spadix greenish, sessile, weakly tapered, measurements unknown, drying medium brown; flowers 3 visible per spiral, drying 2.1 mm long and 1.9 mm wide; tepals papillate-granular on drying; lateral tepals 1.4 mm wide, the outer margins 3-sided, inner margin rounded; stamens not exerted. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium edtysonii* is endemic to Panama, known only from the type locality in Colón Province at or near sea level in a Premontane wet forest life zone.

**Etymology** — *Anthurium edtysonii* is named in honor of Dr Edwin Tyson, formerly a Professor of Biology with the University of Florida who spent most of his professional career in Panama teaching students in the U.S. Military. Ed was one of the most active plant collectors in the 1960's and 1970's and worked with the U.S. Army to develop a collection of plants at facilities of the Army Tropic Test Center located at the Miraflores locks on the Panama Canal. Staff of the Missouri Botanical Garden used those facilities when Dr Walter Lewis conducted expeditions to Panama. Later Ed Tyson helped Lewis establish Summit Herbarium at Summit Gardens where the Missouri Botanical Garden operated a field station for more than 10 years. Upon retirement, Tyson returned to his native Georgia where he raised hybrid cattle on his farm.

**Comments** — *Anthurium edtysonii* seems closest to *A. iguanitense* Croat which differs by having proportionately shorter, more deeply sulcate petioles, broader oblanceolate-elliptic blades which are 10 times longer than petioles (versus 4.5 times longer than petioles for *A. edtysonii*). In the Lucid Anthurium Key, *Anthurium edtysonii* also tracks to *Anthurium acutangulum* Engl., which differs by having proportionately much longer petioles and mostly pendent more or less elliptic blades; *A. caloveborum* Croat which differs by having leaves with proportionately longer petioles and blades that dry generally brownish; *A. ramonense* Engl. ex K.Krause, which differs by being a much larger proportionately more long-petiolate plant with a more or less elliptic blade; *A. oxystachyum* Croat, which differs by having smaller, shorter lanceolate blades and spadices that are acutely pointed and *A. utleyorum* Croat & R.A.Baker, which differs by having proportionately narrower more oblong and more coriaceous blades.

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***Anthurium flagellum*** Croat, **sp. nov.** — Type: PANAMA: Colón: 2–3 km. up the Río Iguanita from the sea, evergreen wet forest, ca. 09°29'N, 79°41'W, 200–300 m, 21 Feb. 1976, H. Kennedy & R. Dressler 3507 (holotype, F-1780156). **Figure 36.**

**Diagnosis:** *Anthurium flagellum* is a member of sect. *Porphyrochitonium* and is recognized by its epiphytic habit, short internodes, semi-intact persistent cataphylls, the long terete petioles which are narrowly flattened and weakly 3-ribbed adaxially, the narrowly lanceolate, caudate-acuminate blades which dry gray above and yellow-green below with an eglandular upper surface and sunken collective veins and the primary lateral veins only weakly discernable as well as by the long-pedunculate (about as long as petioles) slender green inflorescence with a slender, scarcely tapered spadix and a narrow reflexed spathe.

Epiphyte; internodes short, 5 mm diam.; cataphylls 3.5 cm long, persisting semi-intact, reddish brown with fragments of reddish brown epidermis. *Leaves* erect with petioles 14.0–16.3 cm long, 2 mm diam., subterete, narrowly flattened and weakly 3-ribbed adaxially, drying grayish green-brown; geniculum to 1.3 cm long, drying darker than petioles; blades narrowly lanceolate, dark green above, green below, 23.9–28.0 cm long, 3.4–4.8 cm wide (averaging  $26 \times 4$ ), 6.8–7.9 (averaging 7.4) times longer than broad, broadest below middle, 1.7 times longer than petioles, caudate-acuminate at apex (acumen to 3.5 cm), acute at base, drying papyraceous, grayish brown above and yellow-green below; midrib eglandular above, drying bluntly acute and slightly paler above, sparsely glandular-punctate below, drying narrowly rounded, finely ribbed and paler below; primary lateral veins 20 per side, departing midrib at 55–60°, drying weakly convex and concolorous above, narrowly rounded, weakly etched and slightly darker below; collective veins sunken above, bluntly acute below, arising from the basal veins, to 2–3 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface eglandular, densely granular-ridged parallel to the margins upon magnification; lower surface minutely and irregularly granular ridged upon magnification, densely glandular-punctate with the glands dark reddish brown, weakly raised and with an occasional central depression. *Inflorescence* with peduncle green, 17 cm long, 1–2 mm diam., drying weakly 3-ribbed adaxially, grayish green-brown; spathe lanceolate-elliptic, green, reflexed, 3.2 cm long, 4 mm wide, drying subcoriaceous and yellowish brown; spadix yellowish green, slender, cylindrical, scarcely tapered, drying 3.4 cm long, 2 mm wide, medium brown; flowers (in bud) 2–3 visible per spiral, drying 1.1 mm long, 1.3 mm wide; tepals minutely granular on drying; lateral tepals 0.9 mm wide, the outer margins 2-sided, the inner margins rounded. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium flagellum* is known only from the type locality in Colón province at 200–300 m elevation in a *Tropical wet forest* life zone.

**Etymology** — The epithet '*flagellum*' refers to the long flagellate apex of the blade, from the Latin for whip.

**Comments** — *Anthurium flagellum* is most easily confused with *A. bakeri* but that species has thicker, oblong-elliptic, less acuminate, conspicuously bicolorous blades and a much thicker, white, cylindroid spadix.



**Figure 36.** *Anthurium flagellum* Croat. Holotype: *Kennedy & Dressler 3507*.





**Figure 37.** *Anthurium floresii* Croat & O.Ortiz. Holotype: Ortiz et al. 2452.

*Anthurium floresii* Croat & O. Ortiz, **sp. nov.** — Type: PANAMA. Darién: Serranía de Cañasas, Reserva Privada Chucantí, Cima de Cerro Chucantí, 1325 m, 30 Aug. 2014, *O. O. Ortiz, R. Flores, A. Sierra, J. Batista, Y. Guadalupe & C. Rodríguez* 2452 (holotype, MO-6600594; isotype, PMA). **Figure 37.**

*Diagnosis:* *Anthurium floresii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, thin, short, persistent cataphyll fibers, subterete, weakly sulcate petioles, narrowly oblong-elliptic to narrowly elliptic, more or less concolorous, gradually acuminate, brownish drying blades which are narrowly acute at the base with a single pair of collective veins moderately close to the margin with glandular punctations only on lower surfaces, moderately obscure primary lateral veins as well as a long-pedunculate inflorescence with a terete peduncle, a slender reflexed purplish-violet to greenish-red spathe and cylindroid-tapered dark violet spadix with berries which are white with just the apex dark violet.

Epiphyte; internodes very short, ca. 1 cm diam.; cataphylls to 2 cm long, persisting as thin, moderately loose red-brown fibers. *Leaves* with petioles 2.2–4.2 cm long (averaging 3.3 cm), drying gray-brown, 1.5 mm diam., 0.17–0.25 times as long as blades, subterete, weakly sulcate adaxially; geniculum 5–7 mm, drying darker than petioles; blades narrowly oblong-elliptic to narrowly elliptic, 13–17 cm long, 2.1–4.0 cm wide (averaging 15 × 3), 3.6–6.6 (averaging 4.5) times longer than broad, 3.9–5.8 (averaging 4.2) times longer than petioles, gradually acuminate at apex, narrowly acute at base, subcoriaceous, more or less concolorous, drying brownish olive and matte above, slightly paler and grayish yellow-brown and matte below; midrib weakly raised above, round-raised and slightly paler below, drying much thicker than broad and paler above, prominently raised with a medial rib, scarcely paler below; primary lateral veins 9–11 per side, departing midrib at 35–45°, weakly evident on the upper surface, slightly more evident on lower surface; collective veins a single pair arising from the base, 2.0–3.5 mm from margins, scarcely visible above, weakly raised below but scarcely loop-connecting the primary lateral veins; primary lateral veins ca. 10 per side, moderately obscure above, slightly more apparent below; upper surface eglandular, granular and sparsely flattened-pustular, sometimes densely longitudinally ridged; lower surface densely glandular-punctate, densely and minutely pale-speckled. *Inflorescence* long-pedunculate; peduncle 16.5 cm long, 1.5 mm diam. on drying, terete; spathe oblanceolate, 2.3 cm long, 4 mm wide, reflexed, purplish violet to greenish red; spadix 3.5 cm long, 4 mm diam. in fruit, cylindroid-tapered, dark violet, stipitate 2 mm; flowers 3 visible per spiral, 2.5–2.6 mm long, 1.8–2.0 mm wide; tepals coarsely granular; lateral tepals 1.8–2.0 mm wide; inner margin rounded, outer margin 2-sided; stamens barely emerging above edge of tepals, retracting; anthers 0.4 mm long, 0.6 mm wide; thecae ovoid, scarcely divaricate. *Infructescence* with berries white with just the apex dark violet.

**Distribution and Ecology** — *Anthurium floresii* is endemic to Panama, known only from the type locality in Darién Province in the Serranía de Cañasas at 1325 m in a Tropical wet forest life zone.

**Etymology** — *Anthurium floresii* is named after Panamanian botanist, Rodolfo Flores who helped collect the type specimen. Rodolfo is an excellent plant collector and has participated in many expeditions in Panama, visiting remote and botanically unexplored areas. In 2015 and 2016 he was trained in Classical Taxonomy in two renowned botanical gardens in the United States, the Missouri Botanical Garden and Marie Selby Botanical Garden.

**Comments** — *Anthurium floresii* is seemingly closest to both *A. alticola* Croat and *A. tutense* Croat but differs from both in having an glandular upper blade surface.

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***Anthurium gerardoi*** Croat, **sp. nov.** — Type: COSTA RICA. Limón: Cantón de Talamanca, Fila de exploración minera; area between Río Sukut and Río Carbri, Muragubishi, 09°22'50"N, 82°56'50"W, 700 m, 14 July 1989, G. Herrera 3287A (holotype, CR-14986). **Figure 38.**

**Diagnosis:** The sectional placement is in doubt but *Anthurium gerardoi* is here placed in sect. Calomystrum ser. Rupicola. It is distinguished by its epiphytic habit, short internodes, persistent cataphyll fibers, long-petiolate, narrowly lanceolate, greenish drying, epunctate blades with weakly developed primary lateral veins and a long-pedunculate inflorescence with a green, tapered spadix and reddish berries.

Epiphyte; internodes short, 8 mm diam.; cataphylls 3.8 cm long, acute, persisting intact at apex, becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel; petioles 16.3–19.7 cm long, 2 mm diam., subterete, sharply sulcate, drying yellowish brown; geniculum 5 mm long, drying darker than petioles; blades narrowly lanceolate, 14.3–20.8 cm long, 3.1–3.7 cm wide (averaging 18 × 3.3), 4.6–6.1 (averaging 5.2) times longer than broad, broadest at petiole attachment, 0.7–1.3 (averaging 1.0) times as long as petioles, abruptly acuminate at apex, (acumen to 1 cm long), acute at base, drying subcoriaceous, grayish green brown and matte above, greenish brown and weakly glossy below, epunctate both surfaces; midrib drying narrowly raised and darker above, narrowly raised, epunctate and darker below; primary lateral veins 8 (10) per side, departing midrib at 55° near middle, drying weakly and narrowly raised, concolorous above, narrowly raised and darker below; secondary veins drying moderately conspicuous on lower surface, scarcely more visible than surface above; collective veins arising from 1st primary lateral veins 3 mm from margin; basal veins 1 pair; upper surface eglandular, densely granular-pustular with obscure



Figure 38. *Anthurium gerardoi* Croat. Holotype: G. Herrera 3287A.



**Figure 39.** *Anthurium glandulicostum* Croat & O.Ortiz. Isotype: McPherson 20688.





Figure 40. *Anthurium glandulicostum* Croat & O.Ortiz. Holotype: McPherson 20688.

short pale-lineations; lower surface eglandular, sparsely granular-pustular. *Inflorescence* with peduncle 14.7–24.7 cm long; spathe green, 1.7 cm long, to 3 mm wide, oblong-lanceolate, drying moderately coriaceous, medium reddish brown; spadix green, sessile, cylindroid and weakly tapered, 3.7–4.9 cm long, 3–5 mm diam., drying reddish brown; flowers 3 visible per spiral, drying 2.8 mm long and 1.6 mm wide; tepals minutely granular on drying; lateral tepals 1.7 mm wide, the outer margins 2-sided, inner margin rounded; stamens not exerted. *Infructescence* with berries red (fide G. Herrera, pers. comm.).

**Distribution and Ecology** — *Anthurium gerardoi* is known only from the type locality in Limón Province in Costa Rica at 700 m elevation in a *Lower montane rain forest* life zone.

**Etymology** — *Anthurium gerardoi* is named for Costa Rican botanist, Gerardo Herrera who collected the type specimen. Herrera is one of the finest plant collectors in the history of plant exploration in Costa Rica.

**Comments** — *Anthurium gerardoi* is unique in Costa Rica in looking like a member of sect. *Porphyrochitonium* but lacking well-developed glandular-punctations. Most species which resemble *A. gerardoi* have proven to be members of *Anthurium* sect. *Calomystrium* series *Rupicola* but all of the members of this group (so far as is known) were collected in or along streams and usually were growing on rocks in or near flowing water. The Herrera collection was described as an epiphyte so there is some doubt about its sectional placement. *Anthurium gerardoi* is most similar to *A. rupicola* Croat, a member of sect. *Porphyrochitonium* in terms of blade shape, size and coloration but that species differs by having leaf blades glandular-punctate on both surfaces and has the petiole to blade ratio more nearly equal.

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***Anthurium glandulicostum*** Croat & O. Ortiz, **sp. nov.** — Type: PANAMA. Colón: Teck Cominco Petaquilla mining concession, forested slopes, 08°51'18"N, 80°40'08"W, 165 m, 26 June 2008, *G. McPherson* 20688 (holotype, PMA-73428). **Figures 39 & 40.**

*Diagnosis:* *Anthurium glandulicostum* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, few persistent cataphyll fibers, deeply sulcate, glandular-punctate petioles which are about one-third as long as blades and dry weakly glossy and minutely granular, elliptic-oblongate, long-acuminate, grayish-green-drying blades which glandular-punctate on both surfaces, narrowly acute at the base with a single pair of relatively remote collective veins, 7 or 8 pairs of primary lateral veins as well as a short-pedunculate inflorescence, green reflexed lanceolate spathe and long-tapered, green to yellow spadix.

Epiphyte; internodes short, 6–10 mm diam.; cataphylls 3.8–4.0 cm long, acute at apex, persisting semi-intact at apex, becoming pale coarse fibers and fragments of reddish brown epidermis. Leaves with petioles (4.6)8.3–10.5 cm long, 2–3 mm diam., 0.3–0.4 times as long as blades, drying gray-green to yellow-brown, weakly glossy and minutely granular, deeply sulcate with prominently raised acute margin above, acutely angular abaxially; geniculum 1.3–1.7 cm long, drying slightly darker, same thickness; blades elliptic-oblongate, (15)21.3–31.6 cm long, (3.6)5.3–6.7 cm wide, 3.7–4.9 times longer than wide, 2.2–3.3 (averaging 2.8) times longer than petioles, long-acuminate at apex, narrowly acute at base, subcoriaceous, drying weakly glossy and gray-green to grayish olive-green above, weakly glossy and yellowish gray-green below; midrib narrowly rounded, concolorous above, drying acutely raised and slightly darker below, glandular-punctate on both surfaces; primary lateral veins 7–14 per side, departing midrib at 50–60°, weakly and narrowly rounded, concolorous above, narrowly rounded and concolorous to darker below; tertiary veins moderately obscure; basal veins 1 or 2 pairs; collective veins, arising from near the base to the 4th pair of primary lateral veins, 6–8 mm from margin; upper surface smooth to minutely granular, minutely areolate to faintly pale-speckled with a few short pale-lineations, conspicuously dark glandular-punctate; lower surface more coarsely granular, conspicuously dark glandular-punctate. *Inflorescence* short-pedunculate; peduncle 8.7–9.8 cm long, 1.5 mm wide, drying minutely granular, sparsely glandular-punctate; spathe narrowly oblong-lanceolate, ca. 7.5 cm long, 8 mm wide, green, reflexed, drying moderately coriaceous; spadix stipitate to 6 mm, 6.3–9.7 cm long, 3–6 mm diam., 16 times longer than broad, long-tapered, green to yellow, drying green-brown; flowers 3–4 visible per spiral, 2.6–3 mm long, 2.2–2.6 mm wide; tepals minutely papillate-granular on drying; lateral tepals 1.4–1.7 mm wide, inner margin broadly round, outer margin 2-sided; stamens not remaining exerted. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium glandulicostum* is endemic to Panama, known only from the type locality in Colón Province at 165 m in a *Tropical wet forest* life zone.

**Etymology** — The specific epithet is from the Latin ‘*glandula*’ meaning a small gland, ‘*costa*’ meaning midrib, referring to a glandular-punctate midrib.

**Comments** — In the Lucid Anthurium Key, *Anthurium glandulicostum* tracks to *A. bakeri* which differs by leaf blades drying green on upper surface with the collective veins drying much more conspicuously than the primary lateral veins and by having the spadix more cylindroid and whitish; *A. billdarcyi* Croat, which differs by having blades that more narrowly long-acuminate, drying dark brown above with no glandular punctations; *A. boqueronense* Croat, a species which lacks glandular punctations as well as by having proportionately much shorter petioles and a long-pedunculate inflorescence which is nearly as long as the leaves;

*A. comincoense* Croat, which differs by having proportionately longer petioles, 14 or more primary lateral veins, collective veins 3–4 mm from margin and a proportionately much longer inflorescence; *A. gentryi* Croat, which differs by having much smaller blades (to 10 cm long and 2.7 cm wide) with a proportionately much longer inflorescence; *A. paludosum* Engl., which differs by having cataphylls drying intact and much more coriaceous blades; *A. rupicola* Croat, which differs by having proportionately more slender leaf blades, much longer peduncles and a stipitate white spadix and *A. vallense* Croat, which differs by having massive reticulated cataphyll fibers.

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***Anthurium granditepalum* Croat, *sp. nov.*** — Type: PANAMA. Darién: Middle slopes on west side of Cerro Pirre, 07°56'N, 77°45'W, 29 June 1988, 800–1050 m, *T.B. Croat 68939* (holotype, MO-3610809). Figure 41.

*Diagnosis:* *Anthurium granditepalum* is a member of sect. *Porphyrochitonium* and is characterized by its oblong-elliptic, grayish-drying blades with the upper blade surface conspicuously glandular-punctate, with the upper midrib drying acutely raised, the primary lateral veins sunken but with a medial rib on the upper surface and with the primary lateral veins drying undulate on the upper surface. Also characteristic is the long, slender subterete peduncle that is more than twice as long as the longest petiole and by the slender infructescence with only 2–3 flowers visible per spiral and with depressed-globose berries tinged lavender, surrounded by large fruiting tepals (2.8–3.4 mm long).

Epiphyte; internodes short, 1.2 cm diam.; cataphylls 2 cm long, intact, dark reddish brown, fibrous with fragments of brown epidermis. *Leaves* with petioles 7.7–16.3 cm long, 3 mm diam., sharply sulcate, drying grayish brown; geniculum 1.1 cm long, drying much darker than petioles; blades oblong-elliptic, 17.4–30.6 cm long, 4.0–6.9 cm wide (averaging 24 × 6), 3.9–4.6 (averaging 4.2) times longer than broad, broadest midway, 1.6–2.3 (averaging 1.9) times longer than petioles, abruptly acuminate at apex (acumen to 1.2 cm long), acute at base, subcoriaceous, moderately bicolorous, drying grayish brown and matte above, grayish brown and semiglossy below; midrib convex and paler on both surfaces, drying acutely raised, sparsely glandular, concolorous above, narrowly rounded, sparsely glandular and slightly darker below; primary lateral veins 18 per side, departing midrib at 50–55°, sunken above, pleated-raised beneath drying narrowly rounded and concolorous above, narrowly raised and concolorous below; collective veins arising from basal veins, 2–3 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface conspicuously glandular-punctate (glands sometimes sunken in center) and minutely areolate; lower surface glandular-punctate (glands equally dense on both surfaces) and moderately smooth, densely and inconspicuously dark-speckled. *Inflorescence* erect; peduncle long, slender, 36 cm long, drying sharply sulcate, grayish brown;



Figure 41. *Anthurium granditepalum* Croat. Holotype: Croat 68939.





**Figure 42.** *Anthurium gregneversii* Croat. Holotype: Churchill et al. 4619.

spathe green, erect, drying 1.2 cm long, 4 mm wide, reddish brown; spadix green, uniform and weakly tapered, drying 8 cm long, 7 mm diam., reddish brown; flowers 2 visible per spiral, drying 4.5 mm long, 4.3 mm wide; tepals granular on drying; lateral tepals 4.2 mm wide, the outer margins 2-sided, inner margin rounded. *Infructescence* with berries white, tinged lavender, depressed-globose.

**Distribution and Ecology** — *Anthurium granditepalum* is known from the type locality in Panama in Darien Province at 800–1050 m in a *Tropical wet forest* life zone.

**Etymology** — The epithet refers to the large size of the tepals which are unusually large for a spadix of the size for this species.

**Comments** — *Anthurium granditepalum* is closest to *Anthurium cuadosii* Croat, another species from Cerro Pirre, in having blades of similar shape and size and with a short spathe. That species differs however in having the upper blade surface eglandular and has a bluntly and narrowly raised (but not acute) midrib on the upper surface and a short, sharply 2- or 3-ribbed-winged peduncle that is shorter than even the shortest petiole, four flowers visible per spiral and the tepals of the flowering spadix only 1.8–2.0 mm long.

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*Anthurium gregneversii* Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Oleoducto Road, near Continental Divide, Fortuna Dam area, 1000 m, 08°48'N, 82°12'W, 5 Feb. 1984, H.W. Churchill, G. de Nevers & H. Stockwell 4619 (holotype, MO-3210675). **Figure 42.**

*Diagnosis:* *Anthurum gregneversii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, subterete petioles with a conspicuous geniculum, more or less oblong, narrowly acuminate yellow-brown-drying blades which are rounded at the base with a single pair of collective veins close to the margin and with close obscure primary lateral veins, a short slender peduncle, green lanceolate spathe and green weakly tapered spadix.

Epiphyte; stem and leaves erect; internodes short, 4–5 mm diam.; cataphylls 2.7–5 cm long, persisting as straight, pale brown, slender fibers, deciduous at lower nodes. *Leaves* with petioles 8–17 cm long, 1.6 mm diam., subterete, slightly flattened adaxially, drying sulcate; geniculum conspicuously swollen, 6 mm long (including remainder of petiole plexus), drying dark brown, drying sulcate adaxially; blade oblong, weakly tapered to apex, (14.3) 21–23.5 cm long, 2.5–3.4 cm wide, (5.7) 7.5–8.1 times longer than wide, narrowly and sharply acuminate at apex, narrowly rounded at base, moderately coriaceous, drying yellowish brown on both surfaces; midrib narrowly and acutely raised, concolorous above, weakly raised, finely and irregularly

ridged, concolorous; primary lateral veins 20–25 per side, departing midrib at 25–30°, narrowly and weakly raised, concolorous above, narrowly rounded and concolorous, glandular-punctate below; collective veins one pair, 1.5–2.5 mm from margins; densely dark glandular-punctate (with larger glands) below; upper surface drying densely and conspicuously granular and thick pustular, sparsely glandular-punctate above; lower surface drying closely ridge-granular, sparsely glandular on the lower margins. *Inflorescence* erect; peduncle 11.0–13.7 cm long, 0.8 cm diam., finely ribbed and densely granular; spathe green, 1.5–2.0 cm long, 4–6 mm wide, spreading to reflexed-spreading; spadix green, 3.3–4.0 cm long, 4 mm diam.; flowers 4–5 visible per spiral, 2.5 mm long and wide; lateral tepals 0.6 mm wide; stamens weakly protruding, held near the surface of the tepals, all held persisting exerted; anthers 0.6 mm long, 0.7 mm wide; thecae weakly divaricate. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium gregneversii* is endemic to Panama, known only from the type locality in Bocas del Toro Province near the Chiriquí Province limit at 1000 m in at Tropical wet forest life zone.

**Etymology** — *Anthurium gregneversii* is named for Greg de Nevers who, along with Hugh Churchill and Henry Stockwell, collected the type specimen (see also *A. deneversii* above).

**Comments** — Seemingly, *Anthurium gregneversii* is closest to *Anthurium crassiradix* ssp. *purpureospadix* Croat but that taxon has a purple, more long-tapered spadix. It differs from the typical variety of that species by having a narrower, proportionately longer blades which are mostly more than 7.5 or more times longer than broad (versus 2.9–3.5 times longer than broad for *A. crassiradix* ssp. *crassiradix*).

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***Anthurium guaboense*** Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Oleoducto Road, 2 km NE of Continental Divide, on ridge between Río Guabo and Río Guabito, 1000 m, 08°48'N, 82°12'W, 9 Feb. 1984, *H. W. Churchill, D. de Nevers & H. Stockwell 4938* (holotype, MO-3210642). **Figure 43.**

*Diagnosis:* *Anthurium guaboense* is a member of sect. *Porphyrochitonium* distinguished by its epiphytic habit, short internodes, persistent cataphyll fibers, subtriangular petioles which are sharply sulcate adaxially and abaxially, by the dark yellow-brown-drying elliptic blades, long-pedunculate inflorescence with a green spathe and green, long-tapered spadix.

Epiphyte; internodes short, 2 cm diam.; cataphylls to 3.5 cm long, persistent, red-brown, drying reddish brown, fibrous with fragments of pale reddish brown epidermis. *Leaves* with petiole 9.9–10.6 cm long, drying 2–3 mm diam., subtriangular, broadly, sharply sulcate above,

winged above and below, drying sharply sulcate adaxially and abaxially; geniculum 0.7 cm long, drying slightly darker than petioles; blades elliptic, 19.5–23.6 cm long, 7.9–8.0 cm wide (averaging  $22 \times 8$ ), 2.5–3.0 (averaging 2.7) times longer than broad, broadest above midway, 2.0–2.2 (averaging 2.1) times as long as petioles, abruptly acuminate at apex, acute at base, subcoriaceous, drying dark yellowish brown and weakly glossy above, yellowish brown, and semiglossy below; midrib drying narrowly rounded, ribbed adaxially and darker above, narrowly raised and concolorous below; primary lateral veins ca. 23 per side, departing midrib at 55–60°, narrowly rounded, pale pustular-granular and slightly paler above, convex, pale pustular-granular and concolorous below; collective veins arising from basal veins, 2–4 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface glandular-punctate, conspicuously pale-pustular and minutely granular; lower surface more densely glandular-punctate, moderately smooth with minute scattering of tiny pale granules on magnification. *Inflorescence* erect with peduncle 32 cm long, reddish green, 2-winged proximally, drying yellowish brown; spathe narrowly elliptic, reddish green, 6.6 cm long, 9 mm wide, drying coriaceous and yellowish brown; spadix green, long-cylindric, 13.5 cm long, 3 mm wide, drying grayish yellow-brown; flowers 3 visible per spiral, drying 4.2 mm long, 2.2 mm wide; tepals minutely granular on drying; lateral tepals 2.0 mm wide, the outer margins 2-sided, inner margin rounded. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium guaboense* is known only from the type locality in Panamá in Bocas del Toro Province along the Continental Divide at 1000 m in a *Premontane wet forest* life zone.

**Etymology** — The epithet derives from the type locality at the Río Guabo in Bocas del Toro Province.

**Comments** — *Anthurium guaboense* may be confused with *A. pageanum* Croat but that species differs by having typically much longer, typically oblong-elliptic blades ranging from 2.7 to 6.5 times longer than wide and drying grayish with the primary lateral veins markedly undulate on drying as well as in having the minor veins flat, not at all prominulous. In contrast, the blades of *A. guaboense* have leaf blades elliptic, 2.3–2.7 times longer than wide, drying dark brown and have primary lateral veins usually not markedly undulate. In addition, *A. pageanum* has minor veins drying prominulous on both surfaces.

In the Lucid Anthurium Key, *Anthurium guaboense* tracks to *A. alatipedunculum* Croat & A. Baker from the area of the Osa Peninsula on the western slope in Costa Rica which differs by having blades pale short-lineate and eglandular to weakly glandular-punctate above; *A. durandii* Engl., also known only from the western slopes of SW Costa Rica, which differs by



**Figure 43.** *Anthurium guaboense* Croat. Holotype: Churchill 4938.





**Figure 44.** *Anthurium guadalupae* Croat & O.Ortiz. Holotype: Ortiz et al. 2663



**Figure 45.** *Anthurium guadalupeae* Croat & O.Ortiz. Ortiz et al. 2663. Inflorescence.



**Figure 46** *Anthurium guadalupeae* Croat & O.Ortiz. Ortiz et al. 2663. Habit in field.

having conspicuously glandular-punctate upper blade surfaces and a terete peduncle and the spadix 3 times longer than the spathe and *A. vallense* Croat which differs by having a very long cataphyll which forms a pale net-like reticulum.

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***Anthurium guadalupeae*** Croat & O. Ortiz, **sp. nov.** — Type: PANAMA. Darién: Serranía de Pirre, Rancho Plastic, 07°58'07"N, 7°42'26"W, 1208 m. 1 Agosto, 2016, *O.O. Ortiz, R. Flores, E. Campos, Y. Guadalupe & C. Quirós* 2663 (holotype, MO-6724959; isotype, PMA). **Figures 44–46.**

*Diagnosis:* *Anthurium guadalupeae* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, oblong-elliptic, narrowly acuminate blades which are eglandular above and dry dark gray-brown, glandular-punctate below and dry médium yellow-brown with 18–20 markedly wrinkled primary lateral veins per side, collective veins arising from the base and straight close to the margins as well as by its long-pedunculate inflorescence with a linear-lanceolate, spreading, reddish spathe and a sessile, scarcely tapered, moderately long, green spadix.

Epiphyte. Stem short; internodes short, 1.0–1.5 cm diam.; cataphylls 2.5–3.0 cm long, persisting as fine dark red-brown fibers, the innermost more or less intact. *Leaves* with petioles 19–24 cm long, subterete with a longitudinal rib abaxially, drying moderately ribbed, reddish brown, 2 mm diam.; geniculum 1.5–1.7 cm long, drying darker, flattened adaxially; blades narrowly oblong-elliptic to oblong-oblancoate, 24.5–27.4 cm long, 4.3–5.3 cm wide, 4.7–6.0 times longer than wide, 1.0–1.35 times longer than petioles, gradually acuminate at apex, attenuate at base, subcoriaceous, dark olive-green, pale green beneath, drying moderately gray-brown and matte, moderately paler, yellow-brown and weakly glossy below; midrib drying broadly round-raised, finely ribbed, concolorous above, narrowly rounded and darker, finely ribbed below; primary lateral veins 14–16 per side, departing midrib at 45–50°, weakly raised, narrowly rounded, slightly paler above, narrowly rounded, darker, moderately undulate; collective veins arising from the base, 1.0–1.3 mm from the margin, not at all loop-connected, not sunken adaxially; upper surface eglandular, minutely areolate-ridged; lower surface dark glandular-punctate, moderately smooth, minutely brown-speckled. *Inflorescence* sub-pendent; peduncle subterete, 26.5 cm long, drying dark brown, 1.5 mm diam.; spathe linear-lanceolate, reflexed, reddish, margin greenish; spadix erect, sessile, narrowly cylindroid, cane-green, 8.5 cm long, 3.3–3.4 mm diam.; flowers 3 visible per spiral, 2.5–3.0 mm long, 2.0–2.2 mm wide; tepals conspicuously granular, lateral tepals 1.4–1.5 mm wide, inner margin broadly rounded, outer margin broadly 2-sided; stamens included, filaments 0.25 mm wide; anthers 0.25 mm long, 0.15 mm wide; thecae weakly divaricate. *Inflorescence* not seen.



**Distribution and Ecology** — *Anthurium guadalupae* is endemic to Panama, known only from the type locality in Darién Province at 1200 m in a Premontane wet forest life zone.

**Etymology** — *Anthurium guadalupae* is named in honor of Panamanian biologist Yessica Guadalupe from the Universidad de Panama who assisted in collecting the type specimen. Yessica is an avid enthusiast with the study of hornworts and liverworts.

**Comments** — *Anthurium guadalupae* is similar to both *A. pirrense* Croat and *A. caloveboranum* Croat. The former differs by having proportionately broader greenish-drying leaf blades that are 2.9–3.3 times longer than broad (versus 5.7–7.3 times for *A. pirrense*), collective veins which are closer to the margins (5–13 mm versus 2–3 mm for *A. guadalupae*), petioles that are more nearly the length of the blade (petiole-blade ratio of 1.2 versus 0.8 for *A. guadalupae*) and spadix pale orange-brown versus pale green. *Anthurium caloveborum* differs by having the midrib sharp (like the edge of knife) on the upper surface and by having the lower blade surface much paler and brownish speckled.

In the to key to *Anthurium* for the Flora of Mesoamerica (Croat, in press) *Anthurium guadalupae* keys to *A. floresii* Croat & O. Ortiz, another species from the Cerro Pirre área but that species from the nearby Serranía de Cañasas differs by having petioles less than 5 cm long, leaf blades less than 20 cm long and less than 4 cm wide with peduncles less than 16.5 cm long and by having a dark violet spadix.

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***Anthurium heraclioanum*** Croat, **sp. nov.** — Type: PANAMA. San Blas: Río Playón Chico, Campamento to Neba Dummat, 09°15'N, 78°15'W, 50–60 m, 11 July 1994, H. Herrera 1666 (holotype, MO-04642615). **Figures 47–49.**

**Diagnosis:** *Anthurium heraclioanum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent mostly intact and mostly deciduous cataphylls, sharply triangular petiole and peduncle, oblong-elliptic, brown-drying blades which are glandular-punctate only on the lower surface, a single pair of basal veins rather remote from the margins, moderately obscure primary lateral veins as well as by the moderately long-pedunculate inflorescence with a green erect-spreading spathe, green weakly tapered spadix and red berries.

Epiphyte; internodes short, 0.8–3.0 cm diam.; cataphylls mostly deciduous, only the intact basal portion persisting. *Leaves* with petioles 12.7–13.7 cm long, 5 mm diam., 0.4–0.6 times as long as blades, sharply 3-sided and winged on the angles, flattened adaxially with the margins erect, drying acutely triangular, medium brown; geniculum 1.0–1.1 cm long, drying



darker than petioles, the margins sometimes markedly undulate; blades elliptic-obovate, 28.5–33.5 cm long, 8–11 cm wide (averaging  $30 \times 10$ ), 2.7–3.3 (averaging 3.1) times longer than broad, broadest above midway, 1.7–2.2 (averaging 2) times longer than petioles, weakly short-acuminate at apex, acute at base, coriaceous, dark green and semiglossy above, much paler and semiglossy below, drying coriaceous, dark brown to grayish brown and matte to semiglossy above, grayish brown and weakly glossy to semiglossy below; midrib narrowly rounded and paler above, sharply angular below, sparsely glandular and conspicuously granular on both surfaces, drying narrowly raised and paler above, bluntly acute and concolorous below; primary lateral veins 17 per side, along with the collective veins etched above, scarcely raised below, departing midrib at  $65\text{--}70^\circ$ , conspicuously granular on both surfaces on drying, drying narrowly raised and paler above, bluntly acute and concolorous below; collective veins arising from basal veins, 8–10 mm from margin; tertiary veins not visible on either surface; basal veins 1 pair; antemarginal vein present; upper surface minutely and densely granular, glandular-punctate, the glands button-shaped; lower surface glandular-punctate, less densely granular but sparsely pale-pustular and reddish brown speckled. *Inflorescence* erect; peduncle 21.6–28.0 cm long, sharply 3-sided, drying reddish brown; spathe green, erect-spreading, drying 2.5 cm long, 1.1–1.7 cm wide, coriaceous and reddish brown; spadix yellowish green, weakly tapered, 6.3–11.5 cm long, 5–6 mm diam., (13.4 cm long, 1.3 cm diam., in fruit), drying reddish brown; flowers 3 visible per spiral, drying 2.5 mm long, 2.9 mm wide; tepals with subglobular cellular inclusion on drying; lateral tepals 1.5 mm wide, inner margin rounded, outer margins 2-sided; stamens not emergent. *Infructescence* erect; berries red; seeds 1.8 mm long, 1.6 mm wide, ca. 1.2 mm thick.

**Distribution and Ecology** — *Anthurium heraclioanum* is endemic to Panama, known only from the Atlantic slope type in Bocas del Toro, Colón Province and the Comarca of Kunayala (San Blas) at 50–60 m for certain but the sterile collection from Bocas del Toro is almost certainly this species also. It occurs in *Premontane wet forest* life zones.

**Etymology** — *Anthurium heraclioanum* is named in honor of Heraclio Herrera from the Comarca de Kunayala who collected the type specimen. Heraclio is a good explorer who has made many excellent collections in Kunayala.

**Comments** — *Anthurium heraclioanum* is most easily confused with and no doubt closely related to *A. dwyeri* Croat which differs by having usually much narrower, more gray-drying blades which are moderately smooth (not moderately granular) upper surfaces and lavender-white berries.



**Figure 47.** *Anthurium heraclioanum* Croat. Paratype: Croat 60277.



Figure 48. *Anthurium heraclioanum* Croat. Paratype: Knapp 3602.



Figure 49. *Anthurium heraclioanum* Croat. Holotype: Herrera 1666.





Figure 50. *Anthurium hughchurchillii* Croat. Holotype: Churchill 5560.



Paratypes: PANAMA. **Bocas del Toro:** Along road between Fortuna Dam and Chiriquí Grande, 7.3 mi N of bridge over Fortuna Dam, 3.2 mi N of Continental Divide, 08°49'00"N, 82°12'36"W, 700 m, 10 Mar 1985, *T.B. Croat & M.H. Grayum* 60277 (MO). Colón: Portobelo, ca. 1–2 km from the Portobelo Highway up the Río Guanche, 09°30'N, 79°40'W –, 09°30'N, 79°41'W, 0–50 m, 17 Feb 1982, *S. Knapp & R. J. Schmalzel* 3602 (MO).

*Anthurium hughburchillii* Croat, **sp. nov.** — Type: PANAMA. Colón: Road to Santa Rita Ridge, 09°20'N, 79°47'W, 200 m, 29 June 1984, *H.W. Churchill* 5560 (holotype, MO-36705117). **Figure 50.**

*Diagnosis:* *Anthurium hughburchillii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short petioles, elliptic to oblanceolate-elliptic, abruptly acuminate blades drying grayish yellow-brown drying with the upper midrib narrowly acute, the primary lateral veins and the collective veins weakly raised, the surfaces both glandular-punctate as well as by the inflorescence much longer than the petioles with a short, reflexed green spathe and a moderately short, stubby spadix.

Epiphyte; internodes short, 8 mm diam.; cataphylls 3 cm long, intact, persisting as coarse red fibers. Leaves with petioles 2.8–3.7 cm long, 2 mm diam., subterete, broadly and shallowly sulcate above, drying yellowish brown; geniculum to 8 mm long, drying darker than petioles; blades elliptic to oblanceolate-elliptic, 12.1–13.8 cm long, 3.9–4.7 cm wide (averaging 13 × 4), 2.9–3.1 (averaging 3.0) times longer than broad, broadest midway, 3.8–4.3 (averaging 4.0) times longer than petioles, abruptly acuminate, narrowly acute at base, subcoriaceous, slightly bicolorous, drying grayish yellow-brown slightly glossy above, grayish brown and semiglossy below; midrib drying narrowly acute and concolorous above, narrowly raised, sparsely glandular-punctate, minutely ribbed and slightly paler below; primary lateral veins 8 per side, departing midrib at 30–40°, drying narrowly rounded to convex and paler above, narrowly rounded, sparsely glandular-punctate and concolorous below; collective veins arising from basal veins, 3–4 mm from margin, slightly more conspicuous than the primary lateral veins on both surfaces; basal veins 1 pair; antemarginal vein present; upper surface glandular-punctate, glands reddish brown, smaller and darker than on lower surface, with a network of fine reticular ridges with areolae present upon magnification; lower surface more densely glandular-punctate, (glands reddish brown), irregularly ridged but smoother than upper surface. *Inflorescence* with peduncle to 13.2 cm long, drying sharply sulcate, dark yellowish brown; spathe elliptic, green, to 3.8 cm long, 4 mm wide, drying coriaceous and reddish brown; spadix green, uniformly and weakly tapered, drying 3.7 cm long, 3 mm diam., yellow reddish brown; flowers 4 visible per spiral, drying 1.7 mm long, 1.2 mm wide on immature flower, 3.7 mm long 1.7 mm wide on mature flower; tepals pustular on drying; lateral tepals 1.2 mm wide on immature flower, 2.4 mm wide on mature flower, the outer margins 3-sided, the inner margins rounded; stamens probably withdrawn post-anthesis. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium hughchurchillii* is known only from the type locality in Colón Province at 200 m elevation in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium hughchurchillii* is named in honor of the late Dr Hugh Churchill (1946–1993), a graduate of the University of Massachusetts and one of the principal collectors for the Missouri Botanical Garden during the Flora of Panama Project. Hugh was a prodigious explorer and made many collections of Araceae including the type of this species.

**Comments** — *Anthurium hughchurchillii* is similar to *A. tutense* Croat but that species has the blades more narrowly acuminate and downturned at apex, has proportionately longer petioles and reddish to violet-purple spadices.

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***Anthurium iguanitense*** Croat, **sp. nov.** — Type: PANAMA: Colón: 2–3 km up Río Iguantita from sea, evergreen wet forest, ca. 09°29'N, 79°41'W, 200–300 m, 21 Feb. 1976, *H. Kennedy* & *R. Dressler 3504* (holotype, PMA). **Figure 51.**

**Diagnosis:** *Anthurium iguanitense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent cataphyll fibers, short, bluntly V-shaped, deeply and narrowly sulcate petioles, oblanceolate, grayish drying, weakly glossy blades with the collective veins drying sunken above and somewhat more conspicuous than the primary lateral veins as well as by the long-pedunculate inflorescence with a reflexed, linear-lanceolate green spathe and the narrow, slightly light yellow-green, tapered spadix.

Epiphyte; internodes short, 1 cm diam.; cataphylls 5.2 cm long, persisting as medium yellow-brown, erect, semi-organized fibers. Leaves with petioles 3.5–4.3 cm long, 3 mm diam., bluntly triangular, deeply and narrowly sulcate adaxially, narrowly rounded abaxially, drying yellowish brown, the upper margins acute; geniculum 1 cm long, drying darker than petioles; blades oblanceolate, 37.2–37.7 cm long, 8.9–9.0 cm wide, 4.0–4.2 (averaging 4.1) times longer than broad, 8.9–9.9 (averaging 9.4) times longer than petioles, narrowly acuminate and downturned at apex, narrowly acute at base, subcoriaceous, dark olive-green above, semiglossy and paler green below, drying grayish and slightly glossy above, only weakly paler and slightly yellowish gray and slightly more glossy below; midrib narrowly rounded and concolorous above, narrowly raised to bluntly acute and slightly paler below, drying finely several-ribbed on both surfaces, drying slightly darker than surface above, slightly paler than surface below; primary

lateral veins 10–12 per side, departing midrib at 45–50°, sunken above, slightly raised below, drying indistinguishable on the upper surface with minor veins prominulous and only a few mm apart on upper surface, narrowly raised and concolorous and scarcely more prominulous than the interprimary veins on lower surface; tertiary veins prominulous on both surfaces; collective veins arising from the base, 5–7 mm from the margins, weakly sunken above, drying moderately sunken and concolorous above, drying narrowly raised below, slightly more conspicuous than the primary lateral veins on both surfaces; basal veins 1 pair; antemarginal vein present; upper surface eglandular, densely granular and short-ridged on magnification; lower surface conspicuously glandular-punctate and minutely granular. *Inflorescence* with peduncle 33 cm long, dark purple, drying grayish yellow-brown, irregularly ridged, 1.5 mm diam.; spathe lanceolate, green, 6.6 cm long, 6 mm wide, tinged purple along margins, reflexed, acuminate at apex, narrowly acute at base, the margins meeting at a 30° angle, drying with the veins close and raised and with both surfaces densely granular; spadix light yellow-green, narrowly tapered, 6 cm long, drying 3 mm diam., medium yellow-brown, matte; flowers 3–4 visible per spiral, 1.8–2.2 mm long, 1.6–1.8 mm wide; lateral tepals 0.9–1.1 mm wide, the outer margins 2-sided, inner margins straight to broadly rounded; pistils drying dark brown, 0.6 mm long, 0.4 mm wide, held well below the tepals; stamens not seen. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium iguanitense* is known only from the type locality in Colón, Province of Panama along the Río Iguanita relatively near the Caribbean at 200–300 m in a *Tropical wet forest* life zone.

**Etymology** — The epithet refers to the type locality along the Río Iguanita in Colón Province in Panamá.

**Comments** — *Anthurium iguanitense* seems closest to *A. fragrantissimum* Croat which shares leaves of similar size and shape and are also eglandular on the upper blade surface, but that species dries consistently blackened and the lower surface has an obscure whitish speckling and lacks the dense granular texture so prevalent in *A. iguanitense*. In addition, the spadix of *A. fragrantissimum* dries blackened not yellow-brown as in *A. iguanitense*. *Anthurium iguanitense* is also close to *A. terryae* Standl. & L. O. Williams, a species with a similarly grayish, oblanceolate blade but that species has smaller blades, less than 28 cm long which are glandular-punctate above. In having a long, slender spadix, it is similar to *Anthurium acutifolium* Engl., but that species has proportionately longer petioles and more frequently elliptic blades.



**Figure 51.** *Anthurium iguanitense* Croat. Holotype: Kennedy & Dressler 3504.



**Figure 52.** *Anthurium insolitum* Croat & O.Ortiz. Holotype: Zapata et al. 1563.



***Anthurium insolitum*** Croat & O. Ortiz, **sp. nov.** — Type: PANAMA. Darién: Parque Nacional Darién, Cerro Pirre, 1400 m, 07°46'00"N, 77°44'06"W. May 1999, A. Zapata, J. Polanco, C. Brandaris & J. Teucama 1583 (holotype, PMA-82007). **Figure 52.**

*Diagnosis:* *Anthurium insolitum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short slender internodes, dense red-brown cataphyll fibers, long-petiolate leaves, slender, terete, dark brown-drying petioles, oblong-elliptic, narrowly acuminate, brownish drying leaf blades which are narrowly acute to attenuate at base, densely glandular-punctate on the lower surface with a single pair of obscure collective veins arising from near the base and close to the margins as well as by the narrowly long-pedunculate inflorescence with a green, decurrent, reflexed spathe and a narrowly long-cylindroid, brownish spadix.

Epiphyte; stems short, less than 7 cm long; internodes short, ca. 1 cm diam. or less; cataphylls 2.5 cm long, persisting semi-intact with some dark brown fibers. *Leaves* long-petiolate; petioles 13.7–18.5 cm long, slender, terete, drying dark brown, ca. 1 mm diam.; geniculum sulcate, drying 10–12 mm long; blades 16.8–19.5 cm long, 4.6–4.7 cm wide, 3.5–4.1 times longer than wide, 0.9–1.1 times longer than petiole, narrowly oblong-elliptic, narrowly long-acuminate at apex, narrowly acute to attenuate at base, thinly coriaceous, dark green and semiglossy above, slightly paler and semiglossy below, drying gray-brown to dark brown above, dark reddish brown below; midrib narrowly acute and prominently raised concolorous above, rounded darker and wrinkled below; primary lateral veins 6 or 7 per side, departing midrib at 70–75°, inconspicuous, drying concolorous, wrinkled-undulate above, narrowly rounded and slightly darker below; collective veins arising from the base, 1–2 mm from margin, the margin rolled tightly under; tertiary veins inconspicuous; upper surface smooth and eglandular; lower surface densely dark glandular. *Inflorescence* long-pedunculate; peduncle slender, slightly longer than petioles, terete, drying 1 mm diam.; spathe green, lanceolate, shorter than spadix, reflexed; spadix weakly short-stipitate (ca. 1 mm), 13.5 cm long, 1.8 mm diam., green, drying dark brown; flowers 2.3–2.4 mm long, 1.0–1.3 mm wide; lateral tepals 1.8 mm long, inner margins very broadly rounded, outer margins 2-sided; stamens withdrawing below the level of tepals. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium insolitum* is endemic to Panama, known only from the type locality in Darién on Cerro Pirre at 1400 m elevation in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium insolitum* is named from the Latin '*insolitus*' (meaning unusual) referring to the unusual condition of petioles being longer than the blades.

**Comments** — In the Lucid Anthurium Key, *Anthurium insolitum* tracks to *A. amargalense* Croat & M.M.Mora which differs by being much larger and more broadly elliptic, more than 8 cm wide; *A. filiforme* Engl., which differs by having much larger oblanceolate leaf blades and a sessile yellow spadix and *A. umbricola* Engl., which differs by having broadly elliptic blades and a sessile, much shorter, cylindroid spadix.

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***Anthurium jicoteense*** Croat, **sp. nov.** — Type: COSTA RICA. Cartago: Cantón Turrialba. Distrito Tayutic, Jicotea, Finca La Pradera, subiendo la Fila hacia San Antonio, 09°47'15"N, 83°33'15"W, 1400 m, G. Herrera 7886 (holotype, MO-05036250; isotype, CR). **Figure 53.**

**Diagnosis:** *Anthurium jicoteense* is a member of sect. *Porphyrochitonium* and is characterized by its pendent epiphytic habit with short stems, short internodes, loosely persistent reddish brown cataphyll fibers, moderately long-petiolate leaves but with the petioles only about half as long as the blades, narrowly sulcate, subterete petioles, narrowly oblong-elliptic, grayish drying, narrowly acuminate blades which are acute at the base with a single pair of collective veins, dark green, matte and glandular-punctate above with a prominently raised midrib, paler and glandular-punctate below with the primary lateral veins less conspicuous than the collective veins as well as by the long-pedunculate inflorescence with a reddish brown spathe and a long narrowly-tapered green spadix.

Epiphyte; internodes short, 1 cm diam.; cataphylls 3.5 cm long, persisting semi-intact, fibrous with fragments of reddish brown epidermis, the fibers becoming manila. *Leaves* with petioles 16.0–25.4 cm long, 3 mm wide, terete, obtusely and broadly sulcate, drying olive-brown; geniculum 1.3 cm long, drying darker than petioles; blades oblong-elliptic, 34.5–49.2 cm long, 5.1–6.9 cm wide (averaging 42 × 6), 6.7–7.1 (averaging 6.9) times longer than broad, broadest midway, 1.9–2.2 (averaging 2.0) times longer than petioles, abruptly acuminate at apex, acute at base, subcoriaceous, drying brownish olive-green and weakly glossy above, olive-green and semiglossy below; midrib sharply acute, sparsely glandular-punctate and paler above, narrowly rounded, sparsely glandular-punctate, multi-ribbed with one prominent rib abaxially and concolorous below; primary lateral veins 12–14 per side, departing midrib at 40–50°, sunken above, drying narrowly convex and concolorous above, narrowly rounded, sparsely granular and paler below; collective veins arising from basal veins, 3–7 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface sparsely glandular-punctate, densely granular and minutely glandular-ridged upon magnification; lower surface glandular-punctate, smoother and pustular. *Inflorescence* with peduncle 25 cm long, rose-lilac, drying sharply sulcate



Figure 53. *Anthurium jicoteense* Croat. Holotype: Herrera 7886.



Figure 54. *Anthurium jimfolsomii* Croat. Holotype: Folsom 2973.

and dark reddish brown; spathe reddish brown, drying 7.5 cm long, 1 cm wide, coriaceous; spadix green, uniform and weakly tapered, drying 16.7 cm long, 3 mm diam., reddish brown; flowers 5 visible per spiral, drying 2.8 mm long, 1.7 mm wide; tepals subgranular with imbedded cellular inclusions on drying; lateral tepals 1.4 mm wide, the outer margin 2-sided, the inner margin broadly rounded with both margins at times concave. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium jicoteense* is known only from the type locality in Costa Rica, in Turrialba Province, found at 1400 m in a *Premontane rain forest* life zone.

**Etymology** — The species epithet derives from the type locality at Turrialba in Cartago Province.

**Comments** — In the Lucid Anthurium Key, *Anthurium jicoteense* tracks to *A. pageanum* Croat which differs by having smaller leaf blades (less than 28 cm long) and a shorter spadix (usually less than 7 cm long) as well as triangular petioles which are often 4–5 winged adaxially; *A. gracilispadix* Croat, which differs by having much smaller, oblong-elliptic leaf blades that are about 3.4 times longer than broad and a much shorter, prominently tapered spadix and *A. caloveborum* Croat, which differs by having more brownish drying blades that are usually less than 5 times longer than broad and petioles which are nearly as long as the blades or only somewhat shorter than the blades.

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***Anthurium jimfolsomii*** Croat, **sp. nov.** — Type: PANAMA. Veraguas: 6.4 km outside Santa Fé on road that passes the agriculture school, headed toward the cordillera; 5 May 1977, *J.P. Folsom* 2973 (holotype, MO-2603136). **Figure 54.**

**Diagnosis:** *Anthurium jimfolsomii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent cataphyll fibers, petioles about as long as the blades, yellowish green-drying, oblong-elliptic blades which are glandular-punctate and pustular on both surfaces and in having the inflorescence much longer than the leaves. Also characteristic is the short green, reflexed spathe and the long-tapered, acute, green spadix.

Epiphyte; internodes short, 0.4–0.5 cm diam.; cataphylls 2.2 cm long, persisting semi-intact at apex, with reddish brown fibrous persistent below. *Leaves* with petioles 8–11 cm long, drying 1 mm diam., 0.8–1.2 times as long as blades, subterete, slightly flattened, drying yellowish brown, weakly folded longitudinally, weakly glossy; geniculum 0.5 cm long, slightly thicker than petiole shaft and drying blackened; blades oblong-elliptic, 7.9–11.9 cm long, 2.0–3.6 cm wide (averaging  $10 \times 3$ ), 3.1–4.0 (averaging 3.4) times longer than wide, 0.9–1.2



(averaging 1.0) times longer than petiole, gradually short-acuminate at apex, broadest at the middle, acute at base, not at all decurrent, subcoriaceous, drying yellowish gray-green, scarcely bicolorous; midrib scarcely raised and drying concolorous above, thicker, irregularly ridged and slightly paler below; primary lateral veins 5 or 6 per side, scarcely more prominent than the interprimary veins, departing midrib at 45°, weakly raised and concolorous on both surfaces, slightly less prominent than collective veins; collective veins 2 pairs, arising from the base, the innermost 4–5 mm from the margin, the outer 1–2 mm from margin, uniting with the margin in lower 1/3 of blade; margins drying somewhat undulate; tertiary veins moderately weak; upper surface and lower surface sparsely pustulate and densely glandular-punctate. *Inflorescence* erect, long-pedunculate; peduncle 21 cm long, 1.5 mm diam., terete, drying dark brown; spathe green, 2.3 cm long, 5 mm wide, reflexed; spadix narrowly long-tapered, acute at apex, green to yellow-green, 7–8 cm long, 3–5 mm diam., drying matte; flowers 3–4 per visible per spiral, more or less quadrangular, 1.8 mm long, 1.5 mm wide (pre-anthesis), to 3.5–4.2 mm long in fruit, the surface smooth, medium yellow-green; lateral tepals 3-sided, the inner margin broadly rounded, drying raised and convex across the surface. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium jimfolsomii* is known only from the type locality near Santa Fé in Veraguas Province at 500–700 m in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium jimfolsomii* is named for Dr James Folsom, Director of the Huntington Botanical Garden, who collected the type specimen when he worked for the Missouri Botanical Garden while serving as Curator of Summit Herbarium and collecting for the Flora of Panama Project.

**Comments** — *Anthurium jimfolsomii* resembles to *A. gracilispadix* Croat which also has oblong elliptic, greenish drying blades and long-tapered greenish spadices but which differs from that species in having smaller, thicker blades and in having the inflorescences shorter than leaves rather than much longer than leaves. In addition, the leaf blades of *Anthurium jimfolsomii* have the blades merely acute at the base rather than somewhat attenuate at the base. *Anthurium jimfolsomii* is also similar to *A. cuasiacantum* Croat from Darién Province of Panama but that species differs by having the blades narrowly ovate and gradually long-acuminate at the apex and in having tepals drying roughened and dark brown. Another species resembling *Anthurium jimfolsomii* is *A. oxystachyum* Croat, owing to its blades of similar size and color but that species has its blade broader below the middle and are glandular-punctate only on the lower surface. Moreover, it has the inflorescence shorter than the leaves.

*Anthurium kensytsmae* Croat, **sp. nov.** — Type: PANAMA. Colón Prov., Santa Rita Ridge Road, 09°24'N, 79°39'W, 304–365 m, 25 Sep. 1980, *K.J. Sytsma 1322* (holotype, MO-2807213). **Figure 55.**

*Diagnosis:* *Anthurium kensytsmae* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit high in trees (to 15 m), by its short, slender internodes, its short, semi-intact cataphylls, the long, slender petioles which are about as long as or longer than the blades (drying narrowly triangular with a deep sulcus and acute margins), by the oblong-elliptic to almost oblong, brownish-drying blades which are epunctate above and brownish speckled and glandular-punctate on the lower surface as well as the purplish brown spadix sharply tapered to the apex.

Epiphytic in trees up to 15 m; internodes short, 5 mm diam.; cataphylls 1.6 cm long, semi-intact, becoming quickly fibrous, mostly deciduous, and not evident, drying medium brown. *Leaves* with petioles 11.0–12.7 cm long, 2 mm diam., drying narrowly triangular with a deep sulcus and acute margins, slightly reddish brown; geniculum 0.7 cm long, drying darker than petioles; blades oblong-elliptic to almost oblong, 9.5–11.6 cm long, 3.1–4.1 cm wide (averaging  $11 \times 4$ ), 2.8–3.3 (averaging 3.1) times longer than broad, broadest midway, 0.8–1.0 (averaging 0.9) times as long as petioles, abruptly acuminate at apex, base acute to weakly acuminate, rarely obtuse, drying subcoriaceous, grayish brown and matte above, medium brown and weakly glossy below; midrib eglandular on both surfaces, drying narrowly raised to narrowly acute and slightly darker above, narrowly convex and concolorous below; primary lateral veins 7 or 8 per side, departing midrib at 45–50°, drying convex and slightly paler above, narrowly rounded and concolorous below; collective veins arising from 1st pair of basal veins, 2–3 mm from margin; basal veins 2 pairs, the outer pair merging with the margins in lower  $\frac{1}{3}$ ; upper surface eglandular, densely and minutely red-brown speckled; lower surface sparsely glandular-punctate (somewhat irregular), red-brown speckled (irregularly blotched and diffuse), minutely parallel-ridged upon magnification. *Inflorescence* with peduncle to 21 cm long, drying reddish brown; spathe lanceolate-oblong, 4.5 cm long, 5 mm wide, green, drying coriaceous and slightly reddish brown; spadix sessile, purplish brown, sharply tapered, 3.7 cm long, 3 mm diam., drying reddish brown; flowers 3 visible per spiral, drying 1.4–1.5 mm long, 1.1–1.2 mm wide; tepals pustular on drying; lateral tepals 0.8 mm wide, outer margins 2- or 3-sided, inner margin rounded; pistils whitish; stamens withdrawn to slightly lower than level of the tepals. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium kensytsmae* and is known only from the type locality in Colón Province in Panama at between 300 and 365 m in a *Tropical wet forest* life zone.



Figure 55. *Anthurium kensytsmae* Croat. Holotype: Sytsma 1322.



Figure 56. *Anthurium kittredgeanum* Croat. Holotype: Croat 27131.

**Etymology** — *Anthurium kensytsmae* is named in honor of Dr Ken Sytsma, formerly of the Missouri Botanical Garden and presently in the Department of Botany at the University of Wisconsin in Madison. Ken Sytsma worked for the Garden as a collector in Panama and collected the type specimen.

**Comments** — *Anthurium kensytsmae* is similar to *A. oxystachum* Croat in having a sharply pointed spadix but that species differs by having lanceolate blades broadest well below the middle of the blade, lacks the brownish speckling on the lower blade surface on drying and has stamens which are promptly retracted and do not persist exerted as is the case with *A. kensytsmae*. *Anthurium kensytsmae* can also be confused with *A. caloveboranum* Croat owing to its brownish speckled lower blade surfaces but that species has longer blades, usually 3.5–5.0 times longer than wide whereas those of *A. kensytsmae* are less than 3.3 times longer than wide.

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*Anthurium kittredgeanum* Croat, **sp. nov.** — Type: PANAMA. Darién: primary forest along headwaters of Río Tuquesa, ca. 2 km air km distance from Continental Divide, in vicinity of upper gold mining camp of Tyler Kittredge, 08°33'30"N, 77°28'30"W, 450–500 m, 25 Aug., 1974, T.B. Croat 2713 1 (holotype, MO-2253605; isotype, PMA). **Figure 56.**

**Diagnosis:** *Anthurium kittredgeanum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, conspicuous red-brown persistent cataphyll fibers, short-petiolate leaves, narrowly oblong-linear, semi-erect blades which dry dark gray-brown above and yellow-brown beneath with a conspicuously sunken collective veins and obscure primary lateral veins as well as by the long-tapered, moderately stipitate, pale yellow spadix with 13–15 flowers visible per spiral.

Epiphyte; internodes short, 2 cm diam.; cataphylls 9.0–9.5 cm long, drying dark red-brown, persisting as closely parallel, somewhat reticulate, mostly dark red-brown fibers. *Leaves* with petioles 18.3 cm long, narrowly and obscurely sulcate, drying dark brown, semiglossy, sharply and deeply sulcate adaxially, rounded abaxially, several narrowly weak-ribbed on sides, densely short pale-lineate, lacking glandular punctations; geniculum 1 cm long, darker and more shrunk than petiole; blades oblong-elliptic, 86 cm long, 11.8 cm wide, 4.6 times longer than wide, 4.6 times longer than petioles, moderately coriaceous, acuminate at apex, acute at base, dark green above, much paler below, drying dark gray-brown, matte above, moderately paler and yellow-brown, weakly glossy below; midrib drying convex in valley, finely 5–7 acute-ribbed, darker above, much thicker, narrowly round-raised, matte, finely and acutely ribbed, eglandular, slightly darker than surface below; primary lateral veins 20–24 per side, departing midrib at 30–55°, drying narrowly rounded and prominulous above, drying weakly raised



below; collective veins arising from base, 5–7 mm from margins, more deeply sunken than primary lateral veins above, narrowly raised below; tertiary veins scarcely apparent on both surfaces; upper surface eglandular, moderately granular to granular-ridged; lower surface nearly smooth, glandular-punctate. *Inflorescence* erect; peduncle 21.5 cm long, 5 mm diam.; spathe linear-lanceolate, 12.5 cm long, 1.5 cm wide, green, reflexed, weakly acuminate; spadix stipitate 7 mm, moderately tapered, pale yellow, 22 cm long, 8 mm diam., 27.5 times longer than broad; flowers 13–15 visible per spiral, 2.6–2.7 mm long, 1.2–1.3 mm wide; tepals drying medium brown, semiglossy, moderately smooth; lateral tepals 1.6 mm wide, inner margin broadly rounded to straight, outer margin 2-sided, at least one angle broadly rounded; stamens not exerted; anthers 0.3 mm long, 0.8 mm wide; thecae positioned at the tip of the filaments and virtually end to end, positioned 180° apart. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium kittredgeanum* is endemic to Panama, known only from the type locality in Darién Province at 40–500 m elevation in *Tropical wet forest* life zone.

**Etymology** — *Anthurium kittredgeanum* is named in honor of geologist, Tyler Kittredge who provided transportation by helicopter to visit his gold mine on the upper Río Tuquesa where the type was collected.

**Comments** — *Anthurium kittredgeanum* is seemingly most closely related to *A. botijaense* Croat with which it shares many flowers visible per spiral. That species from Colón Province at about 100 m elevation differs by having narrower and longer leaf blades which are more than 12 times longer than wide, less distinct primary lateral veins and a sessile, pale green spadix. *A. kittredgeanum* has been confused with *A. redolens* Croat, a species which differs by having shorter and proportionately broader leaf blades, mostly 45–60 cm long that range from 4.5–8.2 times longer than wide with a typically stipitate, usually lavender spadix with 10–13 flowers per spiral.

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*Anthurium lellingeri* Croat, **sp. nov.** — Type: PANAMA. Darién: Trail from Cana to Colombian border along Río Setigandí, ca. 07°47'N, 77°43'W, 500–600 m, 19 Apr. 1980, A. Gentry, E. Forero, M. Dillon, E. Rentería, L. Skog, M. Sousa & D. Lellinger 28578 (holotype, MO- 2781702). **Figure 57.**

*Diagnosis:* *Anthurium lellingeri* is a member of sect. *Porphyrochitonium* and is characterized by its short, slender internodes, persistent, pale brown cataphyll fibers, slender, subterete petioles, linear, long-acuminate grayish-brown-drying blades which are glandular-punctate on the lower surface with an acute upper midrib as well as by the slender peduncle which exceeds the length of the petiole, a slender, green reflexed spathe and a short, cylindrical green spadix.

Epiphyte; internodes short, 5 mm diam.; cataphylls 1.5 cm long, persistent, drying medium brown, fibrous with fragments of brown epidermis, the fibers manila. *Leaves* with petioles 6.1–7.2 cm long, 2 mm diam. near base, subterete, drying grayish brown; geniculum 0.6 cm long, drying darker than petioles; blades linear, long-acuminate, 25.5–29.9 cm long, 1.1–1.3 cm wide (averaging  $28 \times 1.2$ ), 23.0–23.2 (averaging 23.1) times longer than broad, broadest above midway, 4.2 times as long as petioles, gradually acuminate at apex, acute at base, drying subcoriaceous, grayish brown and matte above, grayish green-brown and weakly glossy below; midrib eglandular above, sparsely glandular below, drying narrowly acute and concolorous above, narrowly rounded and paler below; primary lateral veins 14–16 per side, departing midrib at 35–40°, granular on both surfaces, drying narrowly convex and concolorous above, narrowly rounded and slightly paler below; collective veins arising from basal veins, 1 mm from margin; basal veins 1 pair; antimarginal vein present; upper surface eglandular, with pale, linear cellular inclusions and irregularly parallel granular ridges upon magnification; lower surface glandular-punctate with some low ridging upon magnification, considerably smoother than above, the glands red-brown, weakly and uniformly raised with sunken centers, granules smaller and less uniform. *Inflorescence* with peduncle 10.8 cm long, drying grayish brown; spathe green, reflexed, drying 1.5 cm long, 2 mm wide, coriaceous and medium brown; spadix green, cylindroid, 1.5 cm long, 4 mm diam., drying medium brown; flowers 3 visible per spiral, drying 2.3 mm long, 1.8 mm wide; tepals conspicuously granular with white and dark brown areas on drying; lateral tepals 1.2 mm wide, outer margins 3-sided, inner margin rounded; stamens not emerged; pistils drying as sparse dark irregular spots. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium lellingeri* is known only from the type locality but it is to be expected in adjacent Colombia. It occurs at 500–600 m in a Tropical wet forest life zone.

**Etymology** — *Anthurium lellingeri* is named in honor of botanist, Dr David Lellinger, a fern specialist formerly at the Smithsonian Institution in Washington, D.C. Lellinger worked in the Chocó of Colombia studying ferns and helped to collect the type collection.

**Comments** — *Anthurium lellingeri* is close to narrow-leaved specimens of *A. bakeri* but differs from that species by its green spadix and the dense array of pale, linear cellular inclusions on the upper blade surface.



**Figure 57.** *Anthurium lellingeri* Croat. Holotype: *Gentry 28578*.



Figure 58. *Anthurium loratum* Croat. Holotype: Croat 47085.



Figure 59. *Anthurium loratum* Croat. Isotype: Croat 47085.



*Anthurium loratum* Croat, **sp. nov.** — Type: COSTA RICA. Cartago: 1.5 miles E of Cachi, 10.2 miles NE of junction at Paraiso, ca. 09°49'N, 83°48'W, 1300–1350 m, 5 Feb. 1979, *T.B. Croat* 47085 (holotype, MO-2769783; isotype, INB). **Figures 58 & 59.**

*Diagnosis:* *Anthurium loratum* is a member of sect. *Porphyrochitonium* and is characterized by its pendent epiphyte habit, short internodes, semi-organized, reddish brown cataphyll fibers, terete glandular-punctate heavily sheathed petioles, strap-shaped narrowly and weakly attenuated blades glandular-punctate on both surfaces, more than 25 primary lateral veins per side, 2 pairs of basal veins, a long-pedunculate inflorescence, lanceolate, pink to light green spathe which becomes apricot-orange and twisted in age and a bright reddish brown, cylindroid spadix.

Pendent epiphyte; internodes short, 1.0–1.5 cm diam.; cataphylls 5.5–6.0 cm long, persisting as semi-organized, reddish brown fibers. *Leaves* pendent; petioles 11.5–16.2 cm long, terete, glandular-punctate, drying 2 mm diam., grayish yellow-brown, matte to weakly glossy, sheathed 0.14–0.23 their length; sheath persisting intact; geniculum 0.6–1.0 cm long, blackened; blades strap-shaped, 52–95 cm long, 2.3–3.8 cm wide (averaging  $74 \times 3$ ), 18–40 (averaging 24) times longer than wide, 4.6–5.8 times longer than petioles, narrowly and weakly attenuated at apex, narrowly acute at base, sometimes abruptly ending with base narrowly rounded but no more than 4–5 mm wide near where it ends, subcoriaceous drying grayish to grayish yellow-brown above, concolorous to slightly darker and grayish brown below, matte on both surfaces (the glands above slightly larger than those below); midrib prominently raised and drying darker on both surfaces, narrowly raised and minutely ridged below, somewhat quadrangular to irregularly ridged above, not narrowly flattened and knife-edged; primary lateral veins more than 25 per side, inconspicuous, scarcely more obvious than the interprimary veins, departing midrib at 20–35°, weakly and narrowly raised on both surfaces, about equal to collective veins; collective veins arising from base, 1–3 mm from the margin, weakly raised on both surfaces; basal veins 2 pairs; upper surface velvety, glandular-punctate, drying densely papillate with dense pale-depressions; lower surface dark glandular-punctate, densely papillate often in close rows, with dense pale depressions. *Inflorescence* with both peduncle and spadix erect at anthesis; peduncle 17.0–39.5 cm long, sometimes reddish, drying 2–3 mm diam., matte, finely ribbed, gray-brown; spathe lanceolate, pink to light green, 6.5–10.0 cm long, 6–12 mm wide, narrowly acuminate at the apex, cordulate and contiguous at the base, reflexed-spreading to spreading, twisted, becoming apricot-orange in age; spadix bright reddish brown, cylindroid, 6.2–11.3 cm long, 4–5 mm diam., rounded at apex; flowers 6–7 visible per spiral, 2.2 mm long; lateral tepals 1.6–1.8 mm long, the outer margin obtusely 2-sided, inner margin broadly rounded. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium loratum* is endemic to Costa Rica, known only from 1300–1350 m in the Talamanca Range in Cartago Province in the region of Tapantí and in Limón Province between the upper Río Xichiari and the upper Río Boyei in a *Premontane wet forest* life zone.

**Etymology** — The species epithet ‘*loratum*’, meaning ‘strap-shaped’ in Latin, refers to the strap-shaped leaf blades of this species.

**Comments** — *Anthurium loratum* is most easily confused with *A. friedrichstahliae* Schott, a species that also occurs in Costa Rica at elevations usually below 400 m but occurring up to 800 m. It differs by having petioles sheathed only 0.14–0.23 their length, blades that are 7.2–8.4 times longer than petioles, an inflorescence which is more or less pendent at anthesis and tepals which are 1.0–1.2 mm long. *Anthurium loratum* is also similar to a Panamanian species, *Anthurium pendens* Croat, which differs by having the blade narrowly oblanceolate, broader above the middle and with the peduncle shorter than the petioles. In contrast, *A. loratum* has blades strap-shaped and broadest at the middle with the peduncles longer than the petioles, sometimes up to twice as long. In addition, the petioles of *Anthurium pendens* are sheathed only near the base and the blades are only 8–18 times longer than wide while the upper epidermis dries irregularly ridged with a tight reticulum with a lack of minute papillae.

A cultivated specimen of unknown origin from the Wilson Tropical Botanical Garden (Las Cruces) near San Vito de Java (Croat 32965) may be this species, but it differs by having proportionately shorter (only 14.5 times longer than wide) and wider blades (to 5.3 cm wide) which dry dark yellow-brown. It does however have the same strange epidermal pattern on the upper surface as is present in *Anthurium loratum*.

**Paratypes:** COSTA RICA. Cartago: Upper Río Naranjo headwaters, above Quelitales de Cachi, ca. 1350 m, 2 Aug. 1989, *T. B. Croat & C. Horich* 69774 (MO). **Limón:** Almirante, Divide between the headwaters of the upper Río Xichiari and the headwaters of the upper Río Boyei, 09°45'50"N, 83°19'45"W, 1300 m, 12 Aug. 1995, *G. Herrera* 8441 (INB, MO).

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***Anthurium mercadoi*** Croat & O.Ortiz, **sp. nov.** — Type: PANAMA. Colón: Distrito de Donoso, Área de concesión de Minera Panamá, Coastal Road, km 16, 08°54'38.7"N, 80°39'32.01"W, 101 m, 30 June 2013, *O.O. Ortiz, L. Mercado & M. Ponce* 1825 (holotype, PMA-106388; isotype, MO). **Figures 60–64.**

**Diagnosis:** *Anthurium mercadoi* is a member of sect. *Porphyrochitonium* and is characterized by its terrestrial habit, short internodes, intact cataphylls, subterete petioles somewhat flattened

adaxially, weakly quilted, bicolorous, prominently acuminate, ovate, greenish drying blades with the base rounded-weakly cordate, 2 pairs of basal veins the first of which is 6–10 mm from the margins, the upper surface weakly glandular-punctate and lower surface conspicuously glandular-punctate as well as by the moderately long-pedunculate inflorescence with an oblong-oblancheolate, green, spreading-erect spathe and a sessile, cream-colored, weakly tapered spadix.

Terrestrial herb; **internodes** short, ca. 2 cm diam.; **cataphylls** dark brown, persisting intact, splitting only at the base. *Leaves* erect-spreading to spreading from more or less erect petioles, moderately long-petiolate; petioles 25 cm long, 7 mm diam., terete, flattened adaxially toward apex with several weak longitudinal ribs, drying sharply sulcate, grayish green, weakly glossy; **geniculum** ca. 1 cm long, shrunken and darker than surface; **blades** ovate-elliptic, 29.7 cm long, 16.9 cm wide, broadest slightly below the middle, 1.7 times longer than wide, 1.2 times longer than petioles, gradually long-acuminate at apex, rounded at base, subcoriaceous, moderately bicolorous, dark olive-green and matte above, moderately paler and matte below, drying dark green and weakly glossy above, grayish green and semiglossy below; midrib narrowly rounded on both surfaces; **primary lateral veins** 15–17 per side, departing midrib at moderately steep angle then spreading at 50–60°, except to 70° near the base, weakly quilted-sunken and concolorous above, narrowly raised and darker than surface below; **collective veins** arising from one of the lower primary lateral veins, 4–9 mm from margins, weakly loop-connecting and slightly more prominent than primary lateral veins on drying; **upper surface** weakly glandular-punctate, moderately smooth with minute flecks and very short pale lineations at high magnification; **lower surface** smooth, densely dark-glandular-punctate. *Inflorescence* erect; peduncle 31 cm long, ca. 5 mm diam.; spathe spreading, 6.4 cm long, 1.3 cm wide, green, acute and apiculate at apex, decurrent 1.9 cm at base; **spadix** cream-colored, erect, weakly tapered, 8.7 cm long, 4 mm diam. and dark brown on drying; **flowers** 5–6 visible per spiral, 2.1–2.3 mm long, 1.6–1.8 mm wide; tepals minutely granular, lateral tepals 1.2–1.3 mm wide, inner margin rounded, outer margin bluntly 2-sided; stamens exposed but at least partially withdrawing beneath tepals, 0.6 mm long, 0.6 mm diam., thecae parallel. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium mercadoi* is endemic to Panama, known only from the type locality in Colón Province at about 100 m in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium mercadoi* is named in honor of Panamanian botanist, Luis Mercado who assisted in collecting the type specimen with Orlando Ortiz and Marcos Ponce. Luis worked on the study of the plants in the vicinity of the copper mine in the Donoso region and has contributed to the inventory of that area.



**Figure 60.** *Anthurium mercadoi* Croat & O.Ortiz. Holotype: *Ortiz et al. 1825*.



**Figure 61.** *Anthurium mercadoi* Croat & O.Ortiz. Ortiz *et al.* 1825. Leaves.





**Figure 62.** *Anthurium mercadoi* Croat & O.Ortiz. **Ortiz et al. 1825.** Leaf base.



**Figure 63.** *Anthurium mercadoi* Croat & O.Ortiz. Ortiz *et al.* 1825. Inflorescence.



Figure 64. *Anthurium mercadoi* Croat & O.Ortiz. Ortiz et al. 1825. Cataphylls.



Figure 65. *Anthurium minimum* Croat. Holotype: McPherson 9671.

**Comments** — *Anthurium mercadoi* is most similar to *A. lancifolium* Schott which differs by having typically elliptic-lanceolate blades which are broadest in the middle and usually acute to attenuate at the base. In the Lucid Anthurium Key, *Anthurium mercadoi* tracks also to *A. barryi* Croat, which differs by having elliptic to narrowly ovate blades less than 10 cm wide which are glandular-punctate only on the lower blade surface and have a yellow-green spadix; *A. crassilaminum* Croat which differs by having oblong-lanceolate blades which are glandular-punctate only on the lower surface; *A. gentryi* Croat which differs by having small lanceolate leaf blades which are glandular-punctate on the lower surface and *A. paludosum* Engl. which differs by having narrowly elliptic to oblanceolate concolorous leaves as well as a green spadix.

***Anthurium minimum*** Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Vicinity of Fortuna Dam, along pipeline road leaving main Gualaca-Chiriquí Grande road 2.8 km from Continental Divide, ca. 08°45'N, 82°15'W, 850–900 m, 25 June 1986, G. McPherson 9671 (holotype, MO-33999581). **Figure 65.**

**Diagnosis:** *Anthurium minimum* is a member of sect. *Porphyrochitonium* and is characterized by its short, slender internodes, persistent pale brown cataphyll fibers, slender, subterete petioles, narrowly oblong-elliptic, long-acuminate, grayish brown-drying blades which are glandular-punctate on the lower surface with an acute upper midrib as well as by the slender peduncle which exceeds the length of the petiole, a slender, green, reflexed spathe, and a short, cylindrical, green spadix.

Epiphyte; internodes short, drying 5 mm diam.; cataphylls 2.5 cm long, intact, dark yellowish brown, fibrous with fragments of brown epidermis. *Leaves* with petioles 3.2–6.5 cm long, flattened adaxially, drying 1.0 mm or less in diam., gray-brown, deeply sulcate adaxially with prominently raised acute margins, glandular-punctate; geniculum to 6 mm long with medial ribs, drying darker than petioles; blades narrowly oblong-elliptic, 4.7–11.2 cm long, 1.3–3.0 cm wide (averaging  $8 \times 2$ ), 3.6–3.8 (averaging 3.7) times longer than wide, broadest midway, 1.3–2.2 (averaging 1.8) times as long as petioles, abruptly acuminate at apex, narrowly acute at base, subcoriaceous, drying dark gray-brown and matte on both surfaces; midrib flattened, drying convex and paler above, drying narrowly convex, ribbed, glandular and concolorous below; primary lateral veins 8–10 per side, departing midrib at 35–45°, scarcely more prominent than the interprimary veins above, drying weakly convex and concolorous above, narrowly rounded and slightly paler below; collective veins arising from the basal veins, 2 mm from margin; antemarginal vein present; basal veins 1 pair; upper surface sparsely glandular-punctate, glands weakly raised and almost blackened, conspicuously granular with small cellular inclusions; lower surface prominently glandular-punctate, glands weakly raised and dark brown,



weakly granular and irregularly folded. *Inflorescence* erect; peduncle 11.7 cm long, terete, reddish, drying < 1 mm diam.; spathe reddish, narrowly linear-lanceolate, 2.8 cm long, 5 mm wide, spreading-reflexed, narrowly acute at apex, drying reddish brown and coriaceous; spadix green, narrowly tapered but with a narrowly rounded point, 4.7 cm long, 2 mm diam. on drying; flowers 3–4 visible per spiral, 2.8–3.0 mm long, 1.5–1.7 mm wide; lateral tepals 1.8–2.0 mm wide, densely granular, the outer margins 2-sided, inner margins broadly rounded; stamens not emergent. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium minimum* is endemic to Panama, known only from the type locality in Bocas de Toro Province along the Continental Divide near the road between Fortuna Dam and Chiriquí Grande at 850–950 m in a *Premontane wet forest* life zone.

**Etymology** — The species epithet derives from the Latin ‘minimus’ (meaning the least) referring to the small size of this species.

**Comments** — *Anthurium minimum* is closest to *A. churchillii* Croat which has leaves of similar size and shape which are also glandular-punctate on both surfaces, but that species differs by having leaf blades that dry yellow-brown, bicolorous and with the upper midrib prominently and narrowly raised. In contrast, *Anthurium minimum* has blades that dry dark gray-brown, concolorous and with the midrib on the upper surface more or less flat on drying.

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***Anthurium monroi*** Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Ridge N of Campamento Lucho, 09°05'03"N, 82°44'33"W, 2000 m, 18 Mar. 2004, *A.K. Monro & E. Alfaro 4475* (holotype, MO-5881318; isotypes, BM, INB, MEXU, MO, PMA). **Figures 66–68.**

*Diagnosis:* *Anthurium monroi* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, pale persistent cataphyll fibers, long subterete petioles, narrowly oblong-lanceolate blades with a single pair of collective veins and by its long-pedunculate inflorescence with a reddish brown spathe and pale green to cream spadix as well as by the orange berries.

Epiphyte; internodes short, 7 mm diam.; cataphylls 5.5 cm long, persisting as reddish brown fibers with fragments of reddish brown epidermis. *Leaves* with petioles 34 cm long, 4 mm diam., subterete, drying obtusely and broadly sulcate, yellowish brown; geniculum 1.2 cm long, drying slightly darker than petioles; blades oblong-lanceolate, 45.2–50 cm long, 7.1–8 cm wide, 6.4 times longer than broad, broadest above midway, 1.3 times longer than petioles, abruptly acuminate at apex, weakly attenuate at base, subcoriaceous, dark green, matte with



blue-gray hue above and a yellow-green hue below, moderately bicolorous, drying medium brown, matte above, yellowish brown, weakly glossy below; midrib acutely raised, sparsely glandular-punctate and concolorous above, narrowly raised, sparsely elongated glandular-punctate, with narrow irregular ridges that upon magnification are minutely lined with transverse ridges and slightly darker below; primary lateral veins 16–18 per side, arising at 40–45°, weakly narrowly rounded and concolorous above, narrowly raised and concolorous below; collective veins arising from basal veins, 4–5 mm from margin; basal veins 1 pair; antemarginal vein present and obscured by the revolute margin; upper surface densely granular, sparsely glandular-punctate with glands which are sunken and reddish brown; lower surface glossier but with irregular ridges upon magnification and paler, more densely glandular-punctate with glands which are raised, dark reddish brown. *Inflorescence* with peduncle slender, cream suffused with pink, 27.2 cm long, drying dark reddish brown; spathe ovate-narrow elliptic, greenish, 9 cm long, 7 mm wide, drying dark reddish brown; spadix pale green to cream, uniform, drying 8 cm long, 2 mm wide, dark reddish brown; flowers (immature) 6 visible per spiral, drying 1.0–1.2 mm long, 0.9–1.0 mm wide; tepals sparsely pale pustular on drying; lateral tepals 0.8 mm long, the outer margins 3-sided, the inner margin rounded. *Infructescence* with berries orange.

**Distribution and Ecology** — *Anthurium monroi* is known only from the type locality in western Panama near the Costa Rican border at 2000 m elevation in a *Lower montane rain forest* or *Montane rain forest* life zone.

**Etymology** — *Anthurium monroi* is named for Alex Monro, a Senior Botanist at Kew Gardens, and a researcher at the Natural History Museum in London. A specialist on Urticaceae, he devoted a lot of time collecting in Central America, especially in NE Panama near the Costa Rican border where the type specimen originated.

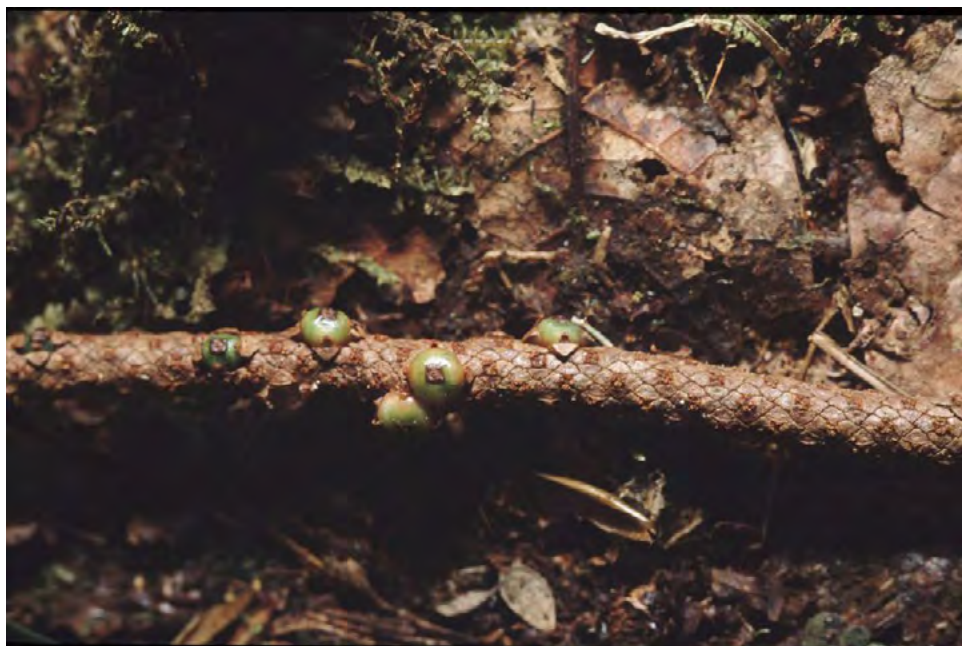
**Comments** — *Anthurium monroi* should be compared with *A. gracililaminum* Croat, *A. hammelii* Croat and *A. lancifolium* Schott. These are the only species that occur above 1500 m with petioles more than 25 cm long. *Anthurium lancifolium* and *A. gracililaminum* both differ in having blades broadest well below the middle. In contrast, the blades of *Anthurium monroi* are broadest at the middle and *A. lancifolium* also differs by having berries purple to white, while *A. gracililaminum* differs by having greenish berries as well as blades that are eglandular on the upper surface. *Anthurium hammelii* differs by having an almost rounded spathe that is purple with a cream spadix.



Figure 66. *Anthurium monroi* Croat. Holotype: Monro 4475.



**Figure 67.** *Anthurium monroi* Croat. *Monro 4475*. Habit in field



**Figure 68.** *Anthurium monroi* Croat. *Monro 4475*. Infructescence with emerging young berries



Figure 69. *Anthurium morrisii* Croat & O.Ortiz. Holotype: Zapata et al. 3501.





**Figure 70.** *Anthurium morrisii* Croat & O.Ortiz. Paratype: Arturo 2069



*Anthurium morrisii* Croat & O. Ortiz, **sp. nov.** — Type: PANAMA. Veraguas: Distrito Sante Fé, Limite norte del Parque Nacional Sante Fé, Quebrada El Cedro, afluente de Río Dos Brazos, proximo a Río Veraguas, 08°42'29"N, 80°53'19"W, 210 m, 6 Feb. 2014, *A. Zapata, A. Morris, G. Abrego, J. Rodríguez & A. Gálvez 3501* (holotype, MO-6578058; isotype, PMA). Figures 69 & 70.

*Diagnosis:* *Anthurium morrisii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, long cataphylls weathering to a network of closely parallel fibers, petioles which are thicker than broad, broadly and sharply deep-sulcate with a prominently raised acute medial rib as well as being narrowly angled abaxially with a thin-winged angle, blades which dry grayish-green and are oblanceolate and gradually acuminate with glandular punctations on both surfaces, narrowly acute at base with a single pair of collective veins as well as a short-pedunculate inflorescence with a green reflexed spathe and a long-tapered spadix with red berries.

Epiphyte; internodes short, ca. 1 cm diam.; cataphylls 5.5–11.5 cm long, soon weathering into a network of moderately parallel pale fibers, mostly persisting. *Leaves* with petioles 4.0–14.1 cm long, ca. 2.5 mm wide, thicker than broad, broadly and sharply deep-sulcate adaxially with a prominently raised acute medial rib, narrowly ribbed abaxially with a thin-winged angle, densely glandular-punctate-short-lineate throughout; blades elliptic, 29.4–31.5 cm long, 5.7–6.5 cm wide (averaging  $30.6 \times 6.2$ ), 4.8–5.2 times longer than wide, 2.3–7.4 (averaging 5.5) times longer than petiole, gradually acuminate at apex, acute to weakly attenuate at base, subcoriaceous, drying dark gray-green and weakly glossy above, moderately paler, gray-green and semiglossy below; midrib narrowly rounded to narrowly round-raised and slightly paler, glandular-punctate above, narrowly rounded, glandular-punctate and darker below; primary lateral veins 13 or 14 per side, arising at 50–60°, scarcely more prominent than the interprimary veins, drying narrowly rounded, minutely granular, narrowly rounded and concolorous below; tertiary veins not prominent; collective veins 1 pair, arising from the base, 3–4 mm from margin; antemarginal veins present; upper surface minutely areolate upon magnification, densely glandular-punctate; lower surface moderately smooth, densely dark glandular-punctate. *Inflorescence* with peduncle 10 cm long, 2.5 mm diam., drying gray-green, granular; spathe 4.1 cm long, 6 mm wide, sparsely pale short-lineate, acuminate, spreading; spadix yellow, 11.5 cm long, 4 mm diam., 28 times longer than wide; flowers 2.5–3 visible per spiral, 3 mm long, 2 mm wide; tepals minutely granular, matte; lateral tepals 2 mm wide, inner margin nearly straight, outer margin obtusely 2-sided with rounded angle; stamens withdrawn beneath tepals, anthers 0.3 mm long, 0.5 mm wide. *Infructescence* spreading; berries reddish, soon and broadly raised, tepals reddish.

**Distribution and Ecology** — *Anthurium morrisii* is endemic to Panama, known only from two collections in the type locality in Veraguas Province at 210 m and 169 m respectively in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium morrisii* is named in honor of Panamanian botanist, Arturo Morris who helped collect the type specimen. Arturo is recognized as a great collector and has collaborated in many floristic studies for many years, focusing mainly on the Fortuna Forest Reserve in Chiriqui Province and the Donoso region in Colon Province.

**Comments** — In the Lucid Anthurium Key *Anthurium morrisii* tracks to *A. cuasicanum* Croat, which differs by having yellow-brown, less conspicuously bicolorous blades, proportionately longer petioles in relation to blades and much longer inflorescences (usually longer than leaves); *A. lustriviridum* Croat, which differs by having much broader elliptic blades with 2 pairs of collective veins; *A. rupicola* Croat, which differs by having proportionately longer and narrower leaf blades, a much stubbier white spadix as well as usually growing on rocks in streams; *A. spathifolium* Sodiro, which differs by its much shorter petioles (3–5 cm long) and proportionately broader (8–10 cm wide) oblanceolate blades drying dark brown; *A. verrucosum* Croat & D. C. Bay, which differs by having blades with verrucose structures on the upper surface and glandular-punctate only on the lower surface and *A. wattii* Croat & D.C.Bay, which differs by having blades with 20 or more primary laterals veins per side, glandular-punctate only on the lower surface and infructescences with purplish red berries.

*Paratype*: PANAMA. Veraguas: Parque Nacional Santa Fé, cerca del río dos Brasos, 8°41'53"N, 80°53'12"W., 169 m, 5 Feb. 2014, *A. Zapata, J. Rodríguez, A. Galvez & G. Abrego* 2069 (PMA).

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*Anthurium muscidiradix* Croat & O.Ortiz, **sp. nov.** — Type: PANAMA. Colón: Teck Cominco Petaquilla mining concession, streamside forest, 08°50'20"N, 80°41'28"W, 121 m, 14 Sep. 2007, *G. McPherson* 19543 (holotype, PMA-59782). **Figure 71.**

**Diagnosis:** *Anthurium muscidiradix* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes with roots few and enveloped in a short-leaved moss, short, weakly fibrous and inconspicuous cataphylls, deeply sulcate petioles with a narrow acute medial ridge and prominently raised acute margins, short blackened geniculum, narrowly elliptic, brownish drying, gradually acuminate blades which are acute to attenuate at base, with a single pair of collective veins arising from base and 1–2 mm from margins, both surfaces dark glandular-punctate as well as by the long-pedunculate inflorescence with a less globose lanceolate, green, spreading spathe and a sessile, long-tapered spadix with red, more or

less globose berries. *Anthurium muscidiradix* is seemingly so closely associated with the moss that tightly envelopes the internodes that presumably the moss does most of the absorption of moisture and nutrients.

Epiphytic; internodes short, ca. 1 cm diam.; roots few, slender, enveloped in a strange short-stranded moss; cataphylls 1.5 cm long, persisting as pale fibers with dark brown fragments of epidermis. *Leaves* with petioles 1.5–3.7 cm long, 0.6–1.6 cm thick, 0.6–1.2 cm wide, deeply sulcate with a narrow acute medial ridge and prominently raised acute margins adaxially, narrowly rounded to acutely 1-ribbed abaxially; geniculum, 2–3 mm long, blackened; blades elliptic to oblong-elliptic, 7.7–13.3 cm long, 2.4–4.0 cm wide (averaging  $10.9 \times 3.2$  cm), 3.3–4.0 (averaging 3.5) times longer than broad, 4.3–5.3 (averaging 4.8) times longer than petioles, prominently and gradually acuminate at apex, narrowly acute to weakly attenuate at base, subcoriaceous, drying gray-brown above, yellow-brown below; weakly glossy on both surfaces; midrib prominently, narrowly round-raised, darker than surface above, broadly angular, short pale-lineate, lacking a ridge, darker brown below; primary lateral veins 4 or 5 per side, weakly raised and concolourous on both surfaces with distinct interprimary veins, departing midrib at 40–50°; basal veins one pair; collective veins arising from the base, 1–2 mm from the margin; tertiary veins not at all conspicuous; upper surface smooth, minutely areolate with conspicuous, mostly sunken dark glandular-punctations; lower surface smooth, minutely brownish speckled with dark brown glandular punctations. *Inflorescence* much longer than leaves; peduncle terete, 13.3 cm long, drying 2 mm diam., yellow-brown, densely granular; spathe lanceolate, green, spreading, 2.3 cm long, 5.2 mm wide; spadix sessile, long-tapered, 7.5 cm long, 2.8 mm diam., drying dark brown; flowers 2 visible per spiral, 3.6 mm long, 3 mm wide; tepals matte with faint cellular inclusions; lateral tepal 2 mm wide, inner margin rounded, outer margin 2-sided. *Infructescence* with berries red, subglobose, 5–6 mm diam.; seeds 4–6 per berry, 1.4 mm long, 0.9 mm wide, yellow-brown.

**Distribution and Ecology** — *Anthurium muscidiradix* is endemic to Panama, known only from the type locality in Colón Province at 121 m in a *Tropical wet forest* life zone.

**Etymology** — The species epithet is derived from the Latin ‘*muscidus*’ (meaning mossy) and ‘*radix*’ (meaning root).

**Comments** — In the Lucid Anthurium Key, *Anthurium muscidiradix* tracks to *A. kallunkiae* Croat which differs by its more broadly elliptic leaf blades which are more attenuated at base and the inflorescence much shorter than leaf blades and *A. pageanum* Croat, which differs by its more decidedly triangular petioles, thinner, more gray drying blades with the lower surface much paler and densely dark-brown-speckled with more inconspicuous glandular punctations.



**Figure 71.** *Anthurium muscidiradix* Croat & O.Ortiz. Holotype: McPherson 19543



**Figure 72.** *Anthurium neei* Croat. Holotype: Nee 7916.

*Anthurium neei* Croat, **sp. nov.** — Type: PANAMA. Panamá: El Llano-Cartí Road, 5 km N of Pan-American Hwy. at El Llano, 09°15'N, 78°55'W, 300 m, 10–11 Nov. 1973, *M. Nee* 7916 (holotype, MO-2274217). **Figure 72.**

*Diagnosis:* *Anthurium neei* is a member of sect. *Porphyrochitonium* characterized by its epiphytic habit, dense coralloid root mass, short, sharply sulcate petioles, narrowly elliptic leaf blades which are glandular-punctate only on the lower surface as well as by its short-pedunculate inflorescence with a reflexed spathe.

Epiphyte; internodes short, 8 mm diam.; cataphylls 2.1 cm long, acute, persisting intact at apex, becoming fibrous with fragments of yellowish-brown epidermis, the fibers reddish brown, mostly closely parallel. Leaves with petioles 1.5–5.4 cm long, 2–3 mm diam., narrowly and acutely sulcate, drying yellowish brown; geniculum 5–8 mm long, drying darker than petioles; blades narrowly elliptic, 14.3–21.5 cm long, 4.9–7.6 cm wide (averaging  $18 \times 6$  cm), 2.7–3.1 (averaging 2.9) times longer than broad, broadest midway, 3.9–10.1 (averaging 6.9) times longer than petioles, gradually short-acuminate at apex, acute to attenuate at base, drying subcoriaceous, medium brown and weakly glossy above, yellowish brown and semiglossy below; midrib drying narrowly raised and darker above, narrowly rounded, finely ribbed and darker below; primary lateral veins 12 per side, departing midrib at 45–50° near middle, drying narrowly rounded, concolorous above, narrowly raised and slightly darker below; tertiary veins drying indistinct above, weakly raised below; basal veins 1 pair; prominent antemarginal vein present; collective veins arising at 1<sup>st</sup> or 2<sup>nd</sup> primary lateral vein, 1 mm from margin; upper surface epunctate, densely granular to minutely areolate, sparsely short pale-lineate; lower surface glandular-punctate, brownish speckled. *Inflorescence* erect, peduncle 2.6 cm long; spathe green, reflexed, 1.7 cm long, 3 mm wide, narrowly elliptic, drying moderately coriaceous, medium reddish brown; spadix weakly tapered, 4.4–6.7 cm long, 5–8 mm diam., yellow-white, drying reddish dark brown; flowers 3 visible per spiral, drying 2.1 mm long and 1.8 mm wide; tepals sparsely lenticellate and minutely granular on drying; lateral tepals 1.4 mm wide, inner margin rounded, outer margins 2-sided; stamens withdrawn below level of tepals; thecae 0.4 mm long, 0.4 mm wide, weakly divaricate. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium neei* is endemic to Panama in Panamá Province, known at present only on the El Llano-Cartí Road at 300 m in a *Premontane wet forest* life zone.



**Etymology** — *Anthurium neei* is named in honor of Dr Mike Nee who graduated at the University of Wisconsin under the supervision of Hugh Iltis and spent his career working at the New York Botanical Garden. Mike was a specialist on Solanaceae but was an excellent collector in all groups. He worked for the senior author as a collector for the Flora of Panama Project for a year and was known for the quality of his collections. Mike is now retired and lives on his family farm in Wisconsin but continues botanizing, including making field trips to Bolivia.

**Comments** — *Anthurium neei* is most easily confused with *A. kallunkiae* Croat which is very similar in superficial characteristics, such as size, leaf blade shape and even coloration of dried leaves. That species differs by having roots spreading and normal in appearance rather than having a coralloid root mass as in *A. neei*, in having leaf blades glandular-punctate on both surfaces, an erect-spreading spathe and a yellow-white spadix.

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*Anthurium nutans* Croat, **sp. nov.** — Type: COSTA RICA. Heredia: Atlantic slope of Volcán Barva, between Río Peje and Río Sardinalito, 10°17'30"N, 84°04'30"W, 700–800 m, 3 Apr. 1986, *M. H. Grayum* 6714 (holotype, MO-3489956; isotype, INB). **Figure 73.**

**Diagnosis:** *Anthurium nutans* is a member of sect. *Porphyrochitonium* and is characterized by its pendent leaves, terete petioles, oblong-linear grayish drying blades which lack glandular punctations on the upper surface, 16–20 primary lateral veins per side, which are scarcely loop-connected with the collective veins, 5–6 mm from the margin in the lower 1/3 of the blade, a pendent inflorescence, green spathe and long greenish brown spadix with 5–6 flowers visible per spiral.

Pendent epiphyte in understory; stem less than 20 cm long; internodes short, 1.5 cm diam.; cataphylls to 7.8 cm long, persisting as reddish brown fibers, sometimes with narrow fragments of epidermis. *Leaves* pendent; petioles 34–39 cm long, more or less terete, drying grayish brown, matte, finely ridged; geniculum 1.3 cm long, drying blackened, slightly thicker than petiole; blades oblong, 49.0–56.5 cm long, 8.0–8.5 cm wide (averaging 53 × 8.2), 6.1–6.6 (averaging 6.4) times longer than wide, 1.6–1.7 times longer than petioles, broadest at about the middle, weakly acuminate at apex, acute at base, coriaceous, semiglossy above, glossy below, drying grayish, nearly matte above, grayish yellow-brown, slightly paler below; midrib convex on both surfaces; primary lateral veins 16–20 per side, departing midrib at 35–45°, scarcely more conspicuous than the interprimary veins, scarcely loop-connected with the collective veins, slightly raised above, obscurely sunken beneath, drying weakly raised and bluntly acute above, weakly raised below; collective veins arising from near the base, extending along the margin 5–6 mm from the margin in the lower 1/3, increasingly more distant from the margins



**Figure 73.** *Anthurium nutans* Croat. Holotype: Grayum 6714.



Figure 74. *Anthurium orosiense* Croat. Holotype: Croat 36123.

and up to 5–10 mm from the margins toward apex, more or less equaling the primary lateral veins in prominence, much more conspicuous than interprimary veins; tertiary veins obscure below; upper surface eglandular, drying areolate granular-ridged, minutely papillate and somewhat uneven; lower surface conspicuously and densely glandular-punctate, finely granular, sparsely pustular, minutely parallel ridged-reticulate. *Inflorescence* pendent; peduncle 24.5 cm long, drying 2.5 mm diam., terete, dark brown; spathe missing; spadix ca. 27 cm long post-anthesis, sessile, greenish brown; flowers 5–6 visible per spiral, 2.2 mm long; lateral tepals 2.2–2.4 mm wide, the inner margin broadly rounded, outer margins 2–3 mm sided; stigma 0.10–0.15 mm wide, circular, drying blackish without a whitish margin. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium nutans* is known only from the type specimen from Volcán Barva in Heredia Province in Costa Rica at 700–800 m in a *Premontane rain forest* life zone.

**Etymology** — The epithet ‘*nutans*’ means nodding or directed downward, and represents the general aspect of the entire plant in natural conditions.

**Comments** — *Anthurium nutans* is closest to *A. tarrazuense* Croat which also has long-petiolate leaves with blades that dry a similar color and texture but *A. tarrazuense* has blades that have the collective veins more remote from the margin (5–6 mm) in the lower 1/3 of the blade, have fewer primary lateral veins (6–8 per side) which are more conspicuous than the interprimary veins on drying and has flowers with a larger elliptic stigma (0.5–0.6 mm long). In contrast, *A. nutans* has more elongated blades (6.2–6.7 times longer than wide), collective veins less remote from the margin (1–2 mm from margin), has more primary lateral veins which are scarcely more prominent than the interprimary veins and have flowers with a smaller style. *Anthurium nutans* is perhaps also related to *A. chiriquense* Standl. but that species differs by having blades more broadly elliptic and only 4 times longer than wide with the upper midrib acute and a stipitate spadix.

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***Anthurium orosiense* Croat, sp. nov.** — Type: COSTA RICA. Cartago: Tapantí Hydroelectric Reserve along Río Orosi, 4.5 km beyond small bridge which crosses river inside the reserve, along road to the diversion dam, 09°47'N, 83°49'W 1500–1700 m, 23 June 1976, T.B. Croat 36123 (holotype, MO-2390064; isotype IMB). **Figure 74.**

*Diagnosis:* *Anthurium orosiense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent cataphyll fibers, long terete petioles more or less equalling the blades, by the narrowly oblong-elliptic blades with weakly developed primary

lateral veins and a more well-developed pair of collective veins, glandular punctations on both surfaces as well as by the green, linear-lanceolate spathe and the long, narrowly tapered, greenish to brownish spadix.

Epiphyte; stems less than 20 cm long; internodes short, 1.2 cm diam.; cataphylls to 6 cm long, persisting as loose, brownish, semi-erect fibers at all upper nodes. *Leaves* with petioles 31.5–33.0 cm long, terete, erect-spreading, drying dark yellow-brown, minutely granular; geniculum 1.5 cm long, drying darker; blades narrowly oblong-elliptic, 33.0–46.6 cm long, 7.0–7.5 cm wide (averaging  $35 \times 7.1$ ), 4.5–7.1 (averaging 5.1) times longer than wide, 1.0–1.4 (averaging 1.1) times longer than the petioles, somewhat pendent from the petioles, weakly acuminate to acute at apex, acute to obtuse at base, subcoriaceous, dark green and semiglossy above, paler and semiglossy below, drying matte and dark grayish brown above, matte and dark yellowish brown below; midrib raised and concolorous above, narrowly raised and slightly paler below, drying 2 or more ridged, bluntly acute above, mostly bluntly acute and slightly darker below; primary lateral veins visible but not prominently raised on either surface, drying weakly and narrowly raised on both surfaces, concolorous and scarcely more prominent than the interprimary veins; collective veins arising from the base, more prominent than the primary lateral veins, 5–8 mm from the margins; the antemarginal pair of veins almost hidden by the revolute margin; tertiary veins moderately few, weakly raised and concolorous on both surfaces; upper surface drying minutely papillate, sparsely glandular-punctate but the glands moderately large; lower surface drying moderately smooth, neither surface drying wrinkled or ridged, more densely and conspicuously glandular-punctate. *Inflorescence* erect-spreading; peduncle 39 cm long, ca. 2 mm wide on drying; spathe green, 7 cm long, 6 mm wide, reflexed to spreading-reflexed, acuminate at apex, rounded at base, the margins joining on the side of the peduncle opposite the direction it is spreading; spadix 15 cm long, 4 mm diam., about 50 times longer than wide, greenish, turning brownish, weakly tapered to apex; flowers 5 visible per spiral, 1.7–1.9 mm long, 1.5–1.7 mm wide on drying; pistils not emerging; lateral tepals 0.9–1.0 mm wide, the outer margins bluntly 2-sided, the inner margin broadly rounded, concave but not held against the pistil on drying; stamens emerging just above the level of the tepals; anthers 0.3 mm long, 0.5 mm wide, the thecae ovoid, scarcely divaricate. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium orosiense* is known only from the type locality in the Tapantí Hydroelectric Reserve in Cartago Province near the Río Grande de Orosi at about 1500 m elevation in a *Premontane rain forest* life zone.

**Etymology** — The species epithet derives from the type locality near the Río Orosi in Cartago Province.

**Comments** — *Anthurium orosiense* is probably closest to *A. utleyorum* Croat & R.A.Baker, a more widespread Costa Rican species which differs by having usually smaller and narrower, more coriaceous blades with the collective veins closer to the margin (usually less than 5 mm versus rarely as close as 5 mm in *A. orosiense*) and by having a shorter, more prominently tapered purplish spadix with protruding pistils.

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***Anthurium paulmaasii*** Croat, **sp. nov.** — Type: PANAMA. Veraguas: Cerro Tute, western slope, 1000 m, ca. 08°31'N, 81°09'W, 23 Oct. 1980, *P.J.M. Maas & R. Dressler 5055* (holotype, U). Figure 75.

**Diagnosis:** *Anthurium paulmaasii* is a member of sect. *Porphyrochitonium* distinguished by its epiphytic habit, short internodes, reddish brown cataphyll fibers, moderately long, subterete, sulcate, large elliptic blades which are glandular-punctate on both surfaces and especially by its short-pedunculate inflorescence with a narrowly ovate-elliptic green spathe and a cylindroid green spadix.

Epiphyte; stems short, less than 10 cm long; internodes short, 1 cm diam.; cataphylls 2 cm long, persisting as medium reddish brown, moderately loose fibers. *Leaves* with petioles 8–12 cm long, deeply and sharply sulcate, yellowish green on drying; geniculum ca. 1 cm long, sulcate, sometimes drying darker than petiole; blades lanceolate, 12.5–20.0 cm long, 6.6–7.8 cm wide (averaging 16 × 7), 1.8–2.9 (averaging 2.5) times longer than wide, 1.2–2.1 (averaging 1.7) times longer than petioles, briefly acuminate and apiculate at apex, acute to attenuate at base, subcoriaceous, dark green and weakly glossy above, paler and semiglossy below, drying dark olive-green to yellowish green above, moderately paler and grayish green below; midrib obtusely raised, darker and faintly several ribbed on drying, obtusely raised and slightly darker below; primary lateral veins 12–17 per side, weakly and narrowly raised and concolorous on both surfaces, only slightly more prominent than the interprimary veins; collective veins 3.5–5.0 mm from the margins, drying somewhat undulate with depressions, equal to the primary lateral veins; upper surface densely papillate and minutely pale granular upon magnification, sparsely dark glandular-punctate; lower surface smooth, densely brownish speckled and densely dark brown glandular-punctate. *Inflorescence* with peduncle 4 cm long, much shorter than even the shortest petioles, drying acutely 1-ribbed on one side, acutely 2-ribbed on the other side but not markedly 3-sided; spathe 3.1 cm long, 1.8 cm wide, green, erect, narrowly ovate-elliptic, 2.8 times longer than wide, narrowly acute at apex; spadix narrowly cylindroid, 4.3 cm long, 4 mm diam., dark green, bluntly rounded at apex; flowers 2 mm wide and long, 4 visible per spiral; tepals conspicuously granular, lateral tepals 1.3–1.5 wide, the outer margins 2-sided, inner margins broadly rounded; stamens weakly emergent and withdrawing beneath the tepals; anthers 0.4 mm wide and long. *Inflorescence* not seen.



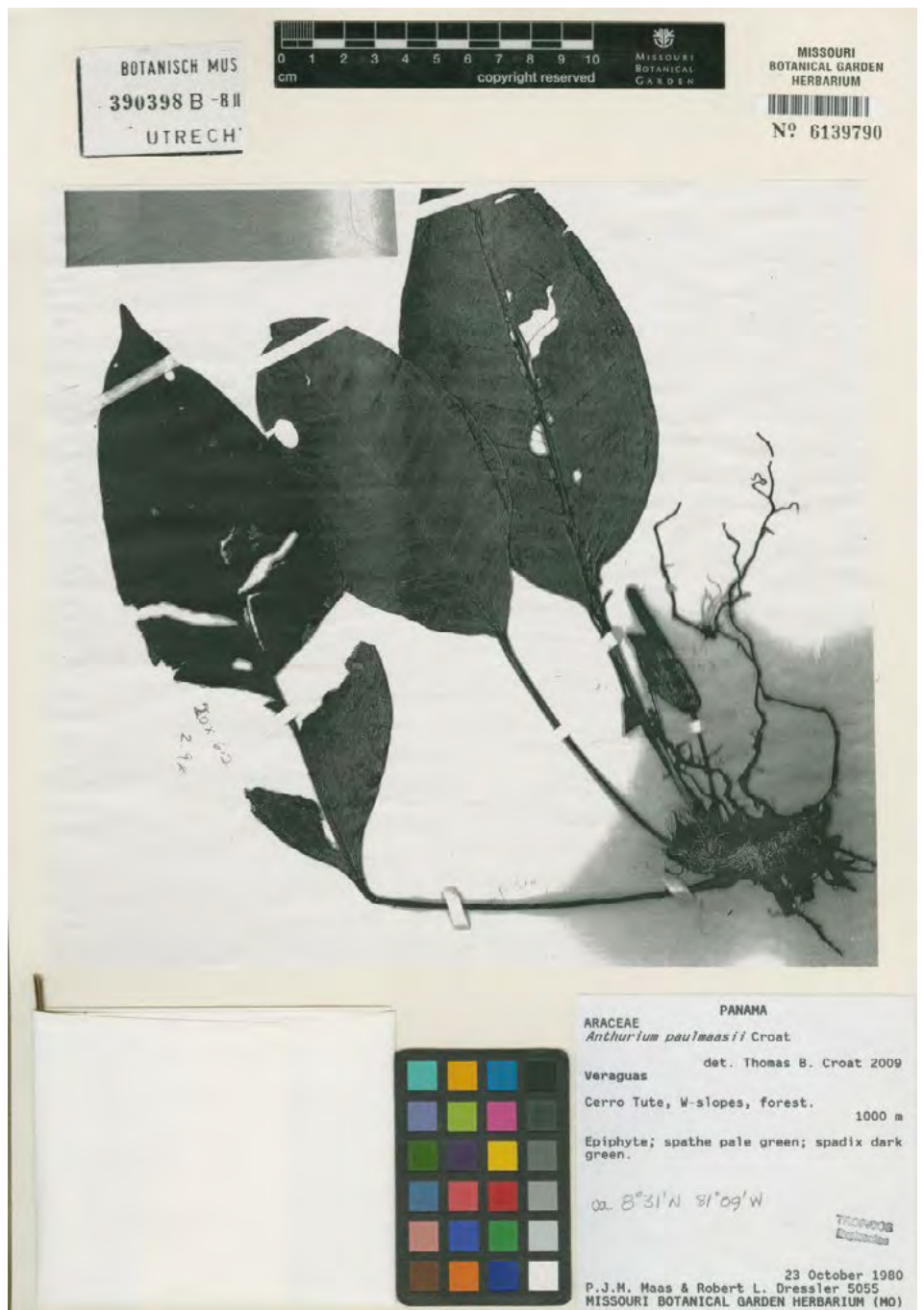


Figure 75. *Anthurium paulmaasii* Croat. Holotype: Maas & Dressler 5055.



Figure 76. *Anthurium perangustum* Croat. Holotype: Mori & Kallunki 6392.

**Distribution and Ecology** — *Anthurium paulmaasii* is endemic to Panama, known only from the type locality in Veraguas Province on Cerro Tute at 1000 m in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium paulmaasii* is named in honor of Dr Paul Maas, now affiliated with the Naturalis Biodiversity Center in Leiden, the Netherlands. Paul collected the species, like many others in this family, in the company of Bob Dressler. Maas has been one of the most prodigious botanists owing to his many collections and work with plant families as diverse as Annonaceae and Costaceae. He spent most of his career at the University of Utrecht and did much of his work with his botanist wife, Hiltje Maas-van de Kamer, who regularly went on his many overseas expeditions.

**Comments** — In the Lucid Anthurium Key, owing to its relatively long petioles and glandular punctations on both blade surfaces, *Anthurium paulmaasii* keys out with *Anthurium crassipalatum* Croat and *A. pageanum* Croat, but both of those species differ in having narrower leaf blades, longer petioles, and proportionately longer spathes.

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*Anthurium perangustum* Croat, **sp. nov.** — Type: PANAMA. Panamá: El Llano-Cartí Road, 9.6 from Interamerican Hwy., ca. 350 m, ca. 09°16'30"N, 78°59'00"W, 26 May 1975, S. Mori & J. Kallunki 6392 (holotype, MO-2274535). **Figure 76.**

*Diagnosis:* *Anthurium perangustum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphyte habit, close network of cataphyll fibers, terete, sulcate petioles, linear-oblongate, narrowly acuminate to acicular blades which are glandular-punctate on both surfaces, have 6 or 7 primary lateral veins per side, collective veins arising from basal veins and 15–20 mm from margin, a single pair of basal veins, an erect inflorescence, short peduncle, small white spathe and red, scarcely tapered spadix with four flowers visible per spiral.

Epiphyte; stem less than 10 cm long; internodes short, 5 mm diam.; cataphylls 3.0–5.3 cm long, persisting as a close network of reddish brown, mostly erect fibers. *Leaves* with petioles 4.5–10.5 cm long, terete, drying 1 mm diam., adaxially sulcate, medium yellow-brown, matte, irregularly ridged; geniculum 3–4 mm long, drying darker than petioles, slightly shrunken compared to petiole; blades linear-oblongate, 24.5–40.7 cm long, 1.1–2.1 cm wide (averaging  $30 \times 1.5$ ), 19–25 (averaging 22) times longer than wide, 3.8–6.1 (averaging 5.5) times

than petioles, narrowly acuminate to acicular at apex, narrowly acute at base, widest in upper half, subcoriaceous, moderately bicolorous, drying dark brown above, medium grayish yellow-brown below, drying essentially matte on both surfaces; midrib drying narrowly rounded and concolorous above, narrowly rounded to bluntly acute, sparsely glandular-punctate and paler below; primary lateral veins 6 or 7 per side, departing midrib at 20°, drying very obscure to weakly raised on both surfaces, directed almost straight to the collective veins; collective veins arising from basal veins, 15–20 mm from margin, about equaling the primary lateral veins and weakly raised on both surfaces; margins prominently rolled under; basal veins 1 pair; antemarginal vein present; upper surface glandular-punctate and finely irregularly ridged with the ridges more or less acute along their upper margins (more prominently so above); lower surface glandular-punctate and finely irregularly ridged. *Inflorescence* erect; peduncle 5.3 cm long, drying 1 mm diam., weakly ribbed; spathe 4.3 cm long, 5 mm wide, white, drying dark brown, abruptly acuminate at apex; spadix red, 9.2 cm long, 3 mm diam. on drying, scarcely tapered to apex, rounded at apex; flowers 4 visible per spiral, 2.2–2.5 mm long, 1.9–2.3 mm wide; lateral tepals 1.0–1.2 mm wide, the inner margins broadly rounded, outer margins 2-sided; stamens emerging and remaining at level of tepals; anthers 0.6 mm long, 0.7 mm wide; thecae moderately divaricate. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium perangustum* is endemic to Panama, known only from the type specimen in Panamá Province at about 350 m elevation in a *Premontane wet forest* life zone.

**Etymology** — The specific epithet '*perangustum*' (meaning very narrow) refers to the narrow blades that characterize the species.

**Comments** — *Anthurium perangustum* is most similar in shape to *A. friedrichsthali* Schott which has blades of similar shape and size. That species differs by having longer peduncles, a green spathe, green tinged purplish spadix, the upper midrib narrowly raised and has the blade surface moderately smooth on drying, finely and acutely ridged.

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*Anthurium polancoi* Croat, **sp. nov.** — Type: PANAMA. Darién: Serranía de Sapo, límite del Parque hasta la cima, 07°58'N, 78°23'W, 300–800 m, *H. Herrera & J. Polanco 804* (holotype, MO-3850742). **Figure 77.**

*Diagnosis:* *Anthurium polancoi* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, moderately long, slender, sulcate petioles, elliptic, grayish-drying, acuminate blades and the slender, long pedunculate inflorescence with a reddish spathe and the short, weakly tapered green spadix with most of the stamens remaining exposed after anthesis.

Epiphyte; internodes short, 7 mm diam.; cataphylls 2.6 cm long, persisting as dense reticulum of fibers, with small fragments of reddish brown epidermis. *Leaves* with petioles 9.2–15.7 cm long, 2 mm diam., C-shaped, sulcate, drying deeply and narrowly sulcate, yellowish to olive-brown; geniculum 8 mm long, drying slightly darker than petioles; blades elliptic, 10.7–14.4 cm long, 3.5–5.6 cm wide (averaging  $13 \times 5$ ), 2.1–3.1 (averaging 2.6) times longer than broad, broadest at middle, 0.9–1.3 (averaging 1.2) times longer than petioles, abruptly acuminate at apex, acute to slightly rounded at base, subcoriaceous, drying grayish to olive-brown and semiglossy above, yellowish brown and weakly glossy below; midrib eglandular on both surfaces, narrowly raised to sharply acute and slightly paler above, narrowly convex, ribbed and slightly darker below; primary lateral veins 9 or 10 per side, departing midrib at 55–60°, convex and slightly paler above, narrowly rounded and concolorous below; collective veins arising from the basal veins, 2 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface eglandular, conspicuously and minutely granular, uniform and pale upon magnification; lower surface smoother with faint medium brown speckles, glandular-punctate, the glands raised, sunken at center and dark reddish brown. *Inflorescence* with peduncle slender, 18.5 cm long, drying deeply and narrowly sulcate and yellowish brown; spathe lanceolate, reddish, drying 2 cm long, 4 mm wide and dark yellowish brown; spadix green, weakly tapered, drying 3.7 cm long, 3 mm diam., dark yellowish brown; flowers 4 visible per spiral, drying 2.2–2.4 mm long, 1.8–2.0 mm wide; tepals minutely granular on drying; lateral tepals 1.3 mm wide, outer margin 2-sided, inner margin rounded; stamens held at level of tepals, most remaining exposed after anthesis; anthers 0.4 mm long and wide, the thecae weakly divaricate. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium polancoi* is known only from the type specimen in Panama on Cerro Sapo in Darién Province at 300–800 m in a *Premontane wet forest* life zone.

**Etymology** — *Anthurium polancoi* is named in honor of one of the collectors of the type specimen, Panamanian botanist, José Polanco. Mr. Polanco works for the Asociación Nacional para la Conservación de la Naturaleza (ANCON) in Panama.

**Comments** — *Anthurium polancoi* is most easily confused with *Anthurium toroense* that differs by having conspicuously bicolorous proportionately narrower blades that are glandular-punctate on the upper surface and are often more than 2.8 times longer than broad and more than 15 cm long. In contrast, *Anthurium polancoi* has leaf blades that are scarcely bicolorous, less than 2.6 times longer than broad and less than 14 cm long with the upper surface lacking



Figure 77. *Anthurium polancoi* Croat. Holotype: *Herrera & Polanco 804*





**Figure 78.** *Anthurium robertii* Croat. Holotype: Kennedy & Dressler 3347.

glandular punctations. In addition, *Anthurium toroense* has the primary lateral veins pleated-raised on the lower surface and has a reddish spathe whereas *A. polancoi* has inconspicuous primary lateral veins, and a green spathe. *Anthurium polancoi* is also similar to *A. terryae* Croat from Cerro Pirre which differs by having blades that are broadest above the middle, drying thin and usually gray-green with a petiole usually less than one-half as long as the blade. In contrast, *Anthurium polancoi* has blades which are broadest at middle and dry grayish to olive-brown above and yellowish brown below with the petioles usually more than one half as long as blades.

*Anthurium polancoi* has been confused with *A. alticola* but that species differs by having longer stems, longer internodes, longer cataphylls, terete petioles and ovate-elliptic to oblong-elliptic blades which are more abruptly narrow-acuminate and are glandular-punctate on the upper surface.

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***Anthurium robertii*** Croat, **sp. nov.** — Type: PANAMA. Panamá Province: El Llano-Cartí Road, km 10–12, ca. 09°19'N, 79°06'W, 350–400 m, 31 Aug. 1974, *H. Kennedy & R. Dressler* 3347 (holotype, US-754002). **Figure 78.**

*Diagnosis:* *Anthurium robertii* is a member of sect. *Porphyrochitonium* recognized by its relatively small size, epiphytic habit, short internodes, persistent cataphyll fibers, short, 3-ribbed petioles, narrowly oblanceolate blades which dry grayish on the upper surface, medium yellow-brown below and with dark glands on both surfaces as well as by the long-pedunculate inflorescence with a long, sharply tapered, yellow-green spadix.

Epiphyte; internodes short, 5 mm diam.; cataphylls 3 cm long, persistent, yellowish olive-brown with fragments of olive-brown epidermis. *Leaves* with petioles 9.5–11.7 cm long, 2 mm diam., D-shaped, flat adaxially with 3 ribs, drying medium brown; geniculum 6 mm long, drying slightly darker than petioles; blades narrowly oblanceolate, 11.8–13.0 cm long, 2.8–3.3 cm wide (averaging  $12 \times 3$ ), 3.9–4.2 (averaging 4.0) times longer than broad, broadest above midway, 3.0–3.9 (averaging 3.6) times longer than petioles, abruptly acuminate at apex, narrowly acute at base, coriaceous, green and glossy above, pale green below, drying subcoriaceous, grayish and matte above, medium yellow-brown and weakly glossy below; midrib drying narrowly raised in sunken valleys above, sparsely glandular and narrowly raised to narrowly acute below; primary lateral veins 8–10 per side, departing midrib at 30–35°, narrowly rounded and concolorous above, etched, narrowly rounded and slightly paler below; collective veins arising from basal veins, 2–3 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface conspicuously areolate-ridged, sparsely glandular-punctate; lower surface smoother, finely parallel-ridged adjacent to veins, sparsely glandular-punctate, the glands

weakly raised and reddish brown. *Inflorescence* with peduncle pale green, 9.5–11.7 cm long, drying sharply sulcate and slightly reddish brown; spathe lanceolate, light green tinged pinkish, drying 2.5–3.0 cm long, 4 mm wide, coriaceous and dark yellowish brown; spadix yellow-green, long and weakly tapered, drying 4.1–10.4 cm long, 0.3–0.4 cm diam., dark yellowish brown; flowers 3 visible per spiral, drying 4.0–4.2 mm long, 2.0–2.2 mm wide; tepals minutely granular on drying; lateral tepals 2.2 mm wide, the outer margin 2-sided, the inner margin rounded; stamens not emergent. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium robertii* is endemic to Panama, known only from the type locality in Central Panama in Panamá Province at about 300 m elevation in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium robertii* is named in honor of the late Dr Robert Dressler (1927–2019), who along with Helen Kennedy collected the type specimen. Dressler, a botanist who worked for the Smithsonian Tropical Research Institute in Panama, was for more than four decades the ever-present force for orchid studies in Central America. He was a colleague to many who visited and often provided the only way to get to the field for many visiting botanists. Dressler, after retiring from Smithsonian Tropical Research Institute, lived near Lancaster Gardens in Costa Rica where he died on October 15, 2019.

**Comments** — *Anthurium robertii* is similar to *A. chaconii* Croat, a Costa Rican species from Limón Province at 600 m, in terms of the size and coloration of its dried leaves but that species has leaf blades typically broadest in the middle, a more attenuated acumen, and a shorter, less tapered spadix that is not prominently sharpened to a point. *Anthurium robertii* is also similar to *Anthurium churchillii* Croat but that species, though possessing a prominently tapered spadix, has a much shorter spadix. The latter species usually also has proportionately longer petioles and has leaf blades that dry more yellow-brown and are typically broadest in the middle. *A. robertii* is also similar to *A. oxystachyum* Croat in having a long tapered spadix but that species differs by having much longer petioles and blades that are broader below the middle. *Anthurium minimum* Croat is similar in size to *A. robertii* but differs by having a shorter, proportionately less pointed spadix and leaf blades that are broadest near the middle, drying dark brown with the upper epidermis densely granular with short pale linear cellular inclusions. In contrast, the blades of *A. robertii* dry with a minutely areolate upper surface and lack the pale linear cellular inclusions. *Anthurium wiehleri* Croat has similarly short-petiolate leaves, is abruptly acuminate at the apex and has a similarly areolate dried upper surface but it is only about one half the size of *A. robertii*, has the blades widest in the middle and has shorter, more slender spadices which are not tapered.

***Anthurium sabanitense*** Croat, **sp. nov.** — Type: PANAMA. Colón: Along route between Sabanitas and Portobello, along drainage of Río Piedras Lumber Road, departing main highway 6.7 mi E. of Sabanitas, 3.9 mi up logging road in direction of Santa Rita Ridge, 250 m, 09°22'30"N, 79°41'30"W, 6 Apr. 1993, T.B. Croat 75165 (holotype, MO-4342327). **Figures 79 & 80.**

*Diagnosis:* *Anthurium sabanitense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent, reddish brown cataphyll fibers, short, subterete, broadly sulcate petioles, narrowly oblong-oblancheolate blades with very close collective veins which are markedly more prominent than the primary lateral veins as well as by the moderately short-pedunculate inflorescence, cream-colored, reflexed spathe and the cylindroid-tapered, gray-green spadix.

Epiphyte; internodes short, 2 cm diam.; cataphyll fibers persisting, red-brown (none available on specimen). *Leaves* with petioles 4.5 cm long, 5 mm diam., terete, broadly sulcate, greenish, drying greenish brown; geniculum 1.5 cm long, drying darker than petioles; blades narrowly oblong-oblancheolate, 44.9 cm long, 5.8 cm wide, 7.7 times longer than broad, broadest above midway, 10 times longer than petioles, abruptly acuminate at apex, attenuate at base, moderately coriaceous and bicolorous, matte, drying greenish brown and semiglossy above, greenish yellow-brown and weakly glossy below; midrib eglandular above, sparsely glandular below, drying narrowly raised and paler above, narrowly rounded, finely ribbed and slightly paler below; primary lateral veins 20–25 per side, departing midrib at 40–45°, scarcely more prominent than interprimary veins, drying narrowly rounded and concolorous above, narrowly rounded and darker below; tertiary veins prominulous on both surfaces; collective veins more prominent than primary lateral veins, arising from basal veins, 2–3 mm from margin, sunken above, narrowly raised below; basal veins 1 pair; antemarginal vein present; upper surface eglandular, moderately smooth; lower surface sparsely glandular-punctate, the glands dark brown, relatively flat and weakly raised, slightly depressed in center. *Inflorescence* erect; peduncle 14.1 cm long, 5 mm diam., cylindrical, drying subterete, medium brown; spathe cream, turning green in age, reflexed, 7.7 cm long, 1.2 cm wide, subcoriaceous, drying greenish yellow-brown; spadix oblong-lanceolate, reddish at base, gray-green toward apex, cylindroid-tapered, drying 13.3 cm long, 8 mm wide, medium brown; flowers 10 visible per spiral, drying 2.1–2.2 mm long, 1.9–2.0 mm wide; tepals moderately smooth on drying; lateral tepals 1.4 mm wide, the outer margins 3-sided, the inner margins rounded; stamens not emergent. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium sabanitense* is known only from the type locality in Central Panama in Colón Province at 250 m in a *Tropical moist forest* life zone.



Figure 79. *Anthurium sabanitense* Croat. Holotype: Croat 75165





**Figure 80.** *Anthurium sabanitense* Croat. Holotype: Croat 75165. Inflorescence and leaves



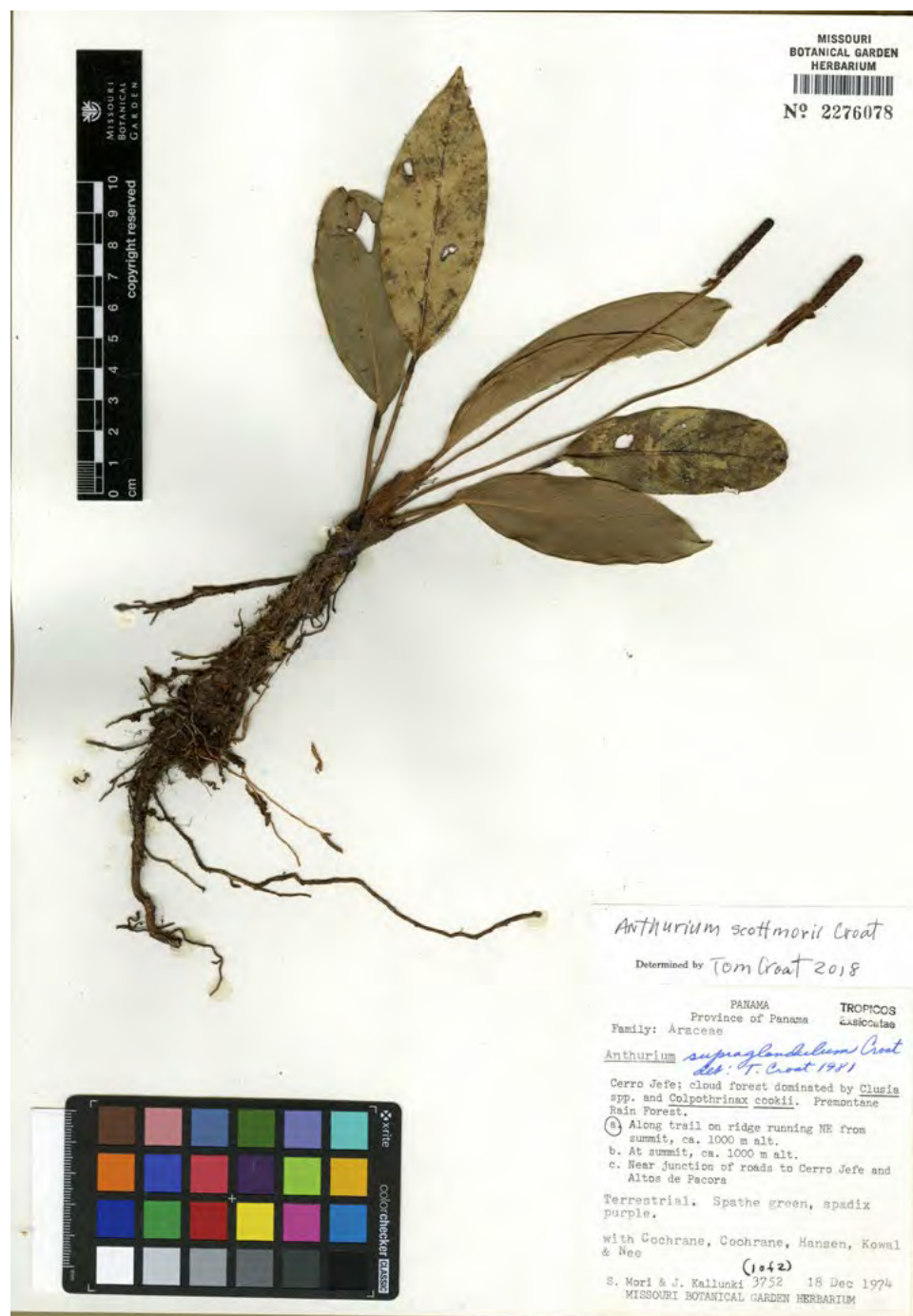


Figure 81. *Anthurium scottmorii* Croat. Isotype: *Mori et al.* 3752.



Figure 82. *Anthurium scottmorii* Croat. Holotype: Mori et al. 3752.

**Etymology** — The species epithet '*sabanitense*' refers to the town of Sabanitas near the type locality.

**Comments** — *Anthurium sabanitense* is closest to *A. bakeri* and *A. redolens* Croat both of which differ in having leaf blades with the collective veins much further from the margins, having the minor veins less prominently and closely raised but instead being further apart, having a more cylindroid, proportionately shorter spadix. In terms of the spadix shape, *Anthurium sabanitense* is closer to *A. redolens* but that species also differs by having the spadix usually stipitate while those of *A. sabanitense* are sessile.

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***Anthurium scottmorii*** Croat, **sp. nov.** — Type: PANAMA. Panamá: Cerro Jefe, cloud forest dominated by *Clusia* spp. and *Colpothrinax cookii*, along trail on ridge running NE from the summit, 1000 m, 18 Dec. 1974, S. Mori, J. Kallunki, B.A. Cochrane, T.S. Cochrane, B.F. Hansen, R.R. Kowal & M.H. Nee 3752 (holotype, MO-2276078–79; isotypes, K, PMA, WIS). Figures 81 & 82.

**Diagnosis:** *Anthurium scottmorii* is a member of sect. *Porphyrochitonium* and is recognized by its small size, short stems, short internodes, sulcate petioles, more or less elliptic blades which are glandular-punctate on both surfaces with a more or less acute apex, and a long pedunculate inflorescence with a short, cylindric reddish to purplish spadix which is 8.0–12.8 times longer than wide with yellow-orange, globose berries.

Usually epiphytic, sometimes terrestrial; stems usually less than 10 cm long; internodes short, 5–10 mm diam.; cataphylls 1.5–2.5 cm long, persisting as moderately closely appressed, reddish brown fibers. *Leaves* with petioles sharply sulcate, (1)2.5–8 cm long, drying 2 mm diam., drying yellow-brown, sharply and deeply sulcate; geniculum drying blackened, 8–10 mm long, 2 mm diam.; blades elliptic to oblong-elliptic, rarely ovate, (3.5)6.0–11.9 cm long, (1.7)2.5–5.6 cm wide (averaging  $9 \times 4$ ), 2.1–2.7 (averaging 2.4) times longer than wide, 1.2–4.1 (averaging 1.9) times longer than petioles, usually rounded to acute at apex with a short apiculum or a moderately short acumen, acute at base, subcoriaceous, drying gray above, grayish yellow-brown below; midrib drying prominently raised and irregularly wrinkled to narrowly acute and more or less concolorous above, irregularly several ribbed and yellow-brown below; primary lateral veins (3)4–5 per side, departing midrib at 25–30°, drying weakly raised on both surfaces, scarcely more prominent than the interprimary veins; collective veins arising from the base, 2–5 mm from margin; upper surface with a minute areolate pattern upon magnification with mostly sunken dark-glandular punctations; lower surface minutely and irregularly ridged with dark, weakly raised glandular punctations. *Inflorescence* erect and usually held well above the leaves; peduncle (9)13–24 cm long, drying yellow-brown, 1.5–2.0 mm diam.; spathe green to yellowish green to greenish white, sometimes tinged with purple,

2.0–2.3 cm long, 5–7 mm wide, abruptly acuminate, reflexed; spadix reddish to purple to red-brown or brownish purple, 2.7–4.8(5.5) cm long, 8.0–12.8 times longer than wide, cylindroid and rounded at apex, sometimes curved; flowers ca. 4 visible per spiral, 2.7–3.2 mm long; lateral tepals 1.5–1.6 mm wide, the outer margins 2-sided, the inner margin broadly rounded. *Infructescence* subglobose, with berries ca 6 mm diam, yellow-orange.

**Distribution and Ecology** — *Anthurium scottmorii* is endemic to the summit of Cerro Jefe in Panama Province at 85–1000 m in a *Primary rain forest* life zone.

**Etymology** — *Anthurium scottmorii* is named after the late Dr Scott Mori (1941–1920), Curator Emeritus at the Institute of Systematic Botany at the New York Botanical Garden where he spent most of his career. Mori was a student of Hugh Iltis (1925–2016) at the University of Wisconsin and specialized in neotropical floristics but particularly the Lecythidaceae. In addition to his work on that family he devoted a lot of time to floristic studies especially in Brazil, French Guiana, and Saba, a Caribbean Island in the Lesser Antilles chain. He traveled widely, often accompanied by his photographer wife, Carol Gracie, an author of several books on plants.

**Comments** — *Anthurium scottmorii* is related to *Anthurium alticola* Croat, a species that is similar in both stature and dried coloration but differs by the blades abruptly acuminate to moderately long-acuminate at apex and with the spadix moderately attenuated toward the apex and 20–31 times longer than wide. *Anthurium alticola* occurs at somewhat higher elevations, to 1850 m elevation, in Chiriquí and Darién Provinces.

*Antonio 4740* is unusual in having somewhat longer blades, 3.5 times longer than broad with an acuminate apex and by having a prominently stipitate spadix. Perhaps it represents a hybrid.

*Paratypes*: PANAMA. Panamá. Cerro Jefe: Vicinity of Cerro Jefe, near tower, 09°12'50"N, 79°23'05"W, 732 cm, 23 May 1980, T.M. *Antonio 4721* (MO); 4740 (MO); 09°14'22"N, 79°22'30"W, 900–1000 m, 30 Aug. 1977, P.J.M. *Maas*, R.L. *Dressler*, & C.C. *Berg 2703* (MO); 1.5 km. before weather station, 09°12'50"N, 79°23'05"W, 850–900 m, 7 Oct. 1980, K.J. *Sytsma 1479* (MO); 09°14'02"N, 79°22'30"W, 2500–3000 ft, 29 June 1978, B. *Hammel 3728* (MO); 800–1000 m, 23 Feb 1977, J.P. *Folsom*, R. *Lantz* & J. *1859* (MO); 1860 (MO); 23 km N of Panamerican Hwy., 1000 m, 11 Apr. 1977, J.P. *Folsom*, L. *Skog* & W.G. *D'Arcy 2530* (MO); 900–1000 m, 8 Oct. 1974, S. *Mori* & J. *Kallunki 2393* (MO); 1.5 km before weather station, 09°12'50"N, 79°23'05"W, 850–900 m, 8 Oct. 1980, K. J. *Sytsma 1515* (MO); New road leading N from summit, 900–1000 m, 26 Sep. 1975, J. T. & F. *Witherspoon 8533* (MO); 1000 m, 29 Aug. 1975, S. *Mori 7983* (MO); Around transmitting tower, 950 m, 23 May 1980, J.P. *Folsom* & J.D. *Mauseth 7793B* (MO); La Eneida, A la largo del camino nuevo que empieza al lado de la casa de López, 09°11'20"N, 79°23'05"W, 750 m, 8 Mar. 1968, M.D. *Correa A.*, R.L. *Dressler* & C.E. *Calderón 820* (MO).

*Anthurium sknappiae* Croat, **sp. nov.** — Type: PANAMA. Coclé: Ridge NW of village of Río Blanco de Norte, between Caño Sucio and Río Blanco de Norte, property of Dideymo Olivera, 08°44'N, 81°40'W; 350 m, 20 Feb. 1982, S. Knapp 3679 (holotype, MO-3043619).

**Figure 83.**

*Diagnosis:* *Anthurium sknappiae* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, pale, persistent cataphyll fibers, relatively short, deeply sulcate petioles, oblong-lanceolate, narrowly long-acuminate blades that are eglandular on the upper surface and glandular-punctate below as well as by the long-pedunculate inflorescence with a green, reflexed-spreading spathe, and narrowly tapered spadix.

Epiphyte; internodes short, 5 mm diam.; cataphylls 1.7 cm long, pale, persistent, the fibers drying manilla. *Leaves* with petioles 8.5 cm long, 2 mm diam., terete, sometimes deeply channeled near apex above, drying subterete to narrowly and sharply flattened, grayish brown; geniculum 0.8 cm long, drying darker than petioles; blades oblong-lanceolate, 30.8–32.5 cm long, 3.2–3.5 cm wide (averaging  $32.0 \times 3.0$ ), 8.8–10.2 (averaging 9.5) times longer than broad, broadest midway, 3.8 times as long as petioles, narrowly long-acuminate, acute at base, drying subcoriaceous, grayish brown and weakly glossy above, grayish green-brown and semi-glossy below; midrib drying narrowly acute and concolorous, eglandular with sparse, ellipsoid, gland-like structures above, sparsely glandular, narrowly raised and paler below; primary lateral veins 14 per side, departing midrib at 25–30°, granular on both surfaces, drying narrowly raised and concolorous above, narrowly rounded and slightly paler below; collective veins arising from basal veins, 2–3 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface eglandular, densely granular to granular-ridged, occasionally sub-areolate upon magnification; lower surface sparsely glandular-punctate (the glands red-brown, flat to weakly raised occasionally with sunken centers), moderately ridged, granular to granular ridged, irregularly folded upon magnification. *Inflorescence* with peduncle 18.7 cm long, terete, drying yellowish medium brown; spathe green, reflexed, drying 8 mm long, 1 mm wide, coriaceous, medium brown; spadix narrowly tapered, stipitate 2 mm, 4.2 cm long, 3 mm diam. at base, drying dark brown; flowers 3 visible per spiral, drying 2.4 mm long, 1.6 mm wide; tepals pustular on drying; lateral tepals 1.4 mm wide, outer margins 3-sided, inner margin rounded; stamens not emergent. *Infructescence* not seen.



**Figure 83.** *Anthurium sknappiae* Croat. Holotype: *Knapp 3679*.





Figure 84. *Anthurium stockwellii* Croat. Holotype: Churchill et al. 4943.

**Distribution and Ecology** — *Anthurium sknappiae* is endemic to Panama, known only from the type locality in Coclé Province at 350 m in a Tropical wet forest life zone.

**Etymology** — *Anthurium sknappiae* is named in honor of Dr Sandra Knapp from the Natural History Museum in London. Sandy collected the type of this plant while working for the Missouri Botanical Garden and collecting for the Flora of Panama Project. Dr Knapp, a specialist on the Solanaceae, worked with Dr William D'Arcy, who at the time was the director of the project and was a fellow Solanaceae expert. She has fortunately not restricted her collecting to that family and has collected a lot of interesting Araceae.

**Comments** — *Anthurium sknappiae* most closely resembles *A. perangustum* Croat which differs by having narrower and longer leaf blades, a shorter peduncle, a white spathe, and a red spadix; *A. friedrichsthali* Schott which differs by having narrower and longer leaf blades and collective veins 1 mm from margin.

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***Anthurium stockwellii*** Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Oleoducto Road, 2 km NE of Continental Divide, on ridge between Río Quabo and Río Quabito, 08°48'N, 82°12'W, 1000 m, 9 Feb. 1984, *H. W. Churchill, G. de Nevers & H. Stockwell 4943* (holotype, MO-3210638). **Figure 84.**

**Diagnosis:** *Anthurium stockwellii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent cataphyll fibers, short, obtusely sulcate petioles, dark brown-drying, oblong-elliptic blades glandular-punctate only on the lower surface, and a long inflorescence with the spadix much longer than the peduncles.

Epiphyte; leaves erect; internodes short, 1 cm diam.; cataphylls 3.5 cm long, persisting semi-intact, yellowish brown with fragments of medium brown epidermis. *Leaves* with petioles 4.5–5.6 cm long, 4 mm diam., subterete, narrowly and obtusely sulcate, drying dark brown; geniculum 5 mm long, drying darker than petioles; blades oblong-elliptic to oblong-oblancoate, 27.3 cm long, 7.5 cm wide, 3.6 times longer than broad, broadest above midway, 6.1 times longer than petioles, abruptly acuminate at apex, acute at base, coriaceous, drying dark brown and weakly glossy above, medium brown and semiglossy below; midrib eglandular on both surfaces, drying narrowly convex, finely ribbed and darker above, narrowly rounded and darker below; primary lateral veins 16–18 per side, departing midrib at 50–55°, drying narrowly rounded and concolorous above, narrowly raised and darker below; tertiary veins

prominulous on both surfaces; collective veins arising from basal veins, 2–4 mm from margin; basal veins 1 pair; antimarginal vein present; upper surface eglandular, moderately smooth, minutely reddish speckled upon magnification; lower surface dark brown-speckled but prominently paler upon magnification, densely glandular-punctate, the glands dark brown and rounded, smooth. *Inflorescence* pendent; peduncle 18.5 cm long, 3 mm diam., drying narrowly and acutely sulcate, medium brown; spathe lanceolate, pale maroon-green, drying 5.8 cm long, 9 mm wide, coriaceous, dark brown; spadix pale maroon-green, uniform and weakly tapered, drying 22.5 cm long, 7 mm wide, dark brown; flowers 5 visible per spiral, drying 4.0–4.2 mm long, 2.4–2.6 mm wide; tepals smooth upon drying; lateral tepals 2.6 mm wide, the outer margins 2- or 3-sided, the inner margins rounded; stamens not emergent. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium stockwellii* is known only from Panama at the type locality in Chiriquí Province at 1000 m in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium stockwellii* is named in honor of Dr Henry Stockwell of the Smithsonian Tropical Research Institute and Gorgas Memorial Hospital in Panama. Henry is an authority on weevils and has participated in many field trips with botanists, as was the case on the trip when the type of this species was collected.

**Comments** — *Anthurium stockwellii* most closely resembles *A. fragrantissimum* Croat, but that species has longer and proportionately narrower blades, and a proportionately much longer and slenderer spadix. It also differs by having the flowers withdrawn beneath the level of the tepals so that only a few are visible at any point.

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*Anthurium sueae* Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Along Continental Divide from road branching N off main Fortuna-Chiriquí Grande Hwy. near Continental Divide, 1.1 mi from main hwy., 08°44'N, 82°17'W, 1200 m, 11 Mar. 1985, *T.B. Croat & M.H. Grayum* 60341 (holotype, MO-3237539). **Figures 85 & 86.**

*Diagnosis:* *Anthurium sueae* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, persistent reddish brown cataphyll fibers, sharply C-shaped to D-shaped short glandular-punctate petioles with erect margins, narrowly lanceolate to narrowly elliptic, brownish drying, acuminate blades which are glandular-punctate on both surfaces with often etched primary lateral veins and collective veins as well by the long-pedunculate inflorescences with the reddish or purplish-tinged spathe and sessile, olive-green, long- tapered spadix usually held above the leaves.

Epiphyte; stems 6 cm long; internodes short, 4–15 mm diam.; cataphylls to 3 cm long, fibers persistent, light reddish brown with fragments of brown epidermis. *Leaves* with petioles 3.2–22.1 cm long, drying 1–2 mm diam., sharply C-shaped to D-shaped, flat adaxially with erect margins, drying medium brown; geniculum 5–8 mm long, drying darker than petioles, sometimes slightly shrunk; blades narrowly lanceolate to narrowly elliptic, 10.2–28.5 cm long, 2.0–5.4 cm wide (averaging  $19 \times 3$ ), 4.3–6.9 times longer than broad, broadest midway, 1.1–3.8 (averaging 2.3) times longer than petioles, narrowly long-acuminate to abruptly acuminate at apex (acumen to 2 cm), acute at base, subcoriaceous, moderately bicolorous, moderately glossy, dark green to gray above, moderately paler below, drying medium to dark brown and weakly glossy above, yellowish to reddish brown and semiglossy below; midrib narrowly raised to triangular, frequently ellipsoid-glandular-punctate above, weakly raised and paler, sparsely ellipsoid-glandular-punctate below, drying concolorous and much thicker than broad on both surfaces, sometimes acute above; primary lateral veins 9–12 per side, departing midrib at  $45\text{--}50(60)^\circ$ , etched to obtusely sunken above, scarcely visible below, drying convex and concolorous above, narrowly rounded and concolorous below; collective veins arising from the lowermost primary lateral veins, (1)3–4 mm from margin, etched above, scarcely visible below; basal veins 1 pair; upper surface somewhat irregular, sparsely glandular-punctate, the glands flat to weakly raised, conspicuously densely granular; lower surface densely glandular-punctate (the glands larger than above, dark brown and flat to weakly raised), granular-ridged, smoother than above. *Inflorescence* with peduncle 15.5–35.9 cm long, green or tinged reddish, narrowly triangular to 4-sided, flattened adaxially with a medial rib, sometimes brick red, drying medium brown; spathe lanceolate, green, tinged reddish or purplish violet, spreading twisted-coiled, soon deteriorating, drying 2.2–4.5(9.2) cm long, (1.5)4–7 mm wide, subcoriaceous and yellowish medium brown; spadix long-tapered, medium to dark green, 3.5–13.7 cm long, drying 2–5 mm wide and medium to dark brown; flowers 2–3 visible per spiral, drying 2.3–2.4 mm long, 1.7–1.8 mm wide; tepals weakly glossy, pustular on drying; lateral tepals 1.5 mm wide, the outer margins 2- or 3-sided, the inner margins rounded; stamens not emergent at anthesis, withdrawing beneath tepals after anthesis. *Inflorescence* not seen.

**Distribution and Ecology** — *Anthurium sueae* is endemic to Panama, known only from the type locality on the Continental Divide along the Bocas del Toro-Chiriquí Province at 1200 m elevation in a *Premontane wet forest* life zone.

**Etymology** — *Anthurium sueae* is named in honor of botanist Dr Sue A. Thompson, formerly of the Carnegie Museum and currently Director of 3 Rivers Ecological Research Center, Pennsylvania Fish and Boat Commission. Dr Thompson has collected many new and interesting species of Araceae in several parts of South America. Her work with *Xanthosoma* made great strides toward a better understanding of that complex genus.



Figure 85. *Anthurium sueae* Croat. Holotype: Croat & Grayum 60341.



Figure 86. *Anthurium sueae* Croat. Isotype: Croat & Grayum 60341.





Figure 87. *Anthurium sukutense* Croat. Holotype: Herrera 3277.

**Comments** — *Anthurium sueae* is seemingly closest to *A. gracilispadix*, which differs by petioles 10–20 cm long, concolorous leaves and a terete peduncle and *A. pageanum* Croat which differs by having triangular petioles and terete peduncles.

**Paratypes:** PANAMA. Chiriquí: Distrito Gualaca; Fortuna Dam area ca. 5 km N of Fortuna Dam, trail along Continental Divide, 08°45'N, 82°15'W, 1200–1300 m, 25 Apr. 1988, *S. A. Thompson 4964* (MO); Bocas del Toro-Chiriquí border above Fortuna Dam, forest along Divide, ca. 08°45'N, 82°15'W, 1200 m, 4 Dec. 1985, *G. McPherson 7743* (MO); Reserva Forestal Fortuna, Sendero Honda A, 08°45'08"N, 82°14'32"W, 1190 m, 8 Dec. 2013, *O. O. Ortiz 1828* (PMA).

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***Anthurium sukutense*** Croat, **sp. nov.** — Type: COSTA RICA. Limón: Cantón de Talamanca; Fila de exploración minera entre Río Sukut y Río Carbri, Murabishi, 09°22'50"N, 82°56'50"W, 700 m, 14 July 1989, *G. Herrera 3277* (holotype, INB). **Figure 87.**

**Diagnosis:** *Anthurium sukutense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent red-brown cataphyll fibers, petioles 3-ribbed adaxially, the margin narrow, prominently 3-ribbed winged abaxially, the wings more prominent, drying moderately sharply sulcate and often longer than the blades, oblong-elliptic grayish drying acuminate scarcely bicolorous blades on drying with glandular punctations on both surfaces, a single pair of collective veins which are rather close to the margins as well as by the moderately long and slender peduncle, brownish red spathe and green spadix with reddish-orange berries.

Epiphyte; internodes short, 1.2–1.5 cm diam., drying coarsely ribbed, dark brown; cataphylls to 5.5 cm long, persisting as loose, reddish brown fibers, mostly erect. *Leaves* with petioles 17–28 cm long, 4–6 mm diam., about 0.8 times as long as blades, drying dark brown, 3-ribbed adaxially with lateral margins narrow, prominently 3-ribbed winged abaxially, the side wings more prominent; geniculum 8 mm long, drying darker than petioles; blades ovate-elliptic, 19.3–26.4 cm long, 8.1–9.3 cm wide (averaging  $23 \times 9$ ), 2.3–2.8 (averaging 2.6) times longer than broad, broadest below midway, 1.1–1.5 (averaging 1.3) times as long as petioles, acute to rounded at apex, acute to weakly attenuate at base, subcoriaceous, drying grayish brown, weakly glossy above, grayish brown and semiglossy below; midrib drying narrowly raised, sparsely glandular-punctate and concolorous above, narrowly rounded, sparsely glandular-punctate, short linear-granulate and darker below with a fine weak medial rib; primary lateral veins 12–14 per side, departing midrib at 60–65° at middle, drying weakly and narrowly rounded, concolorous above, narrowly rounded and slightly darker below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from basal veins, 3–4 mm from margin;

basal veins 1 pair; upper surface conspicuously glandular-punctate, minutely pale-granular and minutely dark-speckled; lower surface conspicuously glandular-punctate, minutely and irregularly dark-speckled. *Inflorescence* with peduncle 56–58 cm long; spathe green, 7.2–13.6 cm long, 1.0–1.5 cm wide, lanceolate, reflexed-spreading, subcoriaceous, drying reddish or yellowish brown; spadix sessile, cylindrical, green, 16.8 cm long, 8 mm diam., drying yellowish brown; flowers 3–4 visible per spiral, drying 4.0–4.2 mm long, 2.6–3.8 mm wide; tepals drying minutely granular; lateral tepals 2.8 mm wide, inner margin rounded to straight, outer margins 2-sided; stamens not emergent; anthers 0.3 mm long, 0.8 mm wide; thecae moderately divaricate. *Infructescence* with berries red-orange.

**Distribution and Ecology** — *Anthurium sukutense* is endemic to Costa Rica, known only from the type locality in Limón Province in the Cantón of Talamanca at 700 m elevation in a *Premontane wet forest* life zone.

**Etymology** — *Anthurium sukutense* is named for the type locality along the Río Sukut on the western slopes of the Talamancas in Limón Province.

**Comments** — *Anthurium sukutense* is seemingly close to *A. rupicolum* Croat, which differs by having the blades conspicuously glandular-punctate on the upper surface and by having a more nearly equal petiole to blade ratio as well as by being a rupicolous herb rather than an epiphyte. *Anthurium sukutense* is also resembles *A. gracililaminum* Croat with that differing by the blades being glandular-punctate on the upper surface. In the Lucid Anthurium Key, *Anthurium sukutense* also tracks to *Anthurium cuasicanum* Croat and *A. dichrophyllum* Croat, which both differ by having blades decidedly broader below the middle and by having the upper blade surface glandular-punctate. In addition, *Anthurium cuasicanum* has thicker blades that dry brown while *A. dichrophyllum* has much more markedly bicolorous blades.

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***Anthurium tarrazuense*** Croat, **sp. nov.** — Type: COSTA RICA. San José: Tarrazu, Nápoles, Ladera Oeste de Cerro Pito, 09°34'50"N, 84°04'10"W, 1500 m, 1 Dec. 1995, G. Herrera, A. Cascante & J. Sánchez 8799 (holotype, CR-196066). **Figure 88.**

*Diagnosis:* *Anthurium tarrazuense* is a member of sect. *Porphyrochitonium* and is recognized by its narrow, long-petiolate leaves that are glandular-punctate only on the lower surface, by the long-pedunculate inflorescence, reddish brown slender spathe and the long brownish spadix.

Epiphyte; internodes short, 1.5 cm diam.; cataphylls to 6.5 cm long, persisting as more or less parallel brownish fibers. *Leaves* with petioles 25.0–35.5 cm long, drying 2–3 mm diam., dark yellow-brown, irregularly ridged; blades narrowly ovate-oblong to narrowly oblong-



**Figure 88.** *Anthurium tarrazuense* Croat. Holotype: Herrera et al. 8799



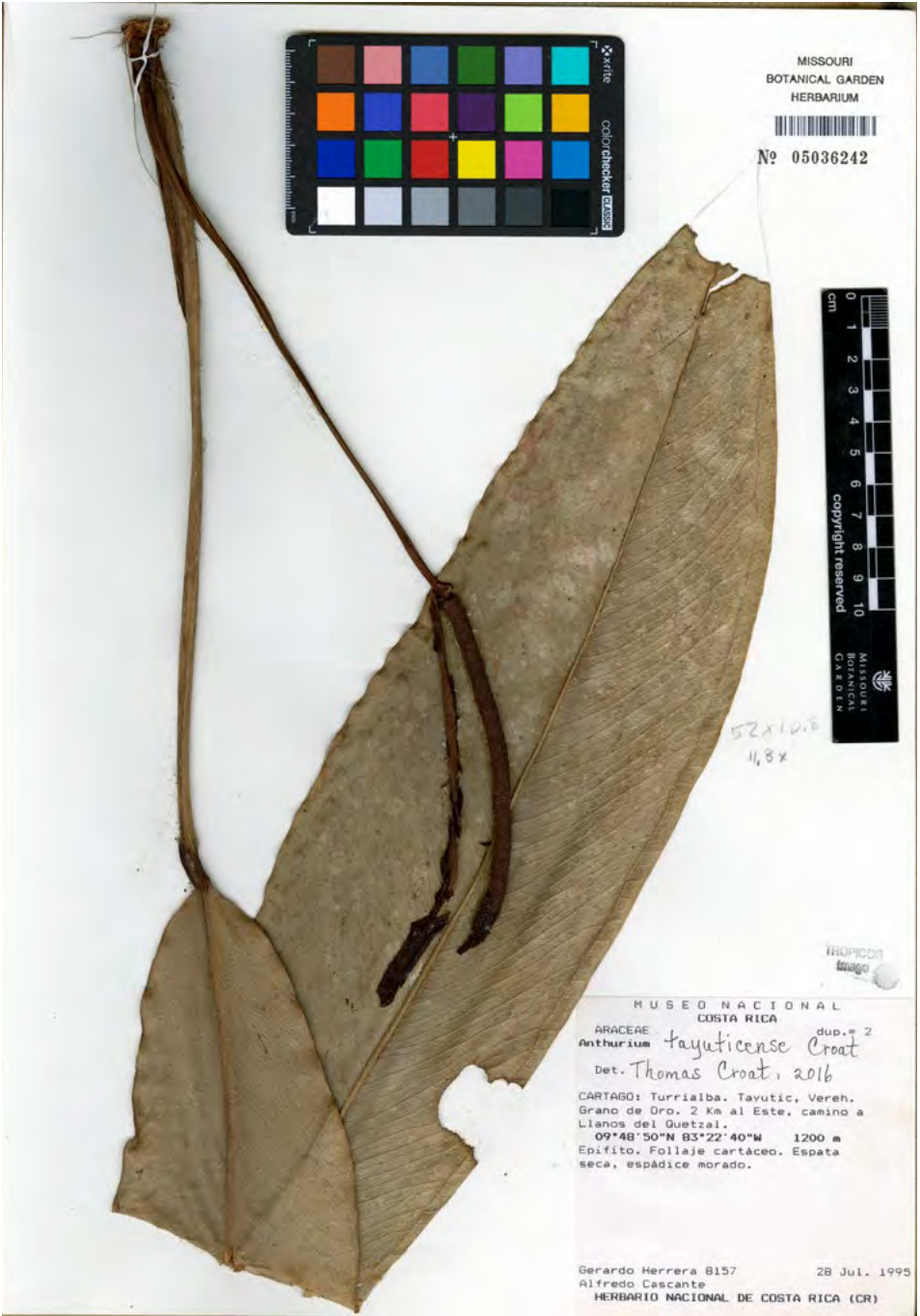


Figure 89. *Anthurium tayuticense* Croat. Holotype: Herrera & Cascante 8157

elliptic, 28.5–39.5 cm long, 4.8–6.3 cm wide (averaging  $33 \times 6$ ), 5.9–6.2 (averaging 6) times longer than wide, equalling petioles, narrowly long-acuminate at apex, obtuse at base, subcoriaceous, drying matte to weakly glossy on both surfaces, greenish gray above, yellowish green below; midrib narrowly convex, drying nearly concolorous, with a few irregular fine ridges on upper surface above, slightly thicker, nearly concolorous, with a few irregular fine ridges below; primary lateral veins 6–8 per side, departing midrib at  $25\text{--}30^\circ$ , drying bluntly acute and concolorous, scarcely more prominent than the interprimary veins below; collective veins arising from the base, 6–9 mm from the margins, slightly more prominent than the primary lateral veins, weakly loop-connecting the primary lateral veins; upper surface eglandular, irregularly covered with blunt bumps; lower surface irregularly short-ridged at higher magnifications, sparsely glandular-punctate. *Inflorescence* with peduncle 39 cm long; spathe 8.7 cm long, 8 mm wide, reddish brown, drying dark brown, narrowly acuminate at apex, rounded at base; spadix weakly stipitate (ca. 1 mm), 16 cm long, drying 4.5 mm diam., turning brownish; flowers 6 visible per spiral, 2.6 mm long, 1.8 mm wide; lateral lobes 1.4–1.6 mm wide, the inner margin broadly rounded, the outer margins 2-sided; anthers 0.3 mm long, 0.5–0.6 mm wide, promptly retracted beneath the margin of the tepals. *Infertescence* not seen.

**Distribution and Ecology** — *Anthurium tarrazuense* is endemic to Costa Rica, known only from the type locality near Tarrazú, Nápoles on the slopes of Cerro Pito at 1500 m in a *Pre-montane wet forest* life zone.

**Etymology** — The species epithet refers to the town of Tarrazú near the type locality.

**Comments** — *Anthurium tarrazuense* is closest to *A. nutans* Croat but that species has more elongated blades (6.2–6.7 times longer than wide), collective veins closer to the margin (1–2 mm from margin in lower 1/3 of the margin), more primary lateral veins (15–20 per side) which are scarcely more prominent than the interprimary veins (from the descriptions these are not different) and flowers with a smaller style (0.1–0.15 mm).

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***Anthurium tayuticense*** Croat, **sp. nov.** — Type: COSTA RICA. Cartago: Cantón Turriaba. Distrito Tayutic. Vereda Grana de Oro, 2 km E., trail to Llanos del Quetzal,  $09^\circ 48' 50''\text{N}$ ,  $83^\circ 22' 40''\text{W}$ , 1200 m, 28 July 1995, G. Herrera & A. Cascante 8157 (holotype, MO-5036242; isotypes CR). **Figure 89.**

*Diagnosis:* *Anthurium tayuticense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, petioles which are sharply sulcate adaxially, yellowish brown on drying, sheathed to 9 cm at base, a geniculum 1.8 cm long, drying darker and 5 mm diam., blades that are oblong-elliptic, eglandular on the upper surface as well as by the purple-violet spadix with only 5 flowers visible per spiral.



Epiphyte; internodes short; cataphylls not seen. *Leaves* with petioles 27 cm long, 4 mm diam., sharply sulcate adaxially, yellowish brown on drying, sheathed to 9 cm at base; geniculum 1.8 cm long, 5 mm diam, drying darker; blades oblong-elliptic, 52 cm long, 10.8 cm wide, 4.8 times longer than wide, acuminate at apex, acute and weakly attenuate at base, subcoriaceous, drying yellowish gray and weakly glossy above, medium grayish yellow and slightly more glossy below, margin sometimes drying markedly undulate, revolute at the margin; midrib convex, slightly paler and drying yellow-brown and finely ridged on drying above, becoming narrow and bluntly acute toward the apex, narrowly raised, drying gray-brown and finely ribbed on bottom; primary lateral veins 15–27 per side, scarcely distinguishable except for a weak indentation at the collective veins, not otherwise distinguishable from the interprimary veins, concolorous and prominulous on both surfaces, 3–5 mm apart, even closer and departing midrib at 30° near the base, at 35–40° at middle; collective veins essentially a single pair with a weak development of small marginal veins near the base, the main vein arising from the base, 1–2 mm from the margin in the lower ¼ of the blade, 5–7 mm from the margin from the middle to apex of the blade, scarcely sunken above, weakly raised and scarcely or not at all more prominent than the lateral veins on upper surface, somewhat more prominent than the primary lateral veins below; upper surface eglandular, drying conspicuously pustular, otherwise smooth; lower surface dark glandular-punctate, drying conspicuously pustular. *Inflorescence* erect; peduncle 20 cm long, drying dark brown, 2 mm diam.; spathe linear, 8 mm wide, promptly drying inrolled, affixed at nearly at a 90° angle; spadix 12.3 cm long, 4 mm diam. near base, stipitate 1–2 mm, narrowly cylindroid, scarcely tapered except very near apex, purple-violet; flowers 9–10 per spiral, 1.6–2.3 mm long, 1.2–1.4 mm wide; lateral tepals 1.0–1.2 mm wide, 2-sided on outer margin, nearly straight on the inner margin, the surface conspicuously pale pustular on magnification; stamens weakly protruded above the tepals; anther 0.10 long, 0.15 mm wide, thecae slightly divaricate. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium tayuticense* is endemic to Costa Rica, known only from the type locality in Cartago Province of Costa Rica at 1200 m elevation in a *Premontane wet forest* life zone.

**Etymology** — The species epithet refers to the town of Tayutic near the type locality.

**Comments** — *Anthurium tayuticense* most closely resembles *A. jicoteense* a species from a similar elevation in Costa Rica Cartago Province, Cantón Turialba but that species has terete, obtusely and broadly sulcate petioles, blades that are less than 7 cm wide and 5–7 times longer than broad which are glandular-punctate on the upper surface with a green spadix with only 5 flowers visible per spiral.

***Anthurium toroense*** Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Cerro Colorado, 9.2 m W of Chamé, along trail E of road which leads down to stream, 08°35'N, 81°50'W, 1450–1480 m, 6 July 1988, *T.B. Croat*, 69016 (holotype, MO-3640327; isotypes, B, CAS, CM, DUKE, F, K, M, MBM, MEXU, NY, PMA, TEX, US). **Figures 90 & 91.**

*Diagnosis:* *Anthurium toroense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, small stature, short internodes, slender petioles 2/3 as long as or slightly longer than the blades, the grayish to grayish yellow-brown, more or less narrowly elliptic blades with glandular punctations on both surfaces as well as by the narrowly long-tapered greenish spadix and lavender berries.

Epiphyte; internodes 1 cm or less in diam.; cataphylls 5 cm long, the uppermost moderately intact, drying light brown, soon persisting as thin, pale fibers. *Leaves* with petiole (4)9–20 cm long, 1.5–3.0 mm diam. (dried), sharply C-shaped, grayish green on drying, flat-sulcate or with a medial rib, the margins sharply erect; blades elliptic to weakly ovate-elliptic, 10–21 cm long, 2.8–6.6 cm wide, 3.1–3.6 times longer than wide, narrowly long-acuminate at apex, narrowly acute to weakly attenuate at base, subcoriaceous, conspicuously bicolorous, drying medium gray and matte above, paler, grayish yellow-brown and weakly glossy below; midrib convex and slightly paler above, acute below, drying bluntly acute and concolorous above, acute and finely ribbed, slightly paler below; primary lateral veins etched-quilted above, pleated-raised below, drying narrowly rounded and concolorous above and below; upper surface densely and minutely granular to granular-ridged, conspicuously dark brown glandular-punctate; lower surface moderately smooth, conspicuously dark brown glandular-punctate, the glands smaller than above. *Inflorescence* erect; peduncle 16–27 cm long, 1–2 mm diam.; spathe green, 2.2–5.5 cm long, 3–6 mm wide, reflexed to spreading; spadix 8–10 cm long, 2–3 mm diam., green at anthesis, yellowish brown in fruit; flowers 2–3 visible per spiral, 3.4–4.0 mm long, 1.5–1.6 mm wide, drying dark yellow-brown; lateral tepals drying minutely granular with outer margins 2-sided, inner margins broadly rounded, almost straight. *Infructescence* with berries pale lavender.

**Distribution and Ecology** — *Anthurium toroense* is endemic to Panama, known only from the type locality on Cerro Colorado in Bocas del Toro and unquestionably also in Chiriquí Province at nearly 1500 m elevation in *Premontane rain forest* life zones.

**Etymology** — The species epithet refers to the type locality in Bocas del Toro Province.

**Comments** — *Anthurium toroense* has been confused with *A. ochrostachyum* Sodiro which has blades of similar color, shape and texture and has narrowly long-tapered spadices which are acute at the apex, but *A. ochrostachyum* differs by having glandular punctations only on the lower surface.



Figure 90. *Anthurium toroense* Croat. Isotype: Croat 69016

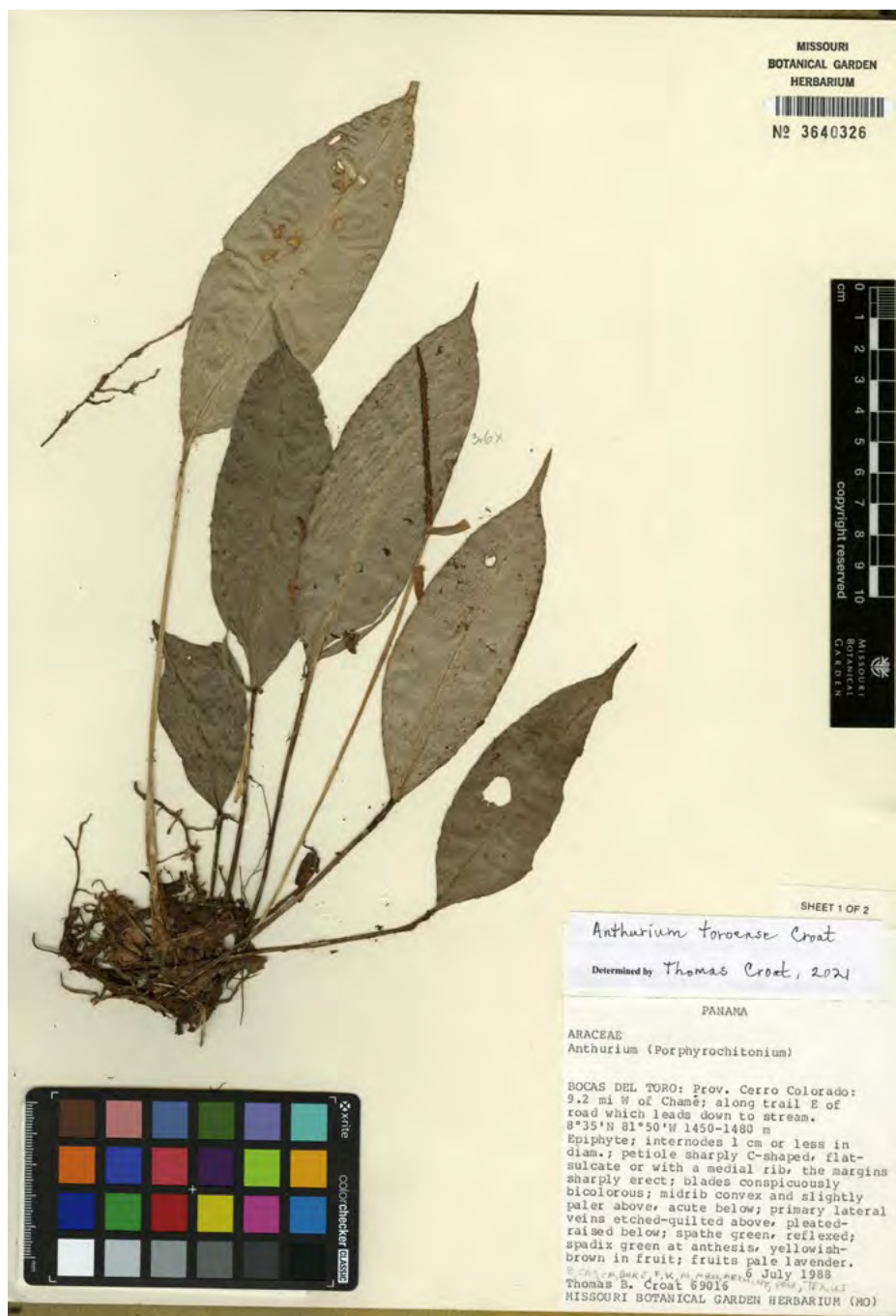


Figure 91. *Anthurium toroense* Croat. Holotype: Croat 69016



Figure 92. *Anthurium tsaiae* Croat. Holotype: McPherson 8588.

***Anthurium tsaiae*** Croat, **sp. nov.** — Type: PANAMA. Bocas del Toro: Along road from Fortuna Dam towards Chiriquí Grande, 10 miles from Continental Divide, 1 mile along side road, ca. 08°55'N, 82°10'W, ca. 120 m, 5 Mar. 1986, *G. McPherson* 8588 (holotype, MO-3486414). **Figure 92.**

*Diagnosis:* *Anthurium tsaiae* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, somewhat intact red-brown, C-shaped cataphylls, C-shaped petiole, narrowly oblong-elliptic, somewhat inequilateral, narrowly acuminate, brownish-drying blades which are eglandular on the upper surface and about twice as long as the petioles and acute at base as well as by the long-pedunculate inflorescence which equals or exceeds the length of the leaves, a linear, spreading, greenish red spathe and a green to dark purple, slightly tapered spadix.

Epiphytic; internodes short, less than 1 cm diam.; cataphylls 1.5–2.5 cm long, somewhat intact, red-brown, becoming fibrous toward base. *Leaves* with petioles C-shaped, 6.5–10.0 cm long, drying reddish brown, narrowly and deeply sulcate adaxially, 1.3 mm wide, 1.8 mm thick, narrowly and weakly ribbed adaxially; geniculum 3–5 mm long, slightly swollen, sulcate adaxially, narrowly rounded abaxially; blades narrowly oblong-elliptic, 15.7–18.5 cm long, 2.2–2.9 cm wide, 6.9–7.4 times longer than wide, 0.5–0.6 times as long as blade, somewhat inequilateral (one side 2–3 mm wider), narrowly acuminate at apex, narrowly acute at base, subcoriaceous, drying medium greenish brown and matte above, weakly paler, grayish brown and weakly glossy below; midrib drying narrowly rounded, irregularly ribbed, densely granular, densely short pale-lineate above, broadly rounded with a thick paler medial rib, finely intermittent ribbed below; primary lateral veins 9–11 per side, departing midrib at 40–50°, 3–5 mm from margin, scarcely loop-connected, not sunken above, about as prominent as primary lateral veins; upper surface eglandular, coarsely granular, faintly and sparsely short pale-lineate, densely and minutely dark-speckled; lower surface sparsely glandular-punctate, sparsely pustular, densely reddish-speckled. *Inflorescence* long-pedunculate, equaling or exceeding the length of the leaves; spathe linear, 3.6–5.6 cm long, 5–6 mm wide, narrowly acute at apex, spreading, greenish red; spadix 8.0–14.7 cm long, drying 2.8–3.0 mm diam., green to dark purple, slightly tapered; flowers mostly 2 visible per spiral, 4.4–5.0 mm long, 3 mm wide; tepals granular;



lateral tepals 2.0–2.8 mm wide, inner margin broadly rounded, outer margin broadly 2-sided; stamens only weakly exerted above tepals, seemingly not withdrawn; anthers 0.4 mm long, 0.5 mm wide; thecae ovoid, somewhat divaricate; *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium tsaiae* is endemic to Panama, known only from the type locality in Bocas del Toro Province at ca. 120 m in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium tsaiae* is named for Jocelyn Tsai, one of the authors of this paper. While she was a student at Washington University Jocelyn devoted a summer to sorting and characterizing many unpublished species of sect. *Porphyrochitonium*, thus helping to lay the groundwork for this paper. Jocelyn is currently at the University of North Carolina.

**Comments** — *Anthurium tsaiae* was confused with *A. crassiradix* Croat var. *purpureospadix* Croat but that taxon has leaf blades that are rounded at the base and have a proportionately shorter, more bluntly pointed spadix. The former may also be confused with *Anthurium tuquesense* but that species has proportionately shorter petioles, leaf blades that are 2–3 times longer than petioles and an inflorescence that is much longer than the leaves.

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***Anthurium tscuiense*** Croat & O. Ortiz, **sp. nov.** — Type: PANAMA. Bocas del Toro: Chagüinola District: Cerro Frío, headwaters of Río Tskui, Point 22, 09°15'37.6"N, 82°30'14.6"W, 1200 m, 27 Oct. 2008, L. Martínez, A.K. Monro & D. Santamaría 382 (holotype, PMA-802208). **Figures 93–95.**

**Diagnosis:** *Anthurium tscuiense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short, moderately thick internodes, densely arranged, more or less erect, reddish brown cataphyll fibers, moderately short-petiolate, 5 ribbed petioles which are 0.2–0.4 times as long as blades, deeply sulcate adaxially and 3-ribbed abaxially, narrowly elliptic, narrowly acuminate blades which are acute to attenuate at base, grayish above, grayish brown below with moderately weak primary lateral veins and a single pair of collective veins moderately remote from the margins, glandular punctations on both surfaces as well as by the long-pedunculate inflorescence which is about 3 times longer than the petioles with a several low-winged-ribbed peduncle, a pale green, linear-lanceolate, erect-spreading spathe and a green, long-tapered spadix.

Epiphytic at 50 cm above soil; internodes short, 1.5–2.0 cm diam., densely rooted; cataphylls ca. 5 cm long, the lower portion persistent as closely parallel thin reddish brown fibers with a few fragments of epidermis. *Leaves* with petioles 8.7–12 cm long, ca. 3.5 mm diam., 0.2–0.4



**Figure 93.** *Anthurium tscuiense* Croat & O.Ortiz. *Martinez et al.* 382. Inflorescence.



**Figure 94.** *Anthurium tscuiense* Croat & O.Ortiz. *Martinez et al.* 382. Habit of living plant



**Figure 95.** *Anthurium tscuiense* Croat & O.Ortiz. Holotype: Martinez et al. 382.





Figure 96. *Anthurium tuquesense* Croat. Holotype: Croat 27276

times as long as blades, deeply and sharply sulcate adaxially, acutely 3-ribbed abaxially; geniculum 7–8 mm long, slightly thicker and darker than shaft, ribbed like petiole; blades narrowly elliptic, 30.5–31.0 cm long, 9.7–10.5 cm wide, 2.9–3.0 times longer than wide, 2.5–3.5 times longer than petioles, gradually acuminate, acute to weakly attenuate at base, subcoriaceous, drying dark gray and weakly glossy above, much paler and gray-brown, almost matte below; midrib narrowly and prominently raised, concolorous, often acute above, narrowly rounded to bluntly acute, drying darker below; primary lateral veins 12 or 13 per side, departing midrib at 45–50°, weakly sunken and concolorous above, drying scarcely raised and concolorous above, weakly and narrowly raised, darker, sometimes undulate below, sometimes scarcely more prominent than interprimary veins; collective veins arising near the base, 7–10 mm from margins; upper surface minutely granular, weakly dark glandular-punctate; lower surface weakly and minutely darkish speckled, conspicuously dark glandular-punctate. *Inflorescence* erect; peduncle 42 cm long, narrowly several-winged; spathe pale green, linear-lanceolate, 7 cm long, 8 mm wide, erect-spreading; spadix long-tapered, bluntly pointed, 14 cm long, 7 mm diam., 20 times longer than wide, green; flowers 4 visible per spiral, 2.6–3.1 mm long, 1.6–2.4 mm wide; tepals densely granular, 1.0–1.2 mm wide, inner margins broadly rounded, outer margins 2-sided. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium tscuiense* is known only from Panama at the type locality in Bocas del Toro Province at 1200 m in a Tropical wet forest life zone.

**Etymology** — The species is named for the type locality along the Río Tskui in Bocas del Toro Province, Chaguinola District.

**Comments** — *Anthurium tscuiense* is most similar to *A. pageanum* Croat owing to its blades of similar shape and color but that species differs by having smaller leaves and sharply triangular petioles. In the Lucid Anthurium Key, *Anthurium tscuiense* tracks to *A. crassitepalum* Croat, *A. cuasicanum* Croat, *A. gracilispadix* Croat, *A. lancifolium* Schott, *A. melastomatis* Croat, *A. oxytachyum* Croat, *A. terryae* Standl. & L. O. Williams, *A. utleyorum* Croat & Baker and *A. vallense* Croat but differs from all in having only a single pair of collective veins and by having winged-ribbed peduncles.

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*Anthurium tuquesense* Croat, *sp. nov.* — Type: PANAMA. Darién: Vicinity of gold mining camp of Tyler Kittredge on headquarters of Río Tuquesa, ca. 2 km from Continental Divide, 08°33'30"N, 77°28'30"W, 450–500 m, 26 Aug. 1974, T.B. Croat 27276 (holotype, MO-2253343). **Figure 96.**



*Diagnosis:* *Anthurium tuquesense* is a member of sect. *Porphyrochitonium* and is characterized by its small size, epiphytic habit, narrowly oblong-linear blades which are eglandular on the upper surface and by its long-pedunculate, long-tapered, purplish spadix. Especially characteristic is the closeness of the collective veins to the margin and the fact that there is yet an additional pair of veins, the antemarginal veins which run immediately adjacent to the margins and extend to the apex.

Epiphyte; internodes short, 9 mm diam.; cataphylls 3.2–3.7 cm long, acute persisting intact at apex, becoming fibrous with fragments of yellowish brown epidermis, the fibers manila, mostly closely parallel. *Leaves* with petioles 3.3–5.0 cm long, 2 mm diam., narrowly and acutely sulcate, drying yellowish brown; geniculum 5 mm long, drying darker than petioles; blades narrowly oblong-linear, 10.9–13.3 cm long, 1.6–2.1 cm wide (averaging  $12 \times 2$ ), 6.3–6.8 (averaging 6.6) times longer than broad, broadest midway, 2.7–3.3 (averaging 3.0) times as long as petioles, abruptly acuminate at apex, (acumen to 8 mm long), attenuate at base, drying subcoriaceous, brown and weakly glossy above, yellowish brown and semiglossy below; midrib drying bluntly acute and concolorous above, narrowly raised, finely ribbed and slightly paler below; primary lateral veins 14 per side, departing midrib at 40–45° near middle, drying narrowly rounded, concolorous above, narrowly rounded and concolorous below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from 1st pair primary lateral veins, 1 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface eglandular, densely granular, sparsely dark-punctate (but with punctations removable); lower surface glandular-punctate with weak longitudinal ribs and dark brown-speckling. *Inflorescence* with peduncle 14.9 cm long, drying 1.5 mm diam.; spathe not seen; spadix purplish, very long and weakly tapered, 10.1 cm long, 3 mm diam., more than 30 times longer than wide, drying reddish brown; flowers 3 visible per spiral, drying 3 mm long and 2.3 mm wide; tepals minutely granular on drying; lateral tepals 1.8 mm wide, the outer margins 2-sided, inner margin rounded; stamens not exerted. *Infructescence* not seen.

**Distribution and Ecology** — *Anthurium tuquesense* is known only from the type locality in Panama's Darién Province near the Continental Divide at 450–500 m in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium tuquesense* is named for the type locality along the Río Tuquesa in near the Continental Divide in Darién Province.

**Comments** — *Anthurium tuquesense* is perhaps closest to *A. jefense* Croat but that species has proportionately broader leaf blades that range from about 3 to 5 times longer than wide and have the collective veins farther from the margins (mostly 4–8 mm) and lack a distinct antemarginal vein.

*Anthurium vanninii* Croat, **sp. nov.** — Type: Cult. J. Vannini ex PANAMA. Panamá Province: Cerro Jefe, SW slope, 09°13'25"N, 79°20'59"W, 900 m, originally collected by J. Vannini, 28 Oct. 2007, vouchered 17 Dec 2012, *T.B. Croat & J. Vannini* 100583 (holotype, MO-6458634; isotype, K, PMA). **Figures 97–100.**

*Diagnosis:* *Anthurium vanninii* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, persistent, reddish brown cataphyll fibers, sharply C-shaped to D-shaped petioles with erect margins, narrowly lanceolate to narrowly elliptic, brownish drying, gradually acuminate blades with etched primary lateral and collective veins as well by the long-pedunculate inflorescences with the green spathe and bright yellow spadix usually held above the leaves.

Epiphyte; stems to ca. 6.0 cm long, 1.8 cm diam.; internodes short, ca. 1 cm diam., leaf scars hidden by cataphylls; cataphylls to 3.5 cm, rounded at apex, initially with several cataphylls intact at upper nodes, drying reddish brown, weathering to network of persistent fibers. *Leaves* with petioles erect and blades more or less spreading; petioles obtusely C-shaped, 5.3–6 cm long, 3.0–3.5 mm diam., 0.4 times as long as blades, medium green, pale-short-lineate, glandular punctate, obtusely and moderately deeply sulcate with narrow medial rib moderately conspicuous in apical half, the margins bluntly acute, sheathed and swollen in lower 1 cm; geniculum ca. 1.5 cm long, moderately paler than shaft; blades narrowly ovate-elliptic, 9.2–19.1 cm long, 2.2–9.2 cm wide (averaging  $13 \times 5$ ), 1.8–4.4 (averaging 2.8) times longer than wide, 0.7–5.4 (averaging 2.6) times longer than petioles, somewhat rounded at apex, obtuse at base, moderately coriaceous, semiglossy, moderately bicolorous, drying matte, dark greenish brown to grayish brown above, moderately paler, weakly glossy, greenish to greenish brown below; midrib glandular punctate, narrowly rounded in a deep valley, narrow and bluntly acute toward the apex, moderately paler than surface in the lower half of the blade, narrowly rounded and paler in lower half, narrowly rounded toward apex below, drying acute and concolorous above, narrowly rounded and irregularly ridged, darker below; primary lateral veins 5 or 6 per side, with interprimary veins sometimes almost as prominent as primaries, departing midrib at (25)30–40°, weakly sunken and concolorous above, weakly raised and slightly paler below, drying weakly raised and concolorous above, scarcely distinguishable from interprimary veins above, drying narrowly rounded and darker below: interprimary veins etched above; collective veins arising from base, about equally sunken as primary lateral veins in the upper half of the blade, more prominent than primary lateral veins; a pair of secondary basal veins much weaker and merging with the margins in the distal  $\frac{2}{3}$  of the blade; upper surface moderately smooth,

sparsely glandular-punctate, the glands moderately sunken when fresh; lower surface weakly granular, densely dark glandular-punctate. *Inflorescence* prominently pedunculate, held well above the leaves; peduncles medium green, 22.7 cm long, 3 mm diam., 3.7 times longer than petioles, subterete, weakly sulcate on one side; spathe greenish, reflexed-spreading to reflexed, narrowly ovate, prominently reflexed, matte inside, semiglossy outside, the margins meeting at an 80° angle; spadix 3.5 cm long, 1.5 cm wide, subsessile, cylindroid, weakly tapered, usually bright yellow at anthesis, semiglossy; flowers 3.8–4.0 mm long, 3.0–3.2 mm wide, margins parallel to spirals straight, margins perpendicular to spiral broadly sigmoid; tepals orange-brown, matte, smooth when fresh, lateral tepals 1.9–2.1 mm wide, inner margin broadly rounded, outer margins 2-sided; pistils rather prominently protruding, pale green, semiglossy, 1.0–1.2 mm wide, quadrangular with rounded corners; stigma slit-like, 0.5 mm long; stamens apparently withdrawing below tepals, 1 mm wide, 0.1 mm long. *Infructescence* with berries orange, subquadrangular and truncate-depressed at apex.

**Distribution and ecology** — *Anthurium vanninii* species is known only from Cerro Jefe, at about 900 m in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium vanninii* is named for Jay Vannini who collected the plant from which the type specimen was made. Jay is a naturalist equally versed in the biology of animals, especially amphibians, as he is with plants. His many years of roaming the forests of Central America, especially Guatemala where he lived for many years, have led to numerous important discoveries. Jay was co-author on a treatment of the Araceae of Guatemala (Croat & Vannini, 2005).

**Comments** — *Anthurium vanninii* most closely resembles *A. bicollectivum* Croat owing to its general blade shape and the yellow-orange berries, but that species differs by having typically more narrowly elliptic blades with 2 well-developed collective veins which extend along the margins nearly to the apex and by having a green to yellow-green, long-tapered spadix. In contrast, *Anthurium vanninii* has only a weak pair of secondary collective veins which merges with the margins near the middle of the blade and an inflorescence with a cylindroid bright yellow spadix. In the Lucid Anthurium Key, *Anthurium vanninii* tracks to *Anthurium crassiradix* Croat which differs by having roots arranged in a coralloid mass, narrowly ovate-oblong blades and *A. paludosum* Engl. which differs by having narrowly oblong-elliptic to oblanceolate blades which are 3.1–3.8 times longer than broad, primary lateral veins 12–14 per side; spadix green, becoming violet-purple or reddish (versus with blades narrowly ovate-elliptic, 2.0–2.1 times longer than wide, primary lateral veins 5 or 6 per side and the spadix pale yellow-orange).



**Figure 97.** *Anthurium vanninii* Croat. Holotype: *Croat & Vannini 100583*.  
Photos by J. Vannini



**Figure 98.** *Anthurium vanninii* Croat. Croat & Vannini 100583. Cataphylls.





**Figure 99.** *Anthurium vanninii* Croat. *Croat & Vannini 100583*. Habit of greenhouse plant.



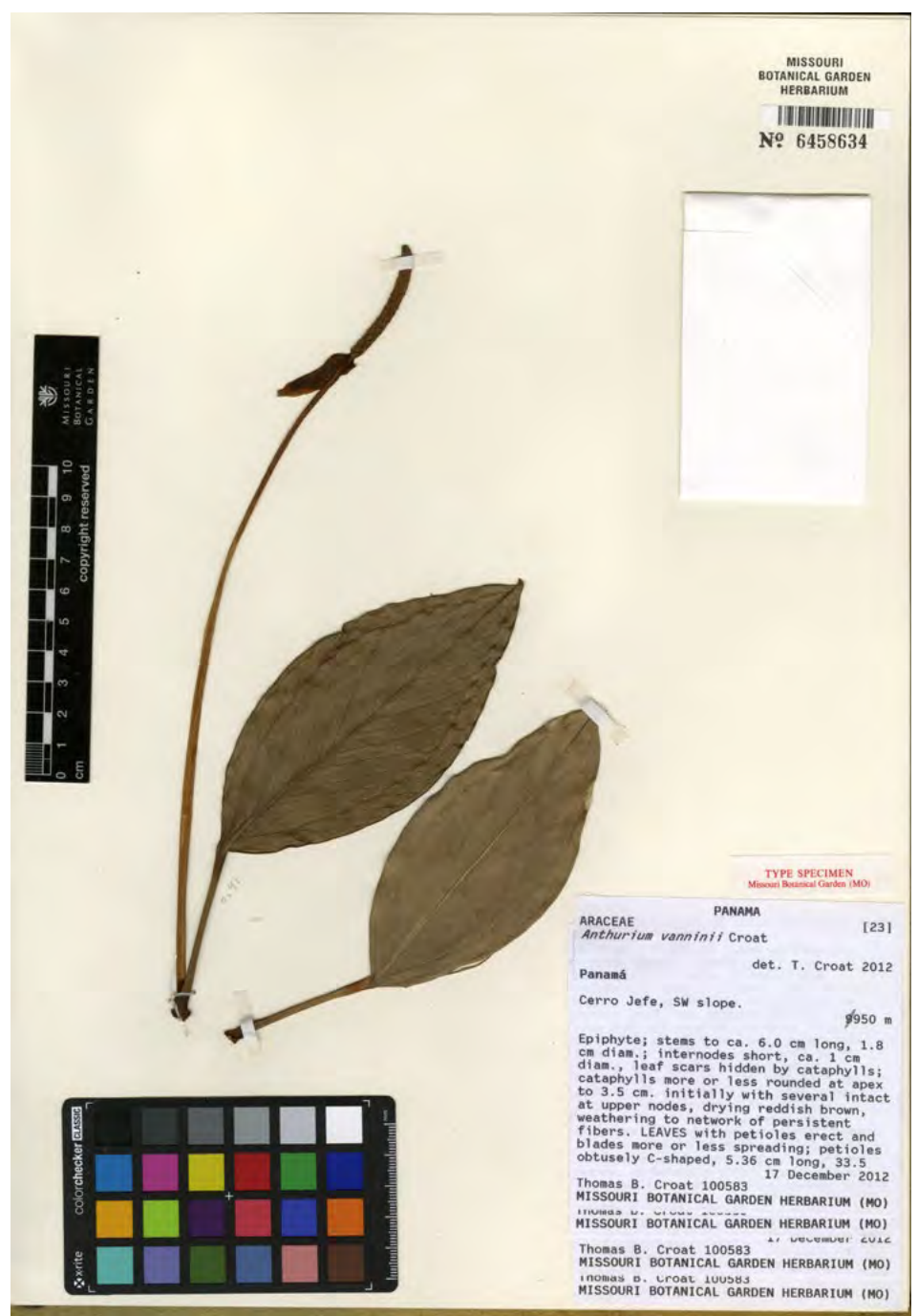


Figure 100. *Anthurium vanninii* Croat. Croat & Vannini 100583. Habit with berries



A collection from the El Llano-Cartí Road (*Mori & Kallunki 5567*) may also be *Anthurium vanninii* but is described as having a purplish spathe, has proportionately narrower blades, and lacks a pair of secondary collective veins.

*Paratypes*: PANAMA. Panamá: Cerro Jefe, 900–1000 m, P.J.M. Maas, R.L. Dressler & C.C. Berg 2703 (MO); Near radio towers, 1000 m, 30 Nov. 1983, W.H. Churchill 3935 (MO); Forest near summit, 850 m, 24 Aug. 1986, G. McPherson 9974 (MO); July 1973, H. Kamemoto & Sagawa 152 (MO); 09°14'02"N, 79°22'30"W, 700–1000 m, 11 Dec. 1978, T.B. Croat 45064 (MO); Chepo, El Llano-Cartí Road, 23.4 km from Inter-American Hwy., 09°18'24"N, 78°57'01"W, 350 m, 13 Apr. 1975, S.A. Mori & J.A. Kallunki 5567 (MO); Vicinity of summit, 09°14'N, 79°22'W, 850 m, 8 July 1987, T.B. Croat 67055 (MO).

***Anthurium veraguense*** Croat & O.Ortiz, **sp. nov.** — Type: PANAMA. Veraguas: Parque Nacional Sante Fe, La Sabaneta, bosque cerrado ca. 6–8 m con alto palmas, 08°40'32"N, 80°59'28"W, 1000–1224 m, 15 July 2009, A. Ibáñez, F. Hernández, J. Guerra & V. Concepción 5694AI (holotype, PMA-106304). **Figure 101.**

*Diagnosis*: *Anthurium veraguense* is a member of sect. *Porphyrochitonium* and is characterized by its terrestrial habit, elongated internodes, pale, persistent cataphyll fibers, narrowly elliptic, narrowly acuminate, grayish to yellowish brown drying blades with a weakly attenuated base, a single pair of collective veins, glandular punctations only on the lower surface, an inflorescence shorter than the leaves an erect-spreading to reflexed, lanceolate-elliptic, green tinged lavender spathe and a pale yellow-green spadix with early-emergent broad pale green berries which are whitish in basal half.

Small terrestrial herb with slender erect stem; internodes 9–15 mm long, 5 mm diam., leaf scars often at an oblique angle, drying dark brown, matte, minutely and densely granular; cataphylls 3.0–3.3 cm long, drying dark brown, soon decomposing with a sparse network of pale fibers and fragments of dark brown epidermis, soon deciduous. *Leaves* with petioles 12.7–17.5 cm long, drying 2 mm diam., subterete, drying narrowly sulcate adaxially, medium brown; geniculum 5 mm long and darker; blades narrowly elliptic, 13.3–17.7 cm long, 5.2–7.7 cm wide (averaging 16 × 7), 2.2–2.5 (averaging 2.4) times longer than wide, about equaling petioles, narrowly and gradually acuminate, weakly attenuated at base, subcoriaceous, dark green and matte above, somewhat paler and semiglossy below, drying dark gray-brown and matte above, grayish yellow-brown and semiglossy below; midrib drying narrowly raised, sometimes acute, concolorous above, narrowly rounded and paler below, drying in part with an acute medial rib toward the base; primary lateral veins (6) 9–12 per side, departing midrib at 45–50°, moderately obscure and concolorous, drying undulated above, weakly and narrowly raised in part,

slightly darker and wrinkled on drying below; tertiary veins obscure below; collective veins arising from the only basal veins, 5–6 mm from margin; upper surface eglandular, drying minutely and closely granular; lower surface moderately smooth, conspicuously and densely dark glandular-punctate (the glands usually depressed in center). *Inflorescence* erect, much shorter than the leaves; peduncle 8 cm long, drying 1 mm diam., terete; spathe lanceolate-elliptic, erect-spreading to reflexed, 2.6 cm long, 7 mm wide, tinged lavender; spadix green in early fruit, 5.3 cm long, 4 mm diam.; flowers 4 visible per spiral, 3.0–3.2 mm long, 2.0–2.2 mm wide; tepals minutely granular-ridged; lateral tepals 1.6–1.8 mm wide, inner margin broadly rounded, outer margin 2-sided. *Infructescence* with berries whitish in basal half, greenish in apical half, ca. 3 mm long, 2.6 mm diam., sparsely imbedded with short pale cellular inclusions throughout.

**Distribution and ecology** — *Anthurium veraguense* is endemic to Panama, known only from the type locality in Veraguas Province in the Parque Nacional Santa Fé at 1000 m in a *Premontane rain forest* life zone.

**Etymology** — The species is named for the type locality in the Province of Veraguas.

**Comments** — In the Lucid Anthurium Key, *Anthurium veraguense* tracks to *A. brevipes* Sodiro which differs by having proportionately narrower blades (to more than 3 times longer than broad) with a much longer acumen and a more narrowly tapered spadix and *A. margaricarpum* Sodiro which has blades more than twice as large and has conspicuously persistent cataphylls. In the Central American Key to Anthurium, *Anthurium veraguense* tracks to *A. subrotundum* Croat, a species with blades nearly as broad as long.

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***Anthurium wendlingeri*** G.M.Barroso var. ***horichii*** Croat, **var. nov.** — Type: cult. Missouri Botanical Garden ex COSTA RICA. Limón: Llanuras de Santa Clara, Atlantic rain forest, rare, pendulous epiphyte on tall old trees of shore-jungle along lower Río Costa Rica near Hacienda "El Zorro Cruel", 10°12'36"N, 83°51'00"W, 250 m, originally collected by Clarence Horich; vouchered Mar. 1990, *T.B. Croat 71837* (holotype, MO-5451888; isotypes, CR, K, US). Figures **102 & 103**.

*Diagnosis:* *Anthurium wendlingeri* var. *horichii* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, pendent leaves, proportionately short, subterete, weakly sulcate petioles, very long, oblong-lanceolate, pendent, more or less concolorous, gradually acuminate blades which are rounded at the base, dark green, glandular-punctate on both surfaces, matte-subvelvety above with a single pair of collective veins relatively remote from

the margin as well as by the weakly stipitate, long and weakly tapered spadix which is pinkish at anthesis then turning purplish.

Epiphyte; internodes short 1.0–1.7 cm diam.; cataphyll fibers persisting, pale. *Leaves* with petioles terete, weakly and narrowly sulcate, dark green, almost matte, weakly short purple-linate on drying, 17.7–27.6 cm long, 3–4 mm diam., greenish brown; geniculum moderately paler than petioles, drying 7–9 mm long, darker than petioles; blade strap-shaped, 63.8–84.6 cm long, 6.3–8.3 cm wide (averaging  $74 \times 7$ ), about ten times longer than broad, 3.6 times as long as petioles, gradually acuminate at apex, (acumen to 2 cm long), obtuse at base, subcoriaceous, dark green and matte-subvelvety above, equally as dark and weakly glossy below, drying essentially concolorous, matte and yellowish green above, weakly glossy and yellowish green below; midrib sparsely glandular-punctate above and below, bluntly acute and slightly paler above, weakly convex and paler below; primary lateral veins ca. 20 per side, departing midrib at  $40^\circ$ , weakly and obscurely raised and concolorous above, flat and obscurely visible below, but scarcely more conspicuous than interprimary veins; collective veins arising from basal veins, 6 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface sparsely and slightly raised glandular-punctate, cells prominently raised; lower surface conspicuously glandular-punctate, minutely areolate-ridged. *Inflorescence* pendent; peduncle 20–44 cm long; spathe and peduncle purplish, linear-lanceolate, drying 4.5–14.4 cm long, 9–12 mm wide, moderately coriaceous, medium reddish brown; spadix stipitate 6 mm, very long and weakly tapered, greenish when young, pinkish at anthesis, turning purplish, drying 15.8–32.9 cm long, 4–5 mm diam., yellowish brown; flowers 5 visible per spiral, drying 2.1 mm long and 1.3 mm wide; tepals minutely granular on drying; lateral tepals 1.5 mm wide, inner margin rounded, outer margins 2-sided; pistils weakly emergent; stamens held at level of tepals, anthers 0.4 mm long and wide, thecae ellipsoid, scarcely divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium wendlingeri* var. *horichii* is known only from the type locality in Costa Rica in Limón Province at 250 m elevation in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium wendlingeri* var. *horichii* is named for the German plant collector, Clarence Horich (né Klaus Hörick) who spent much of his career botanizing in Costa Rica where he collected the living type specimen. Horich was born in Lüdenschied, Germany on 11 May 1930 and died on 1 March 1994 in Costa Rica. Horich had training as a gardener and immigrated to Canada in 1951 when he was 21 years old. Working in a large orchid nursery beginning in 1953, he went on collecting expeditions to Colombia, Ecuador and Bolivia primarily looking for orchids (but also cacti, aroids, and ferns). In 1957, Horich moved to San José, Costa Rica where he married a local woman and took up residence, working in his own private business, collecting plants for export. During his many years of wandering in Costa Rican forests he found and cultivated many interesting plants including this one that bears his name.



**Figure 102.** *Anthurium wendlingeri* G.M.Barroso var. *horichii* Croat. Paratype: Munich 92–3413.





Figure 103. *Anthurium wendlingeri* G.M.Barroso var. *horichii* Croat



**Figure 104.** *Anthurium wiehleri* Croat. Holotype: Croat & Zhu 76546. Infructescence



Figure 105. *Anthurium wiehleri* Croat. Holotype: Croat 71837



**Figure 106.** *Anthurium wiehleri* Croat. Paratype: Kennedy et al. 1122

**Comments** — *Anthurium wendlingeri* var. *horichii* is most easily confused with the typical variety *A. wendlingeri* but that taxon has a white spadix which is white to gray-white and forms a tight spiral before anthesis.

*Paratype*: COSTA RICA. Llanuras de Santa Clara, Hacienda El Zorro Cruel, (1995), *Botanische Garten München* 92/3437 (MO).

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***Anthurium wiehleri*** Croat, **sp. nov.** — Type: PANAMA. Kunayala: El Llano-Cartí Road, Nusigandí, 10.1 mi N of main Pan-American Highway near El Llano, vicinity of base camp, 09°20'N, 79°00'W, 300 m, 1 July 1994, *T.B. Croat & G. Zhu 76546* (holotype, MO-04612799). **Figures 104–106.**

*Diagnosis*: *Anthurium wiehleri* is a member of sect. *Porphyrochitonium* and is characterized by its minute size, epiphytic habit, dense cluster of roots, short internodes, short, subterete, weakly sulcate petioles, small, narrowly oblanceolate leaves which are glandular-punctate on both surfaces and by the slender greenish inflorescences which overtop the leaves.

Epiphytic herb; internodes short, ca. 1 cm diam.; cataphylls 2.7 cm long, acute persisting intact at apex, becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. *Leaves* with petioles 1.7–3.2 cm long, 1 mm diam., subterete, weakly sulcate, drying yellowish brown; geniculum 3–4 mm long, drying darker than petioles; blades narrowly oblanceolate, 4.7–11.3 cm long, 1.4–2.4 cm wide (averaging  $8 \times 2$ ), 3.4–4.9 (averaging 4.2) times longer than broad, 2.0–5.8 (averaging 3.8) times as long as petioles, abruptly acuminate at apex, (acumen to 6 mm long), acute at base, subcoriaceous, green above, yellow green below, drying yellowish brown and weakly glossy above and below; midrib drying narrowly rounded and darker above, narrowly raised, paler below; primary lateral veins 9(10) per side, departing midrib at 25–30°, drying narrowly raised, darker above, narrowly raised, paler below; collective veins arising from basal veins 3 mm from margin; basal veins 1 pair; upper surface weakly granular, glandular-punctate; lower surface moderately smooth, dark glandular-punctate, equally dense as upper surface. *Inflorescence* with peduncle rose, 6.4–6.7 cm long; spathe green to rose, lanceolate, reflexed, 1.4–1.9 cm long, 2–4 mm wide, drying moderately coriaceous, medium reddish brown; spadix green, stipitate 6 mm, slender and weakly tapered, 3.9–4.3 cm long, 2 mm diam., drying reddish brown; flowers 2 visible per spiral, drying 3.2–3.3 mm long and 1.7–1.8 wide; tepals drying with subglobular cellular inclusion; lateral tepals 2.1 mm wide, the outer margins 2-sided, inner margin rounded; stamens not exerted. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium wiehleri* is known only from the type locality in Panama in Colón Province on Santa Rita Ridge at 300 m elevation in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium wiehleri* is named in honor of the late Hans Joachim Wiehler (1930–2003) who collected the type specimen. Wiehler was a noted specialist of Gesneriaceae and formerly a staff member of the Marie Selby Botanical Gardens. Hans was born in the small village of Klettendorf in East Prussia, about 60 miles from the Baltic Sea. His father died during World War II serving in the German army. At age 14, Hans and his mother and two younger brothers fled in horse carts in advance of the invading Russian army, suffered a near drowning when their vessel was hit with a torpedo in the Baltic, then endured years of displacement as refugees. Eventually immigrating to the United States in 1953, Hans later obtained his Master's Degree from Cornell University where he worked on Gesneriaceae and his Ph.D. at Miami University under the direction of Calaway Dodson. Dodson brought Wiehler to Sarasota shortly after the founding of the Marie Selby Botanical Garden. Later Hans Wiehler founded the Gesneriaceae Research Foundation which he ran until near the time of his death. Wiehler became the world's authority on Gesneriaceae and built up one of the most impressive collections of living material in the world. He gave the collection to Selby Gardens before his death.

**Comments** — Because of its minute size, *Anthurium wiehleri* is not likely to be confused with any other known species though it is most similar to small individuals of *A. scottmorii* Croat, a species common at Cerro Jefe in adjacent Panamá Province. *Anthurium scottmorii* shares glands on the upper blade surface and an overtopping inflorescence. However, that species has a stubby, purple to reddish spadix rather than a slender, elongated greenish spadix.

*Paratype*: PANAMA. Colón: Santa Rita Ridge, below rain gauge, 300–350 m, 13 Aug. 1971, H. Kennedy, R. Dresser & H. Wiehler 1122 (PMA).

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***Anthurium zachdufranianum*** Croat & O.Ortiz, **sp. nov.** — Type: PANAMA. Chiriquí: Distrito de Gualaca, Reserva Forestal Fortuna, Sendero Honda B, 08°45'08"N, 82°14'34"W, 1160 m, 9 Dec. 2013, O.O. Ortiz 1837 (holotype, MO-6568069; isotype, PMA). **Figures 107–109.**



*Diagnosis:* *Anthurium zachdufranianum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent, reddish brown cataphyll fibers, moderately long-petiolate leaves, triangular-wing-ribbed petioles, oblong-elliptic, acuminate, brownish drying blades with a narrowly raised upper midrib, dried undulate margins, both surfaces glandular-punctate as well as by the erect inflorescence with a several-winged-ribbed peduncle, green, reflexed spathe and green spadix with pale orange berries.

Epiphyte; internodes short, 6 mm diam.; cataphylls 2.3 cm long, acute, persisting and becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. *Leaves* with petioles 9.1–10.2 cm long, 2 mm diam., triangular-wing-ribbed with up to 8 ribs, drying dark yellowish brown; geniculum 8–9 mm long, drying darker than petioles; blades oblong-elliptic, 11.2–19.3 cm long, 3.3–4.6 cm wide, 3.4–4.2 times longer than broad, broadest at middle or slightly above middle, about twice as long as petioles, gradually acuminate at apex, (acumen to 1 cm long), acute at base, bicolorous, olive-green and glossy above, light green and paler below, drying subcoriaceous, grayish brown and matte above, yellowish brown and weakly glossy below; midrib glandular-punctate, acute on both sides, drying narrowly acute and concolorous above, narrowly raised, finely ribbed and darker below; primary lateral veins 10 per side, departing midrib at 55–60° near middle, drying weakly convex, concolorous above, narrowly raised, finely ribbed and darker below; secondary veins drying indistinct above, moderately conspicuous on lower surface; collective veins arising from basal veins, 5 mm from margin; basal veins 1 pair; lacking antemarginal veins; upper surface glandular-punctate, densely granular, sparsely pustular; lower surface glandular-punctate, densely and weakly brown-speckled, sparsely granular. *Inflorescence* with peduncle 9.8 cm long, ribbed, green; spathe green, ca. 3.3 cm long, 6 mm wide, oblong-lanceolate, drying coriaceous, medium reddish brown; spadix green, very long and weakly tapered, 8.3 cm long, 7 mm diam, drying reddish brown; flowers 3 visible per spiral, drying 2.8 mm long and 2.3 mm wide; tepals minutely granular on drying; lateral tepals 2 mm wide, inner margin rounded, outer margins 2-sided; stamens not usually seen, 0.8 mm long, 0.4 mm wide. *Infructescence* with berries maturing orange.

**Distribution and ecology** — *Anthurium zachdufranianum* is endemic to Panama, known only from the type locality in Chiriquí Province at 1150–1200 m in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium zachdufranianum* is named in honor of Zach Du Fran, former President of the International Aroid Society, who has played a strong role in that organization and in furthering the study of Araceae. Du Fran was instrumental in the founding of the Midwestern Chapter of the International Aroid Society and helped to organize an initial meeting at the Oklahoma City Botanical Garden.



**Figure 107.** *Anthurium zachdufranianum* Croat & O.Ortiz. Holotype: Ortiz 1837.  
Photos by O.O. Ortiz.



**Figure 108.** *Anthurium zachdufranianum* Croat & O.Ortiz. Ortiz 1837. Berries



**Figure 109.** *Anthurium zachdufranianum* Croat & O.Ortiz. Ortiz 1837. Infructescence.



Figure 110. *Anthurium zapatae* Croat. Holotype: Zapata 1037



**Comments** — *Anthurium zachdufranianum* is most closely related to *A. zhui* Croat which shares similar dried blades and proportionately long petioles, but that species differs by having petioles merely 3-sided but not otherwise ribbed as well as by a much longer peduncle which is 3-sided but not otherwise ribbed.

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*Anthurium zapatae* Croat, **sp. nov.** — Type: PANAMA. Colón: Distrito de Donoso, Río Caimito, 08°58'28"N, 80°40'21", 40 m, 5 July 1996, *A. Zapata, D. Mosquera & W. Martínez 1037* (holotype, PMA-50164). **Figure 110.**

*Diagnosis:* *Anthurium zapatae* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, pale cataphyll fibers, long-petiolate leaves, a subterete petiole drying somewhat flattened with a narrow wing on each side, narrowly elliptic, acuminate, somewhat grayish-drying blades with rather obscure primary lateral veins, a single pair of collective veins and both surfaces glandular-punctate as well as by the moderately short-pedunculate inflorescence, the green spreading spathe, and the narrowly oblong, yellowish green spadix with 3 flowers visible per spiral.

Epiphyte; internodes short, 1 cm diam.; cataphylls 3.5 cm long, persisting semi-intact, fibrous with fragments of reddish brown epidermis. *Leaves* with petioles 19.6 cm long, 4 mm diam., glandular-punctate, drying narrowly and obtusely sulcate, prominently flattened with a narrow thin wing on each side, medium gray-brown, matte and minutely granular; geniculum 1 cm long, drying paler than petioles; blades narrowly elliptic, 36.6 cm long, 8.4 cm wide, 4.4 times longer than broad, broadest midway, about twice as long as petioles, abruptly acuminate at apex, acute at base, subcoriaceous, drying grayish olive-green and semiglossy above, yellowish olive-brown and weakly glossy below; midrib sparsely glandular on both surfaces, drying narrowly rounded and paler above, bluntly acute and darker below; primary lateral veins 20 per side, departing midrib at 55–60°, drying convex and paler above, narrowly convex and slightly darker below; collective veins arising from basal veins, 4–5 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface glandular-punctate, the glands dark brown and weakly raised, minutely and regularly areolate, more granular along veins, glossy upon magnification; lower surface conspicuously black-speckled and weakly ridged, equally smooth at upper surface, glandular-punctate, the glands dark brown and markedly raised. *Inflorescence* with peduncle 13.6 cm long, drying yellowish brown; spathe green, drying 3 cm long, 5 mm wide, thinly coriaceous, reddish brown; spadix yellowish green, cylindrical, 7.2 cm long, 3 mm diam., drying dark yellowish brown; flowers 3 visible per spiral, drying 2.5–2.6 mm long, 2.0–2.1 mm wide; tepals granular on drying; lateral tepals 1.7 mm wide, outer margins 2-sided, inner margin rounded; stamens not emergent. *Infructescence* not seen.



**Distribution and ecology** — *Anthurium zapatae* is known only from the type locality in Panama, Colón at 40 m in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium zapatae* is named in honor of Panamanian botanist, Alvin Zapata who with D. Mosquera and W. Martínez collected the type specimen. Alvin has contributed to the knowledge of the medicinal use of plants of Chiriqui Province. He worked for many years at the University of Panama and ANCON (Asociación Nacional para la Conservación de la Naturaleza), participating in many floristic studies in Panama. Currently, Alvin Zapata works in a forest inventory in the copper mine of Donoso region, Colón Province.

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***Anthurium zhui*** Croat, **sp. nov.** — Type: PANAMA. Coclé: Alto Calvario, ca. 6 mi. N of El Copé, 08°38'N, 80°35'W, 770 m, 12 July 1994, *T.B. Croat & G. Zhu 76765* (holotype, MO-04612786). **Figure 111.**

**Diagnosis:** *Anthurium zhui* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, moderately elongated, sharply C- to D-shaped or triangular petioles, its narrowly oblong-elliptic, brown-drying blades which are acute to attenuate at the base and have a single pair of close collective veins as well as by an inflorescence with a green spathe and spadix that overtops the leaves.

Usually epiphytic, low on tree trunks; internodes short, 1 cm diam.; cataphylls not seen. *Leaves* with petioles dark purplish, 3.7–16.7 cm long, 3 mm diam., sharply triangular, sparsely glandular-punctate, drying reddish brown; geniculum 4–10 mm long, drying darker than petioles; blades narrowly oblong-elliptic, 11.9–20.5 cm long, 2.7–5.1 cm wide (averaging 16 × 4), 3.5–5.1 (averaging 4.4) times longer than broad, broadest midway, 1.2–3.9 (averaging 2.3) times as long as petioles, abruptly acuminate at apex (acumen to 1.2 cm long), attenuate at base, subcoriaceous, semiglossy, moderately bicolorous, drying brown and semiglossy above, yellowish brown and weakly glossy below; midrib narrow-raised and paler above, acute and paler below; primary lateral veins (12)13 per side, departing midrib at 55° near middle, drying narrowly rounded, concolorous above and below; secondary veins and tertiary veins drying prominently raised above and below; tertiary veins drying indistinct above, weakly raised; collective veins arising from basal veins 3 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface glandular-punctate, densely granular-pustular-ridged; lower surface glandular-punctate, brownish and white speckled. *Inflorescence* with peduncle sharply flattened on one side, 17.6–31.5 cm long; spathe green tinged purplish, 2.2–4.1 cm long, 3–5 mm wide, oblong-elliptic, drying moderately coriaceous, medium reddish brown; spadix dark



Figure 111. *Anthurium zhui* Croat. Holotype: Croat & Zhu 76765

green, very long and tapered, 3.8–6.8 cm long, 3–4 mm diam., drying reddish dark brown. Flowers 2 visible per spiral, drying 3.2 mm long and 2.7 mm wide; tepals minutely granular on drying; lateral tepals 1.9 mm wide, the outer margins 2-sided, inner margin rounded; pistils pale green; stamens not exerted. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium zhui* is known only from Panama in Chiriqui and Bocas del Toro Provinces in western Panama and in Coclé Province in central Panama. It occurs at 730–1200 m in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium zhui* is named in honor of the late Dr Guanghua Zhu (1964–2005), the first author's former student and fellow aroid specialist who did an excellent revision of the very difficult genus, *Dracontium* (Croat & Zhu, 2004), before his untimely death. Guanghua was with Croat when the type was collected.

**Comments** — *Anthurium zhui* is closest to *Anthurium gracilispadix* Croat because it shares blades of similar shape and size and acutely pointed spadices. The latter species differs by having thinner blades which dry grayish-green rather than yellow-brown and have the inflorescence much shorter than the leaves. *A. zhui* is also similar to *A. pageanum* Croat which differs by having gray drying blades, collective veins arising from base and a violet-red tinged spathe. One collection of *A. pageanum* from Veraguas Province (*Hammel 5171*) is especially noteworthy because it highly resembles *A. zhui* in petiole length, blade shape and by its long-pedunculate inflorescence but it differs by growing only at 200 m elevation and in lacking glandular punctations on the upper blade surface except scantily along the midrib.

*Paratypes*: PANAMA. Coclé: La Pintada, Alto Calvario above El Copé, ca. 6 km N of El Copé, Atlantic slope, along trail through forest W off old lumber trail which leads down to Las Ricas, Limón and San Juan, 08°40'41"N, 80°35'47"W–08°41'04"N, 80°35'50"W, 710–800 m, 23 June 1988, T.B. Croat 68775 (MO); Bocas del Toro, Fortuna Dam region, along trails leaving pipeline road, ca. 08°45'N, 82°15'W, 1000 m, 8 Dec. 1985, G. McPherson 7851 (MO).

## 2. Species from South America

***Anthurium acaimense*** Croat & W.Vargas, **sp. nov.** — Type: COLOMBIA. Quindío: Municipio Salento, Reserva Acaime, 2800 m, Oct. 1992, W.G. Vargas 739 (holotype, MO-5302394; isotype, ICESI). **Figure 112.**

*Diagnosis:* *Anthurium acaimense* is a member of sect. *Porphyrochitonium* and is characterized by its oblong-elliptic, glandular-punctate blades with a single pair of collective veins. It is unusual in having rather elongated internodes for a species in this section. It is further characterized by semi-intact cataphylls, moderately long-petiolate leaves with subterete, sulcate petioles and a long-pedunculate inflorescence with a slender, weakly tapered spadix.

Terrestrial to hemiepiphytic and climbing; internodes to 2.7 cm long (much shorter near apex) 6 mm diam. (dried), drying finely ribbed and blackened; cataphylls persisting with fibers in dark brown reticulum, 5.5–7.0 cm long, narrowly attenuated at apex. *Leaves* 56.8 cm long, clustered near apex; petioles subterete, sulcate, 31 cm long, 0.3–0.4 cm diam., drying medium brown, weakly glossy, finely ribbed; geniculum 0.6 cm long, drying darker than petiole and laterally winged; blades elliptic, 21.5–29.0 cm long, 5.5–7.8 cm wide, 3.7–4.0 times longer than broad (averaging 4.0), acuminate, acute at base, subcoriaceous, moderately dark green, tinged with red and semiglossy above, moderately paler and semiglossy below, drying weakly glossy and grayish olive-green to medium brown above, paler and grayish yellow-brown to grayish yellow-green below; midrib drying narrowly raised to acute in valley above, narrowly raised, finely ribbed, yellow-brown below; primary lateral veins 17–20 per side, departing midrib at 45–55°, drying narrowly raised in shallow valleys above, acutely raised on lower surface; collective veins arising from the basal vein, more prominent than primary lateral veins, 5–7 mm from margin, drying etched above, narrowly raised to bluntly acute below; tertiary veins prominulous below, slightly less so above upon drying; upper surface eglandular, drying matte, with a few scattered pale pustules; lower surface smoother, finely dark glandular-punctate. *Inflorescence* 44.2 cm long, erect; peduncle 39 cm long, 11.1 times longer than spathe, drying dark brown; spathe lanceolate, green, dark brown, 3.5 cm long; spadix cylindroid-tapered, 5.2 cm long, 0.2–0.3 cm diam.; flowers 5–6 visible per spiral, 1.2 mm long, 1.2 mm wide; lateral tepals oval, 3-sided, 0.4 mm wide, 0.8 mm long. *Infructescence* with berries maturing orange.

**Distribution and ecology** — *Anthurium acaimense* is endemic to Colombia, known only from the type locality along the upper Río Quindío in Quindío Department between 2000–2800 m elevation in a Montane wet forest life zone.



Figure 112. *Anthurium acaimense* Croat. Holotype: Vargas 739



Figure 113. *Anthurium alexandroi* Croat. Holotype: Zuluaga et al. 763.





**Figure 114.** *Anthurium alejandroi* Croat. Zuluaga et al. 763. Leaf blade, adaxial surface.



**Figure 115.** *Anthurium alejandroi* Croat. Zuluaga et al. 763. Habit of flowering plant





**Figure 116.** *Anthurium alejandroi* Croat. Zuluaga et al. 763. Inflorescence.

**Etymology** — The species is named for the type locality in the Reserva Acaime in Quindío Department, Municipio de Salento.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium acaimense* tracks to *A. aureum* Engl. which may be distinguished by its shorter petiole (20 cm), broader blade (length-width ratio 3) and long apiculum (2 cm); *A. smithii* Croat which has a long geniculum (2.4 cm), only 4–9 per side of primary lateral veins and the blades have obtuse to rounded bases and *A. trianae* Engl. which has shorter petioles (20 cm), only 8 or 9 primary lateral veins per side and the blades oblong rather than elliptic.

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*Anthurium alejandroi* Croat, **sp. nov.** — Type: COLOMBIA. Antioquia: Municipio Urrao, Corregimiento La Encarnación, Vereda Calles Abajo, Parque Nacional Natural Las Orquídeas, camino entre cabañas de Calles y La Raya, limite entre Urrao y Frontino, 06°31'N, 76°16'W - 06°31'N, 76°18'W, 1000–1280 m, 22 July 2011, A. Zuluaga, P. Pedraza, J. Betancur, M.F. González, R. Arevalo, D. Sanin, J. Serna & A. Duque 763 (holotype, MO-6353148; isotype, COL). **Figures 113–116.**

*Diagnosis:* *Anthurium alejandroi* is a member of sect. *Porphyrochitonium* and is characterized by its terrestrial habit, short internodes, cataphylls persisting as fibers, terete petioles which are longer than the blades, the oblong-lanceolate, narrowly long-acuminate, semiglossy blades which dry dark gray-green above and yellowish olive-brown below with an acute base and the collective veins arising from the base as well as by the long pedunculate inflorescence with a slender peduncle, a slender reflexed spadix and a stipitate, weakly tapered, slender, white spadix.

Terrestrial; internodes short, 1.1 cm diam.; cataphylls 4.9 cm long, acute and persisting intact at apex, becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel; *Leaves* with petioles 33.3–36.5 cm long, 3 mm diam., terete, drying narrowly and obtusely sulcate, gray-brown; geniculum 8–11 mm long, drying slightly darker than petioles; blades oblong-lanceolate, 32.7–32.9 cm long, 6.4–6.6 cm wide (averaging  $33 \times 6$ ), 5.0–5.1 (averaging 5.05) times longer than broad, 0.9 times as long as petioles, abruptly and narrowly acuminate at apex (acumen to 2.8 cm long), acute at base, subcoriaceous, bicolorous, semiglossy glossy on both surfaces, drying dark gray-green, semiglossy above, yellowish gray-brown semiglossy below; midrib drying narrowly raised, sparsely glandular-punctate and concolorous above, narrowly rounded, sparsely glandular-punctate, finely ribbed and paler below; primary lateral veins 12–14 per side, departing midrib at 45° near middle, drying weakly and narrowly raised, concolorous above, narrowly rounded and concolorous below; interprimary veins sometimes present; tertiary veins moderately distinct

above and below; collective veins arising from basal veins 4–5 mm from margin; basal veins 1 pair; antemarginal veins present; upper surface smooth, sparsely and weakly glandular-punctate; lower surface conspicuously glandular-punctate, finely granular in the areoles. *Inflorescence* with peduncle 31.9 cm long; spathe green, reflexed, 3.8 cm long, 1 cm wide, oblong-lanceolate, drying moderately coriaceous, dark brown; spadix white, stipitate 3 mm, slender and weakly tapered, 6.6 cm long, 3 mm diam., drying yellowish brown; flowers 3–4 visible per spiral, drying 2 mm long and 1.7 mm wide; tepals papillate-granular on drying; lateral tepals 1.1 mm wide, inner margin rounded, outer margins 3-sided; stamens not exerted. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium alejandroi* is endemic to Colombia, known only from the type locality in Antioquia Department, at 1000–1280 m in a *Premontane rain forest* life zone.

**Comments** — In the Lucid Anthurium Key, *Anthurium alejandroi* tracks to *A. amargalense* Croat & M.M.Mora which differs by having a much thicker ovate-elliptic blade; *A. purdieanum* Schott, which differs by having longer internodes, persistent intact cataphylls, short petiolate narrowly ovate leaves and a short peduncle; *A. trianae* Engl., which differs by having petioles shorter than the blades and the inflorescence shorter than the leaves and *A. deflexum* Engl., which differs by having more coriaceous blades which are reflexed on the erect petioles with the inflorescence held prominently higher than the leaves.

**Etymology** — *Anthurium alejandroi* is named for Colombian botanist, Alejandro Zuluaga who collected the type specimen. Alejandro is a specialist on Monstera, received his Ph.D. at the University of Wisconsin in Madison, and is now a professor at the Universidad del Valle in Cali, Colombia. Alejandro helped organize the XII International Aroid Conference, in Cali, Colombia in July 2017, the first international conference on aroids to be held in Latin America.

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*Anthurium barfodii* Croat, **sp. nov.** — Type: ECUADOR. Esmeraldas: Zapallo Grande, mixed black and Cayapas Amerindian community along Río Cayapas, second growth vegetation and disturbed rain forests close to village, 00°48'N, 78°54'W, 200 m, 11 Oct. 1983, A. Barfod, L.P. Kvist and D. Nissen 48095 (holotype, AAU). Figure 117.

*Diagnosis:* *Anthurium barfodii* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, short, persistent, dark brown cataphyll fibers, moderately short, sharply sulcate drying petioles, oblong-ob lanceolate yellow-brown drying blades which are glandular-punctate on both surfaces with two pairs of collective veins, the innermost ca.

1 cm from the margins, numerous primary lateral veins that are scarcely distinguishable from the interprimary veins, the long-pedunculate inflorescence with the spathe persisting only as basal fibers, the spadix cylindroid and short with pink berries.

Epiphytic; internodes short, 0.8–1.2 cm diam., cataphylls persisting as scant reddish brown fibers 3–5 cm long. *Leaves* 35 cm long with petioles 6.0–9.3 cm long, 0.3–0.5 cm diam., drying dark brown, C-shaped, markedly sulcate adaxially; geniculum 1 cm long, drying darker than petiole and with lateral margins acute, winged; blades lanceolate-elliptic, 25.5–29.0 cm long, 6.8–7.4 cm wide (averaging  $27.3 \times 7.1$ ), 3.7–4.0 times longer than broad, 0.8–1.2 times longer than petiole, shortly acuminate at apex, cuneate at base, subcoriaceous, drying greenish gray on both surfaces; midrib upper surface convex, drying dark brown, irregularly ribbed and granular, more acute toward the apex, lower surface more narrowly ribbed; primary lateral veins fine, concolorous, 36–40 per side, departing midrib at 30–40°; basal veins 2 pairs, lower pair margining out in lower ¼ blade, upper pair becoming collective veins which are more prominent than the primary lateral veins, arising from the base and running 1 cm from the margin near the base to 0.5 cm from the margin near the apex, drying concolorous with the blade surfaces; upper surface drying obtusely and irregularly granular, densely glandular-punctate, sparsely pustular; lower surface with minute, dark, glandular punctations and larger pustules which are more distinctly rounded and raised on the lower surface. *Inflorescence* not seen; peduncle 38.4 cm long, 0.3 cm diam., terete, drying coarsely ribbed; spathe not seen. *Infructescence* 4.9 cm long, 0.8 cm diam., cylindroid, berries pink protruding, 5 mm diam., drying dark brown.

**Distribution and ecology** — *Anthurium barfodii* is known only from the type locality in Ecuador, Esmeraldas Province at 200 m in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium barfodii* is named for the collector, Anders Barfod, Associate Professor of Bioscience at Aarhus University in Denmark.

**Comments** — *Anthurium barfodii* is similar to *A. calimense* Croat & D.C.Bay, found in Colombia, which differs by having the blade more broadly elliptic (2.6–3.3 times longer than broad), more attenuate at base, more long-attenuated at apex with the spadix more long-tapered; *A. quinquesulcatum* Sodiro which has prominently 5-ribbed petioles, sharply sulcate adaxially with 2-ribs on the sides and an acute rib abaxially, obovate to oblanceolate blades and peduncle 8–30 cm long; *A. tsamajainii* Croat which has smaller blades (8–20 cm long), more prominent primary lateral veins and peduncles 15–30 cm long; *A. sulcatum* Engl. which has petioles 10–12 cm long, oblanceolate blades and collective veins that run 5–7 mm from the margin.





Figure 117. *Anthurium barfodii* Croat. Holotype: Barfod et al. 48095



Figure 118. *Anthurium bueyense* Croat. Holotype: Gentry 17435.

In the Lucid *Anthurium* Key, *Anthurium barfodii* tracks with: *A. cachabianum* Sodiro which has petioles 20–25 cm long, broader blades (2.1–2.3 length/width ratio) and only 8–12 primary lateral veins per side; *A. navasii* Sodiro which has smaller blades (20–25 × 8–12 cm) with the base rounded to obtuse; *A. rhizophorum* Sodiro which has oblong blades, 8–10 primary lateral veins per side, and a collective vein only 3–4 mm from the margin.

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***Anthurium bueyense*** Croat, **sp. nov.** — Type: COLOMBIA. Chocó: North ridge of Alto de Buey, above Dos Bocas del Río Mutata, tributary of Río El Valle, ESE of El Valle, 06°05'30"N, 77°26'00"W, 200–500 m, 8 Aug. 1976, *A. Gentry & M. Fallen 17435* (holotype, COL-205421; isotypes, MO-161952, MO-2464044). **Figure 118.**

**Diagnosis:** *Anthurium bueyense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, subterete, sulcate petioles, oblong-oblancoolate blades that are glandular-punctate on the lower surface and with the collective veins arising from near the base as well as by long-pedunculate inflorescences with a very long-stipitate grayish spadix and a reddish infructescence with red berries.

Epiphytic; internodes short, 1.2–1.5 cm diam.; cataphylls persisting as brown fibers (length uncertain, probably 3–5 cm long) *Leaves* 71 cm long, with petioles 19.5–22.0 cm long, 0.4–0.6 cm diam., broader than thick with 1 medial rib, drying yellow-brown; blades oblong-elliptic, 34–65 cm long (averaging 51), 9.2–11.2 cm wide (averaging 10.3), 3.7–5.8 times longer than broad (averaging 4.9), blade 2.5–3.0 times longer than petiole, long tapered acuminate at apex, long tapered cuneate at base, moderately coriaceous, drying matte, dark yellowish green above, matte lighter greenish yellow below; midrib narrowly convex and finely ribbed above, broadly convex and coarsely ribbed below, drying light yellowish brown on both surfaces; primary lateral veins inconspicuous, 35–40 per side, departing midrib at 30–40°, along with numerous interprimary veins; collective veins arising from the base and running 3–6 mm from margin; upper surface eglandular with scattered minute whitish inclusions; lower surface densely thick low-pustular with sparse folds, conspicuously dark black glandular-punctations, the glands raised with medial depression. *Inflorescence* with stipe 4.1–5.3 cm long; 2 cm diam., peduncle 31–33.2 cm long, broader than thick with 1 medial rib, drying medium brown; spathe not collected, described by collector as yellow; spadix stipitate 4–5 cm, 17.8 cm long, 1.3 cm diam., cylindroid, reddish; flowers 7–8 visible per spiral, 2.5–2.6 mm long and wide. *Infructescence* reddish 7.5–12 cm long, 0.8–1.5 cm diam., drying dark brown; berries reddish, drying bottle-shaped, 8 mm long, 3 mm wide, drying dark brown.

**Distribution and ecology** — *Anthurium bueyense* is endemic to Colombia, known only from Chocó Department in the Alto de Buey at 500–1200 m in *Tropical wet forest* and Premontane wet forest life zones.

**Etymology** — The species is named for the type locality at Altos de Buey in Chocó Department.

**Comments** — *Anthurium bueyense* is most similar to *A. redolens* Croat but that species differs by having larger cataphylls (5–7 cm long), shorter petioles (3–10 cm), which are narrowly and obtusely sulcate adaxially (versus broader than thick with a medial rib and blades with fewer primary lateral veins (7–20(25) per side).

A collection from Alto de Buey at 1200 to 1800 m elevation (Gentry & Forero 7349) is perhaps also this species, but differs by drying much paler yellow-brown.

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***Anthurium certeguense*** Croat, **sp. nov.** — Type: COLOMBIA. Chocó: Along road (under construction in 1979) from Yuto to Lloró (N of Certequí), pluvial forest, along creek ca. 2 km E of Yuto, 50 m, 18. Jan 1979, *A. Gentry & E. Renteria 24435* (holotype, MO-2716751; isotypes, COL, HUA). **Figure 119.**

**Diagnosis:** *Anthurium certeguense* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, short, persistent, red-brown cataphyll fibers, its more or less triangular petioles which are broadly flattened adaxially with sharply erect margins and acute ridges abaxially, by the gray drying blades with glandular punctations on the lower surface, with only a single pair of collective veins arising from near the base as well as by the long pedunculate inflorescence with a green, spreading, frequently incurled (sometimes tinged with white or pink) spathe and the green spadix that turns pinkish or orange post-anthesis. The white berries are also distinctive.

Epiphytic or sometimes terrestrial; internodes 0.4 cm long, 1 cm diam.; cataphylls 4–6 cm long, persisting as shredded reddish brown fibers. *Leaves* 45 cm long with petioles 7.6–36.3 cm long (averaging 18.5), 0.4 cm diam., broadly flattened adaxially with sharply erect margins, acutely ridged abaxially, drying medium brown; geniculum 1.4 cm long, darker than petiole; blades ovate-elliptic, 18.5–30.8 cm long (averaging 26.3), 5.9–11.2 cm wide, 2.1–4.1 times longer than broad (averaging 2.9), 0.8–3.2 times longer than petiole (averaging 1.9), apex cuspidate with down-turning acumen 1.0–1.5 cm long, attenuate at base, moderately coriaceous, drying grayish and weakly glossy above, slightly and grayish and slightly more glossy below; midrib narrowly rounded, inconspicuous above, broadly rounded to flattened, concolorous

below; primary lateral veins 9–14 per side, (average 12), concolorous, departing midrib at 50°–60°, inconspicuous above, finely acute, concolorous below; basal veins 1 pair, forming the only pair of collective veins, these loop-connecting to primary lateral veins 0.5 cm from margin, more conspicuous than primary lateral veins; upper surface eglandular, drying minutely wrinkled; lower surface densely and minutely glandular-punctate, minutely granular. *Inflorescence* 26 cm long with peduncle 8.5–23.7 cm long, 0.2 cm diam.; spathe spreading, green or green tinged with tinges of pink or red, 3.5–5.7 cm long, 0.3 cm wide; spadix green turning red, pink or orange post-anthesis, 5.7–16.8 cm long, 0.3–0.7 diam., with pronounced tapering; flowers 4 visible per spiral, 3.2 mm long, 2.5 mm wide, lateral tepals 2.0 mm long, inner margins slightly convex to nearly straight, no stamens visible. *Infructescence* with distinctive white berries.

**Distribution and ecology** — *Anthurium certeguense* is endemic to Colombia, known only from central Chocó Department in the region of Yuto, Lloró and Certeguí to as far south as the Río San Juan at 5–50 m elevation in a *Tropical pluvial forest* life zone.

**Etymology** — The species is named for the village of Certegui near where the species was first collected in September 1976 by Enrique Forero and R. Jaramillo.

**Comments** — *Anthurium certeguense* is similar to *A. acutangulum* Engl., *A. calimense* Croat & D.C.Bay and *A. punctatum* N.E.Br. *Anthurium acutangulum*, which ranges from Honduras to Panama, differs by having subterete petioles, a frequently pendent inflorescence with a less prominently tapered and somewhat stipitate spadix. *Anthurium calimense* may be distinguished by its longer internodes and cataphylls and blades that dry olive-green. *Anthurium punctatum* differs by having long, slender blades, primary lateral veins that are obscure on both sides and has only been found in Ecuador at higher altitudes (300–600 m). In the Lucid *Anthurium* Key, *Anthurium certeguense* also tracks with *A. ventanasense* Croat which has a longer blade, purple spathe and spadix, green berries and is found in Ecuador at 300 m.

*Paratypes*: COLOMBIA. Chocó: Carretera en construcción Yuto–Lloró, 1 km de Yuto, 70 m, Sep. 8 1976, *E. Forero and R. Jaramillo* 2693 and 2673 (both COL); Quebrada Taparal, alfuente del Río San Juan, alrededores de la comunidad indígena Wuananá de Taparalito, 04°12'N, 77°10'W, 5–10 m, Mar. 27 1979, *E. Forero, R. Jaramillo, L.E. Forero P and N. Hernández* 4232 and 4296 (both COL); Municipio de Quibdó, carretera Quibdó–Yuto, Km 8–9, ramal hacia el Real de Tanado, 80 m, June 29 1983, *E. Forero, R. Jaramillo, J. Espina, L. M Quiñones* 9622 and 9615 (both COL).



Figure 119. *Anthurium certegense* Croat. Holotype: Gentry 24435





Figure 120. *Anthurium chiriacoense* Croat. Holotype: van der Werff et al. 24619.

*Anthurium chiriacoense* Croat, **sp. nov.** — Type: PERU. Amazonas Department, Bagua Provincas: Chiriaco Mountain, lower slope of Cerro Tayu, Campau vegetation, soil thick with humus layer, 05°15'56"S, 78°22'07"W, 500–625 m, 27 Oct. 2012, *H. van der Werff, R. Rojas, L. Valenzuela, G. Shareva, R. Apanu, A. Roca & A.R. Barrantes* 24619 (holotype, MO-6472305; isotype, HOXA). **Figure 120.**

*Diagnosis:* *Anthurium chiriacoense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, conspicuous, reddish brown, sub-parallel cataphyll fibers, moderately short-petiolate leaves with subterete petioles with a swollen blackened geniculum, moderately coriaceous elliptic blades which are rounded and apiculate at the apex and acute at the base with a single pair of collective veins arising from the base and relatively remote from the margins, midrib acutely raised above, primary lateral veins 6–8 per side, which dry etched in surface, glandular punctations on the lower surface only as well as by the long-pedunculate inflorescence as long as or longer than the leaves, a green, spreading spathe and a green spadix.

Epiphytic; internodes short, 1.1 cm diam.; cataphylls 5.1–8.3 cm long, acute and persisting intact at apex, becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. *Leaves* with petioles 6.8–11.7 cm long, 3–4 mm diam., subterete, drying deeply narrowly and acutely sulcate adaxially, finely and acutely ribbed abaxially and on sides, greenish brown; geniculum 1.0–1.3 cm long, drying conspicuously swollen and darker than petioles; blades elliptic, 15.3–26.7 cm long, 6.5–14.2 cm wide (averaging 19 × 9), 1.9–2.5 (averaging 2.2) times longer than broad, 1.7–2.3 (averaging 2.1) times as long as petioles, rounded and apiculate at apex, acute at base, subcoriaceous, drying gray-yellow-brown, matte above, yellowish gray-brown, matte below; midrib drying narrowly raised to narrowly acute and slightly darker above, narrowly raised and slightly paler below; primary lateral veins 6–8 per side, departing midrib at 40–45° near middle, drying deeply sunken with narrowly and prominently raised margins, concolorous above, narrowly and irregularly rounded and concolorous below; secondary and tertiary veins moderately obscure on both surfaces; collective veins arising from basal vein, 5–7 mm from margin; basal veins 1 pair; antimarginal vein present; upper surface conspicuously and irregularly folded, sparsely black-dotted (probably insect eggs); lower surface densely and minutely glandular-punctate. *Inflorescence* with peduncle 36.2 cm long; spathe green, spreading, 5.9 cm long, 8 mm wide, linear-lanceolate, drying subcoriaceous and reddish brown; spadix green, weakly stipitate (1 mm), weakly tapered, 8.5 cm long, 6 mm diam., drying reddish brown; flowers 3 visible per spiral, drying 3.2 mm long, 2.8 mm wide; tepals drying minutely granular; lateral tepals 1.8 mm wide, inner margin rounded, outer margins 2-sided; stamens held at the level of the tepals, 0.5 mm long, 0.9 mm wide; anthers ovate, thecae weakly divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium chiriacoense* is endemic to Peru, known only from the type locality on Chiriaco Mountain, Bagua Province in Amazonas Department at 500–625 m in a *Lower montane rain forest* life zone.

**Etymology** — The species is named for the type locality on Chiriaco Mountain, Bagua Province in Amazonas Department.

**Comments** — *Anthurium chiriacoense* has no obvious relatives and does not closely resemble other species. In the Lucid Anthurium Key, *Anthurium chiriacoense* tracks to *A. cachabianum* Sodiro from the western slopes of the Andes in Esmeraldas Province, Ecuador, which differs by having proportionately longer petioles, thinner blades, less rounded and more gradually acuminate apex and a more long-tapered sessile spadix; *A. tenuispica* Sodiro (from same area) which differs by having the leaf blades narrowly elliptic, proportionately longer petioles and a proportionately longer spadix and *A. yamaykatense* Croat, which differs by having oblong-elliptic leaf blades 3.7 times longer than wide and proportionately longer petioles; and *A. mostaceroi* Croat but that species differs by having cataphylls to 13 cm long, petioles proportionately longer and blades proportionately longer (2.5 times longer than wide) which are gradually long-acuminate.

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*Anthurium claudiae* Croat, **sp. nov.** — Type: ECUADOR. Carchi: Along road from El Chical to El Limonal (Imbabura), 16 km S of junction with main El Chical-Peñas Blancas Road, 2 km S of Río Gualpi Bridge, vicinity of Km 15.5–15.8 markers, 00°52'N, 78°13'W, 2200 m, 13 Oct. 2012, T.B. Croat, G. Ferry, D. Scherberich, C.L. Henríquez R., & E. Levy 104224 (holotype, MO-6429270; isotypes, B, COL, F, K, M, NY, QCNE, S, SEL, US). **Figure 121.**

*Diagnosis:* *Anthurium claudiae* is a member of sect. *Porphyrochitonium* and is characterized by its terrestrial habit, short internodes, dense, persistent, reddish brown cataphyll fibers, petioles weakly to sharply flattened adaxially, elliptic to ovate-elliptic, brownish drying, gradually acuminate blades which are glandular-punctate on both surfaces with a single pair of collective veins, close primary lateral veins as well as by the purplish tinged spreading slender spathe, medium green weakly tapered spadix and white berries.

Terrestrial; internodes short, 1.5–2.0 cm diam., the sap turning dark purple; cataphylls (5.5)7.0–8.5 cm long, drying dark red-brown, fibers reddish brown, mostly straight, closely parallel, sometimes persisting in a reticulum, sometimes with large fragments of reddish brown epidermis. *Leaves* with petioles weakly to sharply flattened adaxially, 14.3–41.9 cm long, drying 2–5 mm diam., yellowish brown to dark brown; geniculum 1.0–1.5 cm long,

drying darker than petioles; blades elliptic to ovate-elliptic, 13.6–32.3 cm long, 6.3–15.9 cm wide (averaging  $21 \times 10$ ), 1.9–2.7 (averaging 2.2) times longer than broad, broadest at mid-point, 0.7–1.2 (averaging 0.9) times as long as petioles, gradually acuminate at apex, (acumen to 1.3 cm long), acute at base, drying subcoriaceous, dark brown and semiglossy above, slightly yellowish brown and semiglossy below; midrib narrowly rounded, glandular-punctate and paler above, bluntly acute, sparsely glandular-punctate and paler below; primary lateral veins 10–14 per side, scarcely more prominent than interprimary veins, departing midrib at 55–60°, quilted-sunken and concolorous above, narrowly raised and concolorous below; secondary veins drying indistinct above, weakly raised below; collective veins arising from basal veins 2–5 mm from margin, equally sunken arising from base; basal veins 1 pair; antemarginal vein present; upper surface conspicuously glandular-punctate, densely and minutely granular and weakly pustular; lower surface smooth, conspicuously glandular-punctate, minutely and irregularly dark-speckled. *Inflorescence* erect; peduncle 31.6–65.1 cm long; spathe tinged purplish, spreading, matte inside, glossy outside, 3.5–5.0 cm long, 1.3–1.4 cm wide, narrowly oblong-elliptic, drying moderately coriaceous, medium reddish brown; spadix stipitate 5 mm, long and weakly tapered, medium green, glossy, 6–14 cm long, 5 mm diam., drying reddish brown; flowers 3 visible per spiral, drying 2.2 mm long, 1.7 mm wide; tepals minutely granular on drying; lateral tepals 1.2 mm wide, the inner margin rounded, outer margins 2-sided; pistils and young berries white; fruiting spadix to 18 cm long with spathe to 9 cm long; stamens not exerted. *Infructescence* with berries white.

**Distribution and ecology** — *Anthurium claudiae* is endemic to Ecuador, known only from the type locality on and near the divide between the valley of the Río San Juan and the valley of the Río Mira at 2000–2200 m elevation in a *Premontane wet forest* life zone.

**Etymology** — *Anthurium claudiae* is named for Claudia Henríquez, one of Thomas Croat's graduate students from Washington University in St. Louis. Claudia was one of the collectors of the type specimen and is a specialist on *Anthurium* sect. *Porphyrochitonium* from the Lita-San Lorenzo Region. While working on a class project, she modified the Lucid Anthurium Key to make it more compatible for determining sect. *Porphyrochitonium*.

**Comments** — *Anthurium claudiae* is seemingly closest to another species based on Croat *et al.* 104182 from the same region which differs by being more conspicuously glandular-punctate on the lower surface and in lacking glandular punctations on the upper surface.

In the Lucid Anthurium Key, *Anthurium claudiae* tracks to *A. amargalense* Croat & M.M.Mora, which differs by having broader, more deeply sulcate petioles and pale magenta berries; *A. cachabianum* Sodiro, which occurs at less than 1000 m elevation in Esmeraldas Province



Figure 121. *Anthurium claudiae* Croat. Holotype: Croat et al. 104224

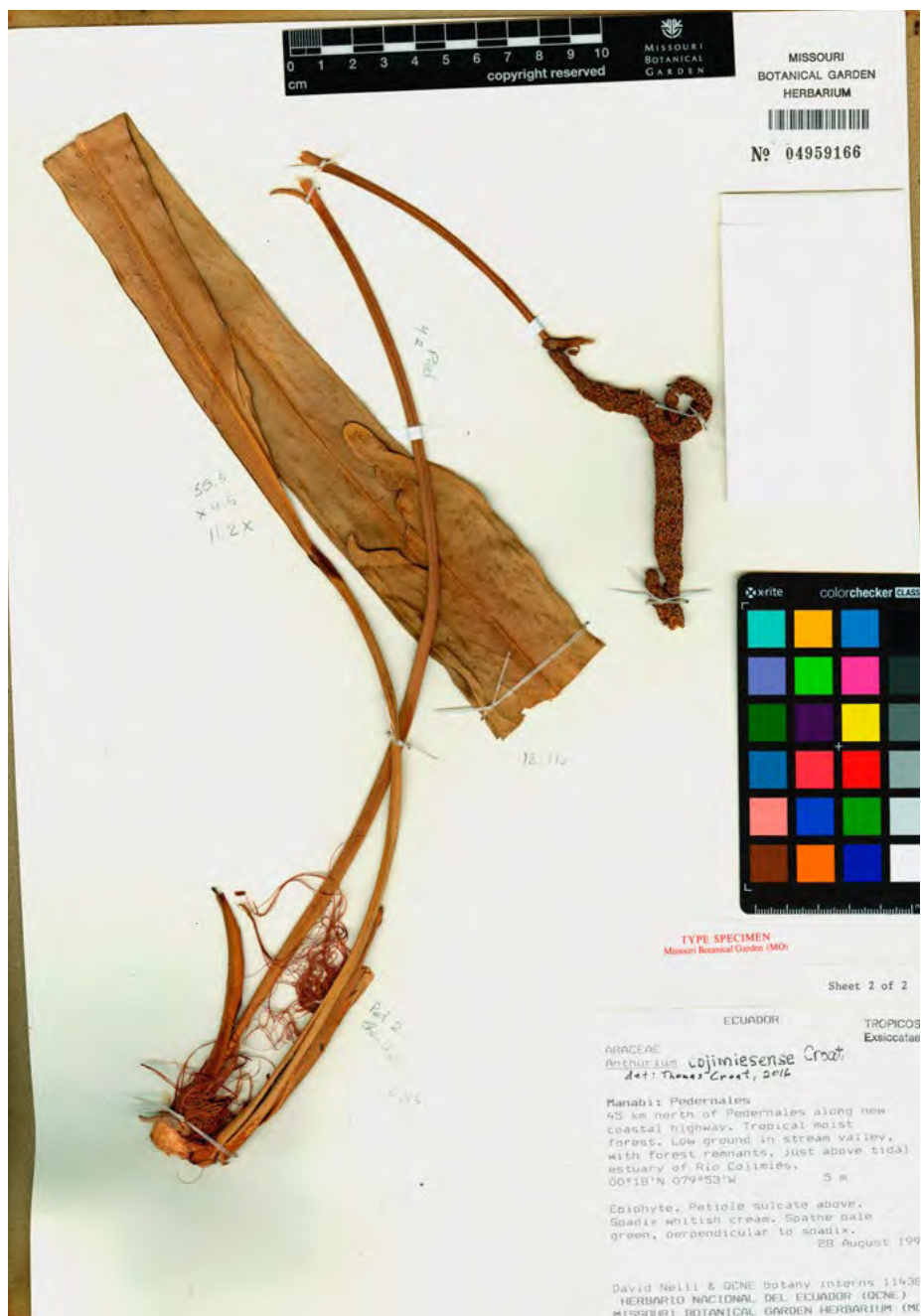


Figure 122. *Anthurium cojimiesense* Croat. Holotype: Neill et al. 11438.



differs by having the leaf blades rounded at apex with an abrupt short acumens (versus gradually acuminate), two pairs of collective veins (versus 1 pair), closer primary lateral veins and proportionately somewhat longer petioles 1.3 times longer than blades (versus 1.3–2 times longer than blades); *A. lancifolium*, which differs by having proportionately narrower, more lanceolate more brownish blades with a more cylindroid usually whitish spadix: *A. myosurus* Sodiro, which differs by having 2 pairs of basal veins and a sessile spadix and *A. victoriense* Croat, which differs by having the leaf blades with the primary lateral veins close and indistinct, hardly distinguishable from the interprimary vein as well as by having conspicuous cross-veins and a much larger inflorescence.

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***Anthurium cojimiesense* Croat, sp. nov.** — Type: ECUADOR. Manabí: Cantón Pedernales, 45 km N of Pedernales, just above the tidal estuary of Río Cojimies, 00°18'N, 79°53'W, 5 m, 28 Aug. x 1998, D. Neill 11438 (holotype, MO-04959165; isotype, QCNE). **Figure 122.**

*Diagnosis:* *Anthurium cojimiesense* is a member of sect. *Porphyrochitonium* and is recognized by its epiphytic habit, short internodes, dark reddish brown, persistent fibers, long-petiolate leaves, strap-shaped gray-green blades glandular-punctate on the lower surface as well as its long-pedunculate inflorescence with a slender, pale green, spreading spathe, and purplish brown, long-tapered spadix.

Epiphytic; internodes short, 0.8 cm long, 1 cm diam.; cataphylls persisting as reddish brown fibers to 5.5 cm long. *Leaves* 75.8 cm long with petioles 17.5–21.2 cm long, 0.4–0.5 cm diam. subterete, sulcate adaxially, drying brownish green; blades long-lanceolate, 50.5–62.4 cm long, 2.9–3.6 cm wide (averaging 56.4 × 3.2), 13.6–21.5 times longer than broad (averaging 17.7), long tapered acuminate at apex, long tapered-cuneate at base, subcoriaceous, drying matte greyish green, concolorous on both surfaces; midrib convex, finely ribbed above, more acute below, drying medium brown above and below; primary lateral veins 24–26 per side, inconspicuous, departing midrib at 20–40°; collective veins arising from the base and running 0.2–0.3 cm from margin; collective veins more prominent than primary lateral veins; upper surface eglandular, moderately smooth with some reticulate venation; lower surface granular, faintly ridged, brownish speckled, sparsely black glandular-punctate. *Inflorescence* to 61.3 cm long, erect; peduncle subterete, 41.3–42.6 cm long, 0.4–0.5 cm diam, 2.3 times longer than spathe, drying medium brown; spathe 18.3 cm long, 0.5 cm wide, pale green, drying dark brown; spadix 17.0–21.5 cm long, 0.5 cm diam., greenish-white, drying dark brown; flowers 4 visible per spiral, 5 mm long and wide; lateral tepals 3–3.5 mm wide, inner margins almost straight to broadly rounded, outer margins 2-sided; stamens not persisting exerted. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium cojimiesense* is endemic to Ecuador, known only from the region along the Pacific coast 45 km N of Pedernales in Manabí Province at 5 m elevation in a *Premontane moist forest* life zone.

**Etymology** — The species name named for the type locality along the Río Cojimías in Manabí Province.

**Comments** — *Anthurium cojimiesense* is easily confused with an unpublished species represented by Ceron 17856, another species from the Pacific coastal area with strap-shaped leaves. That species is from the Province of Guayas in the Cantón Naranjal at the Reserva Ecológica Manglares Churute on Cumbre del Cerro Pancho Diablo at 700 m elevation. It is a member of sect. *Multinervium* and differs by lacking glandular punctations. Another species, a member of sect. *Porphyrochitonium* from Pichincha, Ecuador, with a long, narrow, linear blade is *Anthurium jimwestii* Croat but its blades are 75–95 cm long, and 4.8–6.0 cm wide and has 56–64 primary lateral veins per side. In the Lucid Anthurium Key, *Anthurium cojimiesense* tracks with *A. julospadix* Sodiro which may be distinguished by its shorter petioles (5–20 cm long), shorter blades (25–50 cm long), and shorter spadix (4–15 cm long); and *A. ruprestre* Sodiro which has longer blades (60–90 cm long), primary lateral veins which arise from the midrib at wider angles (50–70°) and collective veins that run 3–5 mm from the margin.

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***Anthurium coquiense*** Croat, **sp. nov.** — Type: COLOMBIA. Chocó: Municipio de Nuquí, Corregimiento de Coquí, Quebrada Trapiche al Sureste de Coquí, ca. 05°32'N, 77°15'W, 100–160 m, Feb.–Mar. 1994, G. Galeano, A. Moreno, G. Moreno & J. Perea 5523 (holotype, COL). **Figure 123.**

**Diagnosis:** *Anthurium coquiense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, short, persistent, light brown cataphyll fibers, dark brownish drying, deeply sulcate petioles, broadly oblanceolate, markedly abruptly long-acuminate, brownish drying blades with a single pair of collective veins arising from the base and are glandular-punctate only on the lower surface as well as by the long-pedunculate inflorescence, terete peduncle, linear-lanceolate green spreading-reflexed spathe and bright red infructescence.

Epiphytic; internodes short, 1.6 cm diam.; cataphylls 4.7–6.6 cm long, acute, persisting intact at apex, semi-intact, becoming fibrous with fragments of light brown epidermis, the fibers manilla, mostly closely parallel. *Leaves* with petioles 9.8–15.1 cm long, 4–5 mm diam., subterete, drying acutely sulcate, yellowish dark brown; geniculum 1.0–1.1 cm long, drying darker than petioles; blades broadly oblanceolate, 41.8–68.4 cm long, 9.7–11.5 cm wide



Figure 123. *Anthurium coquiense* Croat. Holotype: Galeano 5523.



Figure 124. *Anthurium davidneillii* Croat. Holotype: Croat 72340 (sheet 1).





**Figure 125.** *Anthurium davidneillii* Croat. Holotype: Croat 72340 (sheet 2).



**Figure 126.** *Anthurium davidneillii* Croat. Croat 72340. Flowering plant





**Figure 127.** *Anthurium davidneillii* Croat. Croat 72340. Inflorescence

(averaging  $53 \times 10$ ), 4.3–6. (averaging 5.1) times longer than broad, broadest in distal  $\frac{2}{3}$ , 3.2–3.3 (6.9) times longer than petioles, abruptly acuminate at apex (acumen to 2.6 cm), narrowly acute to weakly attenuate at base, drying grayish brown to yellowish brown-green, weakly glossy above, yellowish brown and semiglossy below; midrib drying narrowly acute, and slightly darker above, narrowly rounded, finely ribbed, sparsely glandular-punctate and darker below; primary lateral veins 18–20 per side, departing midrib at  $45^\circ$  near middle, drying weakly and narrowly raised, slightly darker above, narrowly rounded and paler below; tertiary veins weakly visible above, moderately raised below; collective veins arising from basal veins, 4–5 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface eglandular, densely granular; lower surface moderately smooth, conspicuously glandular-punctate. Inflorescence erect-spreading; peduncle 34.8 cm long; spathe green, spreading-reflexed, linear-lanceolate, drying reddish brown; sessile, long, and weakly tapered, 17.1 cm long, 7 mm diam., drying reddish brown; flowers 3–4 visible per spiral, drying 2.5 mm long, 2.0 mm wide; tepals drying minutely granular; lateral tepals 1.2 mm wide, inner margins broadly rounded, outer margins 2-sided; stamens not seen. Infructescence with spadix bright red, berries red, 2-seeded, ovoid-ellipsoid, drying ca. 5 mm long; seeds 1.6 mm long, 1.2 mm wide, ca. 1 mm thick.

**Distribution and ecology** — *Anthurium coquiense* is endemic to Colombia, known only from the type locality in Chocó Department at 100–160 m in a Tropical rain forest life zone.

**Etymology** — The species is named for the type locality in area of Coquí in the Municipio of Nuquí.

**Comments** — In the Lucid Anthurium Key, *Anthurium coquiense* tracks to *A. joaquinense* Croat & D.C.Bay, which differs by having blades broadest in the lower half with 17–27 primary lateral veins per side, and a proportionately much shorter spadix; *A. punctatum* Engl., which differs by having white berries which are purplish at apex; *A. verrucosum* Croat & D.C.Bay which differs by having longer cataphylls to 15 cm long and forming a reticulum and blades that are broader below the middle and *A. wattii* Croat & D. C. Bay, which differs by having a rounded leaf base and more remote collective veins along the margins.

*Galeano et al.* 5404 from the same region as the type locality is perhaps also this species but differs by having the upper surface drying dark brown and the lower surface yellow-brown.

*Anthurium davidneillii* Croat, **sp. nov.** — Type: ECUADOR. Esmeraldas: Cantón, Lita, San Lorenzo, along unfinished road between Lita and San Lorenzo, 37.8 km W of Lita. 00°56'N, 78°39'W, 390 m, 21 Feb. 1992, T.B. Croat 72340 (holotype, MO-4076067–8; isotypes, AAU, B, F, K, SEL, US). **Figures 124–127.**

*Diagnosis:* *Anthurium davidneillii* is a member of sect. *Porphyrochitonium* characterized its short internodes, persistent cataphylls, sharply 5-sided petioles, ovate, abruptly acuminate blades which are usually rounded to weakly subcordate at base and glandular-punctate on both surfaces with collective veins arising from the first pair of basal veins near the base as well as by the pale greenish whitish to cream colored spathe, purplish spadix and pale violet-purple to lilac berries.

Terrestrial to 80 cm tall or epiphytic; internodes short, 4–6 cm diameter; cataphylls 6–20 cm long, persisting with fibers in red-brown reticulum. *Leaves* 88.3 cm long, with petioles 23.5–79.0 cm long (averaging 49.4), 0.5–1.1 mm diam., sharply 5-sided, the sides parallel, broadly V-shaped adaxially with moderately acute lateral margins and an obtuse medial rib, often sharply 3-ribbed abaxially, semiglossy, drying often narrowly and deeply sulcate adaxially, medium-dark yellow-brown; geniculum 3 cm long, drying dark brown; blades ovate to broadly ovate, 28.8–55.0 cm long, 14.2–35.0 cm wide, (averaging 38.9 x 26.2), 1.1–2.9 times longer than broad (averaging 1.5), 0.5–1.8 times longer than petiole (averaging 0.8), abruptly acuminate, rounded to weakly subcordate at base, rarely truncate, semiglossy, moderately coriaceous and moderately bicolorous, drying dark olive to dark gray-green above and medium yellowish gray-green below; midrib convex and paler above, thicker than broad and paler below, drying more or less concolorous and often acute above, usually darker than surface and several-ribbed below; primary lateral veins 13–22 per side, (averaging 17), etched-quilted above, pleated-raised below, drying narrowly rounded and more or less concolorous on both surfaces; collective vein arising from the first pair of basal veins near the base; basal veins 2–3 pairs, the outer pairs margining out in the lower ¼ of blade; antemarginal vein present, sometime obscured by the inrolled margin; upper surface densely glandular-punctate, minutely areolate-granular and faintly pale lineolate-speckled; lower surface smoother for the most part but with many small colorless pustules, more conspicuously glandular-punctate than on upper surface. *Inflorescence* 34.3 cm long, erect; peduncle 9.4–41.5 cm long (averaging 25 cm), 1.2–9.6 times longer than spathe (averaging 1.3), drying 2–4 mm diam., somewhat darker than petiole; spathe 1.8–10.8 cm long (averaging 6.8 cm), 0.5–2.4 cm wide (averaging 1.4 cm), pale greenish white, greenish cream or cream to white, drying medium brown; spadix 3.0–15.8 cm long, drying 4–5 mm diam., dark purple to violet-purple, weakly glossy, becoming paler in fruit; flowers 1.8–2.4 mm long, 2–2.4 mm wide; tepals coarsely granular; lateral tepals 1.4–1.6 mm wide, inner margin broadly rounded to almost straight; outer margins 2–3-sided; stamens (still included), anthers 0.5 mm long, 0.2–0.25 mm long, 0.3–0.4 mm wide; thecae not divaricate to moderately divaricate. *Infructescence* with berries subglobose, pale violet-purple to lilac, drying 5–6 mm long, coarsely short-pale-lineate; seeds 2.6 mm long, 1.8 mm wide, longitudinally striate.

**Distribution and ecology** — *Anthurium davidneillii* is known only from northwestern Ecuador at 50–430 m elevation in *Premontane wet forest* and *Tropical wet forest* life zones, less frequently in *Premontane rain forest* life zones.

**Etymology** — *Anthurium davidneillii* is named for American botanist, Dr David Neill, an intrepid explorer in Ecuador. David is a phenomenal force there, being involved with most aspects of Ecuadorian biology. His training of Ecuadorian students including many indigenous plant collectors, with the assistance of his wife, Mercedes, has been immensely valuable to Ecuadorian science. David Neill collected the new species in one of the areas where it is most common. He has been responsible for collecting many new species during the more than 36 years he has spent in Ecuador. He was employed by the Missouri Botanical Garden for 25 years, 1985 to 2010 and during much of that time he was the driving force behind the country's largest collection, the QCNE herbarium. After his employment with Missouri ended, he became a faculty member at the Universidad Estatal Amazónica, and a curator of the university's herbarium, ECUAMZ, the 'Herbario Amazónico del Ecuador' for which he was largely responsible for building. Currently David and Mercedes are working at new branch of the university in El Pangui where he will devote his attention to the studies in the Cordillera del Cóndor and on building up yet another herbarium in Ecuador.

**Comments** — *Anthurium davidneillii* is closest to another new species, *Anthurium ortizii* Croat, but that species differs by occurring at much higher elevations (900 to 1900 m and averaging 1210 m), in drying dark brown to dark gray-brown above and dark yellow-brown below and in having typically more primary lateral veins and reticulate venation that is more prominent. In contrast, *Anthurium davidneillii* ranges from 50 to 450 m (averages 229 m), has blades that dry dark grayish to gray-green on the upper surface and to medium yellowish green on the lower surface with an average of 4 primary lateral veins per side in the lowermost 6 cm of the blade and with the interprimary veins less prominent and with the reticulate veins markedly less prominent.

*Anthurium davidneillii* keys out in the Lucid Anthurium Key to *A. cachabianum* Sodiro and *A. lustriviridum* Croat. Both species have narrower blades with length/width ratios 2.0–2.8 compared to the broadly ovate blade of *Anthurium davidneillii*. The blades of *Anthurium lustriviridum* dry light olive-green above and lighter grey-green below. *Anthurium lustriviridum* has a prominent double collective vein and the blade has a cuneate base; *A. cachabianum* has shorter petioles (20–25 cm), smaller blades (18–25 cm long, 8–12 cm wide) and has a cuneate base. A single collection (Hoover 1240) said to have been collected between 800 and 1300 m appears to be closer to *Anthurium davidneillii*.

*Paratypes*: ECUADOR. Carchi: Tobar Donoso, Parroqui Tobar Donoso, sendero a Lita, 778800 UTM 10129537, 0–1200 m, *E. Freire & R. Qullupangui* 8960 (QCNE); trail along plain above Tobar Donoso and Río Guape: 800–1300 feet (243–396 m), 19 Feb. 1984, *W. S. Hoover* 1240 (MO, QCA). Esmeraldas: San Miguel, Sector Río Grande, Comunidad Corriente Grande, 00°45'N 78°47'W, 22 Nov. 1992, *Carlos Tipaz, P. Méndez, H. Vargas & M. Chapiro* 2317 (MO, QCNE); Reserva Etnica y Forestal AWA-Mataje., 01°17'N, 78°43'W, 15 Mar. 1988, *J. Rodríguez et al.* 727 (QCA); Reserva Etnica y Forestal AWA, Mataje, 01°17'N, 78°43'W, 15 Mar. 1988, *J. Rodríguez* 727B (HUA, QCA); Reserva Cotacachi-Cayapas, Charco Vicente, 00°39'N, 78°55'W, 8 May 1998, *X. Cornejo & C. Bonifaz* 6310 (GUAY, MO); Eloy Alfaro Reserva Ecológica Cotacachi-Cayapas, Charco Vicente, Río San Miguel, 00°43'N 78°53'W; 06–09 Sept. 1993, *W. Palacios & M. Tirado* 11265 (K, MO, QCNE); 20–31 Sept. 1993, *M. Tirado, E. Albuja & M. Chapiro* 291 (MO, QCNE); San Lorenzo, Parroquia Mataje, Reserva Etnica Awá, Centro Mataje, 01°08'N, 78°33'W, 21 Sep. 1992, *C. Aulestia, G. Tipaz, M. Burbano & B. Canticuz* 338 (MO, QCNE; 382 (MO, QCNE); Comunidad Awa Guadualito, 01°16'N, 78°45'W, 5 June 1996, *C. E. Cerón, C. Montalvo & G. Toasa* 31325 (QAP); 31314 (QAP); Territorio Indígena Awá. Mataje village, 01°13'00"N, 78°34'01"W, 14 Feb. 2000, D. Neill, QCNE interns & Awá foresters 12480 (F, MO, QCNE); 12487 (GH, MO, QCNE); Reserva Etnica Awá. Centro Ricaurte, 01°10'N, 78°32'W, 26 Oct. 1992, *G. Tipaz, C. Aulestia & A. Taicuz* 2204 (MO, QCNE); Vicinity of Río Palaví, eastern bank, along creek flowing into Río Palaví, 200 m downstream from Awa encampment, 01°07'N, 78°37'W, 200 m, 12 Feb. 1988, *W. S. Hoover, P. Gelpi, R. A. Lorentzen & A. Arguello* 3165 (QCA).

***Anthurium friedrichii*** Croat, **sp. nov.** — Type: COLOMBIA. Cauca: Coteje on the Río Timbiquí, below 500 m, Feb. 1899, *F. C. Lehmann* 866 (holotype, K; isotype, NY). **Figure 128.**

*Diagnosis*: *Anthurium friedrichii* is provisionally a member of sect. *Porphyrochitonium* characterized by its short slender stem, short internodes, persistent, reddish brown cataphyll fibers, moderately long petiolate leaves, sulcate petioles, oblong-elliptic, abruptly-acuminate, grayish brown drying leaves with a single pair of collective veins and with both surfaces obscurely glandular-punctate, moderately long-pedunculate inflorescence with a green spreading to spreading-reflexed, long-tapered spathe and slender, long-tapered spadix. *Anthurium friedrichii* is rather unique in having the apparent glands only on the upper surface with the lower surface so densely dark-speckled that the glandular punctations are difficult or impossible to discern. Most of what appear to be glands on both surfaces are easily removed but this may be due to the age of the specimens and their state of preservation. *Anthurium friedrichii* may prove to be a member of sect. *Decurrentia* or some other yet undefined section.

Habit unknown; internodes short, 1.1–1.8 cm diam.; cataphylls 5.6–6.7 cm long, acute persisting as red-brown fibers, somewhat intact at apex, bearing fragments of reddish brown epidermis, the fibers mostly closely parallel. *Leaves* with petioles 7.9–19.1 cm long, 2–3 mm diam., subterete, drying sharply sulcate adaxially with the margins acute, often inturned, broadly convex to narrowly ribbed medially, dark grayish brown; geniculum 6–8 mm long, drying darker than petioles; blades oblong-elliptic, 15.7–24.6 cm long, 5.3–6.8 cm wide (averaging  $21 \times 6$ ), 2.8–3.8 (averaging 3.4) times longer than broad, broadest midway, abruptly long-acuminate at apex (acumen to 1.5 cm), acute at base, subcoriaceous, drying grayish brown, weakly glossy above, grayish brown, semiglossy below; midrib drying narrowly rounded to acute and concolorous above, narrowly acute, granular-punctate and concolorous above below; primary lateral veins (12) 18 per side, departing midrib at  $65\text{--}70^\circ$  at middle, drying weakly and narrowly convex, concolorous above, narrowly rounded and concolorous below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from basal veins, 2–3 mm from margin; basal veins 1 pair; upper surface obscurely and sparsely glandular-punctate, areolate upon magnification, the glandular punctations with a blackened center surrounded by a sunken depression; lower surface obscurely glandular-punctate, densely dark-speckled. *Inflorescence* with peduncle 19.5–27.3 cm long; spathe green, spreading, 5.5–6.5 cm long, 7–9 mm wide, lanceolate, drying coriaceous and grayish brown; spadix sessile, long and tapered, 10.0–11.1 cm long, 3 mm diam. at base, 1.5 mm diam. at apex, drying grayish brown; flowers 3 visible per spiral, drying 3.5 mm long, 2.6 mm wide; tepals drying minutely granular; lateral tepals 1.8–2.2 mm wide, inner margin rounded to straight, outer margins 2-sided; stamens withdrawn under tepal, anther 0.4 mm long, 0.8 mm wide; thecae broadly spreading; pistil quadrangular, drying grayish with a medial depression and a slit-like stigma. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium friedrichii* is believed to be endemic to Colombia, known only from the type locality in SE Cauca Department along the Río Timbiquí, at an elevation of less than 100 m in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium friedrichii* is named for the famed plant collector, Friedrich C. Lehmann (1850–1903) who, while German Consul in Colombia, was one of the earlier and most prodigious plant collectors in Colombia and Ecuador.

**Comments** — *Anthurium friedrichii* is perhaps most closely related to *Anthurium brevipes* Sodiro, which differs by having broader leaf blades (6–8 cm wide), a much shorter peduncle





**Figure 128.** *Anthurium friedrichii* Croat. Holotype: *Lehmann* 866. Infructescence

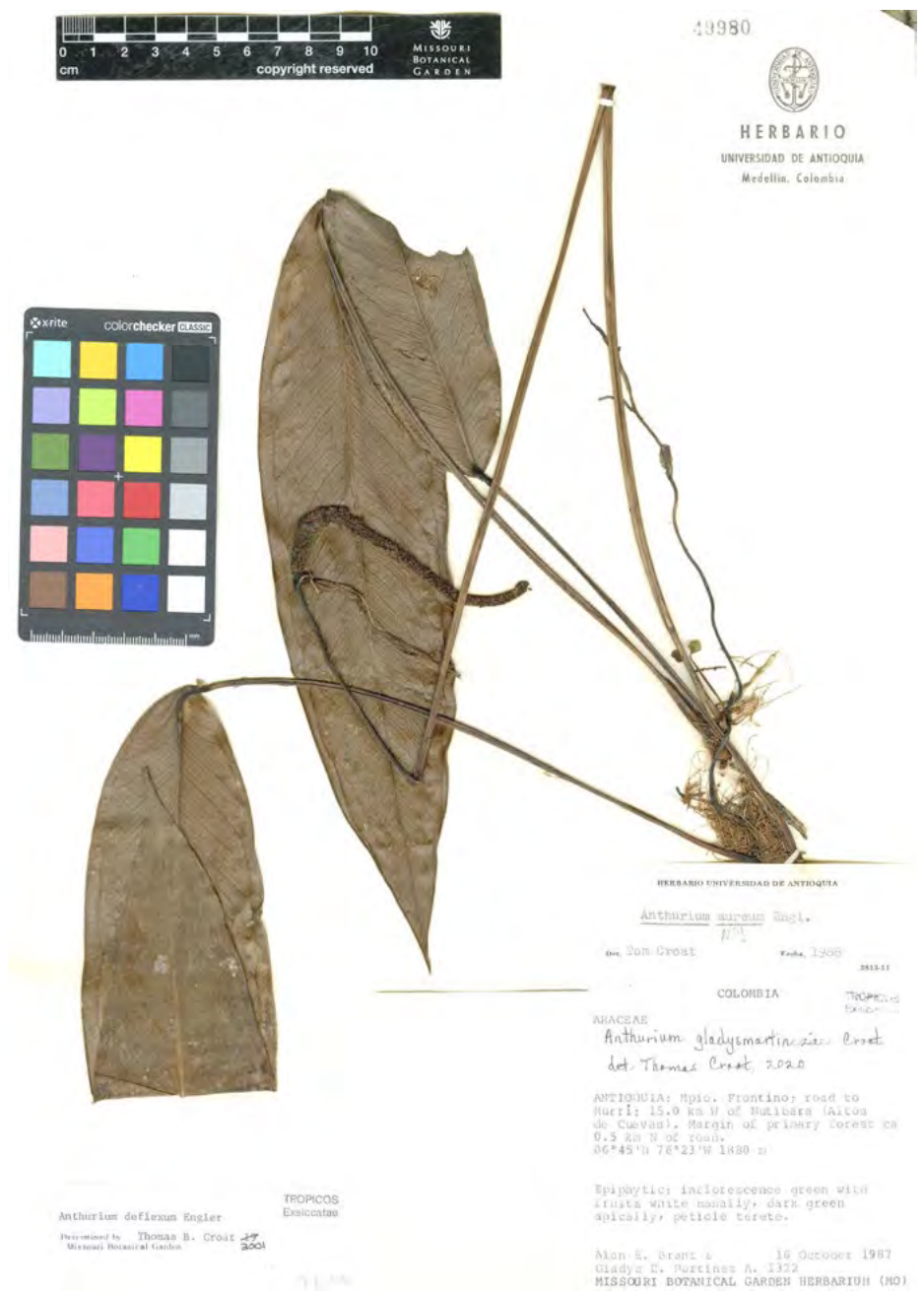


Figure 129. *Anthurium gladysmartineziae* Croat. Holotype: Brant & Martinez 1322

(5–25 cm long), as well as by having more distinct glandular punctations on both surfaces. In the Lucid *Anthurium* Key, *Anthurium friedrichii* tracks to *Anthurium cachabianum* Sodiro which differs by having the collective veins further from the margins (up to 1 cm) and by having distinct glandular punctations only on the lower surface and *A. fuscopunctatum* Sodiro.

While Lehmann reported the elevation of the type locality as less than 500 m, the area must have been at near 40 m, where the town of Cotoje still exists; it would be necessary to travel for more than a day by river to reach elevations of 100 m and several days to reach elevations of 500 m. The coordinates of Cotoje were added with the aid of Google Earth.

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***Anthurium gladysmartineziae* Croat, sp. nov.** — Type: COLOMBIA. Antioquia: Municipio Frontino, road to Murri, 15 km W of Nutibara (Altos de Cuevas), margin of primary forest, ca. 0.5 km N of road, 06°45'N, 76°23'W, 1880 m, *A. Brant & G.E. Martínez A. 1322* (holotype, HUA-49980). **Figure 129.**

*Diagnosis:* *Anthurium gladysmartineziae* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habitat, short internodes, persistent, moderately short, reddish brown cataphyll fibers, terete petioles (drying weakly sulcate), lanceolate, dark brown-drying, narrowly acuminate blades rounded to obtuse at the base, sparsely and obscurely glandular-punctate on both surfaces, as well as by the slender, weak, green, spreading spathe, a rather long weakly tapered violet-purple spadix and berries which are white toward apex and reddish toward the base.

Epiphytic; internodes short, 8–12 mm diam.; cataphylls 5.2–8.4 cm long, acute, persisting semi-intact at apex, becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. *Leaves* with petioles 17.4–27.2 cm long, 2–3 mm diam., terete, drying weakly sulcate, reddish brown; geniculum 8–10 mm long, drying darker than petioles; blades lanceolate to lanceolate-elliptic, 18.6–25.8 cm long, 4.6–6.9 cm wide (averaging  $22 \times 6$ ), 2.9–4.3 (averaging 3.7) times longer than broad, broadest midway or in lower 1/3, 0.9–1.2 (averaging 1.0) times as long as petioles, gradually long-acuminate at apex, narrowly rounded to obtuse or acute at base, subcoriaceous, drying dark brown, weakly glossy above, dark brown, semiglossy below; midrib drying narrowly rounded and slightly paler above, narrowly raised and concolorous below; primary lateral veins 5–8 per side, departing midrib at 50–55° at middle, scarcely more prominent than the interprimary veins, drying weakly and narrowly rounded, paler above, narrowly rounded and concolorous below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from basal veins, 4–5 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface densely areolate-ridged and pitted and sparsely pale-speckled, sparsely and obscurely glandular-punctate

the glands sunken with depressed center; lower surface drying sub-bullate-ridged, inconspicuously and sparsely glandular-punctate. *Inflorescence* with peduncle 42.7–52.1 cm long; spathe green, spreading, 6.4 cm long, 7 mm wide, linear-lanceolate, drying coriaceous and reddish brown; spadix violet-purple, sessile, weakly tapered, 7.7–10.2 cm long, 4–5 mm diam., drying yellowish brown; flowers 4(5) visible per spiral, drying 2.2 mm long, 1.8 mm wide; tepals drying minutely granular; lateral tepals 1.1 mm wide, inner margin rounded; outer margins 2-sided; stamens held at the level of the tepals; anthers 0.5 mm long, 0.6 mm wide; thecae slightly divaricate; berries obovoid, ca. 6 mm long, white basally and dark green apically; seeds 2 per berry, 2 mm long, 1.6 mm diam., drying dark brown. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium gladysmartineziae* is endemic to Colombia, known only from the type locality in Antioquia Department at 1850–2080 m, in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium gladysmartineziae* named for Colombian botanist, Gladys E. Martínez A., who participated in collecting the type specimen. Gladys was a student at the Universidad Nacional de Colombia in Medellín when she participated with Alan Brant in the expedition to the type locality.

**Comments** — *Anthurium gladysmartineziae* has been confused with *Anthurium deflexum* Engl. which differs by having blades prominently reflexed on the petioles, blades with the midrib more narrowly acute on the upper surface and the lower surface more densely glandular-punctate. In the Lucid Anthurium Key, *Anthurium gladysmartineziae* tracks to *A. plantagineum* Sodiro from western Ecuador and is characterized by having shorter petioles (6–10 cm long) which are only 0.4 times as long as blades (versus about as long as or longer than the blades), shorter blades (less than 16 cm long), and a shorter spathe (2–3 cm long).

*Paratypes*: COLOMBIA. **Antioquia**: Frontino, Corregimiento Nutibara, cuenca alta del Río Cuevas, 06°48'16"N, 76°14'51"W, 2000 m, 18 Apr. 1987, *D. Sánchez S. et al.* 1286 (MO); Sitio Murri, vía Nutibara-La Blanquita, Alto de Cuevas, finca El Palmar, 06°45'N, 76°23'W, 1970–2080 m, 13 Feb. 1991, *R. Callejas* 9886 (HUA, MO); Zona de Murri, vía Nutibara-La Blanquita, 5–8 km S de Alto de Cuevas, 1000–1850 m, 14 Feb. 1991, *R. Callejas* 9929 (HUA, MO).

*Anthurium gruesoi* Croat, **sp. nov.** — Type: COLOMBIA. Chocó: Municipio de Nuquí, Quebreda Chaquí, ca. 05°40'N, 77°16'W, ca. 200 m, Feb.–Mar. 1994, G. Galeano, J. Grueso, O. Hurtado & L. Perea 4754a (holotype, COL-403332). **Figure 130.**

*Diagnosis:* *Anthurium gruesoi* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent cataphyll fibers, long-petiolate leaves, petioles drying narrowly and sharply sulcate and about 2/3 as long as the blades, elliptic, abruptly acuminate blades which are acute at the base, gray brownish green and eglandular but warty-pustular above, yellowish green and glandular-punctate below with a singular collective vein rather remote from the margin as well as by the long-pedunculate inflorescence with the green, promptly deciduous spathe and the very long tapered, sessile, yellow spadix.

Epiphytic; internodes short; cataphylls not seen. *Leaves* with petioles 20.5–24.1 cm long, 5–7 mm diam., subterete, drying narrowly and sharply sulcate, greenish brown; geniculum 1.0–1.4 cm long, drying darker than petioles; blades elliptic, 21.8–35.2 cm long, 7.8–14.1 cm wide (averaging 30 × 12), 2.5–2.8 (averaging 2.6) times longer than broad, broadest midway, 1.1–1.5 (averaging 1.3) times as long as petioles, rounded to narrowly rounded and abruptly acuminate at apex (acumen to 7 mm), acute at base, subcoriaceous, drying gray brownish green, matte above, yellowish green, semiglossy below; midrib drying narrowly raised, finely ribbed and paler above, narrowly rounded, finely ribbed and paler below; primary lateral veins 10–16 per side, departing midrib at 55° at middle, scarcely more prominent than the interprimary veins, drying narrowly rounded to pleated and concolorous above, narrowly rounded and paler below; secondary veins and tertiary veins drying prominently raised above and below; collective veins arising from basal veins, 6–10 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface eglandular, smooth except for many prominent pustules; lower surface conspicuously glandular-punctate, smooth except for sparse pustules. *Inflorescence* with peduncle 30.8 cm long; spathe green, deciduous; spadix yellow, sessile, long, and weakly tapered, 15.8–25.9 cm long, 4–6 mm diam., drying dark grayish brown; flowers 3 visible per spiral, drying 3.0–4.2 mm long, 2.0–2.5 mm wide; tepals drying minutely granular; lateral tepals 1.6–2.0 mm wide, inner margin broadly rounded; outer margins broadly 2-sided; stamens not emergent; anthers 0.4 mm long, 0.6 mm wide; thecae broadly ovate, weakly divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium gruesoi* is endemic to Colombia, known only from the type locality in Chocó Department at 200 m elevation in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium gruesoi* is named for Colombian botanist, Juan de Dios Grueso, a native of Nuquí near where the type plant was collected. Juan worked for several years with the Fundación Inguedé, assisting in all its activities including as a field assistant on collecting trips to the Gulf of Tribugá between 1993 and 1999, especially with Colombian researchers Rodrigo Bernal and Gloria Galeano. He now lives in Bogotá.



Figure 130. *Anthurium gruesoi* Croat. Holotype: Galiano 4754a.





Figure 131. *Anthurium habitense* Croat. Holotype: Forero et al. 7358.

**Comments** — In the Lucid Anthurium Key *Anthurium gruesoi* tracks to *A. brevipes* Sodiro, which differs by having much smaller, proportionately more narrowly elliptic, more prominently acuminate blades, a proportionately shorter peduncle and a much shorter, short-tapered spadix; *A. lustriviridum* Sodiro, which differs by having two pairs of collective veins extending to the apex and a long-tapered blade apex; *A. perviride* Croat & D. C. Bay, which differs by having leaf blades attenuate at the base and more narrowly long-acuminate at the base with 2 pairs of collective veins and with glandular punctations on both surfaces; *A. verrucosum* Croat & D. C. Bay which differs by having more narrowly elliptical leaf blades with less conspicuous glandular punctations, a more long acuminate apex, primary lateral veins more numerous and more closely spaced and a less tapered spadix and *A. wattii* Croat & D. C. Bay which differs by having the blade apex narrowly long-acuminate.

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*Anthurium habitense* Croat, **sp. nov.** — Type: COLOMBIA. Chocó: Municipio de San José del Palmar, hoya del Río Torito (affluente del Río Hábito), declive occidental, ca. 04°55'N, 76°15'W, 630–730 m, 16 Mar. 1980, E. Forero, R. Jaramillo, J. Espina Z & P. Palacios H. 7397 (holotype, COL-220715). **Figure 131.**

*Diagnosis:* *Anthurium habitense* is a member of sect. *Porphyrochitonium* and is characterized by its terrestrial habit, short internodes, short, persistent, reddish brown cataphyll fibers, subterete, narrowly sulcate petioles (drying deeply and sharply sulcate), the long-petiolate, more or less elliptic blades which dry grayish adaxially and grayish yellow-brown abaxially, glandular punctate on both surfaces, shortly acuminate at apex and acute to weakly attenuate at base with a single pair of collective veins arising from the base as well as by the slender-pedunculate inflorescence, narrow, tightly inrolled green spreading spathe and the sessile, scarcely tapered, green spadix with no more than 3 flowers visible per spiral and with the squarish pistil clearly visible. Also characteristic are the small white berries.

Epiphytic herb; internodes short, 7 mm diam.; cataphylls 3.4 cm long, acute, persisting as fibers with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. [Leaves](#) with petioles 12.4–20.9 cm long, 2 mm diam., subterete, drying deeply and sharply sulcate, yellowish brown; geniculum 1.1–1.3 cm long, drying darker than petioles; blades elliptic, 18.1–22.8 cm long, 7.5–8.9 cm wide (averaging 20 × 8), 2.4–2.6 (averaging 2.5) times longer than broad, broadest midway, inequilateral (one side 4–7 mm wider), 1.1–1.5 (averaging 1.3) times longer than petioles, abruptly acuminate at apex, acute at base, subcoriaceous, drying gray, weakly glossy above, grayish yellow-brown, weakly glossy below; midrib drying narrowly rounded, glandular-punctate, and paler above, narrowly rounded to bluntly acute, glandular-punctate and concolorous below; primary lateral veins 8–12 per side, departing midrib at 70°, drying weakly and narrowly raised, paler above, narrowly rounded

and slightly darker below; tertiary veins scarcely more visible than surface above and below; collective veins arising from the basal veins, 5 mm from margin; basal veins 1 pair; upper surface conspicuously glandular-punctate, minutely and conspicuously areolate at higher magnification; lower surface glandular-punctate, densely granular and pustular. *Inflorescence* with peduncle 23.3–31.1 cm long; spathe green, spreading, 3.2–3.9 cm long, 3 mm wide, lanceolate, drying coriaceous and yellowish brown; spadix green-white, sessile, weakly tapered, 10.3–13.1 cm long, 4 mm diam., drying yellowish brown; flowers 3 visible per spiral, drying 3.3 mm long, 1.9 mm wide; tepals drying minutely granular; lateral tepals 2 mm wide, inner margin rounded, outer margins 2-sided; stamens not yet emergent, 0.3 mm long, 0.8 mm wide; *Infructescence* with berries white, subglobose, 5 mm diam., the epidermis underlain in lower half with subglobose crystals, 4-seeded; seeds 2–2.4 mm long, 1.2–1.4 cm wide, 1 mm thick, tan.

**Distribution and ecology** — *Anthurium habitense* is endemic to Colombia, known only from the type locality in Chocó Department at 630–950 m in a *Premontane wet forest* life zone.

**Etymology** — The epithet refers to the type locality along the Río Hábita.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium habitense* keys to *A. victoriense* Croat which differs by having typically much larger leaf blades (to 58 × 20 cm) with the veins on the upper blade surface very close and numerous, frequently with a pair of secondary collective veins and with up to 18 primary lateral veins per side, and a greenish white spadix.

*Paratype*: COLOMBIA. Chocó: Municipio de San José del Palmar, hoya del Río Torito (afluente del Río Hábita), declive occidental, Finca “Los Guaduales”, Quebrada Santa Fé, 630–730 m, 14 Mar 1980, E. Forero, R. Jaramillo, J. Espina Z. & P. Palacios H. 7308 (COL-220583).

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***Anthurium jimgribianum*** Croat, **sp. nov.** — Type: ECUADOR. Esmeraldas: Lita-San Lorenzo Region, along road from Lita to San Lorenzo, along Río Bogotá near Awa community, 00°55'N, 78°33'W, 0.5 km NW of Alto Tambo, 737 m, 20 Feb. 1992, T.B. Croat 72285A (holotype, MO-6736175; isotypes, B, COL, F, K, NY, PMA, QCNE, S, US, USM). **Figures 132 & 133.**

*Diagnosis*: *Anthurium jimgribianum* is a member of sect. *Porphyrochitonium* and is characterized by its bluntly C-shaped, weakly sulcate petioles which are about half as long as the blades, blades which are arched, oblong-elliptic, short-acuminate with weakly quilted primary lateral veins, a single pair of primary lateral veins arising from the base or one of the lower primary

lateral veins, weakly loop-connecting and 3–8 mm from the margin, glands on lower surface only as well as by its moderately short-pedunculate, spreading inflorescence with lanceolate, green, spreading, bluntly pointed spathe and weakly tapered, dark green, weakly stipitate spadix with 5–6 flowers visible per spiral and broadly divaricate anthers.

Epiphytic; stems short, 10–15 cm long; internodes 1.5–2 cm diam.; cataphylls 20–2.5 cm long, intact at apex, fibrous lower down, drying dark brown, persistent. *Leaves* numerous, spreading; petioles 6.5–24.5 cm long, 3–5 mm diam., obtusely flattened adaxially, narrowly rounded abaxially, dark green, semiglossy; geniculum 1.5 cm long, more sharply D-shaped with a weak obtuse medial rib, slightly paler; blades oblong-oblancheolate, (14)28–43.5 cm long, (3.7)6.5–11.3 cm long, (3.5)3.8–4.5 times longer than wide, about half as long as petioles, shortly and gradually acuminate at apex, acute to subobtuse at base, subcoriaceous, dark green and moderately glossy above, moderately paler and moderately glossy below; midrib narrowly rounded and slightly paler above, narrowly rounded to weakly raised and slightly paler below; primary lateral veins (12)16–17 per side, arising at a 60–65° angle, quilted-sunken and concolorous above, weakly pleated-raised, narrowly rounded and concolorous below; collective veins 1 pair, arising from the only pair of basal veins or sometimes from one of the lower primary lateral veins, equally sunken as the primary lateral veins, (3)4–6(8) mm from margins; upper surface densely and minutely areolate and pale-granular; lower surface moderately smooth, weakly and minutely areolate, glandular punctate, the glands dark brown, slightly raised, distinct, sometimes donut-shaped. *Inflorescence* spreading-reflexed; peduncle 18–31 cm long, 2.5 mm diam.; spathe ovate-lanceolate, 3.7–6.8 cm long, 1.2–1.8 mm wide, oblong-lanceolate, green, tinged with violet-purple on both surfaces, glossy outside, weakly glossy inside, abruptly short-thick-apiculate with the apiculum turned downward; peduncle 21–30 cm long, terete, green, tinged slightly with violet-purple, semiglossy; spadix green with the pistils faintly purplish red, turning brownish yellow after anthesis, sessile or stipitate 1 mm, 9.5–11.6 cm long, 5–6 mm diam. at base, 4 mm diam. midway, 3 mm diam. at 1 cm from tip (tip narrowly rounded); flowers 5–6 visible per spiral, 2.9–3.6 mm long, 2.1–2.8 mm wide; sides parallel to spiral gradually to jaggedly sigmoid; sides perpendicular to spiral gradually sigmoid; pistils 0.8 mm wide in both directions, weakly raised, green, tinged purplish, concave at apex; stamens held at level of tepals, one on each side of pistil, widely spaced, anthers 0.5–6 mm long, 0.6–0.7 mm wide, thecae moderately divaricate, at least when fully open often at 180° apart; pollen white. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium jimgribianum* is endemic to Ecuador, known only from the Lita-San Lorenzo Region at 737 m elevation in a *Premontane rain forest* life zone.

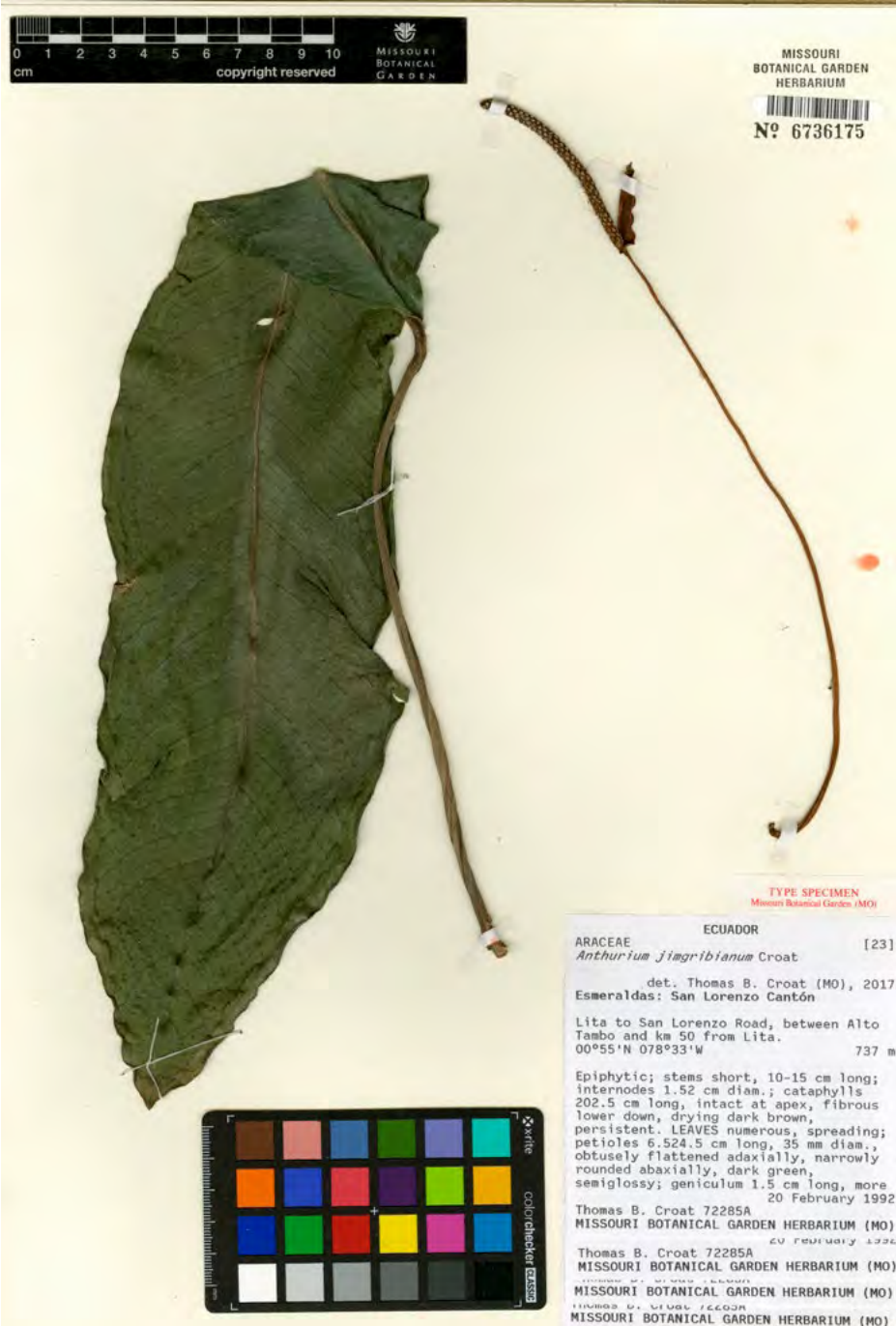


Figure 132. *Anthurium jimgribianum* Croat. Holotype: Croat 72285A.



**Figure 133.** *Anthurium jimgribianum* Croat. Croat 72285A. Habit of greenhouse plant





Figure 134. *Anthurium jimwestii* Croat. Holotype: Croat 95351

**Etymology** — *Anthurium jimgribianum* is named in honor of Jim Grib, Tom Croat's former Volunteer Research Associate in the Aroid Research Group at the Missouri Botanical Garden. Jim, coauthor of this paper, specialized in describing *Anthurium* sect. *Belolochium* and *Porphyrochitonium* as well as *Philodendron* and was responsible for preparing the detailed descriptions of most of the new species in this paper. Professionally he was a chemist and spent his career at the Anheuser-Busch Brewery in St. Louis. After he retired Jim joined the Aroid Research Group at the Missouri Botanical Garden and spent several years helping us study Araceae. He was noted for his attention to detail and the accuracy of his observations. This is one of several species named in his honor.

**Comments** — In the Lucid Anthurium Key *Anthurium jimgribianum* tracks to *Anthurium quinquesulcatum* Sodiro which differs by having the petioles 3-ribbed adaxially, by having proportionately shorter leaves which are broadest above the middle and a proportionately much more short-pedunculate spadix.

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***Anthurium jimwestii*** Croat, **sp. nov.** — Type: ECUADOR: Pichincha, near border with Imbabura, Reserva Guaycuyacu, along Río Guaycuyacu on road from Cielo Verde to Santa Rosa at junction of Río Guaycuyacu and Río Guayabamba on border with Province of Imbabura, 00°13'N, 78°55' W, 500 m, 1 Mar. 2005, T.B. Croat 95351 (*holotype*, MO-4841842; *isotypes*, COL, K, QCNE, US). **Figure 134.**

**Diagnosis:** *Anthurum jimwestii* is a member of sect. *Porphyrochitonium* and is characterized by its long, linear-oblongate leaves with glandular punctations restricted to the lower surface and with the upper surface drying minutely and deeply areolate as well as by the pendent inflorescence with a green spathe and a long-tapered spadix.

Pendent epiphyte; stems less than 15 cm long; internodes 0.5–1.3 cm diam.; cataphylls red-brown, persisting semi-intact, to at least 10 cm long. *Leaves* 111 cm long, pendant; petioles sharply C-shaped adaxially with erect margins and a narrow medial rib, medium green, weakly glossy, 18.7–29 cm long (averaging 25.3), 4 mm diam.; geniculum 1 cm long, darker than petiole; blades narrowly linear-oblongate, 75–95 cm long, 4.8–6.0 cm wide (averaging 85.7 × 5.5 cm), blade 12.5–18.2 times longer than wide (averaging 15.7), blade 3.0–4.5 times longer than petiole (averaging 3.6), long-tapered acuminate at apex, very long, narrow attenuate at base, subcoriaceous, dark green and matte-subvelvety above, slightly paler and matte below, drying matte and medium gray-green on both surfaces; midrib narrowly raised and concolorous above, bluntly acute and slightly paler below; primary lateral veins 56–64 per side, departing midrib at 30–40°, weakly raised and concolorous above and below; collective veins more prominent than primary lateral veins, arising from the base and

running 0.4–0.8 cm from margins; upper surface epunctate, densely areolate-granular; lower surface densely areolate, conspicuously dark glandular-punctate, the glands to 0.2 mm diam., raised with sunken middle. *Inflorescence* 58.2 cm long, pendent; peduncle 34–36 cm long, 0.3 cm diam., ribbed; spathe medium green, lanceolate; spadix 24 cm long, 7 mm diam. post-anthesis; flowers 5–6 visible per spiral; tepals brownish; pistils weakly exerted and faintly purplish. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium jimwestii* is endemic to Ecuador, known only from the type locality in western Pichincha Province at 500 m in a *Premontane wet forest* life zone.

**Etymology** — *Anthurium jimwestii* is named for Mr. Jim West, owner and operator of the Reserva Guaycuyacu. Jim and his wife, Meredith (Mimi), operate a tropical fruits farm and a small hostel which allows visitors to experience real tropics in a rather pristine environment. He has been a pioneer, entering into remote territories accessible only by foot paths and then, with his own ingenuity, building up the property. He has spent the past 30 years living in the tropics of Colombia and Ecuador and has a great interest in conserving tropical plants, especially edible fruits.

**Comments** — In the Lucid Anthurium Key, *Anthurium jimwestii* tracks with *A. julospadix* Sodiro which may be distinguished by its shorter petioles (10–15 cm long), smaller ( $37.0 \times 6.5$  cm), more oblong blades and the presence of a small stipe supporting the inflorescence; *A. rupestre* Sodiro which differs by also having shorter petioles (10–20 cm long), primary lateral veins that arise at a broad angle and collective veins that run only 3–5 mm from the margin and *A. nangaritense* Croat which differs by having shorter, broader blades ( $35.0 \times 7.5$  cm), only 7 or 8 primary lateral veins per side, and a shorter spadix (7–14 cm long). *Anthurium jimwestii* can also be compared with smaller plants of *Anthurium magnifolium* Croat & J. Rodr., another species from the Pacific slope of Ecuador in the vicinity of Volcán Pichincha which has rather remote collective veins, proportionately less elongated blades, being 4.2–4.9 times longer than wide versus 16 times longer than wide in *A. jimwestii*. Superficially *Anthurium jimwestii* looks more closely related to *Anthurium pallidiflorum* Sodiro but that species is not a member of sect. *Porphyrochitonium*, and lacks glandular punctations on either surface. In addition, *Anthurium pallidiflorum* has a short peduncle and a short, erect, white spadix. Another *Porphyrochitonium* from Manabí, Ecuador with a long narrow, linear blade is *Anthurium cojimiesense* Croat but its blades are only 50–62 cm long and 6–11 cm wide.

*Anthurium juanguillermoi* Croat, **sp. nov.** — Type: COLOMBIA. Antioquia: Parque Nacional Natural Las Orquídeas, Sector Calles, margin derecha del Río Calles, 1420 m, 06°31'N, 76°19'W, 25 Mar., 1988, A. Cogollo, J.G. Ramírez & O. Alvarez 2571 (holotype, MO-4241470; isotype, HUA). **Figure 135.**

*Diagnosis:* *Anthurium juanguillermoi* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, persistent, reddish brown cataphylls with frequent fragments of epidermis, long-petiolate, dark-drying leaves with subterete petioles, elongated, oblong-lanceolate, gradually acuminate blades with the base usually acute to narrowly rounded with a single pair of collective veins arising from the base and 3–7 mm from the margin with the upper surface eglandular and the lower surface dark glandular-punctate as well as by the long-pedunculate inflorescence with a narrow, green, spreading spathe and a reddish or yellow spadix with purple to red berries.

Epiphytic, sometimes terrestrial, known to range from 1.7 and 2.3 m high in trees; internodes short, drying 0.8–1.7 cm diam.; cataphylls 4.7–8.3 cm long (averaging 6.5 cm), persisting as reddish brown fibers. *Leaves* 19.0–73.5 cm long; petioles terete, 4.9–23.4 cm long (averaging 16.5 cm), drying 3 mm diam. midway, 6 mm at base and on geniculum, matte, red-brown, finely ribbed, sometimes with 1 or 2 deep grooves; geniculum 0.9–1.8 cm long, drying 2–6 mm diam., darker and thicker than petiole; blades oblong-lanceolate, 14.1–50.1 cm long, 2.4–7.5 cm wide, (averaging 31.6 × 5.0 cm), 4.7–7.8 times longer than broad (averaging 6.3), 1.3–2.9 times longer than petiole (averaging 2.0), broadest below middle, gradually acuminate at apex (acumen ca. 1–2 cm, sometimes downturned), acute to narrowly-rounded and sometimes weakly inequilateral at base, thinly coriaceous, drying dark brown, weakly-glossy to matte above, more yellowish brown, semiglossy below; midrib prominent and concolorous above, rounded to narrowly-rounded, finely ribbed, darker than surface below; primary lateral veins appearing to be too numerous to count above and scarcely more prominent than interprimary veins above, 16–20(25) per side, visible below, departing midrib at 40–55°, drying concolorous on each surface, narrowly raised below; collective veins arising near base, 3–7 mm from margin, drying weakly rounded above, acutely raised below; antemarginal veins present 0.4 mm from margin, slightly more conspicuous below; upper surface eglandular, minutely granular-areolate, weakly granular; lower surface finely dark-speckled to finely granular, minutely ridged, occasionally pustular, densely glandular-punctate, the glands medially sunken. *Inflorescence* erect; peduncle 18.8–46.1 cm long (averaging 34.2), drying 1–5 mm diam., green, drying matte, medium red-brown, granular; spathe narrowly linear-lanceolate, erect-spreading, 4.2–13.6 cm long, 0.6–1.2 cm wide (averaging 7.2 × 0.8 cm), green with a red center, drying dark brown, glossy and short-pale-lineate adaxially, matte abaxially; spadix weakly stipitate (stipe 1 mm long, 3 mm wide), 4.2–16.6 cm long, 3–7 mm diam. (averaging 10.6 cm × 5 mm), cylindroid, drying dark brown; flowers 5–7 visible per spiral, 1.9–2.3 mm

long by 0.9–1.4 mm wide; lateral tepals to 0.8–1.3 mm wide; inner margins broadly rounded; outer margin 2-sided; stamens held at level of tepals, anthers 0.3 mm long, 0.5 mm wide, thecae broadly ovate, weakly divaricate. *Infructescence* with berries purple to red at maturity.

**Distribution and ecology** — *Anthurium juanguillermoi* is endemic to Colombia, known only from the type locality in Antioquia at 1420 m in a *Premontane rain forest* life zone.

**Etymology** — *Anthurium juanguillermoi* is named for Colombian botanist, Juan Guillermo Ramírez from the Jardín Botánico de Medellín, Colombia. Juan is an excellent collector and assisted in the collection of the type specimen.

**Comments** — In the Lucid Anthurium Key, *Anthurium juanguillermoi* tracks to *A. deflexum* Engl. which differs by having the leaves pendent from more or less erect petioles and a long-pedunculate inflorescence which much overtops the leaves. *Anthurium juanguillermoi* also resembles *A. punctatum* N.E.Br., which differs by having 13–16 primary lateral veins per side, and blades oblong-elliptic, drying matte to weakly glossy, tan-gray. *Anthurium juanguillermoi* is similar to *A. gladymartineziae*, also known from the region of the Parque Nacional Natural Las Orquídeas, and which also dries somewhat blackened but differs by having proportionately shorter and narrower blades which are more rounded at the base, less conspicuous glands and white berries which are red at the tip.

One of the specimens, *Cogollo et al.* 2568, differs by having sparsely scattered short-pale-lineations on its upper surface and in that all of the veins are less elevated/raised, yet darker than the type specimen.

Paratypes: COLOMBIA. Antioquia: Amalfi, vereda Arenas blancas, 06°55'00"N, 74°55'00"W, 1100–1250 m, Apr. 1994, *R. Fonnegra G. et al.* 4776 (HUA); Urrao. Parque Nacional Natural "Las Orquídeas", Sector Calles, margen derecha del río Calles, 06°32'N, 76°19'W, 1420 m, 25 Mar. 1988, *Á. Cogollo P. et al.* 2568 (JAUM, MO); *Á. Cogollo P. et al.* 2571 (JAUM, MO); Camino de Venados arriba hacia Calles, 06°34'N, 76°19'W, 1440 m, 25 July 1988, *Á. Cogollo P. et al.* 3491 (JAUM, MO); Vereda Calles; Bosque Nacional Natural Las Orquídeas; Quebrada Honda; Inventario Permanente de bosque húmedo premontano, en el filo al NW de la Cabaña Calles, 06°29'N 76°14'W, 1330 m, 10 Dec. 1992, *J. Pipoly*, 16939 (MO); Vereda Calles, Inventario Permanente Bosque Pluvial Premontano, margen derecha del Río Calles, *A. Duque, F. Giraldo, W. Rodríguez, E. Alvarez*, 06°32'N, 76°19'W, 1450 m, 26 Nov. 1993, *J. Pipoly et al.* 17152 (JAUM, MO); Río Calles, 1400–1500 m, 2 May 1995, *R. Fonnegra G. et al.* 5481 (HUA); 5483 (HUA).



Figure 135. *Anthurium juanguillermoi* Croat. Holotype: Cogollo et al. 2571.





**Figure 136.** *Anthurium koesteri* Croat. Holotype: *Koester & Schnell* 2007



**Figure 137.** *Anthurium koesteri* Croat. Köster & Schnell 2007. Leaf adaxial surface and Inflorescence



**Figure 138.** *Anthurium koesteri* Croat. Köster & Schnell 2007. Close-up of infructescence.

***Anthurium koesteri*** Croat, **sp. nov.** — Type: ECUADOR. Esmeraldas: Bilsa Biological Station, Quinindé Cantón, 00°35'N, 79°07'W, 450–650 m, *N. Köster & A.-M. Schnell* 2007 (holotype, MO-6201335; isotypes, BONN, QCA, QCNE). **Figures 136–138.**

*Diagnosis:* *Anthurium koesteri* is a member of sect. *Porphyrochitonium* and is characterized by its short stem, short slender internodes, finely fibrous, reddish brown cataphyll fibers, moderately elongate, sharply and deeply sulcate, winged, brown-drying, glandular-punctate petioles, the winged-margined geniculum and elliptic, short-acuminate leaf blades which are glandular-punctate on both surfaces, dark green and matte above, paler reddish and glossy below (drying gray-brown and matte above, yellowish red-brown and weakly glossy below), a single pair of collective veins that dry more sunken than the primary lateral veins as well as the slender, long-pedunculate inflorescence with a slender, thick purple spathe folded in on margins, a slender, green, non-tapering spadix and greenish blue berries.

Epiphyte; internodes short, 0.6–1.0 cm diam.; cataphylls 3.5 cm long, persisting as reddish brown fine, mostly parallel fibers. *Leaves* with petioles 6.5–12.6 cm long, 2–3 mm thick, moderately elongate (0.5–1.1 times longer than blades), sharply and deeply sulcate-winged, brown-drying, glandular-punctate; geniculum undulate-winged-margined on 3 sides; blades elliptic, 10.8–17.5 cm long, 4.1–8.3 cm wide, 2.1–3.0 (average 2.6) times longer than wide, short-acuminate at apex, acute at base, subcoriaceous, dark green and matte above, paler reddish and glossy below (drying gray-brown and matte above, yellowish red-brown and weakly glossy below); primary lateral veins arising at a 65–70° angle; collective veins 1 pair, arising from the base, 6–8(10) mm from margins, drying more sunken than the primary lateral veins adaxially; basal veins 2 pairs, the outer pair weak or margining out in lower ¼ of the blade; upper surface drying moderately smooth, dark glandular-punctate; lower surface drying moderately smooth, dark glandular-punctate. *Inflorescence* slender, long-pedunculate, erect; peduncle 25.5–27.0 cm long, tinged faintly reddish; spathe 2.6–3.5 long, 4 mm wide, slender, thick, erect to spreading, purple with margins inward; spadix 8.8 cm long, 3 mm diam., slender, green, non-tapering. *Infructescence* with berries greenish blue.

**Distribution and ecology** — *Anthurium koesteri* is known only from Ecuador in the type locality in the Montañas de Mache in NW Ecuador in Esmeraldas Province at 450–650 m in a *Tropical wet forest* life zone.

**Etymology** — *Anthurium koesteri* is named for Dr Nils Köster of the Berlin Botanical Garden who, along with Anna Marie Schnell, collected the type specimen. They were making collections of epiphytes at the Bilsa Reserve, paying particular attention to the aroids. Köster and the senior author of this paper are also preparing an aroid florula of the Mache-Chindul

Mountains where the Bilsa Field Station is. Nils also works with the taxonomy and phylogeny of *Philodendron*.

**Comments** — *Anthurium koesteri* is most similar to *A. brevipes* Sodiro, which shares leaf blades with a narrowly raised glandular-punctate upper midrib and perhaps also greenish-blue berries. While Sodiro's type description did not mention berry color, other plants in the Lita area fitting *Anthurium brevipes* do possess blue berries. Sodiro also mentions that both blade surfaces of *Anthurium brevipes* are glandular-punctate but a study of the type from the Berlin Herbarium shows that all of the black dots on the upper blade surface are small structures that are easily flicked off with a scapel, not the typical glands that are imbedded into the leaf surface. *Anthurium kessleri*, on the other hand, has distinct and real glandular punctations. In addition, *Anthurium koesteri* differs from *A. brevipes* in having more bicolorous leaf blades which dry gray above, yellow-brown below and are bluntly short-acuminate (versus narrowly and sharply acuminate for *A. brevipes*). In addition, *Anthurium kessleri* has the geniculum with undulate winged-margins which is not true for *A. brevipes*.

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***Anthurium lamanense*** Croat, **sp. nov.** — Type: ECUADOR. Cotopaxi: Along road between Quevedo and Latacunga, 55.5 km from Quevedo, and 23.5 km E of La Maná, on forested slopes above river, 00°53'S, 79°04'W, 930–950 m, 10 Oct. 1983, T.B. Croat 57030 (holotype, MO-2531461; isotype, QCA). **Figures 139–145.**

**Diagnosis:** *Anthurium lamanense* is a member of sect. *Porphyrochitonium* and is characterized by its somewhat intact cataphylls, sharply C-shaped to subtriangular petioles with an adaxial medial rib, narrowly ovate-elliptic, acuminate, coriaceous blades, dark glandular punctations sunken on the upper surface, prominently etched-sunken primary lateral veins, 2 pairs of collective veins, the outermost margining out in lower ¼ of the blades, subtriangular and somewhat sharply flattened peduncle, green, spreading spathe and the slightly tapered, green spadix.

Low trunk epiphyte to about 1 m above ground; stems short, stout, typically less than 15 cm long; internodes short, 0.5–2 cm diam.; cataphylls 4–7 cm long, sometimes pinkish and intact when young, persisting as reddish brown fibers (upper portion intact). *Leaves* 19–54 cm long with petioles (6)13–20 cm long, 0.5 cm wide, 0.6 cm thick, sharply and deeply C-shaped, broadly and sharply sulcate adaxially with a weak to prominent medial rib, medium green and weakly glossy; geniculum 1.5–2 cm long, sharply and deeply sulcate, sometimes with a low medial rib; blades narrowly lanceolate, (14)27–32 cm long, (4.5)7–9 cm wide, 3.4–4.5 times longer than broad, 2.5–3.7 times longer than petiole, gradually short-acuminate at the apex, cuneate at the base, coriaceous, moderately bicolorous, dark green and semiglossy

above, moderately paler and glossy below, drying greenish and matte above, moderately paler, yellowish green and semiglossy below; midrib narrowly rounded to bluntly acute and paler above, sharply to bluntly acute and paler below; primary lateral veins 8–12 per side (average 10), arising from the midrib at a 40–50° angle, etched and sunken above, drying inconspicuous and slightly raised above, narrowly rounded and concolorous below, drying more prominent and acutely raised below; collective veins 2 pairs, the outmost when present arising at the base and margining out in lower ¼ of the blades; the innermost arising near the base and running to the apex, 0.7–1.0 cm from the margin, deeply sunken and equaling primary lateral veins above, drying acutely raised and more prominent than primary lateral veins on lower surface; upper surface densely pale granular, dark glandular-punctate, often deeply pitted; lower surface densely pale-speckled, glandular-punctate, the glands weakly sunken. *Inflorescence* erect; peduncle subtriangular and somewhat sharply flattened on one side 25–45.9 cm long, 0.5 cm diam.; spathe 6.4–9.0 cm long, 0.7–1.2 cm wide, medium green becoming yellowish with age, drying dark brown; spadix (6) 14.9–19.7 cm long, 3–4 mm diam., slightly tapered, olive-green becoming yellowish with age, drying dark brown; flowers 8–10 per spiral, 1–1.8 mm long, 1.2–2 mm wide, lateral tepals, 0.6–0.8 mm wide; inner margin rounded, outer margin 2-sided. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium lamanense* is endemic to the Pacific slopes of Ecuador in Cotopaxi Province at 800–930 m elevation in a Premontane moist forest life zone.

**Etymology** — The species is named for the type locality near La Mana in Cotopaxi Province.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium lamanense* keys to *A. sulcatum* Engl. which differs by having proportionately longer petioles (blades 1.6–2.0 times longer than petioles versus 2.5–3.7 times longer than petiole for *A. lamanense*), petioles which lack a medial rib, more broadly elliptic, less coriaceous blades which lack conspicuously sunken glandular punctations on the upper surface. In addition, *Anthurium sulcatum* has a purplish spadix 10–12 cm long while *A. lamanense* has a green spadix. Other species that are similar to *Anthurium lamanense* are *A. myosurus* Sodirol, which differs by having much longer petioles (15–40 cm long), elliptic blades that are only 2.5 times longer than broad, a peduncle that is about twice as long as petioles and a reddish spadix; *A. punctatum* Engl. which differs by proportionately longer blades to about 5.0 to 5.5 times longer than broad with blade apex more bluntly pointed; *A. verrucosum* Croat & D. C. Bay which differs by having blade upper surface profusely verrucose (10 x magnification) and 13–18 primary lateral veins per side.





Figure 139. *Anthurium lamanense* Croat. Holotype: Croat 57030



**Figure 140.** *Anthurium lamanense* Croat. Croat 57030. Leaf blade, adaxial surface.

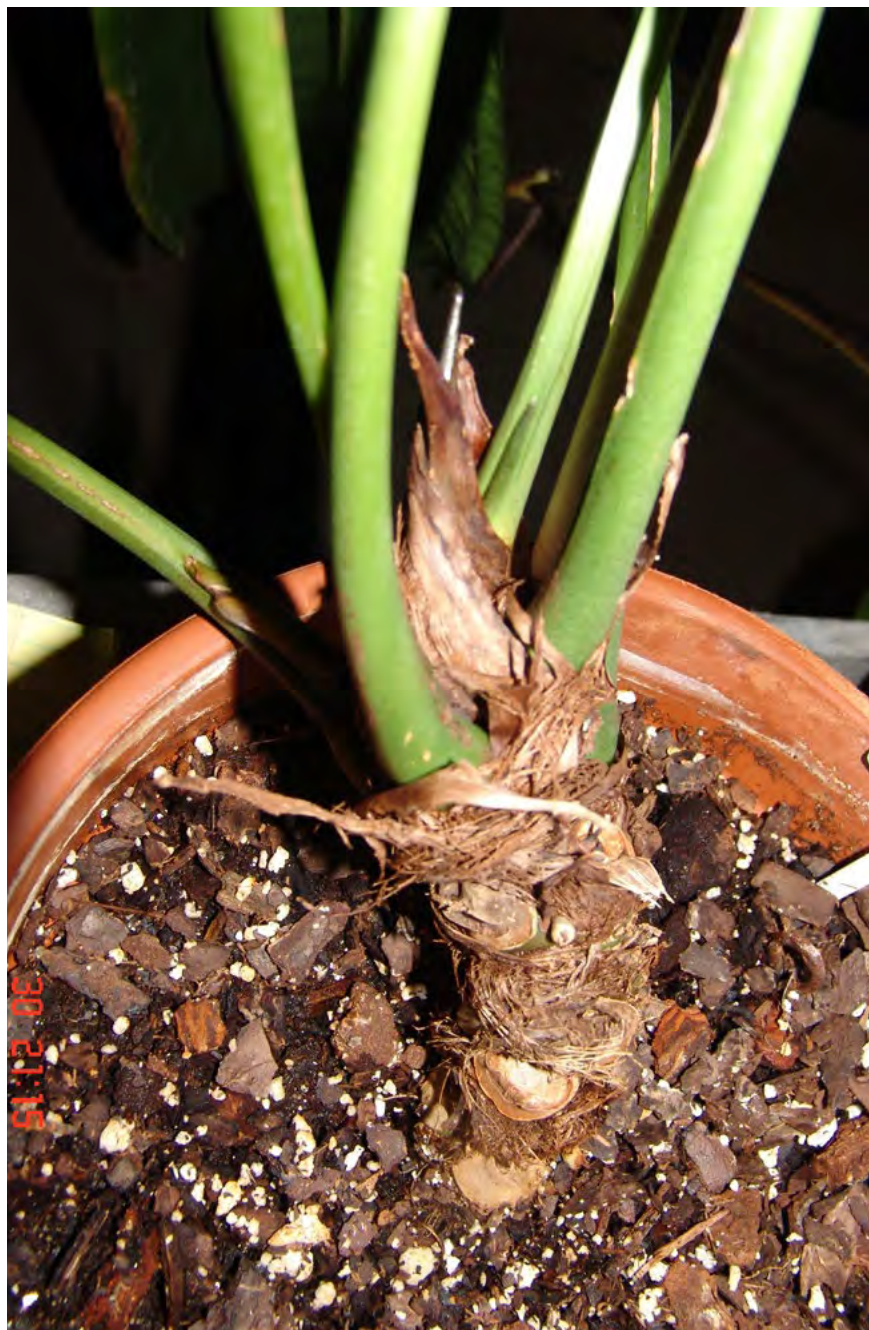


**Figure 141.** *Anthurium lamanense* Croat. Croat 57030. Stem and petioles, showing petiole cross-section



**Figure 142.** *Anthurium lamanense* Croat. Croat 57030. Flowering potted plant





**Figure 143.** *Anthurium lamanense* Croat. Croat 57030. Stem with cataphylls and inflorescence



**Figure 144.** *Anthurium lamanense* Croat. Croat 57030. Potted plant with leaves (adaxial) and inflorescence.





**Figure 145.** *Anthurium lamanense* Croat. Croat 57030. Inflorescence.



Figure 146. *Anthurium lobinii* Croat. Holotype: Croat 103529.

*Paratypes*: ECUADOR. Cotopaxi: Along road between Guayacán (13.1 km NE of La Maná) and Montinuevo (N of Pucayacu), 23.8 km N of Guayacán, 3.5 km N of Pucayacu, 800 m, 00°41'S, 79°06'W, 20 Mar. 1992, T.B. *Croat 73254* (MO, QCNE).

*Anthurium lobinii* Croat, **sp. nov.** — Type: cult. Bonn Botanical Garden ex ECUADOR. Pastaza: Vicinity of Puyo, without exact locality, ca. 01°14'S, 78°59'W, ca. 960 m, Ec-0-BONN-8260, originally collected by Prinsler, vouchered 20 Feb. 2012, T.B. *Croat 103529* (holotype, MO-6352499; isotypes, B, BONN, K, QCNE, US). **Figure 146.**

*Diagnosis*: *Anthurium lobinii* is a member of sect. *Porphyrochitonium* and is characterized by its rosulate epiphytic habit, short internodes, semi-intact cataphylls, terete, narrowly and deeply sulcate petioles, oblong-weakly oblanceolate blades with the quilted sunken primary lateral veins which are eglandular above and glandular-punctate below as well as by the erect inflorescence with the green spreading-recurled spathe and long-tapered yellow-green spadix.

Epiphyte, somewhat rosulate; stems short; internodes short, 2 cm diam.; cataphylls lanceolate, 4–5 cm long, persisting more or less intact. *Leaves* with petioles erect-spreading, 10 cm long, 8 mm diam., subterete, narrowly and deeply sulcate adaxially, dark green, semiglossy, sheathed 3 cm, drying grayish brown; geniculum 1.1 cm long, drying slightly darker than petioles; blades oblong to weakly oblanceolate, 36.6 cm long, 11–13.5 cm wide, 2.6 times longer than wide, broadest slightly above the middle, 3.6 times longer than petiole, obtuse and abruptly short-acuminate at apex (acumen 6 mm long, short-apiculate), acute at base, subcoriaceous, slightly bicolorous, dark green and semiglossy above, moderately paler and semiglossy below, drying brownish gray and matte above, grayish brown and weakly glossy below; midrib obtusely raised with a medial sulcus in the lower ¼, becoming flattened toward the apex, narrowly rounded toward the apex above, narrowly rounded and darker below, drying slightly darker above, darker below; primary lateral veins 20–21 per side, departing midrib at 50–65°, quilted-sunken and concolorous above, narrowly rounded and pleated-raised below, drying slightly darker above, darker below; interprimary veins considerably weaker than the primary veins; collective veins arising from the base, loop-connecting the primary lateral veins, 3–4 mm from the margin; basal vein 1 pair, same as collective vein; upper surface smooth, eglandular, minutely areolate-granular on magnification; lower surface densely and weakly glandular-punctate, minutely and irregularly granular on magnification. *Inflorescence* erect with peduncle 28 cm long, 5 mm diam., slightly or to 3 times longer than petioles, sharply 1-ribbed on side beneath the side opposite the spathe; spathe 11.3 cm long, 1.2 cm wide, linear-lanceolate, narrowly acuminate at apex, yellow-green tinged purplish on the lower surface, especially on margins, spreading-recurled with the apex directed upwards, drying dark brown;

padix yellow-green, sessile, 13 cm long, 6 mm diam. at base, 5 mm diam. midway, 3 mm diam. at 1 cm from tip; flowers ca. 12 per spiral; 1.9–2.1 mm long, 1.6–1.8 mm wide; tepals minutely papillate, the margins obtusely rounded; lateral tepals 1.7–1.9 mm wide, inner margins rounded, outer margins obtusely 3-sided; stamens not yet emergent, ca. 0.6 mm long and wide. Inflorescence not seen.

**Distribution and ecology** — *Anthurium lobinii* is known only from the type locality in Pastaza Province of Ecuador at 960 m in a *Premontane moist forest* life zone.

**Etymology** — *Anthurium lobinii* is named for Dr Wolfram Lobin, Curator at the Bonn Botanical Garden in Germany who provided me the material for the type specimen. The collection was made by Hermann Prinsler and left with the Bonn Botanical Garden, but it was Wolfram's kindness which made this material available to me. Lobin is also an aroid specialist, having worked with the genus *Amorphophallus* in Africa, and *Eminium* and *Arum* in Europe and the Middle East.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium lobinii* keys to *A. cachabianum* Sodiro, *A. fusco-punctatum* Sodiro and *A. pellucido-punctatum* Sodiro, all of which are from the Lita-San Lorenzo region on the western slope of the Andes in NW Ecuador. The first differs by having proportionately much longer petioles (to more than 70 % the length of the blade), and by having blades glandular-punctate on both surfaces. The second, *Anthurium fuscopunctatum*, differs by having an orange spadix which turns purple and by having glandular punctations on both surfaces and the 3<sup>rd</sup> differs by having the upper blade surface lacking glandular punctations. Finally, *Anthurium sulcatum* Engl. differs by having much longer internodes, to 3–5 cm long.

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*Anthurium luzmariae* Croat, **sp. nov.** — Type: COLOMBIA. Antioquia: Carmen de Vibal, Vereda El Porvenir, trocha hacia El Silencio, subiendo al occidente de la escuela por el filo de la montaña, Bosque subandino, 05°53'31.2"N, 73°11'40.6"W; 1390 m, 31 Nov. 2016, J. Aguirre, H. Mendoza, L.M. Gómez & R. Orozco 2103 (holotype, MO-6924641; isotype, FMB). **Figure 147.**

**Diagnosis:** *Anthurium luzmariae* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short stem, short internodes, dense aggregation of red-brown cataphyll fibers, spreading-pendent leaves, subterete petioles which dry shallowly and sharply sulcate with a medial groove adaxially, moderately coriaceous, greyish brown-drying, narrowly lanceolate, narrowly long-acuminate blades with a single pair of weakly loop-connected collective veins, glandular punctations on only the lower surface as well as by the spreading-pendent

inflorescence with a thick green linear-lanceolate spreading-reflexed spathe and a sessile green weakly tapered spadix with early-emergent pistils.

Epiphyte; internodes very short, 1 cm diam.; cataphylls 4.5 cm long, dark reddish brown, persisting as fragments and gnarled pale fibers; petioles 43 cm long, 2.5–3.0 mm diam., drying brownish, matte, deeply and sharply sulcate adaxially with a shallow narrow medial groove, lateral margins thin and erect; geniculum 1.3 cm long, blackened, about as thick as petiole, sharply sulcate adaxially, several warty-ribbed abaxially; blades narrowly lanceolate, 35.5 cm long, 5.8 cm wide, 6.1 times longer than wide, 0.8 times as long as petioles, narrowly long-acuminate at apex, acute at base, moderately coriaceous, medium gray-brown and matte above, slightly paler and semiglossy below; midrib drying convex and finely several-ribbed, concolorous above, narrowly rounded to triangular, concolorous with an acute medial rib and usually 3 close adjacent ribs on each side of middle below; primary lateral veins 9–11 per side, departing midrib at 35–40°, drying narrowly rounded and concolorous with scarcely more conspicuous than interprimary veins; collective veins arising from the base and weakly loop-connecting primary veins, 2–3 mm from margin, not markedly sunken above, weakly raised below; tertiary veins moderately obscure; upper surface moderately smooth, eglandular; lower surface minutely granular and sometimes thick-ridged, dark glandular-punctate, the glands usually raised, sometimes with a medial depression. *Inflorescence* erect, long-pedunculate; peduncle 44.5 cm long, 2 mm diam., moderately densely brownish, small glandular-punctate below; spathe green, 7.1 cm long, 9 mm wide, narrowly oblong-lanceolate, spreading-reflexed, drying blackened, moderately coriaceous, sparsely short-pale-lineate on both surfaces; spadix green, 6 cm long, 6–7 mm diam.; flowers 3–4 visible per spiral, 2.5 mm long and wide; tepals drying orange-brown, moderately granular; lateral tepals, 1.2–1.4 mm wide, inner margin rounded, outer margin 2, sometimes 3-sided; pistils early emergent; stigma 0.6–0.8 mm diam. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium luzmariae* is endemic to Colombia, known only from the type locality in Antioquia at 1390 m in a *Lower montane rain* forest life zone.

**Etymology** — *Anthurium luzmariae* is named for Colombian botanist, Luz Mary Gómez who collected the type specimen with Julian Aguirre-Santoro, the principal collector of the type specimen.

**Comments** — *Anthurium luzmariae* is most easily confused with *A. friedrichstahl* Schott that differs by having proportionately narrower and more nearly oblong leaf blades that are not narrowly long-acuminate at the apex and proportionately much shorter petioles (usually less than 10 cm long). In Antioquia, *Anthurium luzmariae* might be confused with *Anthurium*



**Figure 147.** *Anthurium luzmariae* Croat. Holotype: Aguirre et al. 2103.





Figure 148. *Anthurium mercedesense* Croat. Holotype: Barbosa 7886.

*juanguillermoi* Croat, a species which has similarly shaped leaf blades but that species has blades that dry blackened and less acuminate with the upper surface matte-subvelvety and drying minutely areolate-granular in contrast to drying medium gray-brown and nearly smooth except for its small anastomosing ridged veins. In addition, *Anthurium juanguillermoi* has a dark violet-purple spadix.

***Anthurium mercedesense*** Croat, **sp. nov.** — Type. COLOMBIA. Caldas: Municipio Florencia; Dirección Este, Quebrada Las Mercedes, 05°31'36"N, 75°02'26"W, 1573–1633 m 13 Oct. 1992, C. Barbosa 7886 (holotype, FMB-34568). **Figure 148.**

**Diagnosis:** *Anthurium mercedesense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, short, loose, reddish yellow-brown cataphyll fibers, moderately short, sulcate, yellowish green-drying petioles, narrowly oblong-elliptic, grayish brown-drying, long-acuminate blades with the base acute, a single pair of collective veins arising from the base and running regularly 4–5 mm from the margin and slightly more prominent than the primary lateral veins, surfaces glandular-punctate only below as well as by the moderately long-pedunculate inflorescence with a spreading, green, linear-lanceolate spathe, and a weakly tapered, yellowish ochre spadix with weakly emergent green pistils.

Epiphytic; internodes short, to 1.5 cm diam.; cataphylls 3.5 cm long, intact, acute persisting semi-intact at apex, becoming fibrous with minute fragments of reddish yellow-brown epidermis, the fibers yellowish brown, mostly closely parallel. *Leaves* with petioles 8.5–13.4 cm long, 3 mm diam., terete, drying narrowly and acutely sulcate, yellowish green; geniculum 8–10 mm long, drying darker than petioles; blades narrowly oblong-lanceolate to oblong-elliptic, 32.7–49.1 cm long, 4.2–6.4 cm wide (averaging  $39 \times 5$ ), 6.0–9.7 (averaging 7.8) times longer than broad, broadest midway, 2.5–5.3 (averaging 3.9) times as long as petioles, prominently and gradually acuminate at apex (acumen to 1.5 cm), base narrowly acute, drying grayish brown, semiglossy above, yellowish gray-brown, semiglossy below; midrib drying narrowly rounded, prominently and irregularly ridged and concolorous in shallow valley above, narrowly raised, irregularly and prominently ridged, sparsely glandular-punctate and concolorous below; primary lateral veins 10–13 per side, departing midrib at 45–50°, drying narrowly rounded, concolorous above, narrowly rounded and concolorous below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from basal vein, 4–5 mm from margin; basal veins 1 pair, slightly more prominent than primary lateral veins; antemarginal vein present; upper surface epunctate, drying minutely and irregularly ridged; lower surface glandular-punctate, drying irregularly ridged and minutely granular. *Inflorescence* erect; peduncle 25.2 cm long; spathe green, spreading, 4.8 cm long, 6 mm wide, linear-lanceolate, drying thinly coriaceous and yellowish brown; spadix yellowish ochre, sessile, weakly tapered,

7.7 cm long, 6 mm diam., drying yellowish brown; flowers 4 visible per spiral, drying 2.3 mm long and wide; tepals drying minutely granular; lateral tepals 1.5 mm wide, outer margins 2-sided, inner margin rounded; stamens not emergent; anther 0.3 mm long, 0.4 mm wide; thecae well-separated; pistils green, weakly emergent. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium mercedesense* is endemic to Colombia, known only from the type locality in Caldas Department in the Municipio of Florencia at around 1500 m in a *Premontane rain forest* life zone.

**Etymology** — The species is named for the type locality at the Quebrada Las Mercedes in the Municipio of Florencia in Caldas Department.

**Comments** — In the Lucid Anthurium Key, *Anthurium mercedesense* tracks to *A. acutangulum* Engl., which differs by its elliptic dark brown-drying leaf blades and typically longer, pendent peduncle; *A. margaricarpum* Sodiro, which differs by having proportionately longer petioles in comparison to its blades, broader more elliptic, more greenish drying blades and by its reddish to purplish spadix; *A. lancifolium* Schott, which differs by its larger leaves (8–16 cm wide) and by the white to light green or lavender spadix; *A. lustriviridum* Croat, which differs by its elliptic blades 6–20 cm wide, by its cream to yellow spadix and *A. verrucosum* Croat & D. C. Bay, which differs by its more coriaceous, elliptic, typically broader blades (5–19 cm wide) and by the typically second pair of collective veins near the base. *Anthurium mercedesense* is seemingly closest to *A. bakeri* but that species does not reach such high elevations and differs by having leaf blades that have the collective veins deeply sunken while the primary lateral veins are not sunken and also has a creamy white spadix.

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***Anthurium micosense* Croat, sp. nov.** — Type: COLOMBIA. Cauca: Isla de Gorgona, camino a el Alto de los Micos, playas, 02°58'W, 78°11'W, 0–120 m, 7–11 Sep 1987, J.L. Fernández Alonso, O. Rangel, G. Lozano et al. 7409 (holotype, COL-331242; isotype, NY). **Figure 149.**

**Diagnosis:** *Anthurium micosense* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, persistent, reddish brown cataphyll fibers, short-petiolate, narrowly oblanceolate, gradually acuminate, brownish gray-drying leaf blades with the upper surface glandular-punctate and pustular and the lower surface glandular-punctate and dark-speckled with a single pair of collective veins as well as by a long-pedunculate inflorescence with a pinkish, linear-lanceolate, spreading spathe and a green, scarcely tapered spadix.

Epiphyte; internodes short, 1.0–1.5 cm diam.; cataphylls 4.8–6.6 cm long, narrowly acute persisting mostly as dense mostly parallel reddish brown fibers with fragments of reddish brown epidermis. *Leaves* with petioles 5.2–14.6 cm long, 3 mm diam., 0.3–0.6 times as long as blades, terete, drying narrowly and acutely sulcate, yellowish red-brown; geniculum 1.1–1.3 cm long, drying darker than petioles; blades narrowly oblanceolate, 29.6–46.1 cm long, 5.2–8.3 cm wide (averaging  $35 \times 6$ ), 5.0–5.8 (averaging 5.5) times longer than broad, broadest above midway, 3–5.9 (averaging 4.2) times as long as petioles, gradually acuminate at apex (acumen to 1 cm), narrowly acute at base, subcoriaceous, drying grayish brown, weakly glossy above, yellowish gray-brown, semiglossy below midrib drying narrowly rounded, sparsely glandular-punctate and slightly paler above, convex, sparsely glandular-punctate and darker below; primary lateral veins 15–20 per side, departing midrib at  $40^\circ$  at middle, drying narrowly rounded, concolorous above, narrowly raised and slightly darker below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from basal veins, 3–4 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface glandular-punctate and pustular; lower surface glandular-punctate and dark-speckled. *Inflorescence* erect; peduncle slender, 22.3–27.4 cm long, drying ca. 2 mm diam.; spathe pinkish, spreading, 3.5–5.8 cm long, 3–6 mm wide, linear-lanceolate, drying thinly coriaceous and yellowish brown to dark brown; spadix green, sessile, scarcely tapered, 3.5–13.2 cm long, 3–5 mm diam., drying dark yellowish brown; flowers 4 visible per spiral, drying 1.8 mm long, 1.3–1.6 mm wide; tepals drying minutely granular; lateral tepals 1.2 mm wide, outer margins 2–3-sided, inner margin rounded; stamens held at edge of tepals; anthers 0.6 mm long, 0.8–1 mm wide; thecae ovoid, slightly divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium micosense* is endemic to Colombia, known only from the type locality in the Department of Valle de Cauca on the Isla de Gorgona from sea level to 120 m in a *Lower montane wet* forest life zone.

**Etymology** — The species is named for the type locality at the Alto de Mico on the Isla de Gorgona, an island off the western coast of Colombia in Cauca Department.

**Comments** — In the Lucid Anthurium Key, *Anthurium micosense* tracks to *A. cordobense* Croat & D.C.Bay but that species differs by its larger leaf blades more broadly ending base and the golden yellow spadix and *A. lustriviridum* Croat which differs by having blades more obovate and in drying more yellowish. *Anthurium micosense* seems closest to *A. spatulifolium* Sodiño which differs by having proportionately shorter petioles, blades drying darker brown and with a scarcely acuminate apex, upper surface irregularly short-ridged (not minutely granular or pustular).



Figure 149. *Anthurium micosense* Croat. Holotype: Fernandez et al. 7409.





**Figure 150.** *Anthurium minutiareolum* Croat. Holotype: Croat 82351A.



***Anthurium minutiareolum*** Croat, **sp. nov.** — Type: ECUADOR. Esmeraldas: Lita-San Lorenzo Road, 14.2 km W of Río Lita Bridge (below Lita, 00°52'11"N 78°27'16"W, 4 July 1998, T.B. Croat, R. Mansell, L.P. Hannon & J. Whitehill 82351A (holotype, MO-6927332; isotypes, B, COL, K, QCNE, S, NY, US). **Figure 150.**

*Diagnosis:* *Anthurium minutiareolum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, elongated stems, short, narrow internodes, short, semi-intact cataphylls, sharply C-shaped petioles which are weakly glossy, flattened adaxially with acute, erect margins, elliptic short-acuminate greenish gray to gray-brown blades which are acute at the base, subvelvety-matte and eglandular above and glandular-punctate below as well as by a long-pedunculate inflorescence with a green usually spreading spathe and dark green, narrowly long-tapered spadix with 3 flowers visible per spiral.

Epiphyte; stems short, less than 10 cm long; internodes short, 6–8 mm diam.; cataphylls 3.0–3.3 cm long, drying dark brown, semi-intact with a few thin pale fibers, mostly persistent. *Leaves* erect; petioles 11.0–24.3 cm long, dark green, sharply C-shaped, weakly glossy, flattened adaxially with acute, erect margins and weak medial rib; blades elliptic to narrowly ovate-elliptic, 12.5–18.6 cm long, 4.5–7.7 cm wide, 2.3–2.7 times longer than wide, 0.6–1.1 times longer than petioles, short-acuminate at apex, acute at base, subcoriaceous, dark green and subvelvety-matte above, weakly glossy and somewhat paler below, drying greenish to greenish brown, matte above, slightly paler, yellowish brown and semiglossy below; midrib narrowly raised above, much thicker, sharply acute and paler below, drying narrowly raised, granular and glandular-punctate above, sub-acute, finely ribbed with a medial rib, light brown below; primary lateral veins 6–8 per side, weakly sunken, concolorous above, narrowly raised and concolorous below, drying weakly raised above, narrowly raised, often undulating below; basal veins 1 pair (sometimes with an obscure marginal vein near the base; collective veins arising from the base, moderately straight, 4–6 mm from margins; upper surface eglandular, densely and minutely areolate and granular; lower surface moderately smooth, weakly granular, conspicuously brownish glandular-punctate. *Inflorescence* erect; peduncle 25.5–38.0 cm long; spathe 2.5–5.3 cm long, 3.5–5.0 mm wide, green, spreading or sometimes reflexed; spadix 6.3–10.8 cm long, 2.5–3.5 mm diam., narrowly long-tapered, dark green, glossy; flowers 3 visible per spiral, 3 mm long, 1.8 mm wide; tepals finely granular, lateral tepals 1.7–2 mm wide, inner margins broadly rounded, outer margins 2-sided; stamens included, anthers 0.3 mm long, 0.5 mm wide, thecae ovoid-ellipsoid, weakly divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium minutiareolum* is endemic to Ecuador, known only from the type locality in the vicinity of Alto Tambo in the Lita-San Lorenzo Region at 400 m in a *Premontane rain forest* life zone.

**Etymology** — The species epithet is from the Latin ‘*minutus*’ (very small, minute) and ‘*areolatus*’ (areolate, with areoles) referring to the finely areolate upper dried blade surfaces.

**Comments** — *Anthurium minutiareolum* is most easily confused with *A. burbanoi* Croat from the Awá Centro Mataje at 200 m elevation. That species differs by having its leaf blades sub-rounded and apiculate at apex with the upper surface minutely ridged-granular as well as by having a violet-purple, sub-cylindroid spadix. In contrast *Anthurium minutiareolum* has its leaf blades gradually acuminate at the apex with its upper blade surface minutely areolate and it has a green long-tapered spadix.

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***Anthurium minutiglandulum*** Croat, **sp. nov.** — Type: ECUADOR: Los Ríos: Centinella, 0.2 km past Escuela Mixta La Centinella, along trail to left of road, exactly 13 km from main Santo Domingo-Quevedo Hwy. in Patricia Pilar, 00°32’S, 79°11’W, 1000 m, 14 Mar. 1992, T.B. Croat 73281 (holotype, MO-1083188). **Figures 151–154.**

**Diagnosis:** *Anthurium minutiglandulum* is a member of sect. *Porphyrochitonium* and is characterized by its short internodes, short, somewhat intact cataphylls, sharply sulcate petioles, oblong-elliptic blades with the apex down-turned and apiculate and the base broadly acute with a single pair of collective veins and moderately quilted-sunken primary lateral veins with the lower surface weakly and minutely glandular as well as by the short-peduncular inflorescence with an ovate-elliptic, pale green, spreading spathe and a cylindroid, greenish spadix.

Epiphyte; internodes short, ca. 1 cm diam.; cataphylls 1.2–2.0 cm long, medium brown, persisting moderately intact, eventually fibrous *Leaves* with petioles 4–8 cm long, 3 mm diam., sharply and shallowly sulcate in apical half, obtusely so in lower half, medium green, matte; geniculum 0.7–1.3 mm long, 4 mm diam., darker; blades oblong-elliptic, 10.5–20.0 cm long, 2.0–4.1 cm wide, 4.8 times longer than wide, 3.1 times longer than petioles, acute and apiculate, down-turned at apex, broadly acute at base, subcoriaceous, dark green and semiglossy above, moderately paler and semiglossy below; midrib narrowly rounded and paler above, narrowly rounded and weakly paler below; primary lateral veins 6–8 per side, departing midrib at 45–50°, etched and concolorous above, weakly raised and slightly darker below, about as prominent as the collective veins; collective veins moderately straight, arising from one of the lowermost primary lateral veins or from the only pair of basal veins; upper



**Figure 151.** *Anthurium minutiglandulum* Croat. Holotype: Croat 73281. Base of leaf blade showing detail of venation.



**Figure 152.** *Anthurium minutiglandulum* Croat. Croat 73281. Habit of potted plant.





**Figure 153.** *Anthurium minutiglandulum* Croat. Croat 73281. Inflorescence.



**Figure 154.** *Anthurium minutiglandulum* Croat. Croat 73281. Leaf blade, adaxial surface.





Figure 155. *Anthurium miriamiae* Croat. Holotype: Croat 61381.



**Figure 156.** *Anthurium miriamiae* Croat. Croat 61381. Habit with inflorescence.

surface eglandular, minutely papillate on magnification, drying conspicuously granular; lower surface minutely, densely and inconspicuously dark glandular-punctate, drying moderately smooth, sparsely pustular. *Inflorescence* spreading; peduncle 6.0–24.5 cm long, 2 mm diam.; spathe pale green, spreading, ovate-elliptic, 1.7–2.3 cm long, 8–9 mm wide at base, 8 mm wide in distal  $\frac{2}{3}$ , rounded and apiculate at apex, twisted and often strongly recurled at tip; spadix cylindroid, medium dark green, semiglossy, 1.7–6.7 cm long, 4.0–5.5 mm diam.; flowers 4–6 visible per spiral, 2.0–2.5 mm long and wide; lateral tepals 0.9–1.2 mm wide, inner margins rounded, outer margin obtusely rounded, sub-3-sided; stamens held at level of tepals in a tight cluster around the style at anthesis, persisting exposed throughout the length of spadix; anthers 0.3–0.4 mm long, 0.6 mm wide; thecae subrounded, moderately divaricate; pollen white. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium minutiglandulum* is endemic to Ecuador, known only from the type locality in Los Rios Province at Centinela in a *Premontane wet forest* life zone.

**Etymology** — The species epithet is from the Latin ‘*minutus*’ (meaning minute, very small) and ‘*glandula*’ (a small gland) referring to very minute glandular punctations on the lower leaf blade surface.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium minutiglandulum* tracks to *A. andinum* Engl. which differs by having much larger leaves and a spadix to 10 cm long and 4 mm diam.; *A. cachabianum* Sodirol, which differs by its elliptic blades and slender spadix 6–15 cm long and 2–8 mm diam.; *A. centinellense* Croat, which differs by its oblanceolate blades more than 30 cm long and 9 cm wide with dark glandular punctations on both surfaces; *A. jimwestii* Croat, which differs by its narrowly linear-oblanceolate leaf blades more than 75 cm long; *A. margaricarpum* Sodirol, which differs by having proportionately more long-petiolate, narrowly elliptic, long-acuminate blades; *A. myosurus* Sodirol, which differs by elliptic, long-petiolate leaves and long, slender spadix and *A. tenuispica* Sodirol, which differs by its much larger, narrowly elliptic blades and the very long slender spadix.

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***Anthurium miriamiae* Croat, sp. nov.** — Type: COLOMBIA. Valle del Cauca: Bajo Calima Region, within forestry concession of Cartón de Colombia, between Buenaventura & Río Calima, 6.5 km beyond Porton Tomar (at km 27), 22.3 km beyond Camp Portada Pulpapel, 33.3 km beyond main Calí–Buenaventura Highway, 04°02’N, 77°07’W, 50 m, 8 July 1986, T.B. Croat 61381 (holotype, MO-3610751; isotype, CUVIC). **Figures 155 & 156.**

*Diagnosis:* *Anthurium miriamiae* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short, thick, highly branched internodes, reddish brown, persistent, semi-

intact cataphyll fibers, sharply C-shaped petioles with a concave sulcus, ca. 0.4 times as long as the blade, oblong-ob lanceolate, gray-green-drying, moderately coriaceous blades with the apex nearly rounded to obtuse, the abruptly acute apex and acute base with 2 pairs of collective veins both relatively remote from the margin with both surfaces glandular punctate as well as by the long-pedunculate inflorescence with the green spreading spathe and the narrowly tapered violet-purple spadix.

Appressed epiphyte; internodes short, 2 cm diam.; roots highly branched, thin; cataphylls 7.5–15.0 cm long, semi-intact, acute, persisting intact at apex, becoming fibrous with fragments of yellowish-brown epidermis, the fibers reddish brown, mostly fine, closely parallel. *Leaves* with petioles sharply C-shaped, concave-sulcate, drying 13.7–20.1 cm long, 3–7 mm diam., acutely sulcate, yellowish gray-brown; geniculum 1.1–1.9 cm long, drying darker than petioles; blades oblong-ob lanceolate, 24.2–46.7 cm long, 7.0–14.8 cm wide (averaging  $35 \times 11$ ), 2.8–3.6 (averaging 3.2) times longer than broad, broadest above midway, 1.6–3.0 (averaging 2.3) times longer than petioles, abruptly short-acuminate at apex (acumen to 1.5 cm), base acute, coriaceous, semiglossy, moderately bicolorous, drying gray-green, matte above, gray-green, semiglossy below; midrib convex on both sides, whitish below drying narrowly raised, sparsely glandular-punctate and slightly paler above, narrowly rounded glandular-punctate, finely ribbed and darker below; primary lateral veins 15–16(18) per side, departing midrib at 40–45° at middle, etched-sunken above, weakly raised below, drying narrowly rounded and concolorous above and below; tertiary veins drying prominently raised above and below; collective veins more prominently sunken than primary lateral veins, 2 pairs arising from 1st and 2nd basal vein, inner pair up to 1.5–2.0 cm from margin, outer pair (3)5(8) mm from margin; basal veins 2 pairs; antemarginal vein present; upper surface sparsely and inconspicuously glandular-punctate, minutely areolate; lower surface glandular-punctate, minutely areolate-granular. *Inflorescence* with peduncle 36.4 cm long; spathe greenish, spreading, 10 cm long, 1.2 cm wide, lanceolate, drying coriaceous and yellowish brown; spadix violet-purple, sessile, narrowly tapered, 11 cm long, 7 mm diam., drying yellowish brown; flowers 6 visible per spiral, drying 1.6–1.9 mm long, 1.5–1.7 mm wide; tepals drying minutely granular; lateral tepals 1.3–1.6 mm wide, inner margin slightly rounded, outer margins 2-sided; stamens held at level of tepals, 0.3 mm long and wide; thecae weakly divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium miriamiae* is endemic to Colombia, known only from Valle del Cauca Department at 50 m elevation in a transition area between Tropical rain forest and *Tropical wet forest* life zones.

**Etymology** — *Anthurium miramiae* is named for Colombian botanist, Miriam Monsalvae who worked extensively in the Bajo Calima Region, preparing collections, and illustrations for the Flora of Bajo Calima. Miriam, a dear friend, is now a teacher and lives with her daughter in Cali.

**Comments** — *Anthurium miramiae* is most similar to *A. vallense* Croat which differs by having a single pair of collective veins which are much closer to the margins and a green to yellow spadix. In the Lucid Anthurium Key, *Anthurium miramiae* also tracks to *A. quinquesulcatum* Sodiro which differs by having shorter cataphylls (to 6 cm long) and a green glaucescent spadix; *A. spathulifolium* Sodiro, which differs by having only a single pair of collective veins; *A. colonchense* Croat & Cornejo, which differs by having proportionately longer blades with a single pair of collective veins as well as a bright yellow spadix and *A. cabuyulense* Croat & Rodr., which differs by its much longer, more oblanceolate leaf blades with a single pair of collective veins.

An unpublished but apparently related Ecuadorian species is similar to *Anthurium miramiae*. The collection (Hoover 1234) was made in Ecuador near Tobar Donoso in western Carchi Province, somewhere between 800 and 1200 m. It differs by having longer cataphylls, oblong-elliptic, narrowly acuminate blades with the primary lateral veins more numerous and much closer and the collective veins much closer to the margins.

*Anthurium miramiae* was treated as Species #1 in Dorothy Bay's Ph.D. thesis dealing with the Araceae of Bajo Calima (Croat 61381).

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***Anthurium nonoense*** Croat, **sp. nov.** — Type: ECUADOR. Pichincha: Along road from Nono to Nanegal, south of Nanegalito, 13 km SE of Nanegal, 00°02'12"N, 78°40'43"W, 1440 m, 4 Sep. 1976, T.B. Croat 38900 (holotype, MO-3828932; isotypes, COL, K, NY, SEL, S, US). **Figure 157.**

**Diagnosis:** *Anthurium nonoense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent cataphyll fibers, moderately long-petiolate leaves, sharply sulcate petioles, elliptic-oblanceolate, acuminate, moderately bicolorous blades drying grayish green above and grayish yellow-brown below, a single pair of collective veins arising from the base and close to the margins, moderately close, moderately obscure primary lateral veins as well as by the long-pedunculate inflorescences, green, lanceolate, spreading spathes, and sessile, green, weakly tapered spadix.

Epiphytic; internodes short; cataphylls persistent as fibers. *Leaves* with petioles broadly and sharply canaliculated, drying 13.6–26.9 cm long, 3 mm diam., drying narrowly and acutely sulcate, greenish brown; geniculum 9–18 mm long, drying darker than petioles; blades elliptic-oblongate, 20.1–34.6 cm long, 7.2–12.6 cm wide (averaging  $27 \times 11$ ), 2.1–3.1 (averaging 2.6) times longer than broad, broadest midway, 1.1–1.8 (averaging 1.4) times as long as petioles, abruptly acuminate at apex (acumen to 1.5 cm), base acute, subcoriaceous, moderately bicolorous, semiglossy, drying grayish green, semiglossy above, grayish yellow-brown, semiglossy below; midrib round-raised above, raised below, drying narrowly raised, finely ribbed and slightly paler above, narrowly rounded, conspicuously glandular-punctate and slightly paler below; primary lateral veins 16–18 per side, departing midrib at  $55^\circ$  at middle, sunken above, weakly raised below, drying weakly and narrowly raised, concolorous above, narrowly rounded and slightly paler below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from basal veins, 2–6(12) mm from margin; basal veins 1 pair; antimarginal vein present; upper surface epunctate, minutely areolate-granular with many irregular bumps (caused by a weak puckering of surface); lower surface conspicuously glandular-punctate, minutely dark-speckled, the glandular punctations with a depressed center. *Inflorescence* erect; peduncle 24.6–39.8 cm long, drying 3–4 mm diam.; spathe spreading at  $90^\circ$  and recurved, 3.6–6.6 cm long, 6–7 mm wide, lanceolate, drying coriaceous and yellowish brown; spadix green, turned forward from peduncle at ca.  $90^\circ$ , sessile or sometimes stipitate 2–7 mm, weakly tapered, 6.2–11.8 cm long, 3–5 mm diam., drying yellowish brown; flowers 3–4 visible per spiral, drying 3 mm long, 2.7 mm wide; tepals drying minutely granular; lateral tepals 1.2–1.7 mm wide, outer margins 2- or 3-sided, inner margin rounded; stamens held at level of tepals; anthers 0.4 mm long, 0.6 mm wide; thecae ovoid, moderately divaricate; pollen white. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium nonoense* is endemic to Ecuador, known only from the type locality in Pichincha Province at 1440 m in a *Premontane wet forest* life zone.

**Etymology** — The species is named for the type locality at Nono in Pichincha Province.

**Comments** — In the Lucid Anthurium Key, *Anthurium nonoense* tracks to *A. cachabianum* Sodiro, which differs by having proportionately longer petioles and both surfaces glandular-punctate; *A. margaricarpum* Sodiro, which differs by its more prominent collective veins which arise from one of the lower primary lateral veins and which are more distant from the margins; *A. marginellum* Sodiro, which differs by having more narrowly oblong-elliptic blades which are more narrowly acuminate at apex and more narrowly acuminate at base as well as by having blades glandular-punctate on both surfaces; *A. myosurus* Sodiro, which differs by its proportionately much more long-petiolate leaves with glandular punctations on upper





Figure 157. *Anthurium nonoense* Croat. Holotype: Croat 38900.



Figure 158. *Anthurium oblitum* Croat. Holotype: Croat 59633A.



**Figure 159.** *Anthurium oblitum* Croat. Croat 59633A. Stem with cataphylls.



**Figure 160.** *Anthurium oblitum* Croat. Croat 59633A. Habit of potted plant.





**Figure 161.** *Anthurium oblitum* Croat. Croat 59633A. Leaf and inflorescence.



**Figure 162.** *Anthurium oblitum* Croat. Croat 59633A. Leaf blade, abaxial surface.



surface as well as by its reddish spadix; *A. rupestre* Sodiro, which differs by having linear-lanceolate pendent blades with proportionately much shorter petioles; *A. sulcatum* Engl. which differs by more narrowly lanceolate-elliptic, more narrowly acuminate blades that are more than 3.5 times longer than broad and dry blackened; *A. tenuispica* Sodiro, which differs by having more narrowly elliptic blades and a much longer non-tapering spadix and *A. verrucosum* Croat & D.C.Bay, which differs by its more coriaceous, larger blades with a second pair of basal veins.

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***Anthurium oblitum*** Croat, **sp. nov.** — Type: PERU. San Martín: Along road between Tarapoto and Yurimaguas, just beyond the tunnel, collected in Jan. 2002 by B. Feuerstein, cultivated at Missouri Botanical Garden; plant vouchered 16 July 2012, *T.B. Croat 59633A* (holotype, MO-6940797; isotypes, B, CAS, COL, F, HOXA, K, L, NY, QCNE, USM, S, US. **Figures 158–162.**

*Diagnosis:* *Anthurium oblitum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, pale-fibrous cataphylls, terete petioles, narrowly oblong-elliptic blades which are glandular-punctate only on the lower surface, 6–8 primary lateral veins per side, a single pair of collective veins from the lowermost pair of primary lateral veins and equally sunken as primary lateral veins, a pale green, lanceolate spathe and sessile, dark violet-purple, tapered spadix.

Epiphyte; stems 10–15 cm long; internodes short, 1.5–2.5 cm diam.; cataphylls 4–7 cm long, becoming pale-fibrous with some small fragments of epidermis. *Leaves* semi-erect to spreading; petiole 5–24 cm (averaging 18 cm) long, terete and not sulcate when young, moderately flattened adaxially in age and moderately sulcate adaxially in age, sheathed 2 cm at base, pale green, weakly glossy, smooth; geniculum 2.0–2.5 cm long, 4 mm wide, 5 mm thick, sulcate, drying slightly darker than petiole; blade narrowly oblong-elliptic, spreading to sub-pendent from semierect to spreading petioles, pendent from spreading petioles, 17.3–36.3 cm long, 3.3–7.7 cm wide, (averaging 31.2), (1.3–4 times longer than wide) 1.3–4 times longer than petioles, narrowly acuminate to narrowly long-acuminate at apex, acute to attenuate at base, moderately coriaceous, dark green, matte above, moderately paler and weakly glossy below, the margins curled under; midrib slightly paler than surface, convex at base, narrowly rounded at middle, becoming bluntly acute toward apex above, thicker, narrowly rounded and moderately paler, glossier below; primary lateral veins (5)6–8 per side, departing midrib at 20–25°, weakly quilted-sunken and concolorous above, weakly raised and narrowly rounded and slightly darker below; collective veins arising from the lowermost pair of primary lateral veins, equally sunken as primary lateral veins above, and equally raised below (abaxially); upper surface eglandular, irregularly ridged and granular, sparsely short pale-lineate; lower surface dark

glandular-punctate, the glands raised, often with radiating ridges weakly granular-ridged. *Inflorescence* 26 cm long, peduncle 33 cm; spathe narrowly oblong-lanceolate, 5.6–8.0 cm long, 1.3–1.6 cm wide, pale green, becoming heavily tinged purple, subcoriaceous, matte above, glossy outside in bud, becoming weakly glossy outside; spadix sessile to stipitate to 2.2 mm (stipe 5.5 mm diam., green), 8.0–9.5 cm long, 5–6 mm diam., dark violet-purple, moderately glossy; flowers 5–7 visible per spiral, 2.5–3.0 mm long, 2.5–2.7 mm wide; tepals markedly curved upward, more or less clam-shell-shaped, broadly rounded on inside, narrowly rounded outside; lateral tepals 0.8 mm wide; inner margin broadly rounded, outer margin 2-sided; pistils broadly rounded, tinged purple; stamens held at the level of the tepals, remaining exerted throughout length of spadix; anthers 0.3 mm long, 0.4 mm wide; thecae broadly ovoid, moderately divaricate; lateral tepals emerging up to 20 spirals ahead of the anterior lobes; pollen white. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium oblitum* is endemic to Peru, known only from the type specimen in Loreto Department on the road between Tarapoto to Yurimaguas, at less than 500 m in a *Premontane wet forest* life zone.

**Etymology** — The epithet is from the Latin ‘*oblitus*’ (forgotten), referring to the fact that the species was forgotten or overlooked by being confused with another species, *Anthurium betsyae*.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium oblitum* tracks to *A. atamanii* Croat and *A. tumbesense* Croat, both of which differ by lacking a purple spadix and *A. yamayakatense* which differs by having cataphylls 7.5–16.0 cm long, proportionately shorter, narrowly elliptic and equilateral leaf blades, 9–11 primary lateral veins per side, a spadix to 17 cm long with 7–8 flowers per spiral. In contrast, *Anthurium oblitum* has cataphylls less than 7 cm long, leaf blades narrowly oblong-elliptic and 4.5–6.1 times longer than wide, 7 or 8 primary lateral veins per side, and 4–5 flowers visible per spiral.

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***Anthurium omarescobarii*** Croat, **sp. nov.** — Type: COLOMBIA. Antioquia: Municipio Frontino, Corregimiento Nutibara, region of Murri, Nutibara-La Blanquita Road, 20–32 km, ca. 06°45’N, 75°20’W, 950–1380 m, 20 Apr. 1988, J.L. Luteyn, R. Callejas & O. Escobar 12122 (holotype, HUA-52861). **Figure 163.**

**Diagnosis:** *Anthurium omarescobarii* is a member of sect. *Porphyrochitonium* and is characterized by its terrestrial habit, long persistent cataphylls with a prominent, pale brown reticulum of fibers, moderately short, shallowly sulcate petioles, narrowly oblong-elliptic, grayish green-drying with an acuminate downturned apex, acute base, a single pair of basal veins giving

rise to a collective vein and prominent glandular punctations on both surfaces as well as by long-pedunculate inflorescence with a narrowly oblong, erect, maroon-suffused spathe and a long-tapered, green to maroon spadix.

Terrestrial; internodes short, 1.1 cm diam.; cataphylls 10.2 cm long, acute, persisting intact at apex, becoming fibrous with fragments of yellowish-brown epidermis, the fibers yellowish brown, mostly closely parallel. *Leaves* with petioles 4.8–9.4 cm long, 3 mm diam., 0.2–0.4 times as long as blades, subterete, shallowly sulcate, drying narrowly and acutely sulcate, dark brown; geniculum 9–16 mm long, drying darker than petioles; blades narrowly oblong-elliptic to weakly oblong-oblongate, 14.3–27.1 cm long, 4.2–6.8 cm wide (averaging  $19 \times 5$ ), 3.4–4.0 (averaging 3.8) times longer than broad, broadest above midway, 2.0–3.8 (averaging 2.6) times as long as petioles, gradually acuminate and downturned at apex (acumen to 1 cm), acute at base, subcoriaceous, drying grayish green, matte to weakly glossy above, yellowish gray-brown, semiglossy below; midrib drying narrowly acute, conspicuously glandular-punctate, finely ribbed and darker above, narrowly rounded, conspicuously glandular-punctate, finely ribbed and concolorous below; primary lateral veins 13–18 per side, departing midrib at  $40^\circ$  at middle, narrowly rounded, concolorous above, narrowly rounded and concolorous below; tertiary veins drying moderately distinct above and below; collective veins arising from basal veins, 5–7 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface faintly ribbed, densely granular, conspicuously and densely glandular-punctate, the glands sunken, medially pitted; lower surface smooth to faintly granular, dark glandular-punctate, the glands sunken, medially sunken. *Inflorescence* with peduncle 19.7 cm long; spathe erect, maroon-suffused green, 5.6 cm long, 1 cm wide, narrowly oblong, drying subcoriaceous and reddish brown; spadix green to maroon, sessile, moderately tapered, 16.2 cm long, 5 mm diam., drying reddish brown; flowers 3 visible per spiral, drying 2.6–2.9 mm long, 1.7–1.8 mm wide; tepals drying minutely granular; lateral tepals 1.6–1.8 mm wide, outer margins 2-sided, inner margin broadly rounded; stamens not emergent, filament 0.6 mm long, 1 mm wide, anthers affixed to the distal margin. *Inflorescence* not seen.

**Distribution and ecology** — *Anthurium omarescobarii* is endemic to Colombia, known only from the type locality in Antioquia Department at 950–1380 m in a Lower montane wet forest life zone.

**Etymology** — *Anthurium omarescobarii* is named for Colombian botanist Omar Escobar from the National University of Colombia (UNAL), who helped collect the type specimen.



Figure 163. *Anthurium omarescobarii* Croat. Holotype: Luteyn et al. 12122.



**Figure 164.** *Anthurium orellanense* Croat. Holotype: *Jaramillo et al.* 21532.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium omarescobarii* tracks to *Anthurium andinum* Engl. from the western slopes of Ecuadorian Andes at 2400 m which differs by having cataphylls only 4–5 cm long and not conspicuously net-like, larger blades 35–45 cm long and up to 10 cm wide, larger petioles 20–30 cm long; *A. lustriviridum* Croat, which differs by its thick green-drying narrowly elliptic blades with two pairs of collective veins extending to the apex with many close veins near the petiolar plexus and *A. spatulifolium* Sodiro which differs by its much more oblanceolate leaf blades. *Anthurium acutangulum* Engl., *A. arusiense* Croat & M.M.Mora, *A. amargalense* M.M.Mora and *A. ramosense* Engl. are all similar in the key but all differ by having glandular punctations only on the lower surface.

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***Anthurium orellanense*** Croat, **sp. nov.** — Type: ECUADOR. Orellana: Transecta de vegetación de 150 × 5 m en area pantanosa, 230 m al sur de la plataforma del pozo OBE, Bloque 31, 76°02'W, 01°08'S, 25 Nov. 2000, J. Jaramillo 21532 (holotype, QCA). **Figure 164.**

**Diagnosis:** *Anthurium orellanense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, subterete petioles, oblong-elliptic, narrowly acuminate bicolorous blades with 9 primary lateral veins, a single pair of collective veins which are 8–10 mm from margin, darkly speckled, conspicuously glandular-punctate on the lower surface as well as by the long-pedunculate erect inflorescence with a spathe green, linear-lanceolate spathe and narrowly cylindroid, weakly tapered green spadix with 4–5 flowers visible per spiral.

Epiphyte; internodes short, 1 cm diam.; cataphylls 2.5–3.7 cm long, persisting as red-brown, linear fibers. *Leaves* 50.1 cm long; petioles 16 cm long, subterete, drying 2.5 mm wide, medium yellow-green, weakly glossy, sulcate adaxially, finely ribbed; geniculum 1 cm long, drying dark brown; blade oblong-elliptic, 33.5 cm long, 8.4 cm wide, 3.9 times longer than wide, 2.1 times longer than petiole, narrowly acuminate at apex, narrowly acute at base, subcoriaceous, drying matte and brown above, semiglossy and yellow-green below; midrib convex above, drying darker than surface, narrowly rounded below, drying bluntly acute and paler below; primary lateral veins 9 per side, departing midrib at 45–50°, drying weakly and narrowly raised and concolorous above, narrowly rounded and concolorous below, not markedly stronger than the interprimary veins; collective veins 1 pair, arising from the base, running 8–10 mm from margin in the middle of the blade; upper surface epunctate, drying smooth, light gray-green and weakly glossy, lower surface sparsely granular to ridged, darkly speckled, conspicuously glandular-punctate. *Inflorescence* 25.6 cm long, erect; peduncle 17 cm long, 2.5 mm diam., drying gray-green with stipe 0.8 mm long; spathe green, linear-lanceolate, 4.2 cm long (1 cm decurrent on peduncle), 7 mm wide, abruptly acuminate at apex, reflexed; spadix 7 cm long, 5.5 mm diam, green, stipitate 4 mm in back, 1.9 mm in front, narrowly cylindroid, only weakly tapered to apex; flowers 4–5 visible per spiral, 2.5–3.0 cm long; lateral tepals 1.3 mm wide,



outer margin 3-sided, the inner margin almost straight; pistils weakly protruding; ovules 2 per locule. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium orellanense* is known only from the type locality in far western Ecuador in Orellana Province in the Yasuní National Park at 230 m elevation in a Tropical moist forest life zone north of the Río Nariño above its mouth at the Río Yasuní.

**Etymology** — The species is named for its location in Orellana Province.

**Comments** — Sect. *Porphyrochitonium* is a group relatively rare in the Amazon Basin at low elevations. Two other species in the region which must be compared are *Anthurium bakeri*, which differs by having the primary lateral veins much less conspicuous than the collective veins versus being roughly equal in *A. orellanense*. This new species has primary lateral veins more conspicuous than interprimary lateral veins whereas in *Anthurium apaporanum* R.E. Schult., there are many more primary lateral veins and these are scarcely more conspicuous than the interprimary veins and the collective veins are closer to the margin (1–2 mm) while in *A. orellanense* the collective veins are 8–10 mm from the margin. In the Lucid Anthurium Key, *Anthurium orellanense* also tracks with: *A. cachabianum* Sodiro which has longer petioles (20–25 cm), smaller blades 18–25 × 8–12 cm) and a sessile spadix; *A. julospadix* Sodiro which has narrower blades (length/width ratio 4.5–8.0), a peduncle twice the length of the petiole rather than about the same and bright purple spadix; *A. pellucidopunctatum* Sodiro which has somewhat narrower oblong-lanceolate blades (3.6 length/width ratio), and a yellowish green, sessile spadix; and *A. sulcatum* Engl. which has asymmetrical, oblong, lanceolate blades that are somewhat narrower (length/width ratio 3.5) and a dark purple, sessile spadix.

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***Anthurium ortizii* Croat, sp. nov.** — Type: ECUADOR. Carchi: Tulcán Canton, Parroquia Tobar Donoso, Reserva Indígena Awá, Centro El Baboso, 78° 25'W, 00°53'N, 1800 m, 17–27 Aug. 1992, G. Tipaz, M. Tirado, C. Aulestia, N. Gale & P. Ortiz 1728 (holotype MO-4374762; isotype, QCNE). **Figure 165.**

**Diagnosis:** *Anthurium ortizii*, a member of sect. *Porphyrochitonium*, is distinguished by persistent brown cataphylls, its atypical, large and broad elliptic-ovate leaves that dry brown and have a rounded to weakly subcordate base, as well as by the prominently raised primary lateral veins on lower leaf surface, cream-colored spathe and a dark purplish spadix.

Terrestrial to 80 cm tall or epiphytic; stems moderately long; internodes short, 1–2 cm long, (2) 4–6 cm diam.; cataphylls persisting with fibers in red-brown, net-like reticulum and partly

semi-intact with moderately coarse fibers 6–29 cm long. *Leaves* erect with petioles 30.3–98.0 cm long (averaging 61.8 cm), 0.7–1.8 mm diam., sharply triangular to 5-sided, the sides parallel, broadly flattened adaxially with moderately blunt lateral margins and a weak medial rib, drying dark brown, more concave adaxially with narrowly raised, acute lateral margins, sharply 3-ribbed adaxially; geniculum (1)3–4 cm long, slightly wider, drying dark brown to dark tan; blades ovate to broadly ovate to elliptic-ovate, 28–42 cm long, 17–35 cm wide, (averaging  $37.5 \times 29.2$ ), 1.2–1.8 times longer than broad (averaging 1.3), 0.5–1.0 times as long as petiole (averaging 0.7), abruptly and sharply long-acuminate, rounded to weakly subcordate at base, rarely truncate, moderately coriaceous and moderately bicolorous, semiglossy, drying dark brown to dark gray-brown above, slightly paler dark yellow-brown, glossier than upper surface below; midrib convex and paler above, thicker than broad and paler below, drying more or less concolorous and often acute above, usually darker than surface and several-ribbed below; primary lateral veins 18–33 per side, (averaging 22), departing midrib at 50–60° near middle, departing midrib at steeper angle near base, etched-quilted above, pleated-raised below, drying narrowly rounded and more or less concolorous on both surfaces; tertiary veins very few, distinct; basal veins 6 or more pairs, arising from or near base; collective veins arising from first pairs of primary lateral vein, 2–4 mm from margin, as prominent as primary lateral veins; antemarginal vein present, arising from base; upper surface densely glandular-punctate; lower surface more conspicuously glandular-punctate with prominent reticulate venation. *Inflorescence* 37.5–55.6 cm long, erect; peduncle 9–40 cm long (averaging 27.5 cm), 2.6–4.9 times longer than spathe (averaging 3.8), drying 2–4 mm diam., somewhat darker than petiole; spathe 4.5–8.2 cm long (averaging 6.8 cm), 1.1–1.5 cm wide (averaging  $6.8 \times 1.3$  cm), pale greenish white, greenish cream or cream to white, drying medium brown; spadix 5.8–15.6 cm long (averaging 10 cm), drying 4–5 mm diam., dark purple to violet-purple, weakly glossy, drying blackish brown, becoming paler in fruit; flowers (3)4–6 visible per spiral, 1.8–2.1 mm long and wide, lateral tepals 0.8–0.9 mm wide; inner margin nearly straight, outer margins 2-sided. *Infructescence* with berries pale violet-purple to lilac.

*Distribution and ecology* — *Anthurium ortizii* is known from and northwestern Ecuador in Tulcán Canton in Carchi, and southwestern Colombia near Barbacoas in Nariño Department, at 900–1900 m elevation in Premontane wet forest, Tropical wet forest, and *Premontane rain forest* life zones.

*Etymology* — *Anthurium ortizii* named for Ecuadorian botanist Patricio Ortiz who assisted in collecting the type specimens along with Galo Tipaz, Milton Tirado, Carlos Aulestia and Nathan Gale in Tulcán Canton in Carchi and Barbacoas in Nariño Department.



**Figure 165.** *Anthurium ortizii* Croat. Paratype: *Tipaz 255*.



Figure 166. *Anthurium pacevedoi* Croat. Holotype: Acevedo 1335.

**Comments** — *Anthurium ortizii* is closest to another new species, *A. davidneillii* Croat, which differs by occurring at much lower elevations (50–400 m and averaging 240 m), in blades drying grayish to gray-green above and light yellowish gray-green below and in having typically fewer primary lateral veins and reticulate venation that is not very prominent. In contrast, *Anthurium ortizii* ranges from 900–1800 m (average: 1210 m), has blades that dry dark brown to dark gray-brown on the upper surface and dark yellow-brown below often with 6 or more pairs of basal veins and with the interprimary veins also rather prominent and with the reticulate veins markedly prominulous. In the Lucid Anthurium Key, *Anthurium ortizii* tracks to *Anthurium cachabianum* Sodiro and *A. lustriviridum* Croat, both of which differ in having narrower blades with length/width ratios 2.0–2.8 compared to the broadly ovate blade of *Anthurium ortizii*. The blades of *Anthurium lustriviridum* dry light olive-green above and lighter grey-green below. *Anthurium lustriviridum* has a prominent double collective vein and the blade has a cuneate base; *A. cachabianum* has shorter petioles (20–25 cm), smaller blades (18–25 cm long, 8–12 cm wide) and also has a cuneate base.

Paratypes. COLOMBIA. Nariño: El Espino-Tumaco, 30 km W of Ricaurte, 10 km W of Ataquer, El Mirador, Finca Santa Lucia, 01°17'N, 78°07'W, 950 m, 9 Dec. 1988, B. Hammel & A. Navaruez 17188 (MO); Barbacoas, Vertiente Occidental, corregimiento Junín El Paramo, 01°20'N, 78°08'W, 1260 m, 21 Feb. 1993, J. Betancur et al. 3950 (COL, MO). EC-UADOR. Carchi: Tulcán Canton, Reserva Indígena Áwa, 1600 m, Tipaz et al. 255 (QCNE, MO); Centro El Baboso, 1800 m, Tipaz et al. 1728 (QCNE, MO); Parroquia El Chical, 1150 m, Armando et al. 489 (QCNE, MO); Parroquia Tobar Donoso, 1800 m, Tipaz et al. 1908 (QCNE, MO); Maldonado, Parroquia Tobar Donoso, Reserva Etnica Awá, Sabalera, 00°55'N, 78°32'W, 900 m, 22 Nov. 1992, C. Aulestia et al. 779 (MO, QCNE); Tulcán, around encampment in Gualpi Chico area of Awá Reservation, NW and SE, 1330 m, 00°58'N, 78°16'W, 22 Jan. 1988, W.S. Hoover et al. 3667 (MO, QCA); Reserva Etnica Awá, 1150 m, Parroquia El Chical, Sector Gualpi Medio, Río Canumbí, topografía muy irregular, suelo negro franco-arcilloso, 01°02'N, 78°15'W, 19–28 Feb. 1993, A. Grijalva et al. 489 (MO, QCNE); Reserva Indígena Awá, 1800 m, Parroquia Tobar Donoso, Centro El Baboso, 00°53'N, 78°25'W, 1800 m, 17–27 Aug. 1992, Tipaz et al. 1728 and 1908 (both MO, QCNE).

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***Anthurium pacevedoi*** Croat, *sp. nov.* — Type: COLOMBIA. Antioquia: Municipio Frontino; Corregimiento Nutibara, Región Murí, carretera hacia La Blanquita, 06°45'00"N, 76°18'W, 1700 m, 13 July 1986, P. Acevedo, G. Martínez, C.E. Orrego, D. Restrepo, D. Sánchez & E. Silva 1335 (holotype, MO-3582733; isotypes, HUA, US). **Figure 166.**

**Diagnosis:** *Anthurium pacevedoi* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, short persistent cataphylls with pale fibers, petioles ½

to  $\frac{2}{3}$  as long as the blades which are obtusely flattened adaxially and drying prominently sulcate, oblong-elliptic, narrowly long-acuminate, grayish brown blades with both surfaces glandular-punctate and with a single pair of basal veins as well as by the slender, green, spreading spathe and the stipitate, yellowish spadix and red berries.

Epiphytic; internodes short, to 6–8 mm diam.; cataphylls 2–3 cm long, densely fibrous, with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. *Leaves* with petioles 4.9–19.4 cm long, 2 mm diam., obtusely flattened adaxially, drying narrowly and acutely sulcate, grayish brown; geniculum 4–11 cm long, drying darker than petioles; blades nearly oblong to oblong-elliptic, 8.8–24.8 cm long, 1.7–5.3 cm wide (averaging  $17 \times 4$ ), 3.3–6.2 (averaging 5.0) times longer than broad, broadest midway, 0.9–2.3 (averaging 1.6) times longer than petioles, gradually acuminate at apex (acumen to 2.3 cm), obtuse at base, subcoriaceous, drying grayish brown, weakly glossy to matte above and below; midrib drying narrowly raised, finely and acutely ribbed and slightly paler, glandular-punctate above, narrowly raised, densely glandular-punctate, mostly 3-ribbed and moderately paler below; primary lateral veins 14–18 per side, departing midrib at  $60^\circ$  at middle, drying weakly and narrowly rounded, concolorous above and below; tertiary veins drying indistinct above and below; collective veins arising from basal veins, 2 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface conspicuously glandular-punctate, weakly granular-ridged; lower surface conspicuously and densely glandular-punctate, conspicuously granular. *Inflorescence* with peduncle 24.6–34.8 cm long; spathe green, spreading, 2.2–3.8 cm long, 4–5 mm wide, linear-lanceolate, drying coriaceous and yellowish brown; spadix yellowish, stipitate (to 4 mm), cylindroid, 1.8–6.6 cm long, 3–5 mm diam., drying yellowish brown; flowers 2–3 visible per spiral, drying 2.8 mm long, 2.5 mm wide; tepals drying minutely granular; lateral tepals 1.8 mm wide, inner margin rounded, outer margins 2-sided; stamens held at level of tepals, 0.6 mm long, 0.6 mm wide, at least sometimes with all four stamens present at a time. *Infructescence* with berries red.

**Distribution and ecology** — *Anthurium pacevedoi* is endemic to Colombia, known only from the Municipio Frontino and Municipio Urrao in the region of the Parque Nacional Natural Las Orquídeas at 1500–1860 m in a *Lower montane wet* forest life zone.

**Etymology** — *Anthurium pacevedoi* is named for Puerto Rican botanist, Pedro Acevedo Rodríguez from the Smithsonian Institute. Pedro is a specialist in the systematics and floristics of Sapindaceae and the floristics of the West Indies, especially of Puerto Rico and the Virgin Islands and works also with the diversity and evolution of Neotropical lianas and climbing plants.



**Comments** — In the Lucid Anthurium Key, *Anthurium pacevedoi* tracks to *A. deflexum* Engl. and resembles that species. That species differs by having more coriaceous, darker brown-drying blades with the upper blade surface having distinctly mound-shaped epidermal cells and with its glandular punctations few and diffuse as well as by having berries which are usually white or white tinged reddish at apex, not fully red as in *Anthurium pacevedoi*.

*Sanchez et al.* 987 is perhaps also *Anthurium pacevedoi* but differs by having blades somewhat more elliptic (3.2–3.8 times longer than broad) and flowers with all the stamens persisting, in contrast to other known collections of *A. pacevedoi* which have only a few stamens persisting (stamens presumably being withdrawn after anthesis).

Paratypes: COLOMBIA Antioquia: Municipio Frontino, 06°52'03"N, 75°44'46"W, 1630 m 15 Jan. 1987, *D. Sánchez S.* 987 (MEDEL); Frontino, Corregimiento Nutibara, Cuenca Ala del Río Cuevas, 1750 m, 06°47'00"N, 76°15'00"W, 8 July 1986, *D. Sánchez S.*, *C. Orrego*, *S. Sylva*, *G. Martínez* & *D. Restrepo et al.* 178 (MEDEL); Municipio Frontino, Corregimiento La Blanquita, Región Murri, road from Nutibara to La Blanquita, 14.6 km west of Nutibara, 4–7 km from Alto de Cuevas-La Blanquita, 1350–1450 m, 06°45'00"N, 76°25'00"W, 10 July 1988, *R. Callejas et al.* 6524 (HUA, MO); Municipio Frontino; km 17 on Nutibara to La Blanquita Road, Region of Murri, 1860 m, 06°45'00"N, 76°24'00"W, 3 Nov. 1988, *J. L. Zarucchi*, *G. McPherson*, *F.J. Roldán*, & *O. Escobar* 7058 (COL, MO); Municipio Urrao, Sector de Calles, Quebrada “La Siberia”, 1380–1530 m, 06°31'00"N, 76°19'00"W 25 Mar. 1991, *J.G. Ramírez et al.* 4018 (JAUM, MO).

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***Anthurium pallidifibrum*** Croat, **sp. nov.** — Type: COLOMBIA. Antioquia: Parque Nacional Natural Las Orquídeas, Sector Venados, margen derecha del Río Venados, 850 m, 06°33'N, 76°19'W, 850 m, 4 June 1988, *A. Cogollo* & *J.G. Ramírez* 3208 (holotype, JAUM-018253). **Figure 167.**

**Diagnosis:** *Anthurium pallidifibrum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short slender internodes, dense, semi-erect, pale brownish cataphyll fibers, moderately short-petiolate leaves with subterete petioles and a short geniculum, more or less oblong, gradually long-acuminate blades which dry grayish brown and eglandular above, yellowish brown and conspicuously glandular-punctate below, a narrowly raised upper midrib and primary lateral veins somewhat less conspicuous than the collective vein which arises from the base as well as by the long-pedunculate inflorescence with a pale yellow, inrolled spathe, a yellowish green, narrowly long-cylindroid spadix and violet-purple berries.



Figure 167. *Anthurium pallidifibrum* Croat. Holotype: Cogollo & Ramirez 3208.



**Figure 168.** *Anthurium palmitasense* Croat. Holotype: Pipoly et al. 17507.

Epiphytic; internodes short, 8 mm diam., drying 5–6 mm diam.; cataphylls 6.3–6.5 cm long, densely moderately pale brown-fibrous, the fibers mostly closely parallel; petioles 6.2–12.5 cm long, 2 mm diam., subterete, drying acutely sulcate, yellowish brown; geniculum 5–6 mm long, drying darker than petioles; blades narrowly oblong-lanceolate to oblong oblanceolate, 25.8–31.0 cm long, 2.6–3.6 cm wide (averaging  $28 \times 3$ ), 8.6–10.3 (averaging 9.5) times longer than broad, broadest midway, 2.5–4.3 (averaging 3.3) times longer than petioles, gradually and prominently acuminate at apex (acumen to 1.4 cm), obtuse at base, subcoriaceous, drying grayish brown and weakly glossy above, yellowish brown and weakly glossy below; midrib drying narrowly acute and darker above, narrowly raised and concolorous below; primary lateral veins 12–14 per side, departing midrib at  $55\text{--}60^\circ$  at middle, narrowly rounded, concolorous above and below; tertiary veins drying moderately distinct above and below: collective veins arising from basal veins, 2–3 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface eglandular, densely dark-speckled, minutely areolate on magnification, sparsely pustular; lower surface conspicuously and densely glandular-punctate, faintly dark-speckled, sparsely pustular. *Inflorescence* with peduncle 12.5–25.2 cm long; spathe pale yellow, inrolled, 3.3–5.4 cm long, 2–4 mm wide, linear, drying thin and pale brown, easily deciduous; spadix yellowish green, subsessile, narrow and scarcely aperted, 6.6–10.9 cm long, 3–7 mm diam., ca. 22 times longer than broad, drying pale brown; flowers 2–3 visible per spiral, drying 2.4–3.3 mm long, 2.8 mm wide; tepals drying minutely granular; lateral tepals 1.4–1.7 mm wide, inner margin broadly rounded, outer margins 2-sided; stamens not yet emergent; anther 0.6 mm wide, 0.15 mm long, thecae broadly divaricate. *Infructescence* with berries violet-purple (as per label, not seen).

**Distribution and ecology** — *Anthurium pallidifibrum* is endemic to Colombia, known only from the Department of Antioquia in the Parque Nacional Natural Las Orquídeas, Sector Venados at 850 m in a Tropical wet forest life zone

**Etymology** — The species epithet comes from the Latin ‘*pallidus*’ (meaning pale) and ‘*fibra*’ (meaning fiber) referring to the pale cataphyll fibers so prominently displayed on the stems.

**Comments** — *Anthurium pallidifibrum* is most similar to *A. friedrichsthali* Schott based on the size and shape of its blade but that species differs by having proportionately more slender, more elongated leaf blades and bright yellow-orange rather than violet-purple berries.

***Anthurium palmitasense*** Croat, **sp. nov.** — Type: COLOMBIA. Antioquia. Municipio Urao, Zona limítrofe del Parque Nacional Natural Las Orquídeas, Vereda Calles, Alto de Palmitas, ca. 1 km de Cabaña de Calles del INDERNA, 06°32'N, 76°19'W, 1300–1400 m, 1 Dec. 1993, J. Pipoly, W. Rodríguez, J. Velez & O. Alvarez 17507 (holotype, MO-04603594; isotype, JAUM, not seen). *Figure 168.*

*Diagnosis:* *Anthurium palmitasense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent, brownish cataphyll fibers, subterete, slender petioles drying narrowly and sharply sulcate, narrowly ovate-elliptic, gray-green-drying blades which are narrowly long-acuminate at apex and weakly attenuate at the base, glandular-punctate on both surfaces as well as by the long-pedunculate inflorescence, slender peduncle, narrowly inrolled, green, spreading spathe and moderately long-stipitate, narrowly cylindroid, green spadix.

Epiphytic; internodes short, 1.1 cm diam.; cataphylls 2.0–2.5 cm long, persisting as loose, pale, more or less spreading fibers; petioles 5.2–11.3 cm long, 2 mm diam., subterete, narrowly and sharply sulcate, grayish brown; geniculum 4–8 mm long, drying darker than petioles; blades narrowly ovate-elliptic, 8.8–13.2 cm long, 1.5–4.2 cm wide (averaging  $10 \times 3$ ), 3.1–5.9 (averaging 4.0) times longer than broad, broadest below midway, 0.9–1.8 (averaging 1.4) times longer than petioles, gradually acuminate at apex (acumen to 1.5 cm), acute to weakly attenuate at base, subcoriaceous, drying gray-green, weakly glossy above, yellowish gray-green, slightly glossier below; midrib drying narrowly raised, sparsely glandular-punctate and slightly paler above, narrowly raised to narrowly acute, sparsely glandular-punctate and slightly paler below; primary lateral veins 5 or 6 per side, departing midrib at 55°, drying narrowly rounded and concolorous above, narrowly raised and concolorous below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from basal veins, 3 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface moderately densely glandular-punctate, densely granular, weakly black-speckled, sparsely pustular; lower surface conspicuously and more densely glandular-punctate, densely granular, moderately pustular. *Inflorescence* erect, as long as or longer than the leaves; peduncle 18.8–21.2 cm long, drying 1.5 mm diam., greenish brown; spathe mostly missing, green, spreading; spadix green, stipitate (2–5 mm), cylindroid, 2.5–3.7 cm long, 4 mm diam., drying brown; flowers 3 visible per spiral, drying 2.2–2.4 mm long, 1.8–2.0 mm wide; tepals drying papillate-granular; lateral tepals 1.3 mm wide, outer margins 2-sided, inner margin rounded; stamens held at level of tepals; anthers 0.4 mm long and wide; thecae ellipsoid, scarcely divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium palmitasense* is endemic to Colombia, known only from the type locality in Antioquia Department in the Parque Nacional Natural Las Orquídeas at 1300–1400 m in a *Tropical wet forest* life zone.

**Etymology** — The species is named for the type locality on the Alto de Palmitas in the Parque Nacional Natural Las Orquídeas in Antioquia Department.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium palmitasense* tracks to *A. brevipes* Sodiro, which differs by having larger blades which are more acute at the base and shorter peduncles; *A. chucunesense* Croat which differs by having blades which dry dark brown with a prominent collective veins; *A. friedrichstabilii* Schott, which differs by having longer, proportionately more slender, typically pendent leaf blades and *A. purdieanum* Schott, which differs by having longer internodes, intact cataphylls and more broadly ovate blades.

*Anthurium palmitasense* comes to *Anthurium gracililaminatum* Croat in the key to Panamanian species but that species differs by having much larger blades, much more prominent primary lateral veins, less prominent glandular-punctations on the upper surface and peduncles only about as long as or slightly longer than the petioles.

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***Anthurium pedernalense* Croat, sp. nov.** — Type: ECUADOR. Manabí: Pedernales Cantón, Reserva Ecológica Mache-Chindul, Cerro Pata de Pájaro, Cabaceras de Río Vite, estero Nuquepe, bosque al norte de La Loma de Pájaro y carretera vial Carmen, 00°01'N, 79°45'W, 300–700 m, 7 Apr. 1977, J.L. Clark, T. Nuñez and C. Robles 4327 (holotype, QCNE; isotype, MO-5161042). **Figure 169.**

**Diagnosis:** *Anthurium pedernalense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, cataphylls persisting as fibers, petioles acutely triangular with 2 marginal ribs, the oblong-elliptic blades glandular-punctate on both surfaces and with inconspicuous primary lateral veins and prominent collective veins as well as by its long, gradually tapered spadix with purple, cone-shaped berries.

Epiphytic; internodes short 0.3–0.5 cm, 0.6 cm diam.; cataphylls persisting as dark brown fibers, 2–6 cm long. *Leaves* 70 cm long; petioles 23–25 cm long, acutely triangular with 2 marginal ribs, drying gray-green; blades oblong-elliptic, 43–46 cm long, 11–13 cm wide, 3.7 times longer than broad, 1.8 times longer than petiole, long-tapered acuminate at apex, cuneate at base, subcoriaceous, drying semiglossy, dark grey-green above, matte, light gray-green below; midrib narrowly acute adaxially, broadly convex abaxially drying coarsely ribbed; primary lateral veins inconspicuous, about 60 per side, departing midrib at 40–50°; collective veins more prominent than primary lateral veins, arising from the base, running 1.3 cm from the margin near the base to 0.3 cm from the margin near the apex; upper surface minutely granular textured with dark glandular punctations; lower surface dark glandular punctate with larger, light pustules. *Inflorescence* with peduncle 32.4 cm long, 0.3 cm diam.; spathe green 9.5 cm long,





Figure 169. *Anthurium pedernalense* Croat. Holotype: Clark et al. 4327



**Figure 170.** *Anthurium prominor* Croat. Holotype: Croat & D. C. Bay 75676 (sheet 2).



**Figure 171.** *Anthurium prominor* Croat. Isotype: Croat & D. C. Bay 75676 (sheet 3).





**Figure 172.** *Anthurium prominor* Croat. Croat & D. C. Bay 75676. Inflorescence.



**Figure 173.** *Anthurium prominor* Croat. Croat & D. C. Bay 75676. Habit of potted plant.

1.5 cm wide; spadix narrowly long-tapered, 17 cm in early fruit, 5.5 mm diam.; flowers 0.9–1.1 mm long, 1.3–1.4 mm wide, tepals moderately granular, 1.2–1.4 mm wide, broadly 2-sided, stamens held at level of tepal, closely aggregated 0.4 mm long, 0.4 mm wide; *Infructescence* 48.9 cm long, erect; with purple, cone-shaped berries 3 mm long, 1.5 mm diam. drying dark brown; berries purplish violet with pale cellular inclusions; seeds 2.5 mm long, 1.8 mm diam.

**Distribution and ecology** — *Anthurium pedernalense* is endemic to NW Ecuador in the Mache-Chindul Ecological Reserve at 300–700 m in a *Premontane wet forest* life zone.

**Etymology** — *Anthurium pedernalense* is named for the type locality in Pedernales Cantón in Manabí Province.

**Comments** — In the Lucid Anthurium Key, *Anthurium pedernalense* tracks with *A. centinellense* Croat which has cataphyll fibers which persist as longer fibers (4–12 cm) and oblanceolate blades with 8–12 distinct primary lateral veins per side; *A. pellucidopunctatum* that has shorter petioles (15–20 cm), smaller blades (30–35 × 8–10 cm), a shorter peduncle (15–18 cm) and a shorter spadix (9 × 5 cm).

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***Anthurium prominor*** Croat, **sp. nov.** — Type: COLOMBIA. Valle del Cauca: Bajo Calima Region, along road between Buenaventura and Málaga, vicinity of km 50.7, right (N side) of road in deep ravine along stream, 04°02'N, 77°05'W, 43 m, 12 July 1993, T.B. Croat & D.C. Bay 75676 (holotype, MO-4572432). *Figures 170–173.*

*Diagnosis:* *Anthurium prominor* is a member of sect. *Porphyrochitonium* and is distinguished by its long, dark brown roots, narrow, ovate-elliptic blades which are dark punctate on both surfaces, the sharply sulcate petioles and particularly by the rather stout spadix which is blunt at the apex, usually golden-yellow in flower and lavender in fruit with white berries. Another feature is the peduncle which is very smooth and reddish both fresh and dried.

Epiphytic; stem short, to 20 cm long; internodes 1.0–2.5 cm wide; roots few per node, to 30 cm long, often branching, drying dark brown; cataphylls 6–16 cm long, persisting as weathered fibers, light tan to light red. Leaves 18.4–66.1 cm long (averaging 42.1), erect to erect spreading with petioles 3.0–24.8 cm long (averaging 14.8 cm), 3–7 mm diam., sharply C- or U-shaped adaxially, medium green, drying olive-green; geniculum 1.0–1.8 cm long, drying darker than petiole; blades ovate to narrowly elliptic, 15.4–41.3 cm long, 4.4–14.8 cm wide (averaging 27.3 × 8.7), 2.2–5.6 times longer than wide (averaging 3.3), 0.9–5.1 times longer than petiole (averaging 2.0), broadest near the middle or slightly below, subcoriaceous,



acuminate to abruptly acuminate at apex, cuneate to obtuse at base, drying semiglossy to glossy, rarely matte, dark green to yellow-green above, semiglossy to glossy, drying matte, light olive-brown, paler than upper surface below; midrib convex, somewhat acute toward apex, drying reddish above, paler below; primary lateral veins 17–29 per side, departing midrib at 35–60°, straight to innermost collective vein, concolorous, obscure to weakly raised above and below; collective veins arising from the base, running 1.0–1.5 cm from the margin near the base, to 0.5 cm near the middle and 3–4 mm near the apex, narrow, acute but distinct yet less prominent than the collective veins of many sect. *Porphyrochitonium* species, 2nd pair of collective veins forming in lower 1/6 of blade; tertiary veins inconspicuous and reticulate; upper surface minutely dark brown glandular-punctate; lower surface abundantly dark brown glandular-punctate, often somewhat verrucose. *Inflorescence* erect, 16–72 cm long (averaging 35.5 cm) with peduncle 7.5–32.0 cm long (averaging 18.7 cm), often longer than petiole and reddish or purplish, drying smooth and medium reddish brown; spathe spreading to reflexed, 5–14 cm long, 0.7–1.5 cm wide, green tinged with purple, acuminate at apex, drying dark brown; spadix sessile, cylindrical but slightly tapered near apex, 7.3–40.3 cm long (averaging 17.5 cm), 0.5–1.2 cm diam. near the base, 3–4 mm near the apex, greenish becoming yellow or golden-yellow, lavender in fruit; flowers 5–8 visible in spiral, 3–5 mm long, 1.5–3.0 mm wide; tepals granular on the surface, the outer margins 3-sided, inner margins slightly rounded, lateral tepals 2.7–3.5 mm wide, stigma 0.2–0.3 mm long, linear, stamens scarcely emerging beyond tepals, thecae divaricate, 0.8 mm wide, 0.4 mm long. *Infructescence* with berries lavender to white, globose, depressed in the center, seeds ellipsoid, 2 mm long, 1.1 mm diam., 2 per berry.

**Distribution and ecology** — *Anthurium prominor* ranges along the Pacific Andean slopes of Colombia and in Esmeraldas Province, Ecuador and occurs in Tropical wet forest transition to Premontane rain forest life zones from sea-level to 550 m. In the Bajo Calima region, it was collected in primary and regrowth forest. *Anthurium prominor* was collected in the Bajo Calima region when in flower in February, July, August, September and November and when in fruit in July and December.

**Etymology** — The species epithet comes from the Latin ‘*prominens*’ (meaning prominent) and ‘*minor*’ (meaning smaller or lesser), referring to the prominence of the minor veins which are so outstanding on this species in comparison to the normal minor lateral veins in the section.

**Comments** — In the Lucid Anthurium Key, *Anthurium prominor* tracks to: *A. joaquinense* Croat & D.C.Bay which may be distinguished by its dried blades being dark green rather than dark brown, primary lateral veins departing midrib at 55–60° (rather than 45–55°), a spadix

which is usually smaller at 6–12 cm and berries that are maroon to purple; *A. paludosum* Engl. which differs by having shorter cataphylls (3–4 cm), shorter geniculum 4–5 mm long, smaller blades (usually 12–15 × 4–5 cm), a smaller spathe (3.5–4.0 cm long) and stipitate spadix; *A. wattii* Croat & D.C. Bay which has longer petioles (18–36 cm), longer blades (30–55 cm), glandular punctations present only on the lower surface and dark red berries.

*Anthurium prominor* has been confused with the *Anthurium barbacoasense* Engl. from 500 m in the area of Barbacoas in Nariño Department. That species differs by having cataphylls less than 4 cm long that persist intact, petioles sheathed 0.35–0.40 its length (versus 0.1–0.2(0.3) its length for *Anthurium prominor*), leaf blades which are proportionately broader toward the base and narrowly rounded at the apex with a weak apiculum (versus shortly and abruptly acuminate in *A. prominor*) and has primary lateral veins and the minor veins prominently raised on both surfaces with the punctations both more sparse and less conspicuous.

Material described here was included in the original version of the Araceae of Bajo Calima (D. C. Bay, 1996) as *Anthurium barbacoense* Engl. but recent comparisons with the type specimen of that species has proven it to be distinct.

**Paratypes:** COLOMBIA. **Chocó:** Along road between Medellín and Quibdó, 73 km W of Bolívar, 533 m, 11 Dec. 1979, *T.B. Croat* 49281 (MO). Valle del Cauca: Bajo Calima, along road between Buenaventura and Málaga, 04° 02'N, 77°05'W, 43 m, 12 July 1993, *T.B. Croat & D.C. Bay* 75676; 75676A (MO); Km 51.7 from main Cali-Buenaventura Hwy, 04°03'N, 77°05'W, 50 m, 16 July 1993, *T.B. Croat & D.C. Bay* 75794 (MO); at 40 km, 04°04'N, 77°09'W, 100 m, 5 Feb. 1990, *T.B. Croat* 70166 (MO); Between Río Calima, Carretera Hans at km 22 on main road to Canalete, 04°02'N, 77° 51'W, 50–60 m, 21 July 1988, *T.B. Croat* 69504 (MO); 40 km N of Buenaventura, W of San Isidro, 03°58'N, 77°00'W, 50 m, 19 Dec. 1987, *A. Gentry, M. Monsalve, M.D. Heredia & R. Keating* 59608 (MO); Along road from Buenaventura to Río Calima at 12.5 km, 03°56'N, 77°01'W, 160 m, 4 Feb. 1990, *T.B. Croat* 70140 (MO); Concesión Pulpapel/Buenaventura, 03°55'N, 77°01'W, 100 m, 7 Sep. 1984, *M. Monsalve B.* 371 (MO); Concensión Cartón de Colombia, 03°56'N, 77°10' W, 230 m, *D. C. Bay* 261 (MO); 50–100 m, 11 Feb. 1984, *A. Juncosa* 2124 (MO); 100 m, *M. Monsalve* 190 (MO).

***Anthurium purpuribacca*** Croat, **sp. nov.** — Type: ECUADOR. Pastaza: Cantón Pastaza, 5.3 km NW of center of Shell, along gravel rd. 1.1 km N of hwy., 01°27'S, 78°04'W, 1180 m, 4 Apr 1992, T.B. Croat 73502 (holotype, MO-5197448; isotypes, B, CAS, F, K, MO, NY, US). **Figures 174–177.**

*Diagnosis:* *Anthurium purpuribacca* is a member of sect. *Porphyrochitonium* and is distinguished by sharply and deeply sulcate petioles, subcoriaceous, dark green and somewhat glossy blades with glandular punctations on only the lower surface as well as by the square pistils and purple fruits.

Terrestrial; internodes short, 1.8–2.5 cm diam.; cataphylls 4–6 cm long. *Leaves* with petioles 20–38 cm long, 1/6–1/7 as long as blades, terete when young, becoming thicker than broad, 7 mm thick, less than 5 mm wide, sharply and deeply sulcate, dark green, weakly glossy, drying dark yellow-brown; geniculum 3 cm long, broader than petioles, sharply sulcate; blades oblong-elliptic, 35–57 cm long, 10–19 cm wide, 3.0–3.5 times longer than wide, weakly short-acuminate at apex, acute at base, subcoriaceous, weakly glossy above, yellow-green, moderately paler and glossy below, drying gray-brown and matte above, yellowish gray-brown and semiglossy below; midrib raised on both surfaces, more acutely so on upper surface, drying pale yellow, darker on the lower surface; primary lateral veins 15 or 16 per side, departing midrib at 60° (to 80° near base); basal veins 2 pairs, both arising near base, the inner pair extending to the apex, 1.0–1.2 cm from margin; collective veins 2 pairs, both arising from near the base, inner pair extending to apex, outer pair of collective veins 1–2 mm from margin, merging with margin near apex; upper surface eglandular, densely granular to ridged-granular; lower surface smoother, somewhat pale speckled, conspicuously dark glandular-punctate. *Inflorescence* erect; peduncle 52.5 cm long; spathe green, reflexed-spreading, oblong, 7.5 cm long, 8 mm wide, acuminate at apex with pointed tip, drying dark brown; spadix 9–11 cm long, weakly tapered toward apex, dark green, soon tinged purple; flowers 7–8 per spiral, 3.8–4.3 mm long, 3.2–3.5 mm wide; lateral tepals 2.5–2.7 mm wide, outer margin 3-sided to weakly shield-shaped, inner margin straight to concave; pistil square in visible area, 1.3 mm x 1.0 mm wide. *Infructescence* with berries purple.

**Distribution and ecology** — *Anthurium purpuribacca* is endemic to Ecuador, known from the region of Pastaza, growing at 1180 m in a Premontane wet forest life zone.

**Etymology** — The species epithet is from the Latin '*purpureus*' (purple) and '*bacca*' (berry).

**Comments** — In the Lucid Anthurium Key, *Anthurium purpuribacca* tracks to a number of species, all of which occur only on the Pacific slope of the Andes, *A. fuscopunctatum* Sodiro which differs by having petioles about 1/3 as long as the blades rather than 1/6 to 1/7th as long as the blades, leaf blades which are 4 or more times longer than broad versus less than 3.5 times longer as well as a much longer spadix (15–20 cm long); *A. julospadix* Sodiro, from the Lita-San Lorenzo region, which differs by having long slender blades 5.7–5.8 times longer than wide; *A. myosuroides* Sodiro, from Imbabura Province, which differs by having a



Figure 174. *Anthurium purpuribacca* Croat. Holotype: Croat 73502.



**Figure 175.** *Anthurium purpuribacca* Croat. Croat 73502. Habit of potted plant.





**Figure 176.** *Anthurium purpuribacca* Croat. Croat 73502. Leaf blade, adaxial surface.





**Figure 177.** *Anthurium purpuribacca* Croat. Croat 73502. Cataphylls.



Figure 178. *Anthurium sursumtepalum* Croat. Holotype: Cajellas et al. 6704.

spadix about 3 or more times longer than spathe (compared to only slightly longer than spadix for *A. purpuribacca*) and with white rather than purple berries; *A. punctatum* N.E.Br., which differs by having proportionately longer, more slender leaf blades more than 5 times longer than wide as well as by its white berries; *A. quinquesulcatum* Sodiro, which differs by having both surfaces of the blades glandular-punctate and by having a many-ribbed peduncle and *A. tenuispiccum* Sodiro which differs by having proportionately longer petioles which are nearly as long as the blades, more grayish drying blades and a more slender, proportionately longer spadix, 25–30 cm long.

*Paratypes*: ECUADOR. Napo: Cantón Aguarico, Parque Nacional Yasuní, Lagunas de Graza Cocha, 01°01'S, 75°47'W, 200 m, *C.E. Cerón & N. Gallo 5003* (MO); Res. Faunística Cuyabeno near Pto. Bolívar at confluence of Río Tarapui and Río Cuyabeno, 00°05'S 76°10'W, 300 m, *H. Balslev 4780* (NY).

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***Anthurium sursumtepalum*** Croat, **sp. nov.** — Type: COLOMBIA. Antioquia: Municipio Frontino, Corregimiento La Blanquita, Región de Murri, vía Nutibara-La Blanquita, 14.5 km O. de Nutibara, 15–16 km del Alto de Cuevas-La Blanquita, 06°45'N, 76°25'W, 890–900 m, 13 July 1988, *R. Callejas, J. Betancur, A.L. Arbeláez & I.D. Castaño 6709* (holotype, MO-3686691; isotype, HUA). **Figure 178.**

*Diagnosis*: *Anthurium sursumtepalum* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, persistent, reddish brown cataphyll fibers, long-petiolate leaves, petioles which dry sharply sulcate adaxially and have a very short geniculum, narrowly oblanceolate, brown-drying, acuminate blades which are eglandular on the upper surface with an acute midrib and obscure primary lateral veins and glandular-punctate with faint primary lateral veins on the lower surface as well as by the long-pedunculate inflorescence with a green, linear spathe and very long, scarcely tapered, green spadix with very long flowers and with the dried tepal margins turning outward.

Epiphytic; internodes short, 1.4–1.7 cm diam.; cataphylls 5.8–6.2 cm long, persisting intact at apex, becoming fibrous with fragments of brown epidermis, the fibers brown, loosely parallel. *Leaves* with petioles 7.2–18.8 cm long, 3 mm diam., subterete, drying acutely sulcate, dark yellowish brown; geniculum 6–13 mm long, drying darker than petioles, about as thick; blades narrowly oblong-oblanceolate, 27.5–35.3 cm long, 4.9–7.3 cm wide (averaging 32 × 6), 4.8–5.6 (averaging 5.3) times longer than broad, broadest above the middle, 1.9–3.9 (averaging 3.0) times as long as petioles, gradually acuminate at apex, acute at base, subcoriaceous, drying dark brown, matte above, yellowish red-brown, weakly glossy below; midrib drying narrowly acute, and slightly darker above, narrowly raised, sparsely glandular-punctate, finely ribbed

and slightly darker below; primary lateral veins 16–18 per side, departing at 55–60° at middle, drying weakly and narrowly raised, paler above, narrowly rounded and concolorous below; tertiary veins drying indistinct above, weakly raised below; collective veins arising from basal veins, 3–4 mm from margin; basal veins 1 pair; antemarginal vein present; upper surface epunctate, moderately smooth, sparsely pustular; lower surface sparsely and weakly glandular-punctate, densely pustular. *Inflorescence* erect-spreading; peduncle 22.5–28.3 cm long; spathe green, 6.2 cm long, 5 mm wide, linear, drying subcoriaceous and reddish brown; spadix green, sessile, long and weakly tapered, 24.7–25.9 cm long, 3–4 mm diam., drying brown; flowers 3 visible per spiral, drying 4.0–4.7 mm long, 1.6–2.0 mm wide; tepals drying minutely granular; lateral tepals 3.1 mm wide, outer margins 2-sided, inner margin broadly rounded; stamens not visible. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium sursumtepalum* is endemic to Colombia, known only from the type locality in Antioquia Department, Municipio Frontino at 890–900 m in a *Pre-montane rain forest* life zone.

**Etymology** — The epithet comes from the Latin ‘*sursum*’ (meaning upwards, from below) referring to the upturned margins of the dried tepals on the spadix.

**Comments** — *Anthurium sursumtepalum* appears to be closest to *A. margaricarpum* which differs by having proportionately thinner, greenish drying, longer acuminate leaf blades and a shorter spadix. In the Lucid Anthurium Key, *Anthurium sursumtepalum* also keys to *A. acutangulum* Engl., which differs by having proportionately broader, more elliptic blades with more prominent primary lateral veins and a pendent inflorescence; *A. arusiense* Croat & M.M.Mora which differs by having proportionately shorter petioles, blades with more prominent primary lateral veins and the upper blade surface short-pale-lineate as well as by having a proportionately shorter spadix which is light grayish brown; *A. brevipes* Sodiro which differs by its proportionately shorter more elliptic blades, by a shorter spreading spathe with the margins rolled under and a shorter sharply pointed spadix and *A. punctatum* N.E. Br. from western Ecuador which differs by having blades more acute at the apex, collective veins that are more remote from the margins and by its stipitate spadix.

*Paratype*: COLOMBIA. Antioquia: Parque Nacional Natural “Las Orquídeas”, Sector Venados, margen derecha de Río Venados, 850 m, 4 June 1988. *A. Cogollo* & J.G. Ramírez 3217 (JAUM).

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*Anthurium tarapuiense* Croat, **sp. nov.** — Type: ECUADOR. Napo: Cantón Aquarico, Reserva Faunística Cuyabeno near Pto. Bolívar at confluence of Río Tarapui and Río Cuyabeno, 00°05’S, 76°10’W, 300 m, 19 Jan. 1984, *H. Balslev* 4780 (holotype NY; isotype, MO-3683284). **Figures 179 & 180.**

**Diagnosis:** *Anthurium tarapuiense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, subterete petioles with a medial rib, ovate to narrowly elliptic blades which are 1.6–2.6 times longer than petioles, prominent collective veins which arise at the base and run 5–8 mm from the margins as well as a green, lanceolate spathe and a green spadix.

Epiphytic; internodes short, 2–4 mm long, 0.8 cm diam.; cataphylls persisting as short reddish brown fibers 3–5 cm long. *Leaves* 56 cm long with petioles subterete, 13.5–23.8 cm long, 3–4 mm diam., adaxially sulcate with acute margins and a medial rib, drying medium brown; blades ovate to narrowly elliptic, 35.0–37.5 cm long, 6.4–12.0 cm wide (averaging 9 cm), 3.2–5.5 times longer than wide (averaging 4.4), 1.6–2.6 times longer than petiole (averaging 2.2), acuminate at the apex, narrowly cuneate at the base, subcoriaceous, drying dark brownish green above, lighter yellowish green below; midrib narrowly convex, finely ribbed, concolorous upper and lower surfaces; primary lateral veins 16–18 per side, departing midrib at 50–60°, concolorous on upper and lower surfaces, irregularly curved or angled, inconspicuous and with many interprimary veins not markedly weaker than the primary lateral veins; collective veins more prominent than primary lateral veins, running 5–8 mm from margin; upper surface eglandular, somewhat pustular; lower surface minutely dark glandular-punctate with paler and larger pustules. *Inflorescence* ca. 21 cm long, erect; peduncle 14–16 cm long, 2 mm diam., ribbed; stipe 3 mm long, 2 mm diam.; spathe sub-pendent, green, 3.5–5.0 cm long, 0.6–1.0 cm wide, oblong-elliptic, drying dark brown; spadix 5.5–8.4 cm long 0.5–0.8 cm wide, green, drying dark brown; flowers 4–5 per spiral, 3-sided, tepals 0.8 × 0.5 m. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium tarapuiense* is endemic to Ecuador, known only from the type locality in Napo Province at 300 m elevation in a Tropical moist forest life zone.

**Etymology** — The species epithet refers to the Río Tarapui in the type locality.

**Comments** — *Anthurium tarapuiense* is most easily confused with *A. apapuranum* R.E.Schult. that differs by having the collective veins 1–2 mm from the margins and in having the primary lateral veins slightly more prominent than the interprimary veins and with many more interprimary lateral veins present. *Anthurium apapuranum* also has a longer, wider spadix; *A. collettianum* may be distinguished from *A. tarapuiense* in having purplish violet spadices and spathes that are longer and more slender. In the Lucid Anthurium Key, *Anthurium tarapuiense*



Figure 179. *Anthurium tarapuiense* Croat. Holotype: Balslev 4780.





Figure 180. *Anthurium tarapiense* Croat. Paratype: Ceron & Gallo 5003.



Figure 181. *Anthurium unguense* Croat. Holotype: Gentry 17039.

tracks with *A. julospadix* Sodiro which may be distinguished by having longer, narrower blades (length-width ratio 5–7) and a spadix that is magenta to purple in color; *A. pedunculare* Sodiro which differs by having smaller blades (15–20 cm × 3.5–5 cm), collective veins only 2–4 mm from the blade margin and peduncles twice the length of the petioles and *A. verrucosum* Croat & D.C.Bay in which the upper surface of the blades is conspicuously and profusely verrucose, the primary lateral veins are prominently raised and darker than the blade on the lower surface and the spadix is sessile.

*Paratypes*: ECUADOR. Napo: Cantón Aguarico; Parque Nacional Yasuní, Lagunas de Garza Cocha, 22 Sep. 1988, C.E. Cerón & N. Gallo 4863 and 5003 (both MO).

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*Anthurium unguiense* Croat, **sp. nov.** — Type: COLOMBIA. Chocó: Serranía del Darien west of Unguía on Panamanian border, ca. 08°02'51"N, 77°13'25"W, 1150 m, 26 July 1976, A. Gentry, H. Leon & L.E. Forero 17039 (holotype, MO-2400439). **Figure 181.**

*Diagnosis*: *Anthurium unguiense* is a member of sect. *Porphyrochitonium* and is characterized by its epiphytic habit, short internodes, fine, reddish brown, persistent cataphyll fibers, subtriangular-winged petioles, oblong-elliptic, brownish drying blades with a single pair of basal veins, glandular punctations on lower surface only, as well as by the short-pedunculate inflorescence with a slender, reddish, erect-spreading spathe and a green, weakly tapered spadix. The upper dried blade surface is unusual in being densely dark-speckled (not glandular-punctate) and prominently pale short-lineate-pustular to punctiform-pustular.

Epiphytic; internodes short, 9 mm diam.; cataphylls 3.4–3.7 cm long, acute persisting intact at apex, becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown, mostly closely parallel. *Leaves* with petioles 5.8–13.7 cm long, 3–4 mm diam., about half as long as blades, subtriangular, somewhat flattened adaxially with thin erect margins and several faint ribs medially, acutely angular-winged abaxially, drying reddish dark brown; geniculum 6–7 mm long, drying darker than petioles, shaped like the petiole; blades oblong-elliptic, 14.6–30.6 cm long, 2.6–6.1 cm wide (averaging 24 × 5), 5.0–5.6 (averaging 5.2) times longer than broad, (1.7) 2.2–2.5 (averaging 2.3) times longer than petioles, gradually acuminate at apex, narrowly acute at base, drying subcoriaceous, dark olive-brown and matte above, yellowish medium brown and matte below; midrib drying round-raised and slightly darker above, narrowly raised and darker below; primary lateral veins 9–12 per side, but difficult to discern from interprimary veins, departing midrib at 65°, drying weakly and narrowly raised, concolorous above, narrowly raised and concolorous below; secondary veins drying scarcely more visible than surface above, prominulous below; collective veins arising from basal veins 3–4 mm from margin; basal veins 1 pair; upper surface eglandular, densely

dark- speckled and prominently pale short-lineate-pustular to punctiform-pustular; lower surface glandular-punctate, sparsely dark speckled and irregularly short-ridged. *Inflorescence* with peduncle 6.3 cm long, triangular-winged; spathe erect-spreading, reddish, moderately coriaceous, drying dark reddish brown; spadix green, sessile, long weakly tapered, 7.4 cm long, 4 mm diam., 16.5 times longer than broad, drying dark reddish brown; flowers 4 visible per spiral, drying 2.7 mm long and 2 mm wide; tepals minutely granular on drying; lateral tepals 1.9 mm wide, inner margin rounded, outer margins 2-sided; stamens not exerted. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium unguiense* is known only from a single collection made in Colombia in Chocó Province on the border with Panama in the Serranía del Darién west of Unguía on Panamanian border at 1150 m in a Premontane rain forest life zone. While the type collection was purportedly made in Colombia, *Anthurium unguiense* is assumed here to also be present in adjacent Panama from which Gentry approached the locality.

**Etymology** — The species named for the town of Unguía, Colombia in Chocó Department which is near the type locality on the Panamanian border.

**Comments** — In the Lucid Anthurium Key, *Anthurium unguiense* tracks to *A. brevipes* Sodiro which differs by having the inflorescence about as long as or longer than leaves; *A. cachabianum* Sodiro, which differs by having proportionately broader blades, petioles about as long as the blades and blades which are glandular-punctate on both surfaces; *A. pedunculare* Sodiro, which differs by having more oblong leaf blades which are rounded at the base and with peduncles twice as long as the petioles and *A. margaricarpum* Sodiro, which differs by having proportionately longer petioles, more elliptic blades and an inflorescence which typically exceeds the blades. *Anthurium unguiense* has been confused with *Anthurium dwyeri* Croat which has more conspicuously triangular petioles, typically much broader blades which lack the conspicuously granular and pustular surface.

In the Central American Anthurium revision (Croat, 1986), *Anthurium unguiense* keys out to *A. cartiense* Croat which lacks the leaf blade upper surface conspicuously granular when dried.

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***Anthurium victoriense*** Croat, **sp. nov.** — Type: COLOMBIA. Valle del Cauca: Vicinity of Queremal, Vereda La Victoria, just S of Queremal, on moderately steep slopes, 03°31'06"N, 76°42'57"W, 1450–1480 m, 27 July 1997, *T.B. Croat & J. Gaskin 80411* (holotype, MO-04939346; isotype, CUVc). **Figure 182.**

*Diagnosis:* *Anthurium victoriense* is a member of sect. *Porphyrochitonium* and is characterized by its semi-intact, persistent cataphylls, terete petioles, the large oblong-elliptic blades which are dark green and velvety above and much paler and semiglossy below, with numerous primary lateral veins as well as by its green, reflexed spathe and the greenish white, narrowly cylindroid spadix.

Terrestrial or hemi-epiphytic, to 2 m; internodes short or to 3 cm long, 1.0–2.7 cm diam.; cataphyll persisting semi-intact. Leaves with petioles terete, 26.5–78.4 cm long (averaging 53.9), 0.2–0.7 cm diam., drying coarsely ribbed, medium brown; blades ovate-elliptic, 17.7–56.0 cm long, 7.3–20.8 wide, 2.0–3.3 times longer than broad, 0.5–0.8 times as long as petiole (averaging 0.7), broadly acuminate at apex, broadly cuneate at base, moderately coriaceous, moderately glossy, olive-green, velvety, much paler and semiglossy below, drying dark brownish green above, semiglossy, light grayish green below; midrib narrowly rounded and paler above and below, drying acute and more or less concolorous above, narrowly rounded and more or less concolorous below; primary lateral veins 14–23 per side, quilted-sunken above, pleated-raised below, departing midrib at 40–60°; collective veins more prominent than primary lateral veins, arising 0.7 cm from the margin at the base and running to 0.2 cm near the apex; upper surface with scattered, minute, dark, gland-like punctations; lower surface drying textured and finely granular with abundant, reddish brown, glandular punctations. *Inflorescence* erect; peduncle 53.7 cm long, 0.4 cm diam., drying coarsely ribbed and dark brown; spathe green, reflexed spreading, 11 cm long, 1.3 cm wide; spadix greenish white, semiglossy, 14.2 cm long, 8 mm diam.; flowers 6–7 per spiral, tepals 4 sided. Infructescence not seen.

**Distribution and ecology** — *Anthurium victoriense* is endemic to Colombia, known only from Valle del Cauca Department on the western slope of the Cordillera Occidentale in a Montane rain forest life zone.

**Etymology** — The species epithet refers to the type locality at Vereda La Victoria in Valle del Cauca Department.

**Comments** — *Anthurium victoriense* perhaps most closely resembles *A. claudiae* Croat but that species has longer petioles, peduncles, spathes and spadices, dries dark brown on the upper surface and is more attenuated at the base with a more prominent and narrower acumen at the apex and has fewer primary lateral veins (up to 14 pairs). In addition, *Anthurium victoriense* is found at 1450–1480 m in a Montane rain forest life zone whereas *A. claudiae* is found at 2200 m in Premontane wet forest. Owing to the large size and shape of its leaves, *Anthurium victoriense* may be confused with *A. joaquinense* Croat & D.C.Bay and *A. amargalense* Croat & M.M.Mora.





Figure 182. *Anthurium victoriense* Croat. Holotype: Croat & Gaskin 80411.





Figure 183. *Anthurium vlastimilii* Croat. Holotype: Zak & Espinoza 4727.

Both *Anthurium amargalense* and *A. joaquinense* are found below 150 m in a Tropical wet forest life zone. The blades of *Anthurium amargalense* are more ovate and those of *A. joaquinense* are narrower than the blades of *A. victoriense*.

In the Lucid *Anthurium* Key, *Anthurium victoriense* also tracks with *A. acaimense* Croat, which differs by having an average of 26 primary lateral veins (versus an average of 19 per side), narrower blades with length/width ratio averaging 4 (versus 2.6) and a smaller spathe,  $3.5 \times 0.5$  cm (versus  $11 \times 1.3$ ); *A. apaporanum* R.E.Schult. may be distinguished by its shorter petioles, averaging 28 cm long (versus averaging 54 cm for *A. victoriense*), having primary lateral veins that arise at wider angles ( $55\text{--}70^\circ$ ) and by lacking glandular punctations on the upper surface of the blade and *A. margaricarpum*, which differs by having proportionately shorter petioles, 15–25 cm (versus 27–78), proportionately narrow blade which are broader above the middle.

*Paratype*: COLOMBIA. Valle del Cauca, along the road between Querebral and Anchicayá on old Cali-Buenaventura Road,  $03^\circ 32' 23''\text{N}$ ,  $76^\circ 45' 26''$ , 1250 m, 26 July 1997, T.B. Croat & J. F. Gaskin 80345 (MO).

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*Anthurium vlastimilii* Croat, **sp. nov.** — Type: Ecuador. Morona-Santiago: Teneco "Garza" oil well, ca. 35 km NW of Montalvo, hills with short trees and red dystrandept soil,  $01^\circ 49'\text{S}$ ,  $76^\circ 42'\text{W}$ , 260 m, 2–12 July 1989, V. Zak & S. Espinoza 4727 (holotype, MO-3789018; isotype, QCNE (not seen). **Figure 183.**

*Diagnosis*: *Anthurium vlastimilii*, a member of sect. *Decurrentia*, is distinguished by its minute size, deciduous caudate-acuminate cataphylls, numerous slender roots, narrowly oblanceolate, grayish drying blades with close collective veins, upper leaf surfaces with granules and warts (colorless to white), a very slender peduncle, green spathe and spadix, and coarse and rhomboidal lateral tepals. Although this species appears superficially to be a *Porphyrochitonium*, with features such as the collective vein, typical blade shape and short internode length, it does not have any noticeable glandular punctations.

Epiphytic; stems short; cataphylls 3–4 cm long, drying pale reddish brown, caudate-acuminate at apex, fibers persisting intact, eventually deciduous; roots slender, fine, numerous, branched, less than 1 mm diam. *Leaves* with petioles 2–3 cm long,  $\frac{1}{3}\text{--}\frac{1}{4}$  as long as blades, drying 1 mm diam., drying sulcate, with narrow ridges, drying grayish green; geniculum not obvious; blades elliptic to oblanceolate, 9–11 cm long, 2–3 cm wide, 3.9–4.5 times longer than wide, short-acuminate at apex (acumen ca. 1.2 cm long), attenuate at base, subcoriaceous, drying gray-green, weakly glossy above, paler and glossier, gray-green below; midrib drying raised

on both surfaces, more prominently so on lower surface, drying yellowish green on lower surface and gray-green on upper surface; primary lateral veins 7–9 per side, departing midrib at 40–50°, drying concolorous on both surfaces; tertiary veins drying prominulous on lower surface; collective vein arising from near the base, from the first primary lateral vein, 0.8–1.4 mm from margin, drying sharply raised on lower surface; antemarginal vein present, arising from base; upper surface eglandular, drying minutely granular (granules concolorous to white), and with warty raised areas;; lower surface smoother, eglandular. *Inflorescence* with peduncle 5 cm long, drying 0.3 mm diam.; spathe green, reflexed, lanceolate, 1.7 cm long, 3 mm wide; spadix green, 2.5 cm long, tapering, 2 mm diam. at base, 1 mm diam. at apex, sessile; flowers drying black, 1–2 visible per spiral, 1.8–2.1 mm long, 2.0–2.5 mm wide; lateral tepals coarse and rhomboidal, 1.0–1.2 mm wide, inner margin slightly 2-sided, outer margin 2-sided. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium vlastimilii* is endemic to Ecuador, known from the region of Morona-Santiago, growing in a *Tropical moist forest* life zone.

**Etymology** — *Anthurium vlastimilii* is named for Vlastimil Zak who helped to collect the type specimen.

**Comments** — In the Lucid *Anthurium* Key, *Anthurium vlastimilii* tracks to *A. caulorhizum* Sodiro from the Pacific slope of northwest Ecuador, which differs by having much larger, reddish brown-drying leaf blades and a long peduncle, more than 15 cm long; *A. decurrens* Poepp. which differs by its long internodes, larger leaf blades (16–36 cm long) and long-stipitate spadix; *A. sarmentosa* Engl., which differs by its larger (18–20 cm long), more ovate, reddish brown-drying blades and reddish spadix; *A. sydneyi* Croat & Ligan, which differs by the much longer petioles (mostly more than 5 cm long), longer spadix (3.6–7.2 cm long) and *A. whitmoiei* Croat & Ligan which differs by its larger, more blackish drying, prominently acuminate blade and its 4-sided, 4-winged peduncle.

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***Anthurium yatuense*** Croat, **sp. nov.** — Type: VENEZUELA. Amazonas: Río Yatuá, 01°16'35"N, 66°06'50"W, 84 m, Rubiaceae and Palms dominant, black water, sand-clay mix, many epiphytes, 2 Feb 2005, K.M. Redden, R. Williams, W. Diaz, O. Leon, O. Santaella, D. Garcia and A. Garcia 3483 (holotype, US). **Figure 184.**

*Diagnosis:* *Anthurium yatuense* is a member of sect. *Porphyrochitonium* and is characterized by intact, persistent cataphylls, large oblanceolate blades which are more than twice as long as petioles, primary lateral veins which are scarcely distinguishable from the numerous interprimary veins, more prominent collective veins and the presence of dark glandular punctations

and white pustules on the under surfaces of the blades as well as a long-pedunculate inflorescence with a green, lanceolate spathe, and white sessile spadix with 5–6 flowers visible per spiral.

Epiphyte; **internodes** short, 1–2 cm long, 1 cm diam.; **cataphylls** persisting as reddish brown fibers 5–8 cm long. *Leaves* 61–68 cm long; **petioles** 21.8–23.6 cm long, 4 mm diam., C-shaped adaxially with acute lateral margins and a medial rib; geniculum 1.6 cm long drying medium gray-green; blades oblanceolate, 40–43 cm long, 8.6–11 cm wide, 3.9–4.4 times longer than wide, 1.7–2.2 times longer than petiole, abruptly acuminate and downturned at the apex with a 1 mm apiculum, acute at base, subcoriaceous, drying semiglossy, dark gray-green above, semiglossy, light gray-green, moderately dark brown-pustular below; midrib broadly rounded and finely ribbed on upper and lower surfaces; primary lateral veins 20–25 per side, scarcely more prominent than interprimary veins, departing midrib at 40°–50°; collective veins arising from the base, running 1 cm from the margin, more prominent on the lower surface; upper surface eglandular, drying smooth, weakly granular at higher magnifications; lower surface dark glandular-punctate, drying with scattered colorless pustules. *Inflorescence* erect, 40.3 cm long; peduncle 31.5 cm long, 2.5 mm diam., sulcate adaxially, drying finely ribbed and medium brown; spathe green, lanceolate, 4.8 cm long, 1 cm wide, drying light gray-green; spadix white, sessile, 8.8 cm long, 6 mm diam., tapering slightly, drying dark brown; flowers 5–6 visible per spiral, 2.1 mm long, 2.0 mm wide, lateral tepals 1.3 mm wide, outer margins straight, three-sided, inner margins broadly rounded with slight concave dip at margins, surface smooth with globular pale cellular inclusions. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium yatuense* is known only from the type location in Amazonas State near the Yatuá River in Venezuela in a Tropical wet forest life zone.

**Etymology** — *Anthurium yatuense* is named for the Río Yatuá in Amazonas State where it was found.

**Comments** — *Anthurium apaporanum*, *A. bakeri*, and *A. collettianum* Croat are similar in appearance and may be confused with *A. yatuense*, but *A. apaporanum* has inconspicuous collective veins which run 1–2 mm from the margin of the blade; *A. bakeri* has blades which are conspicuously with the collective vein markedly sunken and the spadix is longer and thicker than in *A. yatuense* whereas *A. collettianum* has fewer primary lateral veins that are loop-connected to the collective veins. In addition, *Anthurium collettianum* lacks white pustules on the lower surface of the blade. In the Lucid Anthurium Key, *Anthurium yatuense* tracks with *A. huanucense* Engl. which has very short petioles (4–7 cm), smaller, narrower blades



Figure 184. *Anthurium yatuense* Croat. Holotype: Redden 3483.

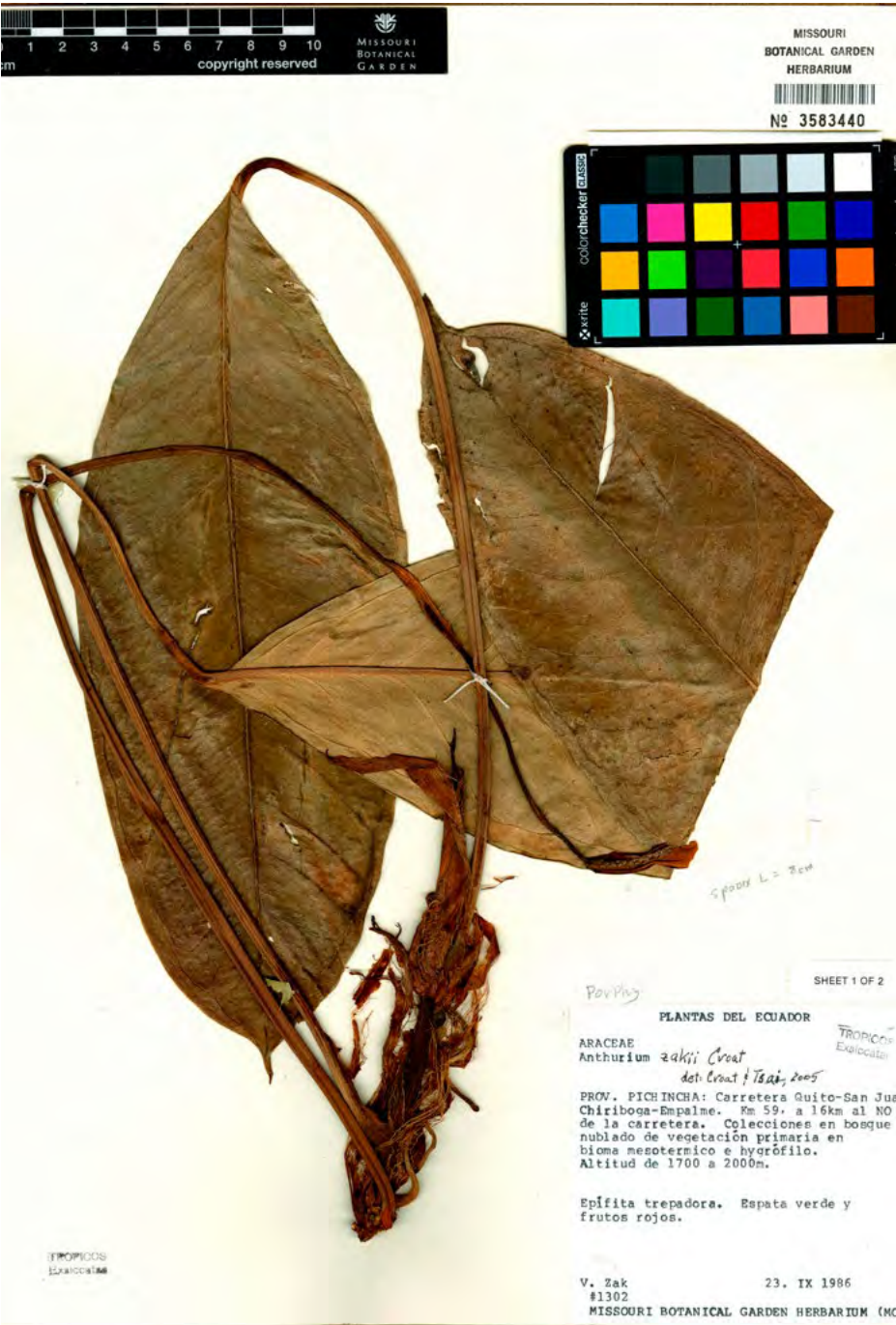


Figure 185. *Anthurium zakii* Croat. Holotype: Zak 1302.





**Figure 186.** *Anthurium zakii* Croat. Paratype: Rodríguez 580.

(23–27 × 4–5 cm) and only 15 primary lateral veins per side; *A. quinesulcatum* Sodiro which has shorter petioles (5–15 cm), shorter blades (20–30 cm long) and only 12–15 primary lateral veins per side; *A. wattii* Croat & D.C.Bay which is from Baja Colima, Colombia, and differs by having blades widest near the middle, a longer spathe (8–15 cm) and a spadix which is colored green, yellowish or orangish.

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***Anthurium zakii*** Croat, **sp. nov.** — Type: ECUADOR. Pichincha: Carretera Quito-San Juan-Chiriboga-Empalme, Km 59, 16 km NW of the main Quito–Santo Domingo Hwy at El Empalme, vic. of Reserva Ecológica “Río Guajalito”, ca. 00°38’S, 78°49’W, 1700–2000 m, 23 Sep. 1986, V. Zak 1302 (holotype, MO-3583441; isotype QCA, US-3583440). **Figures 185 & 186.**

*Diagnosis:* *Anthurium zakii* is a member of sect. *Porphyrochitonium* and is characterized by its elongate stem, internodes typically much longer than broad (unusual for sect. *Porphyrochitonium*), persistent, pale brown cataphyll fibers scattered along the stem, its subterete, sulcate petioles which are about as long as the blades, abruptly acuminate blades which are elliptic, glandular-punctate on both surfaces, drying yellow-brown on the lower surface and have a single pair of collective veins arising at or very near the base, as well as by its long-pedunculate, linear-lanceolate, green spathe and narrowly long-tapered, green to yellowish spadix and red berries.

Terrestrial and climbing or epiphytic; internodes 2–4 cm long, 0.8 cm diam.; cataphylls persisting with red-brown fibers, 4–6 cm long, 0.5 cm wide. *Leaves* 47.3 cm long with petioles subterete, 16.2–30.5 cm long (averaging 22.7 cm) 0.3–0.4 cm diam., drying 5-ribbed with sulcus adaxially and convex abaxially, medium brown; blades lanceolate, 17.8–30.5 cm long and 4.8–11.2 cm wide, 2.4–3.7 times longer than wide, blade 0.9–1.4 (averaging 1.1) times longer than petiole, tapered acuminate at apex, obtuse at base, subcoriaceous, drying drying semiglossy, dark greenish gray above, semiglossy, medium yellow-brown below; midrib convex, finely ribbed, adaxially and abaxially, drying medium brown; primary lateral veins less conspicuous, 10–26 per side, departing midrib at 40°–50°; collective veins more conspicuous, arising from the base, running 1.0–1.7 cm from the margin, forming prominent arches where they join the primary lateral veins; upper surface reticulate, with scattered dark glandular-punctations; lower surface densely dark glandular-punctate. *Inflorescence* 63 cm long, erect; peduncle drying terete, medium brown; spathe green, lanceolate, 7–12 cm long, 0.3–1.2 cm wide, drying dark brown; spadix green to yellow, 9.5–13.2 (averaging 10.7), 0.3–0.4 cm wide, drying dark brown. *Infructescence* with red berries.

**Distribution and ecology** — *Anthurium zakii* is endemic to Ecuador, known only from the type locality from the slopes of Volcán Pichincha in Pichincha Province at 1700–2000 m in a Montane wet forest life zone.

**Etymology** — *Anthurium zakii* is named for Ecuadorian collector Vlastimil Zak who collected the type specimen.

**Comments** — *Anthurium zakii* keys out in the Lucid Anthurium Key to *A. cachabianum* Sodiro, a species from the Lita-San Lorenzo region in Esmeraldas Province that has shorter, much thicker internodes, much larger leaves up to 20 cm wide and white berries. Another species suggested by the Lucid Anthurium Key was *A. septuplinervium* Sodiro but that species has larger leaves, more than 40 cm long and up to 20 cm wide, and has 2 pairs of collective veins instead of a single pair.

*Paratypes*: ECUADOR. Pichincha: Carretera Quito-San Juan-Chiriboga-Empalme, Km 59 a 15 km al NO de la carretera. Colecciones en bosque nublado de vegetación primario en bioma mesotermica e hygrophilo, 1700–2000 m, 23 Sep 1986, V. Zak 1309 (MO); Reserva Floristica-Ecologica “Río Guajalito”, 00°13'53"S, 79°48'10"W, 1800–2000 m, 25 Jan 1992, J. Jaramillo & E. Grijalva 14584 (QCA, NY) and 14627 (QCA); 79°49'10"W, 00°13'38"S, 1800–2000 m, 9 Sep 1994, J. Mutke 30 (QCA); Santo Domingo de los Colorados, a 3.5 km al NE de la carretera, estribaciones occidentales del Volcán Pichincha, 2200 m, 14 Dec 1986, J. Rodríguez 580 (QCA).

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<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Species							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. abelardoi</i>	1							1	
<i>A. acutangulum</i>	1					1	1	1	1
<i>A. alatiattenuatum</i>	1								1
<i>A. alatipedunculatum</i>	1							1	
<i>A. alatipetiolatum</i>	1								1
<i>A. albifructum</i>	1								1
<i>A. alexespinosae</i>	1								1
<i>A. alticola</i>	1							1	1
<i>A. ariztutense</i>	1								1
<i>A. attenuatifolium</i>	1								1
<i>A. austinsmithii</i>	1						1	1	
<i>A. bajobonitense</i>	1								1
<i>A. bakeri</i>	1	1	1			1	1	1	1
<i>A. barryi</i>	1								1
<i>A. belenense</i>	1								1
<i>A. bergii</i>	1								1
<i>A. berguidoi</i>	1								1
<i>A. bicollectivum</i>	1								1
<i>A. billdarcy</i>	1								1
<i>A. billbahnii</i>	1								1
<i>A. botijaense</i>	1								1
<i>A. bratsiense</i>	1							1	
<i>A. brevispadix</i>	1								1
<i>A. brunneum</i>	1								1
<i>A. caloveboranum</i>	1								1
<i>A. carrionii</i>	1								1
<i>A. cartiense</i>	1								1
<i>A. chiriquense</i>	1							1	1
<i>A. churchillii</i>	1								1
<i>A. circinatum</i>	1								1
<i>A. collinsii</i>	1								1

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Species							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. comincoense</i>	1								1
<i>A. crassilaminum</i>	1								1
<i>A. crassinradix</i> ssp. <i>crassinradix</i>	1								1
<i>A. crassinradix</i> ssp. <i>purpureospadix</i>									1
<i>A. crassitepalum</i>	1								1
<i>A. cuadrosii</i>	1								1
<i>A. cuasicanum</i>	1								1
<i>A. curvilaminum</i>	1								1
<i>A. deneversii</i>	1								1
<i>A. dichrophyllum</i>	1								1
<i>A. diversurense</i> ,	1								1
<i>A. duocostatum</i>	1								1
<i>A. durandii</i>	1							1	1
<i>A. duyeyi</i>	1							1	1
<i>A. edtysonii</i>	1								1
<i>A. flagellum</i>	1								1
<i>A. floresii</i>	1								1
<i>A. fragrantissimum</i>	1								1
<i>A. friedrichsthalii</i>	1						1	1	1
<i>A. gentryi</i>	1								1
<i>A. glandulicostum</i>	1								1
<i>A. gracililaminum</i>	1								1
<i>A. gracilispadix</i>	1								1
<i>A. granditepalum</i>	1								1
<i>A. gregneversii</i>	1								1
<i>A. guaboense</i>	1								1
<i>A. guadalupeae</i>	1								1
<i>A. heraclioanum</i>	1								1
<i>A. hughchurchillii</i>	1								1

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Species							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. iguanitense</i>	1								1
<i>A. insolitum</i>	1								1
<i>A. jefense</i>	1								1
<i>A. jicoteense</i>	1							1	
<i>A. jimfolsomii</i>	1								1
<i>A. kallunkiae</i>	1								1
<i>A. kensytmae</i>	1								1
<i>A. kittredgeanum</i>	1								1
<i>A. lactifructum</i>	1								1
<i>A. lancifolium</i>	1						1	1	1
<i>A. lellingeri</i>	1								1
<i>A. longistipitatum</i>	1							1	1
<i>A. loratum</i>	1							1	
<i>A. louisii</i>	1							1	
<i>A. melastomatis</i>	1								1
<i>A. mercadoi</i>	1								1
<i>A. minimum</i>	1								1
<i>A. monroi</i>	1								1
<i>A. morrisii</i>	1								1
<i>A. muscidiradix</i>	1								1
<i>A. neei</i>	1								1
<i>A. nutans</i>	1							1	
<i>A. orosiense</i>	1							1	
<i>A. oxystachyum</i>	1								1
<i>A. pageanum</i>	1							1	1
<i>A. paludosum</i>	1							1	1
<i>A. paulmaasii</i>	1								1
<i>A. pendens</i>	1							1	1
<i>A. perangustum</i>	1								1
<i>A. pirrense</i>	1								1
<i>A. polancoi</i>	1								1

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Species							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. ramonense</i>	1						1	1	1
<i>A. redolens</i>	1								1
<i>A. robertii</i>	1								1
<i>A. rupicola</i>	1								1
<i>A. sabanitense</i>	1								1
<i>A. sagawae</i>	1								1
<i>A. scherzerianum</i>	1		1					1	
<i>A. scottmorii</i>	1								1
<i>A. sknappiae</i>	1								1
<i>A. stockwellii</i>	1								1
<i>A. subrotundum</i>	1								1
<i>A. sueae</i>	1								1
<i>A. sukutense</i>	1							1	
<i>A. tacarcunense</i>	1								1
<i>A. tarrazuense</i>	1							1	
<i>A. tayuticense</i>	1							1	
<i>A. terryae</i>	1								1
<i>A. toroense</i>	1								1
<i>A. tsaiae</i>	1								1
<i>A. tscuiense</i>	1								1
<i>A. tuquesense</i>	1								1
<i>A. tutense</i>	1								1
<i>A. unguiaense</i>	1								
<i>A. utleyorum</i>	1							1	
<i>A. vallense</i>	1								1
<i>A. vanninii</i>	1								1
<i>A. veraguense</i>	1								1
<i>A. wendlingeri</i> var. <i>wendlingeri</i>	1						1	1	1
<i>A. wendlingeri</i> var. <i>horichii</i>								1	

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Species							
	#	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. wiehleri</i>	1								1
<i>A. zachdufranianum</i>	1								1
<i>A. zapatae</i>	1								1
<i>A. zhui</i>	1								1
<i>Porphyrochitonium</i> totals	122	1	2	0	0	2	7	29	108
New <i>Porphyrochitonium</i> in this paper						0	0	9	59



<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Endemics							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. abelardoi</i>	1							1	
<i>A. acutangulum</i>	1								
<i>A. alatiattenuatum</i>	1								1
<i>A. alatipedunculatum</i>	1							1	
<i>A. alatipetiolatum</i>	1								1
<i>A. albifructum</i>	1								1
<i>A. alexespinosae</i>	1								1
<i>A. alticola</i>	1								
<i>A. ariztutense</i>	1								1
<i>A. attenuatifolium</i>	1								1
<i>A. austinsmithii</i>	1								
<i>A. bajobonitense</i>	1								1
<i>A. bakeri</i>	1								
<i>A. barryi</i>	1								1
<i>A. belenense</i>	1								1
<i>A. bergii</i>	1								1
<i>A. berguidoi</i>	1								1
<i>A. bicollectivum</i>	1								1
<i>A. billdarcy</i>	1								1
<i>A. billhahnii</i>	1								1
<i>A. botijaense</i>	1								1
<i>A. bratsiense</i>	1							1	
<i>A. brevispadix</i>	1								1
<i>A. brunneum</i>	1								1
<i>A. caloveboranum</i>	1								1
<i>A. carrionii</i>	1								1
<i>A. cartiense</i>	1								1
<i>A. chiriquense</i>	1								
<i>A. churchillii</i>	1								1
<i>A. circinatum</i>	1								1
<i>A. collinsii</i>	1								1

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Endemics							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. comincoense</i>	1								1
<i>A. crassilaminum</i>	1								1
<i>A. crassiradix</i> ssp. <i>crassiradix</i>	1								1
<i>A. crassiradix</i> ssp. <i>purpureospadix</i>									1
<i>A. crassitepalum</i>	1								1
<i>A. cuadrosii</i>	1								1
<i>A. cuasicanum</i>	1								1
<i>A. curvilaminum</i>	1								1
<i>A. deneversii</i>	1								1
<i>A. dichrophyllum</i>	1								1
<i>A. diversurense</i> ,	1								1
<i>A. duocostatum</i>	1								1
<i>A. durandii</i>	1								
<i>A. dwyeri</i>	1								
<i>A. edtysonii</i>	1								1
<i>A. flagellum</i>	1								1
<i>A. floresii</i>	1								1
<i>A. fragrantissimum</i>	1								
<i>A. friedrichsthalii</i>	1								
<i>A. gentryi</i>	1								1
<i>A. glandulicostum</i>	1								1
<i>A. gracililaminum</i>	1								1
<i>A. gracilispadix</i>	1								1
<i>A. granditepalum</i>	1								1
<i>A. gregneversii</i>	1								1
<i>A. guaboense</i>	1								1
<i>A. guadalupeae</i>	1								1
<i>A. heraclioanum</i>	1								1
<i>A. hughchurchillii</i>	1								1

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Endemics							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. iguanitense</i>	1								1
<i>A. insolitum</i>	1								1
<i>A. jefense</i>	1								1
<i>A. jicoteense</i>	1							1	
<i>A. jimfolsomii</i>	1								1
<i>A. kallunkiae</i>	1								1
<i>A. kensytsmae</i>	1								1
<i>A. kittredgeanum</i>	1								1
<i>A. lactifructum</i>	1								1
<i>A. lancifolium</i>	1								
<i>A. lellingeri</i>	1								1
<i>A. longistipitatum</i>	1								
<i>A. loratum</i>	1							1	
<i>A. louisii</i>	1							1	
<i>A. melastomatis</i>	1								1
<i>A. mercadoi</i>	1								1
<i>A. minimum</i>	1								1
<i>A. monroi</i>	1								1
<i>A. morrisii</i>	1								1
<i>A. muscidiradix</i>	1								1
<i>A. neei</i>	1								1
<i>A. nutans</i>	1							1	
<i>A. orosiense</i>	1							1	
<i>A. oxystachyum</i>	1								1
<i>A. pageanum</i>	1								
<i>A. paludosum</i>	1								
<i>A. paulmaasii</i>	1								1
<i>A. pendens</i>	1								
<i>A. perangustum</i>	1								1
<i>A. pirrense</i>	1								1
<i>A. polancoi</i>	1								1

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Endemics							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. ramonense</i>	1								
<i>A. redolens</i>	1								
<i>A. robertii</i>	1								1
<i>A. rupicola</i>	1								1
<i>A. sabanitense</i>	1								1
<i>A. sagawae</i>	1								1
<i>A. scherzerianum</i>	1								
<i>A. scottmorii</i>	1								1
<i>A. sknappiae</i>	1								1
<i>A. stockwellii</i>	1								1
<i>A. subrotundum</i>	1								1
<i>A. sueae</i>	1								1
<i>A. sukutense</i>	1							1	
<i>A. tacarcunense</i>	1								1
<i>A. tarrazuense</i>	1							1	
<i>A. tayuticense</i>	1							1	
<i>A. terryae</i>	1								1
<i>A. toroense</i>	1								1
<i>A. tsaiiae</i>	1								1
<i>A. tscuiense</i>	1								1
<i>A. tuquesense</i>	1								1
<i>A. tutense</i>	1								1
<i>A. unguiaense</i>	1								
<i>A. utleyorum</i>	1							1	
<i>A. vallense</i>	1								
<i>A. vanninii</i>	1								1
<i>A. veraguense</i>	1								1
<i>A. wendlingeri</i> var. <i>wendlingeri</i>	1								
<i>A. wendlingeri</i> var. <i>borichii</i>								1	

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>		Endemics							
	No.	Mex	Guat	Bel	E. Salv	Hon	Nic	CR	Pan
<i>A. wiehleri</i>	1								1
<i>A. zachdufranianum</i>	1								1
<i>A. zapatae</i>	1								1
<i>A. zhui</i>	1								1
<i>Porphyrochitonium</i> totals	122	0	0	0	0	0	0	13	91
New <i>Porphyrochitonium</i> in this paper						0	0	9	59

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>	SPECIES				
	species	COL	EC	VEN	Gui
<i>A. abelardoi</i>	1				
<i>A. acutangulum</i>	1	1			
<i>A. alatiattenuatum</i>	1				
<i>A. alatipedunculatum</i>	1				
<i>A. alatipetiolatum</i>	1				
<i>A. albifructum</i>	1				
<i>A. alexespinosae</i>	1				
<i>A. alticola</i>	1				
<i>A. ariztutense</i>	1				
<i>A. attenuatifolium</i>	1				
<i>A. austinsmithii</i>	1				
<i>A. bajobonitense</i>	1				
<i>A. bakeri</i>	1	1	1	1	1
<i>A. barryi</i>	1				
<i>A. belenense</i>	1				
<i>A. bergii</i>	1				
<i>A. berguidoi</i>	1				
<i>A. bicollectivum</i>	1				
<i>A. billdarcyi</i>	1				
<i>A. billhabnii</i>	1				
<i>A. botijaense</i>	1				
<i>A. bratsiense</i>	1				
<i>A. brevispadix</i>	1				
<i>A. brunneum</i>	1				
<i>A. caloveboranum</i>	1				
<i>A. carrionii</i>	1				
<i>A. cartiense</i>	1				
<i>A. chiriquense</i>	1				
<i>A. churchillii</i>	1				
<i>A. circinatum</i>	1				
<i>A. collinsii</i>	1				



<i>Anthurium</i> sect. <i>Porphyrochitonium</i>	SPECIES				
	species	COL	EC	VEN	Gui
<i>A. comincoense</i>	1				
<i>A. crassilaminum</i>	1				
<i>A. crassiradix</i> ssp. <i>crassiradix</i>	1				
<i>A. crassiradix</i> ssp. <i>purpureospadix</i>					
<i>A. crassitepalum</i>	1				
<i>A. cuadrosii</i>	1				
<i>A. cuasicanum</i>	1				
<i>A. curvilaminum</i>	1				
<i>A. deneversii</i>	1				
<i>A. dichrophyllum</i>	1				
<i>A. diversurense</i> ,	1				
<i>A. duocostatum</i>	1				
<i>A. durandii</i>	1				
<i>A. dryeri</i>	1				
<i>A. edtysonii</i>	1				
<i>A. flagellum</i>	1				
<i>A. floresii</i>	1				
<i>A. fragrantissimum</i>	1	1	1	1	1
<i>A. friedrichsthalii</i>	1	1	1		
<i>A. gentryi</i>	1				
<i>A. glandulicostum</i>	1				
<i>A. gracililaminum</i>	1				
<i>A. gracilispadix</i>	1				
<i>A. granditepalum</i>	1				
<i>A. gregneversii</i>	1				
<i>A. guaboense</i>	1				
<i>A. guadalupaeae</i>	1				
<i>A. heraclioanum</i>	1				
<i>A. hughchurhillii</i>	1				

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>	SPECIES				
	species	COL	EC	VEN	Gui
<i>A. iguanitense</i>	1				
<i>A. insolitum</i>	1				
<i>A. jefense</i>	1				
<i>A. jicoteense</i>	1				
<i>A. jimfolsomii</i>	1				
<i>A. kallunkiae</i>	1				
<i>A. kensytsmae</i>	1				
<i>A. kittredgeanum</i>	1				
<i>A. lactifructum</i>	1				
<i>A. lancifolium</i> Schott	1	1			
<i>A. lellingeri</i>	1				
<i>A. longistipitatum</i>	1				
<i>A. loratum</i>	1				
<i>A. louisii</i>	1				
<i>A. melastomatis</i>	1				
<i>A. mercadoi</i>	1				
<i>A. minimum</i>	1				
<i>A. monroi</i>	1				
<i>A. morrisii</i>	1				
<i>A. muscidiradix</i>	1				
<i>A. neei</i>	1				
<i>A. nutans</i>	1				
<i>A. orosiense</i>	1				
<i>A. oxystachyum</i>	1				
<i>A. pageanum</i>	1				
<i>A. paludosum</i>	1	1	1		
<i>A. paulmaasii</i>	1				
<i>A. pendens</i>	1	1			
<i>A. perangustum</i>	1				
<i>A. pirrense</i>	1				
<i>A. polancoi</i>	1				

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>	SPECIES				
	species	COL	EC	VEN	Gui
<i>A. ramonense</i>	1	1			
<i>A. redolens</i>	1	1			
<i>A. robertii</i>	1				
<i>A. rupicola</i>	1				
<i>A. sabanitense</i>	1				
<i>A. sagavae</i>	1				
<i>A. scherzerianum</i>	1				
<i>A. scottmorii</i>	1				
<i>A. skenappiae</i>	1				
<i>A. stockwellii</i>	1				
<i>A. subrotundum</i>	1				
<i>A. sueae</i>	1				
<i>A. sukutense</i>	1				
<i>A. tacarcunense</i>	1				
<i>A. tarrazuense</i>	1				
<i>A. tayuticense</i>	1				
<i>A. terryae</i>	1				
<i>A. toroense</i>	1				
<i>A. tsaiae</i>	1				
<i>A. tscuiense</i>	1				
<i>A. tuquesense</i>	1				
<i>A. tutense</i>	1				
<i>A. unguiaense</i>	1	1			
<i>A. utleyorum</i>	1				
<i>A. vallense</i>	1	1			
<i>A. vanninii</i>	1				
<i>A. veraguense</i>	1				
<i>A. wendlingeri</i> <i>var. wendlingeri</i>	1	1			
<i>A. wendlingeri</i> <i>var. borichii</i>					
<i>A. wiehleri</i>	1				

<i>Anthurium</i> sect. <i>Porphyrochitonium</i>	SPECIES				
	species	COL	EC	VEN	Gui
<i>A. zachdufranianum</i>	1				
<i>A. zapatae</i>	1				
<i>A. zhui</i>	1				
<i>Porphyrochitonium</i> totals	122	12	4	2	2
New <i>Porphyrochitonium</i> in this paper					

# **Boycea, a new genus of the tribe Aglaonemateae Engl. (Araceae)**

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## **ABSTRACT**

The new genus *Boycea* A.Hay is described for Bornean *Nepthytis bintuluensis* A.Hay, Bogner & P.C.Boyce which molecular analyses have indicated to be closer to Indomalaysian *Aglaonema* than to the African species of *Nepthytis* to which it is strikingly similar morphologically. The new combination *Boycea bintuluensis* (A.Hay et al.) A.Hay is made.

Keywords: *Nepthytis bintuluensis*, Aroideae, Borneo, Sarawak

## **BACKGROUND**

Bornean *Nepthytis bintuluensis* was found in 1994, almost simultaneously, independently, and at the same locality in Sarawak, Malaysia, both by the author and by Josef Bogner and Peter Boyce, with the generous guidance of then staff of the Sarawak Forestry Department. This followed a 'tip-off' from Queensland plant collector Arden Dearden who had observed it sterile there in 1990. The discovery was cited as a remarkable range extension for the otherwise entirely West African genus *Nepthytis* Schott from which *N. bintuluensis* appeared to differ qualitatively only in its single-leaved deciduous geophytic habit, whereas African *Nepthytis* are evergreen, almost always with at least two leaves together per shoot, and with a superficially creeping rhizome (Hay et al., 1994).

This rather rare plant has not been included in most of the various molecular phylogenetic studies of Araceae carried out since then. However, that of Nauheimer et al. (2012), using chloroplast markers, pointed to *Nepthytis bintuluensis* grouping with Asian *Aglaonema* Schott (incl. *Aglaodorum* Schott — see Van et al., 2020), while the African species of *Nepthytis* grouped with African *Anchomanes* Schott. This suggested either that *Nepthytis bintuluensis* should be transferred to *Aglaonema*, from which it markedly differs in numerous respects, not least its tripartite, solitary, relatively early-emerging reticulately veined leaves (versus multiple late-emerging, striate-veined leaves lacking posterior lobes), or that it should be transferred into its own genus, which would clearly be the more appropriate course, as suggested some years ago by Boyce & Wong (2015). Ten year after Nauheimer et al.'s phylogeny, the most recent molecular phylogeny of Araceae in which *Nepthytis bintuluensis* was included (Haigh et al., in prep.), this time based on multiple nuclear genes, corroborates (rather than simply repeats) the closer relationship of *Nepthytis bintuluensis* to *Aglaonema* than to the African *Nepthytis* species, and hence naming a new genus for it can now proceed with the necessary confidence.



**Figure 1.** *Boycea bintuluensis* near Jepak, Bintulu Division, Sarawak (not collected). Fairly young leaf lacking epiphylls, with traces of sediment from previous inundation, and showing the characteristic abrupt change in divergence angle of the primary veins about one third of the way along the anterior costa. In forest dominated by species of *Shorea* sect. *Pachycarpae* (Dipterocarpaceae). — Photo A. Hay.



**BOYCEA**

**Boycea** A.Hay, **gen. nov.** — Type species: *Boycea bintuluensis* (A.Hay, Bogner & P.C.Boyce) A.Hay, **comb. nov.** [basonym: *Nepthytis bintuluensis* A.Hay et al., Novon 4 (1994) 365, figs. 1 & 2].

**Diagnosis:** *Boycea* differs from *Aglaonema* Schott, to which is most closely allied on molecular data, in the former's deciduous geophytic habit, early-emerging solitary sagittate leaf blades with well developed posterior costae and conspicuously reticulate venation, its smaller pollen (20–28 µm diam.; Hay et al., 1994) with verruculate exine [vs. evergreen epigeal or creeping habit, late-emerging grouped leaves lacking posterior lobes and with striate venation, larger pollen with psilate exine (37–67 µm diam.; Grayum, 1992: 19, 20)]. *Boycea* differs from *Nepthytis* Schott, which it most closely resembles, in the former's deciduous geophytic habit, flowering distant from and occasionally without the leaves, the spathe barely opening at anthesis, the female zone of the spadix estipitate and mostly adnate to the spathe, and in its smaller pollen (as above) [vs. almost always evergreen, superficially creeping habit, flowering with the leaves, the spathe opening wide or reflexed at anthesis, the female zone stipitate and free, and medium-sized pollen (mean 46 µm diam.; Grayum, 1992: 27)].

Moderately robust, irregularly deciduous unifoliar geophyte; stem a fully subterranean creeping, occasionally branching rhizome to ca. 2 cm thick bearing numerous cataphyll scars, intermittent rather distant leaf and peduncle scars, and scattered rather brittle roots; leaf solitary, emerging in a rather unexpanded state; petiole unarmed, slender, at first with the lower part clasped by the dead remans of a cataphyll, often green and cream-blotched with a very short sheath and a long apical geniculum; blade sagittate, widest level with or posterior to the petiole insertion, with both anterior and posterior lobes acuminate, sometimes sparsely to heavily cream-blotched; anterior costa emitting primary lateral veins at a wide angle in the lower  $\frac{1}{4}$ – $\frac{1}{3}$  of the anterior lobe and there on each side running more or less straight to a looping intramarginal vein, more distal primary lateral veins emitted at an abruptly lower angle in the rest of the anterior lobe and there arcing acropetally into an intramarginal vein, the secondary venation reticulate and forming a submarginal vein; posterior lobes with the costae naked in the sinus and not quite reaching the tips. *Bloom* solitary, often appearing ahead of and remote from (or in the absence of) the leaf, subtended by several increasingly large cataphylls, raised above the ground on a fairly short and mostly subterranean peduncle; spathe naviculiform, basally slightly convolute, not constricted, coriaceous, cream/ivory-coloured at anthesis thence becoming green, apically conspicuously cuspidate, persistent into fruit and becoming partly orange; spadix sessile, bluntly subcylindric, about equalling the body of the spathe (exceeded by the cuspidate tip), fertile throughout; female zone dorsally adnate (except in the uppermost part) to the spathe, contiguous with the weakly tapering male zone; sterile interstice and appendix absent; pistils lacking staminodes, flask-shaped, unilocular with a single basal anatropous ovule; stigma raised on a short style, button-like, centrally impressed, minutely papillate; male zone apparently a mass of stamens not organised into male florets; stamens with very short thick

filaments, anthers truncate with apical pores; pollen inaperturate, 20–28  $\mu\text{m}$  diam. with rough exine covered with very easily dislodged verrucae ca. 2–4  $\mu\text{m}$  diam.; infructescence subtended by the persistent spathe, orange throughout except for the green spathe tip and margins; berries large and individually distinct; seed solitary, large, exalbuminous, seed coat extremely thin; embryo large, green, ellipsoid.  $2n = 36$ . [See Hay et al. (1994) for a fuller description and typification of the only species, line drawings, and SEM of pollen]. **Figures 1–3.**

**Distribution and ecology** — Endemic to Sarawak, Malaysian Borneo, observed in Bintulu and Miri Divisions, in lowland riverine (alluvial-depositional) perhumid broadleaf evergreen tropical forest (Boyce & Wong, 2015) at 80–165 m altitude. Boyce & Wong (2012) recorded that at some localities it is inundated to depths of a metre or so for days at a time during the wet season.

**Etymology** — The new genus is named for Peter Charles Boyce (b. 1964) who, in collaboration with Wong Sin Yeng, has done more than anyone to progress knowledge of Araceae in Borneo, the most species-rich area of the world for the family after northwestern South America, and the richest of all in aroid genera.

**Pollination and dispersal** — There are yet no observations on duration of anthesis, floral scent, thermogenesis, pollen shed, floral visitors, or frugivory for the new genus. *Boycea bintuluensis* has been observed flowering in February and November, and fruiting in February and July.

**Discussion** — The inclusion of two genera with such very different habit and leaf form in the same tribe of Araceae–Aroideae is matched in the neotropical Spathicarpeae (e.g., multifoliar *Dieffenbachia* with striate-veined, late-emerging leaves lacking posterior lobes, and unifoliar *Taccarum* with reticulate-veined, relatively early-emerging, tripartite, and in that case highly divided leaves).

Although *Boycea bintuluensis* is classed as deciduous because it becomes leafless some considerable time before a new leaf is produced, it is not regularly deciduous seasonally nor even annually. The leaves are observed to persist for about four years in wild plants, accumulating thick coatings of epiphylls, and have been recorded persisting in cultivation for five years (Boyce, unpubl. obs.). Indeed, the combination of very long-lived leaves and periodically deciduous habit is most unusual. Growth of the rhizome may continue quite extensively without producing a new leaf, and lead to blooms emerging from the ground at some considerable distance ahead of the leaf, this apparently able to occur repeatedly over a long period before the production of a new leaf (see Hay et al., 1994: Figure. 1A).

Most molecular phylogenies to date have proposed that African *Anchomanes* [and very closely allied *Pseudohydrosme*: see Cheek et al. (2021) and Moxon-Holt & Cheek (2021) for distinguishing characteristics] group with *Nephtytis* (forming the tribe *Nephtytideae* sensu Mayo et al., 1997: 216), and are together sister to [Aglaonema + Boycea] — the Aglaonemateae sensu Mayo et al. (1997: 223). However, the phylogeny presented by Haigh et al. (in prep.) breaks



**Figure 2.** *Boycea bintuluensis* near Jepak, Bintulu Division, Sarawak (not collected). Older leaf blade with accumulation of epiphylls. — Photo A. Hay.





**Figure 3.** *Boycea bintuluensis* near Jepak, Bintulu Division, Sarawak (not collected). Three blooms in succession showing (left) the persistent spathe greened after anthesis; a petiole (just left of centre) mostly concealed by a withered cataphyll. — Photo A. Hay.

this sister relationship between the Nephthytideae and Aglaonemateae which may suggest an even more remote relationship between *Boycea* and *Nephthytis*.

### Acknowledgements

I thank Wong Sin Yeng and Peter Boyce for their outstanding hospitality and kindness in Sarawak 2019, enabling me to again photograph *Boycea* (and many other plants) in the field, and for valuable scientific discussions about Bornean Araceae over many years. Two referees are also thanked for their valuable criticism and suggestions for improvement of the manuscript.

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# Jan Dirk Bastmeijer

(22 October 1943 – 18 February 2022)

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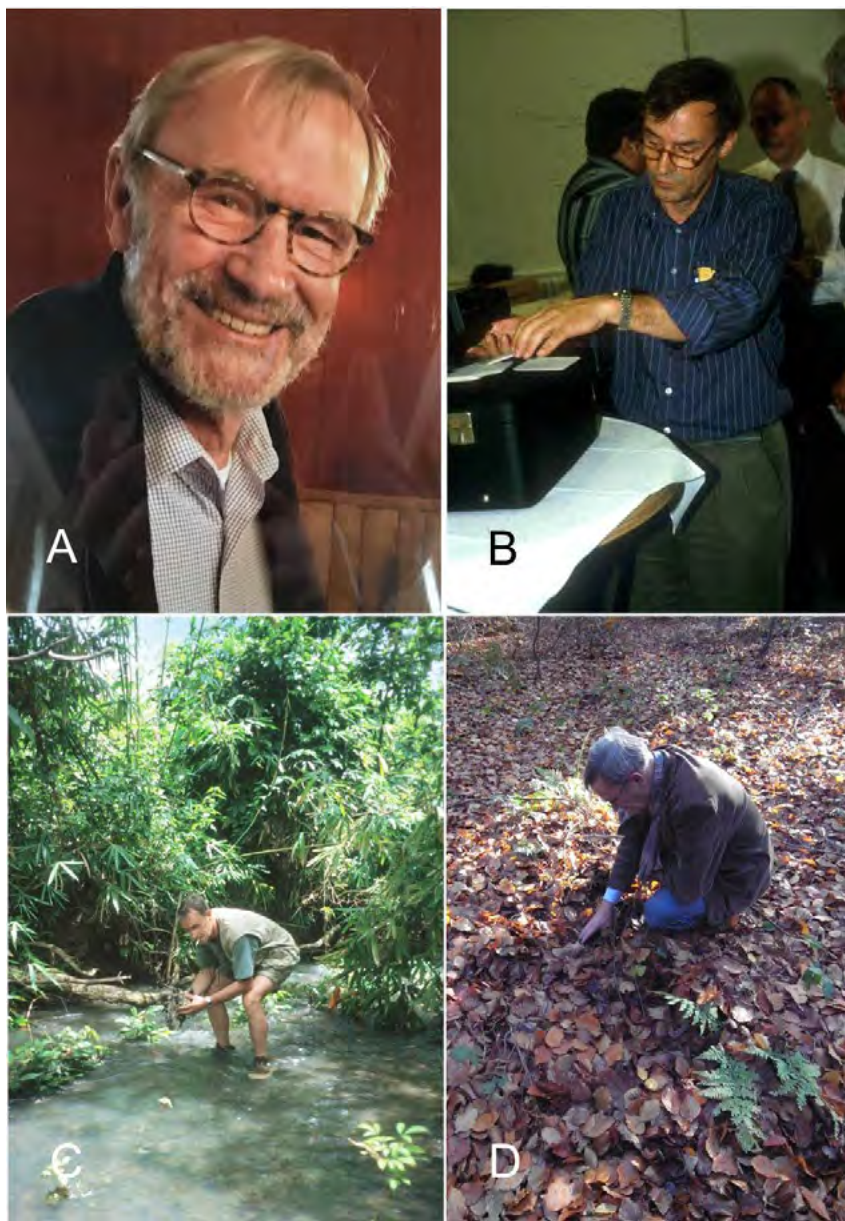
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*Cryptocoryne* lost one of its leading experts when, after a few years of declining health, Jan D. Bastmeijer passed away in February this year.

Jan was born in Alkmaar, about 30 km NNW of Amsterdam, The Netherlands. After school and military service, he studied physics, mathematics, and astronomy in Leiden. A free time occupation was fishing in the canals of Leiden, such a passion that on his marriage to Cora Bastmeijer-Sneijders, his friends gave him a fishbowl with fish and plants. You could say this was a starting point of his fascination of aquatic plants, further promoted by a large aquarium given to him later by Cora. Jan would go on to be one of the leading experts on the Araceous genera *Cryptocoryne* and *Lagenandra*, on which he over the years published 90 articles and a unique website ‘*the Crypts pages*’: <https://crypts.home.xs4all.nl/Cryptocoryne/index.html>.

Jan’s formal training in physics, mathematics and astronomy led him to a job as teacher in the high school and the pedagogical academy in Emmen. He much enjoyed the challenge of teaching physics to children. Later, he came to the Windesheim University of Applied Sciences in Zwolle as teacher coach for physics and later studied computer science at CPIM in Eindhoven. During the years teaching in Zwolle his interest in aquatic plants was nourished by his involvement in the Dutch Aquarium Society, in Werkgroep Aquatische Planten (WAP), which held regular meetings, especially during colder parts of the year. Cultivating plants has for centuries been a characteristic of the Dutch – just to mention their flair for producing enormous numbers of tulip cultivars and other bulbous plants. In decorating and cultivating plants in aquaria, there is even a ‘scaping class called ‘Dutch style’ which in short has the characteristic of an aquarium densely planted with different aquatic plants. Cultivating plants in an aquarium is one thing, but when you want to communicate how you manage to grow them, you eventually need to know the name of the plants you are growing, otherwise there is no communication. Naming of the aquatic plants in the 1960s and 70s was not without problems, especially within the genus *Cryptocoryne*, where there were many problems in naming the many different plants that were imported in large quantities from SE Asia. Some were easy to grow while others proved more difficult or close to impossible in the then given circumstances.





**Figure 1.** Jan D. Bastmeijer. (A) 2017.

(B) Preparing a colour slide show at aquarium plant meeting 1996.

(C) Philippines, Palawan, S of Tayay, collecting *Cryptocoryne pygmaea* Merr., B 790.

(D) Sampling *Fagus* leaf peat soil in Emmen 2012.

Photographs mainly from Jan's archives.

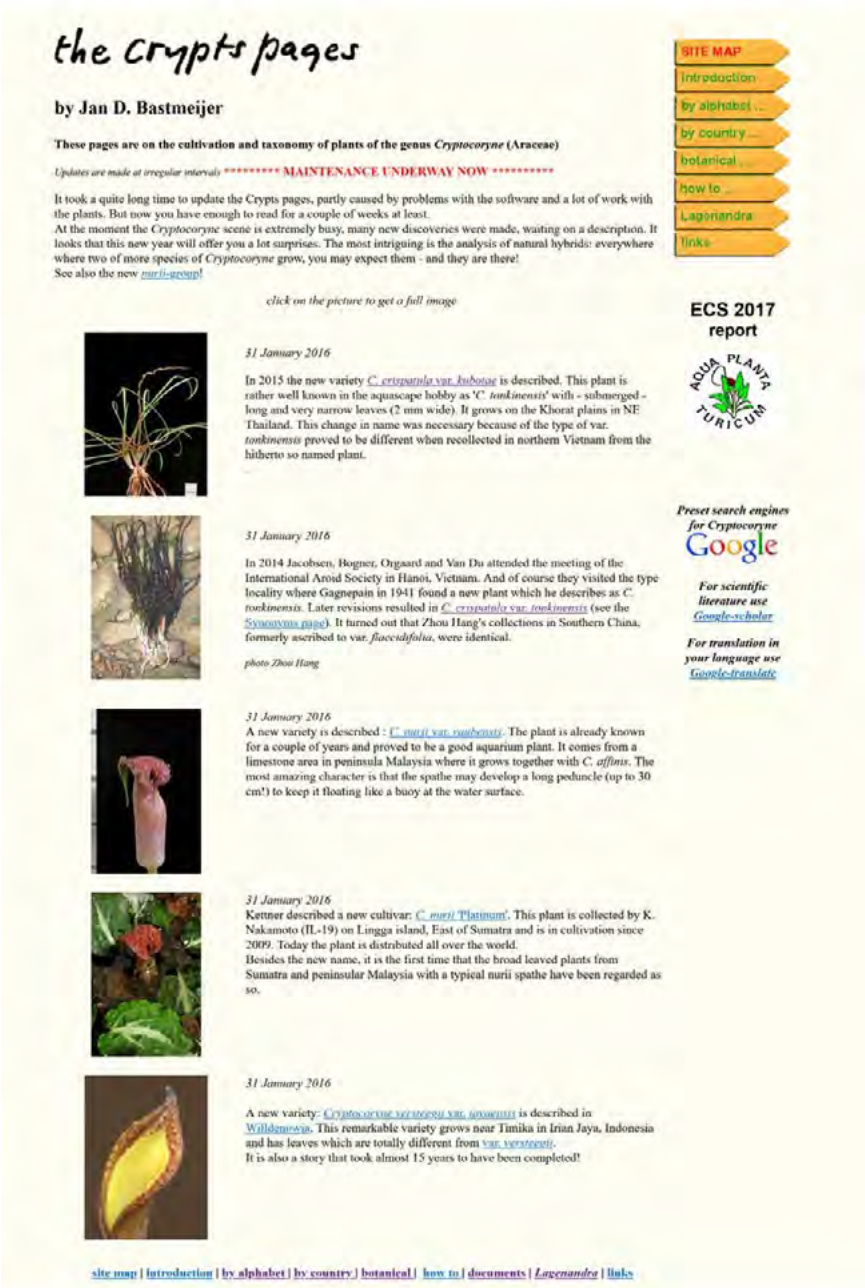


Figure 2. Front page of Jan D. Bastmeijer’s web site ‘the crypts pages’. Figure 3.

Another aspect for *Cryptocoryne* was that then knowledge of the species did not really match the plants being imported. In Engler's (1920) treatment of *Cryptocoryne* 4 species were listed from Sri Lanka, and with our knowledge today we accept 10 species, and a named natural hybrid. It has furthermore proven that these species are variable, and the propagation by stolons has resulted large populations made up of clones. Populations consisting of fixed clonal genotypes are a blessing and a nightmare for gardeners: when you have grown a certain clone for years in an aquarium you know it quite well, and speak with a certain authority about its identity, but the same clone grown under different soil and water conditions may look quite different. It furthermore proved that the Sri Lanka *Cryptocoryne* species were variable: *C. wendtii* De Wit is very variable with both diploid and triploid clones. A great morphological variation within this species formed a basis for many discussions about what is what. Within *Cryptocoryne*, although there are differences in leaf size, shape, and colour, it is in morphological characters of the spathe, and especially the limb, that provides the final taxonomical characteristics. So, you must make them flower before you can identify them, and flowering submerged aquarium conditions is not that frequent at all. You therefore must concentrate on development of methods to cultivate them to flowering condition. Jan's contribution to all this was to make the plants flower, document the results, compare all flowering material, and build a case for identification.

During the 1960s and 1970s there was a strong interest and tradition in The Netherlands for keeping aquaria and of course plants, hence the journal 'Het Aquarium'. Regarding plants this interest was nourished by Prof. H.C.D. de Wit in Wageningen, publishing a number of articles about *Cryptocoryne* in 'Het Aquarium' from 1958-1971, and a book on aquarium plants, which appeared in several editions, the latest in 1990; Bastmeijer 1989; Bogner & Bastmeijer 2001).

Besides being intrigued by the many different *Cryptocoryne* species in circulation, difficulties identifying them, no doubt challenged Jan's mind set, developed from his education within physics, mathematics, and computer sciences – where everything is logic and possible to describe in logic terms. You need to have a consequent and logic approach if you want to make experiments with electricity or thermodynamics. So, Jan's approach to *Cryptocoryne* was to obtain all available data, i.e., literature references and document plants and flowerings with colour pictures. Preserve the flowering plants as herbarium and alcohol specimens of (to be able to see size and shape of spathe and spadix), and of course document the origin. All live plant accessions received a greenhouse accession number, and Jan had cultivated more than 1.700 *Cryptocoryne* and *Lagenandra* accessions over the years. His collection of literature accessions related to *Cryptocoryne* and *Lagenandra* and, e.g., related ecological subjects amounted to more than 1.000. His list of *Cryptocoryne* and *Lagenandra* specimens (world herbaria) and species/localities from literature and live plants amounted to more than 3.000.

His lists would look something like this:

*Cryptocoryne nevillii* Hook.f., Nevill s.n., TYPE, Nov 1885, Sri Lanka, N 07°14' E 081°34' (cood approx. from map). Amparai district: Grukamana Tank near Wawinna. Only tip of spathe protruded above ground. Amongst grass, flowers November (1885) (Hook. 1898).

*Cryptocoryne schulzei* De Wit, coll.: Schulze 553, TYPE, 08 Sep 1970, Malaysia, Johor, 45 miles E of Keloeang.

With Jan's teaching in computer science, it was of course natural for him to apply it to his work with *Cryptocoryne*, and the introduction of digital photography and development of the internet opened a completely new horizon of communication. Jan's website 'the Crypts pages' quickly became a prime source of information and for communication. Building blocks of the web site are the description of each *Cryptocoryne* species, with a short introduction, a reasonable number of photographs, captions for the pictures and lastly a list of relevant literature references. This makes it easy for readers to see the basic data backing each species. The website was an up-to-date source of information for aquarists who wanted to identify plants they were growing, but also for plant enthusiasts in SE Asia wanting to know something about plants they found in nature. Any questions or contributions could be handled through e-mail.

The web site and the following contact correspondence with very many people was also a start of an increasing exchange of plants. Jan was of course up to date on the known species of *Cryptocoryne*, and it was only natural that Jan was involved in most of the identifications of new species cooperating with many people in getting new species published. This would be the early days of networking also leading to what we today would call citizen science. Jan keeping track of everything.

Presently the first dated folders on the website are from 1997, and naturally the most well-known species followed quickly afterwards. After 2000 a number of species were quickly added, and they were added to as quickly as they were published. Around 2016 a little more than 80 taxa of *Cryptocoryne* were included in Jan's list, and seven were waiting to be included. Today, only about six years later 105 named taxa (species, varieties & hybrids) are accepted.

Besides Jan's work in documenting and the development of the website, Jan was also involved in aquatic plant meetings both in The Netherlands and in Germany, from the 1970'ies and onwards. The broad palette of contacts resulted in the first meeting at Cora and Jan's house in Emmen for *Cryptocoryne* fans in 2000 with about a dozen participants. Next year the meeting was held in Waiblingen, Germany, and establishment of the European *Cryptocoryne* Society was a fact. These yearly meetings have continued ever since, each year taking place in a different place somewhere in Europe, the two years of 2020 and 2021 as internet meetings though, joint hosting from Hamburg and Stockach, Germany. The gathering starts Friday evening before dinner time and lasts till Sunday after breakfast. With general talks and discussions among participants, and presentations on various aspects of *Cryptocoryne* (and *Lagenandra*) – cultivation experiences, identifications, and discussions of the latest news – species – articles. A visit to the local botanical garden if such exists. Society build-up is simple: There is no board, no chair-

man, no annual fees, and no association laws. Each participant pays their own travel and hotel expenses. Everyone with surplus of plants brings them, labelled with data in separate plastic bags. There is a 'plant market' with free distribution where people can take what they want. There is always enough to go around. This free sharing of plants has been a general idea with Jan and within ECS. The only point in the agenda for the ECS meetings is to decide where the meeting is to be held next year. Even though Jan did not put himself in front during the ECS meetings, he was always a person the participants would consult about questions or seeking advice. He was a modest man always helping others with whatever he could. We have been many who have enjoyed the hospitality of Jan and Cora over the years in their hideout in Emmen.

Jan himself made one trip to SE Asia in May 1999. The *Cryptocoryne* species of Philippines had always been special interest. He visited the islands of Luzon, Busuanga, and Palawan together with Hersan Morco (Bastmeijer & Morco 2000). He continued to Singapore where people from Oriental Aquarium helped him visit Johor, Peninsular Malaysia. In Singapore he visited Bukit Timah Nature Reserve and found that the *Cryptocoryne* growing there was a natural hybrid new to science and it was named *Cryptocoryne* × *timahensis* Bastm. (Bastmeijer & Kiew 2001).

Over the years Jan's interest in *Cryptocoryne* developed to a 'full time' hobby. He started off with growing plants in aquaria, where the front glass could be opened, and he could tend for his plants from the side. He had several aquaria on top of each other in his 'office' where he also kept his herbarium and alcohol collection, now transferred to the herbarium in 'Naturalis' in Leiden. Jan had a dream of having his own greenhouse where he could grow his aquatic/amphibious *Cryptocoryne*. He was fortunate to be able to retire at an early age and in 2003 he began to build a greenhouse in their garden. Well actually it was more of a growth chamber with a vast number of technical installations (his physics background and love for electrical gadgets) and light coming from one large window facing southeast and a smaller window facing southwest. There were tables where plants were grown in pots standing in 2 cm water or in 1-5 litre tanks where plants were more or less submerged. In wintertime plants received additional lighting and during summertime they were heavily shaded. During European summertime plants of the *Cryptocoryne crispatula* Engl. complex from Mainland Asia drop their leaves, and the plants were then stored in the 'technical' room under the greenhouse.

From the old days when Jan was cultivating *Cryptocoryne* in his office, he became a professional plant grower and taxonomist. During the years of cultivating *Cryptocoryne* in his office tanks he learned how to cultivate different species in such a way that he could bring them to flower, almost as he wanted. Moving into the new greenhouse he had the possibility to vary cultivation conditions even more and was able to cope with almost all new species that came into cultivation after turn of the millennium. He cultivated, e.g., *C. sivadasanii* Bogner very well, but flowering it in cultivation has yet to be seen – for any of us.

He learned to cultivate all the different *Cryptocoryne* species, and his contributions to the world can be seen from the publication list and from his website where any plant enthusiast immediately can obtain information and knowledge of *Cryptocoryne* species.





**Figure 3.** (A) Participants of the ECS-meeting in Göttingen, Germany, 2009, waiting at the bus stop on the way to the botanical garden. (B) ECS 2008 take home poster (A3) designed by Jan, of what was to become *Cryptocoryne crispatula* var. *deculus-mekongensis* T.Idei, Bastm. & N.Jacobsen. (C) ECS 2009 take home poster of the in July by Takashige Idei recollected *Cryptocoryne dewitii* N.Jacobsen (first found in 1971 and described in 1977).





**Figure 4.** (A) The aquaria in Jan’s office around 1985. (B) The setup in 2004. (C) The alcohol collection, plant press material and colour slides below, and herbarium on top, in the office in 2006.



**Figure 5.** (A) The greenhouse 2007. Work facilities left and growth facilities right. (B) Jan's technical installations computer controlled. (C) Practical work facilities a few m away from the plants, 2019.



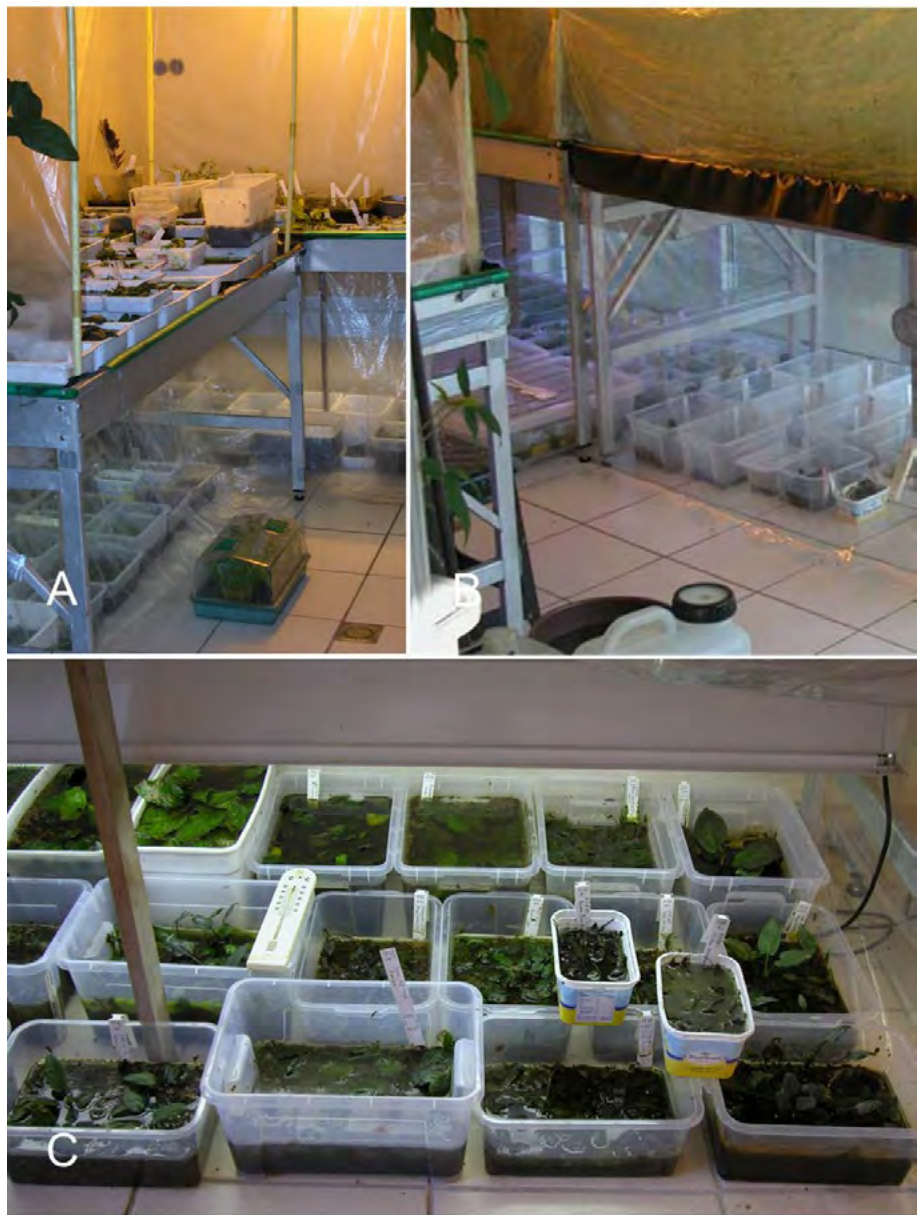


**Figure 6.** Long table in the greenhouse next to the window with more light requiring plants, 2010 (left to right). (A) Mostly *Lagenandra*. (B) Narrow leaved *C. crispatula* varieties and Sri Lanka species. (C) Sri Lanka species and various species in front.



**Figure 7.** (A) Mixed *Cryptocoryne* species and cultivation modes, Malaysian species in tanks. 2017. (B) Malaysian species submerged with *Fagus* leaf peat as substrate, 2010.



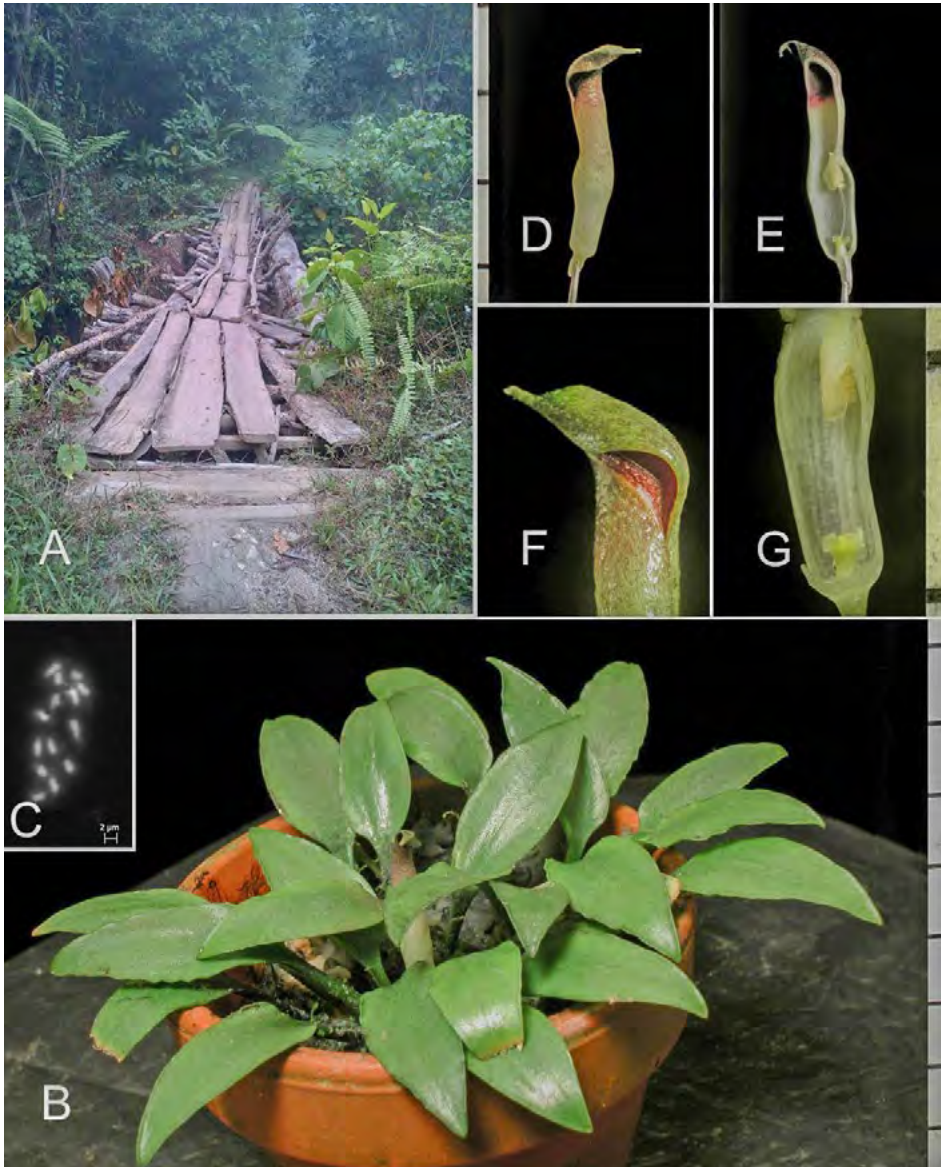


**Figure 8.** Setup in greenhouse when there is not enough space on the tables: (A – C) New accessions and extras are given extra space in mostly 5 l tanks on the floor, 2010.



**Figure 9.** (A) Pot cultivation of mostly some newer Malesian accessions; arrow shows the tetraploid *C. ciliata* (Roxb.) Schott var. *bogneri* N.Jacobsen, type collection. 2018. (B) Mainly *C. crispatula* varieties from the Mekong region. They develop leaves during winter in northern Europe, March 2011.





**Figure 10.** One of the six new species from Kalimantan described by Wongso et al. (2017), *Cryptocoryne bastmeijeri* Wongso, SW 1567. (A) Roads to discover new species are not always easy. (B) From type collection showing one of the typical ways of Jan's cultivation methods. (C) A chromosome number of  $2n = 14$  was the first record of this number for *Cryptocoryne*. (D – G) Spathe pictures showing the typical way Jan would photograph and document a flowering plant. Scale 1 cm.



**Figure 11.** (A) The ‘first’ aquarium still in use for maintaining various accessions under a different way of cultivation with among others *Schismatoglottis prietoi* P.C.Boyce, Medecilo & S.Y.Wong, *Cryptocoryne crispatula* var. *balansae* (Gagnep.) N.Jacobsen, *C. lingua* Engl., *C. crispatula* var. *kubotae* N.Jacobsen & Bastm., *C. wendtii* De Wit, *C. cordata* var. *siamensis* (Gagnep.) N.Jacobsen & Sookch. ‘Rosanervig’, *C. affinis* Hook.f., *C. consobrina* Schott, *C. crispatula* var. *tonkinensis* (Gagnep.) N.Jacobsen, *C. sivadasanii* Bogner and *Bucephalandra* sp., 2017. (B) Cora and Jan, 2017. (C) Jan and Josef, 1st ECS-meeting, Emmen, 2000.

Around 2017 Jan began to become ill and did not continue to update the website. At the moment possibilities of continuing and updating of Jan's website are being investigated. But for now, you can find it on Crypts pages (xs4all.nl). For the new *Cryptocoryne* species, varieties, and hybrids not on Jan's website, a list is provided in Table 2 with references and links to the original publications. Although becoming increasingly ill, Jan still contributed to the description of many of these new taxa.

Jan lived most of his life in the small town of Emmen, about 145 km NE of Amsterdam. Jan is survived by his wife Cora Bastmeijer-Snijders and their four children.

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Wongso, S., J.D. Bastmeijer, T. Idei, K.R. Jensen, M. Ørgaard & N. Jacobsen 2020. *Cryptocoryne* hybrids (Araceae) 4: A *Cryptocoryne* hybrid from the Meratus mountains, South Kalimantan, Indonesia. *Aroideana* 43(1–2): 285–298.

**New *Cryptocoryne* species not included in Jan D. Bastmeijer's website, Crypts pages but of which he contributed to the publication of many of them.**

<https://crypts.home.xs4all.nl/Cryptocoryne/index.html>

*Cryptocoryne* *×agusii* N.Takahashi (*C. ferruginea* var. *sekadauensis* *× C. fusca*)

In Wongso, S., J.D. Bastmeijer, Hendrik, K.R. Jensen, H. Kishi, M. Ørgaard, N. Takahashi & N. Jacobsen (2020). *Cryptocoryne*-hybriden (Araceae): *Cryptocoryne* *×ikezewaldiae* und *C. ×agusii*, zwei neue Hybriden aus West-Kalimantan, Indonesien. *Aqua Planta* 45(2): 44–57.

*Cryptocoryne* *×ardyi* Wongso (*C. cordata* var. *wellyi* *× C. scurrilis*)

In Wongso, S., N.P.S. Asih, J.D. Bastmeijer, W. Reichert, K.R. Jensen, M. Ørgaard & N. Jacobsen (2019). Four new *Cryptocoryne* (Araceae) taxa from Sumatera, Indonesia: a new variety and three interspecific natural hybrids. *Taiwania* 64(3): 326–338. <https://taiwania.ntu.edu.tw/pdf/tai.2019.64.326.pdf>

*Cryptocoryne* *aura* Wongso & Ipor

In Wongso, S., I.B. Ipor, C.S. Tawan, H. Budianto, J.D. Bastmeijer & N. Jacobsen (2016). *Cryptocoryne* *aura* (Araceae), a new species from West Kalimantan, Indonesia. *Willdenowia* 46: 275–282. <https://bioone.org/journalArticle/Download?urlId=10.3372%2Fwi.46.46209&referringURL=https%3A%2F%2Fbioone.org%2Fjournals%2Fwilldenowia%2Fvolume-46%2Fissue-2&isResultClick=True>

*Cryptocoryne* *bastmeijeri* Wongso

In Wongso, S., J.D. Bastmeijer, H. Budianto, I.B. Ipor, K.R. Munk, M. Ørgaard & N. Jacobsen (2017). Six new *Cryptocoryne* taxa (Araceae) from Kalimantan, Borneo. *Willdenowia* 47: 325–339. <https://doi.org/10.3372/wi.47.47314>

*Cryptocoryne ciliata* (Roxb.) Schott var. *bogneri* N.Jacobsen

In Jacobsen, N., J.D. Bastmeijer, K.R. Jensen & M. Ørgaard (2018). A new tetraploid variety of *Cryptocoryne ciliata* (Araceae) from Sarawak. Willdenowia 48: 425–431. <https://doi.org/10.3372/wi.48.48312>

*Cryptocoryne cordata* Griff. var. *wellyi* Wongso

In Wongso, S., N.P.S. Asih, J.D. Bastmeijer, W. Reichert, K.R. Jensen, M. Ørgaard & N. Jacobsen (2019). Four new *Cryptocoryne* (Araceae) taxa from Sumatera, Indonesia: a new variety and three interspecific natural hybrids. Taiwaniana 64(3): 326–338. <https://taiwania.ntu.edu.tw/pdf/tai.2019.64.326.pdf>

*Cryptocoryne crispatula* Engl. var. *albida* (Parker) N.Jacobsen, Maneean. & T.Idei

In Idei, T., S. Maneeanakekul & N. Jacobsen (2022). Stories from the Mekong, part 3. *Cryptocoryne* (Araceae) habitats in the Kok River, Chiang Rai Province, Northern Thailand. *Aroideana* 45(1): 281–295.

*Cryptocoryne* × *decus-silvae* De Wit, emend. N. Jacobsen et al.

In Jacobsen, N., J.D. Bastmeijer, H. Ganapthy, I.B. Ipor, K.R. Munk, A.S. Othman, R. Rosazlina, J. Siow, T. Komala & M. Ørgaard (2020). *Cryptocoryne* hybrids (Araceae) 3: Hybrids between *Cryptocoryne cordata* and *Cryptocoryne nurii* from southern Peninsular Malaysia. *Aroideana* 43(1 & 2): 255–284.

*Cryptocoryne erwinii* Wongso & Ipor

In Wongso S., J.D. Bastmeijer, H. Budianto, I.B. Ipor, K.R. Munk, M. Ørgaard & N. Jacobsen (2017). Six new *Cryptocoryne* taxa (Araceae) from Kalimantan, Borneo. Willdenowia 47: 325–339. <https://doi.org/10.3372/wi.47.47314>

*Cryptocoryne* × *griffithioides* N.Jacobsen (*C. griffithii* × *C. nurii* var. *nurii*)

In Jacobsen, N., J.D. Bastmeijer, K.R. Jensen, A.S. Othman & M. Ørgaard (2020). *Cryptocoryne* hybrids (Araceae) 2: Two *Cryptocoryne* hybrids from southern Peninsular Malaysia. *Aroideana* 43(1–2): 240–254.

*Cryptocoryne* × *bendrae* Wongso (*C. hutoroi* × *C. striolata*)

In Wongso S., J.D. Bastmeijer, T. Idei, K.R. Jensen, M. Ørgaard & N. Jacobsen (2020). *Cryptocoryne* hybrids (Araceae) 4: A *Cryptocoryne* hybrid from the Meratus mountains, South Kalimantan, Indonesia. *Aroideana* 43(1 & 2): 285–298.

*Cryptocoryne* × *ikezewaldiae* Bastm. (*C. cordata* var. *grabowskii* × *C. pallidinervia*)

In Wongso, S., J.D. Bastmeijer, Hendrik, K.R. Jensen, H. Kishi, M. Ørgaard, N. Takahashi & N. Jacobsen (2020). *Cryptocoryne*-hybriden (Araceae): *Cryptocoryne* × *ikezewaldiae* und *C.* × *agusii*, zwei neue Hybriden aus West-Kalimantan, Indonesien. *Aqua Planta* 45(2): 44–57.



*Cryptocoryne isae* Wongso

In Wongso, S., J.D. Bastmeijer, H. Budianto, I.B. Ipor, K.R. Munk, M. Ørgaard & N. Jacobsen (2017). Six new *Cryptocoryne* taxa (Araceae) from Kalimantan, Borneo. Willdenowia 47: 325–339. <https://doi.org/10.3372/wi.47.47314>

*Cryptocoryne* × *jambiensis* Bastm. (*C. bangkaensis* × *C. nurii* var. *nurii*)

In Wongso, S., N.P.S. Asih, J.D. Bastmeijer, W. Reichert, K.R. Jensen, M. Ørgaard & N. Jacobsen (2019). Four new *Cryptocoryne* (Araceae) taxa from Sumatera, Indonesia: a new variety and three interspecific natural hybrids. Taiwania 64(3): 326–338. <https://taiwania.ntu.edu.tw/pdf/tai.2019.64.326.pdf>

*Cryptocoryne joshanii* Naive & Villanueva

Naive, M.A.K. & R.J.T. Villanueva (2018). *Cryptocoryne joshanii* (Araceae), a new species serendipitously discovered in Sulu archipelago, Philippines. Taiwania 63(3): 248–250. <https://taiwania.ntu.edu.tw/pdf/tai.2018.63.248.pdf>

*Cryptocoryne* × *nakamotoi* Bastm. (*C. uenoi* × *C. verrucosa*)

In Asih, N.P.S., S. Wongso, Hendrik, J.D. Bastmeijer, S. Reitel, K.R. Jensen, M. Ørgaard & N. Jacobsen (2022). New *Cryptocoryne* (Araceae) from West Kalimantan, Indonesia: a new species and a new interspecific natural hybrid. Aroideana 45(1): 296–312.

*Cryptocoryne regina* Wongso & Ipor

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*Cryptocoryne sahalii* Wongso & Ipor

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# New species and a new combination of *Anthurium* (Araceae) from Central America

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## ABSTRACT

Five species of *Anthurium* are described as new. These are *Anthurium breedlovei* Croat, Vannini & Fred Mull. (sect. *Pachyneurium*) from Mexico, *A. diabloense* Vannini, Croat, & Cast.Mont (sect. *Andiphilum*) from Guatemala and Belize, *A. fredmulleri* Vannini, Croat & Cast.Mont from northern Central America (sect. *Andiphilum*), *A. ixtenamense* Croat, Cast.Mont & Vannini from Guatemala (sect. *Andiphilum*) and *A. ustupoense* Croat, Fred Mull. & Vannini from Panama (sect. *Cardiolonchium*). One new combination is made, elevating *Anthurium clidemioides* Standl. subsp. *pacificum* to the species level, *A. pacificum* (Croat & Grayum) Vannini & Croat. *Anthurium andresloviniense* Matuda is re-evaluated and re-described with a new, more complete description.

**Keywords:** Araceae, *Anthurium*, sect. *Andiphilum*, sect. *Cardiolonchium*, sect. *Pachyneurium*, new species.

## INTRODUCTION

With 382 species (389 taxa) known from Central America, *Anthurium* is one of the larger genera among the region's flora. This constitutes nearly half of the total 784 species of Araceae in Central America. The last treatment of the genus *Anthurium* for Central America (Croat, 1983; 1986) included 122 species in Part I (Mexico and Middle America) and 148 in Part II (Panama) with 6 new species published in Part I and 82 new species in Part II, for a total of 270 species documented for the region by the mid-1980s.

Several new species have been published since that time including *Anthurium bagsaterianum* Haager (Haager, 1991); *A. acutifolium* var. *berrerae* Croat (Croat, 1991); *A. clidemioides* ssp. *pacificum* Grayum and *A. obtusum* ssp. *puntarenense* Grayum (Grayum, 1997); *A. faustomirandae* Pérez-Farr. & Croat (Pérez-Farr. & Croat, 2001); *A. daryi* Croat (Croat, 2005); *A. guatemalense* Croat, Cast.Mont & Vannini, (Croat et. al., 2008); a new species in sect. *Cardiolonchium* from Panama,

*A. kunayalense* Croat & Vannini (Croat & Vannini, 2010); 16 species of sect. *Calomystrium*, mostly from Panama (Croat et. al., 2013), *A. coicoyanense* Croat & Ávila Blomb., a member of sect. *Andiphilum* from Mexico (Croat & Ávila Blomberg, 2015); *A. carrasquillanum* Croat & O. Ortiz in sect. *Decurrentia* (Ortiz & Croat, 2015); *A. montezulense* Croat, O. Ortiz & Baldini and *A. batistae* Croat, O. Ortiz & Baldini in sect. *Xialophyllum* (Ortiz et al., 2015); several species of *Anthurium* sect. *Polyneurium*, *A. christeliae* Croat & O. Ortiz, *A. intactum* Croat & O. Ortiz and *A. palosecense* Croat & O. Ortiz (Croat & Ortiz, 2016); two species from the Chucantí Nature Reserve, *A. annularum* O. Ortiz, Baldini & Croat in sect. *Xialophyllum* and *A. chucantiense* O. Ortiz, Baldini & Croat in sect. *Polyneurium* (Ortiz et al., 2016); two species of sect. *Andiphilum* from Guatemala, *A. archilae* Croat, *A. altaverapazense* Croat & Hormell (Croat & Hormell, 2017); four new species in sect. *Calomystrium* from Mexico and Panama, *A. totontepecense* Croat from Mexico and *A. hartmanii* Croat & O. Ortiz, *A. mikenecii* Croat and *A. virididifusiforme* Croat & O. Ortiz, all from Panama (Croat et al., 2017); 31 new species from Central America and Panama (Ortiz et al., 2020) as well as three new species of sect. *Andiphilum* from Mexico, *A. ixtlanense* Diaz Jim., Pérez-Farr. & Croat and *A. luzense* Diaz Jim., Pérez-Farr. & Croat (Diaz Jim. et al., 2020), and *A. roseonervium* Croat & Hodel from northern Oaxaca State (Croat & Hodel, 2020a; 2020b). Thus, a total of 51 species and three subspecies or varieties were published in Central America since the last revisions by Croat and up to the present time. In addition to the above mentioned, two additional new species of *Anthurium* were recently discovered in Mexico in sect. *Andiphilum*: *Anthurium tacotalpense* Pérez Farr., Díaz-Jim. Croat, Hentrich, Padilla Veg. and Aguilar-Rod., 2022; and another is in the process of being published by several regional botanists including Mexican botanists, Pedro Díaz Jiménez and Miguel Pérez-Farrera, and Costa Rican botanist, Marco Cedeño Fonseca. Curiously few species previously described from South America and not accounted for in earlier treatments have been found in Central America.

In summary, the Central American taxa of *Anthurium*, now numbering 389 are distributed in 15 different sections in the following quantities: *Andiphilum* (45); *Belolonchium* (8); *Calomystrium* (60); *Cardiolonchium* (31); *Dactylophyllum* (4); *Decurrentia* (11); *Digitinervium* (1); *Leptanthurium* (1); *Cordato-punctatum* (7); *Pachyneurium* (45); *Polyneurium* (13); *Polyphyllum* (4); *Porphyrochitonium* (128); *Semaeophyllum* (7); *Tetraspermium* (5) and *Xialophyllum* (22).

Recent fieldwork by botanists and naturalists working in Mesoamerica has revealed several new *Anthurium* species. As our understanding of regional phytogeography improves and plant collections are made in previously unexplored or lightly botanized, biodiverse regions of Mexico and Central America, many more novelties are to be expected. Finally, five new species are being published in this paper.

## Methods and Materials

Species described here were studied from both living material in the field and herbarium specimens at the Missouri Botanical Garden (MO) and at the Universidad San Carlos (AGUAT) in Guatemala City as well as in the living collections of Jay Vannini. Species were compared with all similar species from Central America as well as adjacent areas of Colombia as well as all

appropriate type specimens which are mostly available for study at the Missouri Botanical Garden or by using online databases. The Lucid Anthurium Key which was used to help isolate the new species is a multi-entry computerized key wherein all appropriate conservative character states have been recorded and the key works by a process of elimination. As conservative character states are entered into the computer, any species lacking that state are eliminated, resulting in a list of up to ten or more species. These species are then carefully compared with the material being studied to see if there are matches. To assure that a species is a novel one, other attempts are used in the key using other characters. The Lucid Anthurium Key was first developed at Kew Gardens, but for the past 15 years the key has been further modified and greatly augmented with more species at the Missouri Botanical Garden. More information can be obtained from Lucid, see <https://www.lucidcentral.org/key-search/>

Colors referenced by HEX numbers can be defined as a series of numbers. For more information see <https://www.codeconquest.com/hex-color-codes/>

### NEW SPECIES DESCRIBED HERE

***Anthurium breedlovei*** Croat, Vannini & Fred Mull., **sp. nov.** — Type: MEXICO. Chiapas: Municipio de Berriozábal, on flats near Berriozábal, thorn woodland (secondary growth), ca. 16°47'22"N, 93°14'58"W, 830 m, 23 Aug. 1981, *D. E. Breedlove 52375* (holotype, MO-3028705; isotype, CAS, not seen). **Figures 1–9.**

*Diagnosis:* *Anthurium breedlovei* is most characteristic of *Anthurium* sect. *Pachyneurium* in having short internodes, a dense cluster of roots and rosulate leaves but is quite different from any other member of the sect. in Mexico. In the Lucid Anthurium Key, the species tracks to *Anthurium nizandense* Matuda which sometimes shares a similar leaf blade shape, but that species differs by its more long-petiolate leaves, blades that dry darker brown and less coriaceous with the primary lateral veins extending mostly to the margins as well as by having inconspicuous tertiary veins. *Anthurium breedlovei* might be confused with young plants of *A. jimenezii* Matuda, but even in their juvenile condition, they do not have petioles shaped like those of *A. breedlovei*, but rather they are subrounded or trapezoidal.

Terrestrial or epiphytic; stems short, less than 6 cm long; internodes short, ca. 1 cm diam.; cataphylls 4.5–5.6 cm long, 1-ribbed, persisting intact, gray-brown, matte. *Leaves* with petioles (2.5)3.0–3.5 cm long, sharply and deeply sulcate adaxially on drying, narrowly rounded abaxially, sometimes sharply quadrangular, drying light brown, matte; blades lanceolate, 27–40.5 cm long, 4.2–9.5 cm wide, 2.6–3.8 times longer than wide, acute with a short apiculum at apex, acute to weakly attenuate at base, drying grayish yellow-brown and weakly glossy above, slightly paler, yellow-brown and semiglossy below; midrib narrowly rounded, drying irregularly and prominently ridged above, narrowly rounded, finely and regularly ridged, darker below; primary lateral veins 6 to 8(11) per side, departing midrib at a 40–50° angle, narrowly rounded and only weakly apparent above, narrowly rounded and moderately prominent, concolorous below; tertiary veins prominulous upon drying on both surfaces; collective veins arising from middle to upper primary lateral veins, 7–10 mm from margins; upper surface smooth and



**Figure 1.** *Anthurium breedlovei* Croat, Vannini & Fred Mull. Habit.





**Figure 2.** *Anthurium breedlovei* Croat, Vannini & Fred Mull. Habit, showing abaxial leaf blades.



**Figure 3.** *Anthurium breedlovei* Croat, Vannini & Fred Mull. Leaf blade,



**Figure 4.** *Anthurium breedlovei* Croat, Vannini & Fred Mull. Leaf blade, abaxial surface.



**Figure 5.** *Anthurium breedlovei* Vannini & Fred Mull. Stems and petioles.





**Figure 6.** *Anthurium breedlovei* Croat, Vannini & Fred Mull. Juvenile plant (cultivated by J. Vannini).



**Figure 7.** *Anthurium breedlovei* Croat, Vannini & Fred Mull. (left) Compared with *A. guatemalense* (right), juvenile plants (cultivated by Jay Vannini, photo J. Vannini).





**Figure 8.** *Anthurium breedlovei* Croat, Vannini & Fred Mull. Herbarium specimen showing entire plant with leaf blade, abaxial surface, with apex folded over, revealing adaxial surface.



Figure 9. *Anthurium breedlovei* Croat, Vannini & Fred Mull. Herbarium specimen showing entire plant with leaf blade, abaxial surface and inflorescence.

glossy at higher magnifications, sometimes sparsely pustular; lower surface matte and granular at higher magnifications. *Inflorescence* erect; peduncle 23–35 cm long, drying 2.5 mm diam, bluntly ribbed; spathe oblong-lanceolate, green, 4.3–5 cm long, 0.5–1.5 cm wide, reflexed; spadix green becoming red post-anthesis, cylindroid-tapered, sessile, 3.3–4.7 cm long, 5.3–7 mm diam. at base, 3.5–5 mm diam. at 1 cm from apex; flowers 7–8 visible per spiral, 1.5–1.8 mm long and wide; tepals; stamens held in contiguous cluster around the style at the level of the tepals; anthers 5–6 mm long, 7–8 mm wide; thecae narrowly ovate, somewhat divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium breedlovei* is endemic to Mexico and is known only from the type locality in eastern Chiapas State at 830 m in a *Tropical deciduous forest* life zone (Holdridge, 1967).

**Etymology** — This species is named in honor of the late, Dr. Dennis Breedlove from the California Academy of Science who discovered the type specimen. Breedlove spent several years collecting in Chiapas while working on an ethnobotanical study under the direction of Peter Raven at Stanford University.

**Comments** — Another similar *Pachyneurium* in the region is *Anthurium guatemalense* Croat, Cast. Mont & Vannini which differs in having longer, more-or-less oblong, darker brown drying and proportionately much narrower blades that are more than 8 times longer than broad. Seemingly similar in appearance are some specimens of *Anthurium seleri* Engl. and *A. ixtenamense* in sect. *Andiphilum* with which this species shares many features, especially the sharply sulcate petiole and long, narrow leaf blades.

*Paratype*: CULTIVATED. California. Origin: Mexico. Chiapas: Vic. of Berriozábal, ca. 16°49'N, 93°17'W, 1000 m, vouchered, July 2021, T. B. Croat & J. Vannini 107941 (CHIP, MO).

***Anthurium diabloense*** Vannini, Croat & Cast.Mont, **sp. nov.** Type: GUATEMALA. Izabal: onshore, immediately adjacent to Cayos del Diablo, Aldea Las Pavas, Santo Tomás de Castilla Municipality, 15°26'56"N, 88°38'49"W, 8 m, J. J. Castillo Mont & J. Vannini 3108 (holotype, AGUAT; isotypes, K, MO). **Figures 10–17.**

*Diagnosis*: *Anthurium diabloense* is in sect. *Andiphilum* and is distinguished by its mostly lithophytic habit, short internodes, terete or slightly flattened petioles distally, and its conspicuously triangular-sagittate, coriaceous, highly glossy, gray-green or pewter-colored fresh leaf blades that are held upright with elongated posterior lobes and with flat, slightly concave, or slightly convex lateral margins as well as the bright orange berries with large seeds. In addition, it has an unusual and characteristic arcuate to subcordate venation pattern where the first pair of collective veins form a narrowly ovate line from the very base to the apex of the blade.

Lithophyte on exposed karst, occasionally terrestrial loosely rooted into leaf litter; foliage to 50 cm tall; stem short; internodes short; cataphylls chartaceous-subcoriaceous, 5.0–9.0 cm



**Figure 10.** *Anthurium diabloense* Vannini, Croat & Cast. Mont. Plant in habitat.





**Figure 11.** *Anthurium diabloense* Vannini, Croat & Cast. Mont. Cultivated plant showing side view of leaf.



**Figure 12.** *Anthurium diabloense* Vannini, Croat & Cast. Mont. Petioles and cat-





**Figure 13.** *Anthurium diabloense* Vannini, Croat & Cast. Mont. Leaf blade, adaxial surface.



**Figure 14.** *Anthurium diabloense* Vannini, Croat & Cast. Mont. Fruits.



**Figure 15.** *Anthurium diabloense* Vannini, Croat & Cast. Mont. Seeds.





**Figure 16.** *Anthurium diabloense* Vannini, Croat & Cast. Mont. Flattened leaf with inflorescence.



**Figure 17.** *Anthurium diabloense* Vannini, Croat & Cast. Mont. Herbarium specimen showing leaf blade, adaxial surface with petiole and inflorescence.

long, narrow acuminate, with two acutely margined ribs at base, pale greenish pink when fresh and drying light brown, persisting intact at apex, and splitting at base. *Leaves* with petioles terete for most of their length, slightly flattened in distal  $\frac{1}{4}$  to  $\frac{1}{3}$ , geniculum shallowly sulcate 1–2 cm long, scarcely thicker than or paler than petiole; blades conspicuously triangular-sagittate, to 35 cm long, 24 cm wide, 0.8–1.5 times longer than wide; posterior lobes directed upward and outward from the midrib (rarely almost touching) and the sinus spatulate to narrowly spatulate, the lobes more spreading when flattened and the sinus parabolic to open V-shaped or arcuate; basal veins 2 or 3 pairs, etched in upper surface, weakly raised below, 1st pair free to the base, 2nd & 3rd pairs fused to 1 cm, entirely naked along the sinus; upper surface usually gray-green or pewter-colored, drying light yellowish brown; anterior lobe 9.5–16.0 cm long, the margins flat, at least in the lower half, somewhat concave or broadly convex toward apex and narrowly acuminate and downturned at apex; posterior lobes 7–a19 cm long, 4–8 cm wide, 1.5–2.0 times longer than wide; midrib slightly raised above and below and concolorous above, narrowly rounded and slightly paler below; primary lateral veins 2 per side, sunken above and slightly raised below, departing midrib at a 65° angle; collective veins arising from the 1st pair of arcuate to subcordate basal veins, spreading broadly then prominently curved toward the apex and obliquely merging with the margins near the tip of the blade; 2nd pair of collective veins reflexed-spreading toward apex and merging with the margin above the middle of the blade. Fully mature plants hold up to 20 leaves in cultivation, although usually far fewer in nature. *Inflorescence* erect, held well above the foliage at anthesis, decumbent when in fruit; peduncle to 23 long, 2 mm diam., terete; spathe lanceolate, pale green, reflexed, moderately tapered, 4–8 cm long, 1.3 cm wide, narrowly long-acuminate (acumen 1.3 cm long); spadix subsessile, 3–11 cm long, 1.4–7.0 mm diam. at base, tan or reddish brown at anthesis, dark green to gray-green post-anthesis if pollinated, brown if not; flowers 2(3) visible per spiral, 3.4–3.6 mm long, 3.2 mm wide; pistils weakly protruding, 1 mm diam., square, weakly raised, purplish violet; stamens held at the surface of the tepals, crowded around and covering stigma, 0.6 mm long, 0.4 mm wide. *Infructescence* pendent, spadix to 11 cm long, berries subglobose, ridged or occasionally faceted when green, ripening from dark green to orange (HEX color code #fa691d) with a sunken brown apex when fully ripe, to 12 mm × 8.5 mm, seeds 1 or 2 per berry, white to cream-colored, to 7 × 7 mm.

**Distribution and ecology** — *Anthurium diabloense* is endemic to eastern Guatemala in the Departments of Izabal, Alta Verapaz, El Petén, and extreme southwestern Belize in the Toledo District from sea level to ca. 300 m in *Subtropical wet forest* life zones.

**Etymology** — The species is named for Cayos del Diablo, a pair of forested karst outcrops located adjacent to the coast in the southwestern Bahía de Amatique and just opposite the type locality on the mainland.

**Comments** — This species is highly localized in its distribution at all localities we are familiar with, although it can be conspicuous and locally abundant where it does occur. It is a shade-obligate, canopy-dependent species and despite successfully colonizing very old road cuts near the type locality, does not appear to survive in heavily disturbed forest fragments. Both in nature and in cultivation the species will flower and fruit year-round.



This slender rain forest understory inhabitant is visually like the Chiapan upland endemic, *Anthurium berriozabalense* Matuda, and a Tabascan lowland endemic, *A. tacotalpense*, especially owing to their coriaceous blades that are upright with elongated posterior lobes as well as bright orange berries with large seeds. Despite long held reservations by the two senior authors as to its proper taxonomic placement, it has previously been combined with that species despite key morphological and ecological differences (Croat & Vannini, 2006; this paper). *Anthurium diabloense* differs clearly from *A. berriozabalense* by its terete or slightly flattened petioles (versus D-shaped to sharply sulcate), more elongate cataphylls, its highly glossy gray-green or pewter-colored fresh leaves (versus semiglossy medium green fresh leaves) with flat, slightly concave or slightly convex margins (versus convex margins when mature) and its characteristic arcuate or subcordate vein pattern (versus numerous lateral veins departing the midrib at a ca. 100° angle that impart a “fishbone” aspect) where the 1st pair of collective veins form a narrowly ovate line from the very base to the apex and form the principal pair of collective veins. Mixed collections of the newly described *Anthurium tacotalpense* Pérez Farrera et al., *A. diabloense*, *A. berriozabalense* Matuda, and at least one central Chiapan upland sect. *Andiphilum* sp. nov. (Croat & Vannini, in prep.) stored in herbaria (including MO) and identified as *A. berriozabalense* Matuda or *Anthurium seleri* Engl., readily explain the confusion surrounding these very distinct and locally endemic *Anthurium* species.

*Anthurium berriozabalense*, as now defined, is a lithophytic or terrestrial species endemic to middle elevation cloud forest ecosystems of western Chiapas State, Mexico on the Gulf drainage between ca. 1,000 and 1,500 masl.

*Anthurium diabloense* is most closely related to *A. tacotalpense* Pérez-Farr. et al. from “bosque tropical perennifolio” of the Gulf drainage of Tabasco and northern Chiapas, Mexico between 50 and 130 masl. This species differs from *A. diabloense* in its basal and lateral vein arrangements, having a flattened or D-shaped petiole, leaf lamina broadest at the middle, bright green spadix at anthesis and smaller berries.

*Paratype*: CULTIVATED. California, cultivated plant grown from type locality (Guatemala. Izabal: onshore, immediately adjacent to Cayos del Diablo, Aldea Las Pavas, Santo Tomás de Castilla Municipality, 15°26'56"N, 88°38'49"W, 8 m, cultivated by Jay Vannini in California), vouchered, 11 March 2021, T. B. Croat & J. Vannini 107917 (BIGU, MO, US).

***Anthurium fredmulleri* Vannini & Croat, sp. nov.** — Type: Cultivated in California. T. B. Croat & J. Vannini 107897 (holotype, MO-6940748; isotypes, AGUAT, K, TEFH, US). **Figures 18–28.**

*Diagnosis*: *Anthurium fredmulleri* is in sect. *Andiphilum* and is characterized by its large mature size, terrestrial habit, short internodes, short somewhat deciduous cataphylls, subterete petioles, narrowly triangular-sagittate, narrowly long-acuminate, matte, subvelvety to velvety blades which are 1.1–1.7 times longer than wide above with a parabolic to hippocrepiform



**Figure 18.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Adult leaf blade, adaxial surface.



**Figure 19.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Adult leaf blade, adaxial surface.



**Figure 20.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Adult leaf blade, abaxial surface with geniculum.





**Figure 21.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Stem apex and weathered fibrous cataphylls.





**Figure 22.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Infructescence with nearly ripe berries.



**Figure 23.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Stem with pre-anthesis inflorescence, roots, and cataphylls.



**Figure 24.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Newly opening inflorescence at anthesis, side view.



**Figure 25.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Newly opening inflorescence.





**Figure 26.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Newly opening inflorescence at anthesis with close-up of stamens.





**Figure 27.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Infructescence with nearly ripe berries.



**Figure 28.** *Anthurium fredmulleri* Vannini, Croat & Cast. Mont. Inflorescence with loose berries.

sinus, 4 or 5 pairs of basal veins with the 1st pair free to the base, a posterior rib to 8 cm long and naked throughout most of their length as well as a spreading-reflexed green spathe and a weakly to prominently stipitate medium green spadix.

Plant terrestrial in mixed rock and clay soils in very wet areas, including streamside; stems short; internodes short, 2–3(5) cm diam.; roots moderately sparse, thick, to 5 mm diam; cataphylls to 12 cm long, soon turning medium dark, yellow-brown, somewhat briefly persisting, somewhat marcescent, then deciduous. *Leaves* with petioles (16)50–90(150) cm long, (4)8–10 mm diam., terete in distal ½, becoming flattened to obscurely sulcate at base, medium green, matte, densely pale-speckled throughout, held more or less erect; geniculum (2)3–4 cm long, (5)7–9 mm diam., slightly paler and slightly thicker than shaft of petiole; blades narrowly triangular-sagittate, (25)50–90 cm long, (15)29–60 cm wide, 1.1–1.7 (averaging 1.4) times longer than wide, as long as or 1.8 times longer than petioles, sub-pendent from petioles, narrowly long-acuminate at apex, deeply lobed at base; margins sometimes broadly undulate, dark green and matte-velvety above, paler and semiglossy below, drying greenish and matte above, green and semiglossy below; anterior lobe 20–65 cm long (much larger), 1.5–2.5 times longer than posterior lobes, broadly rounded to nearly straight along the margins, occasionally undulate; posterior lobes 9–25 cm long, 6–12 cm wide, directed toward the base and slightly in-turned and with inner margins sometimes turned up against each other in life, 9–13 cm long, 6–9 cm wide; sinus parabolic to hippocrepiform when flattened, 5–20 cm deep, 4–10 cm wide; major veins on upper surface usually paler green with a discolored space along margins, especially the midrib and upper basal veins; basal veins 4–6 pairs, 1<sup>st</sup> pair free to the base, 2<sup>nd</sup> pair fused from a few mm to 3–4 cm, 3<sup>rd</sup> pair fused 4–8 cm; 4<sup>th</sup> pair fused to 12 cm; posterior ribs nearly straight, naked throughout most of their length; midrib narrowly rounded and paler above, less narrowly rounded and slightly paler below; upper surface conspicuously velvety, drying densely and uniformly granular, matte; lower surface moderately glossy with inconspicuous minor veins, drying moderately paler, semiglossy and smooth, punctations and short pale lineations absent on both surfaces. *Inflorescences* sub-erect; peduncle 7–14 cm long, 6 mm diam.; spathe spreading-reflexed, to spreading, 10 cm long, 4 cm wide, green, tinged with purple on inner surface (appearing light brown), pale green on outer surface, long-acuminate at apex, obliquely attached at ca. a 45° angle, the sides sometimes turned downward, persisting into fruit; spadix slightly tapered, medium green to yellowish green, matte to semiglossy, 9–10 cm long, (5)7–10 mm diam., weakly to prominently stipitate to ca. 1 cm (stipe medium green and glossy); stamens scarcely protruding above the tepals; anthers faintly yellowish, the filament weakly exposed; thecae weakly divaricate; pollen loose, pale yellow. *Infructescence* erect, sub-cylindroid, ca. twice as long as broad, the spadix prominently stipitate; berries dark green with a ridged, sunken apex, ripening bright orange (HEX color code #ff781f)\*, subglobose, slightly longer than broad, 1.6 cm long, 1.3–1.6 mm diam., emerging and suspended on 4 slender filaments; seeds to ca. 1 cm long. \*[A HEX color is expressed as a six-digit combination of numbers and letters defined by its mix of red, green and blue (RGB)].

**Distribution and ecology** — *Anthurium fredmulleri* is known from cultivation in Guatemala and California but wild populations occur at near 1,000 m in a *Lower montane wet forest* or *Montane moist forest* life zones. Plants in nature inhabit shady, very humid areas in the understory, in-

cluding stream banks where some plants had their root systems submerged for several months of the year during the rainy season. The exact details of the locality of the single known wild population will remain unpublished owing to the rarity and beauty of this species and its obvious interest to ornamental horticulture. This decision was made to prevent the intense commercial collecting pressure that has followed recent descriptions of several horticulturally desirable Araceae around the world with vulnerable populations (see *Philodendron patriciae* Croat and *Alocasia azlanii* K.M.Wong & P.C.Boyce for two examples).

**Etymology** — The species is named in honor of naturalist and explorer, Fred Muller, who discovered and photographed the species in nature. Fred, a native of the Department of Alsace in France, operates a natural history-oriented guiding business in Guatemala and has a special interest in Araceae, as well as herpetology. Because his business involves tours to remote regions of the neotropics in search of rare flora and fauna, he has opportunities to find many interesting plant species.

**Comments** — *Anthurium fredmulleri* is perhaps closest to *A. leuconeurum* Lem., a much smaller species with more numerous and contrast-colored leaf veins and slender, elongated inflorescences held well above the foliage that occurs in middle elevations forests of Chiapas State, Mexico, and adjacent Guatemala in the Department of Huehuetenango, and does share several characteristics, especially in its lithophytic habit, general aspect and thick, partially exposed roots. It also resembles *Anthurium archibae* Croat from western Guatemala that also has subvelvety leaves but that species differs in being much smaller in size at maturity, having a shorter more robust peduncle, almost sessile inflorescence, and a short stubby spadix, cupped, suborbicular spathe and adaxial leaf blade surfaces that are subglossy to subvelvety in aspect. *Anthurium fredmulleri* was photographed in nature, flowering and with berries at varying stages of development in October. Young plants in cultivation will flower year-round.

***Anthurium ixtenamense*** Croat, Cast.Mont & Vannini **sp. nov.** — Type: Guatemala: Huehuetenango: San Sebastián Coatán, Aldea Ixtenam, ca. 1700 m, cultivated by Jay Vannini, California, 1 Jan. 2004, J. J. Castillo Mont & J. A. Castillo Mont 3049 (holotype, AGUAT; isotypes, K, MEXU, MO, US). **Figures 29–41.**

**Diagnosis:** *Anthurium ixtenamense* is an unusual member of sect. *Andiphilum* (owing to its more or less oblong leaves) and is characterized by its persisting intact cataphylls, narrow lanceolate coriaceous leaves with truncate to acuminate posterior lobes, deeply and narrowly V-sulcate petioles which may be sharply acute to 7-ribbed abaxially, 8–10 primary lateral veins per side which are etched and concolorous above, flat below, with two pairs of basal veins, a single pair of collective veins arising from the lowermost pairs of basal veins as well as a long-peduncle inflorescence with green spathe and spadix and orange berries.

Terrestrial; stem short; internodes short, to 2.5 cm diam.; cataphylls 1 / 2 to almost fully as long as petioles, medium green, turning brown and persisting more or less intact. Leaves with petioles 8–21 cm long, 5–10 mm thick, 3.5–8.0 mm diam., medium green, weakly glossy, deep-



**Figure 29.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Habit.

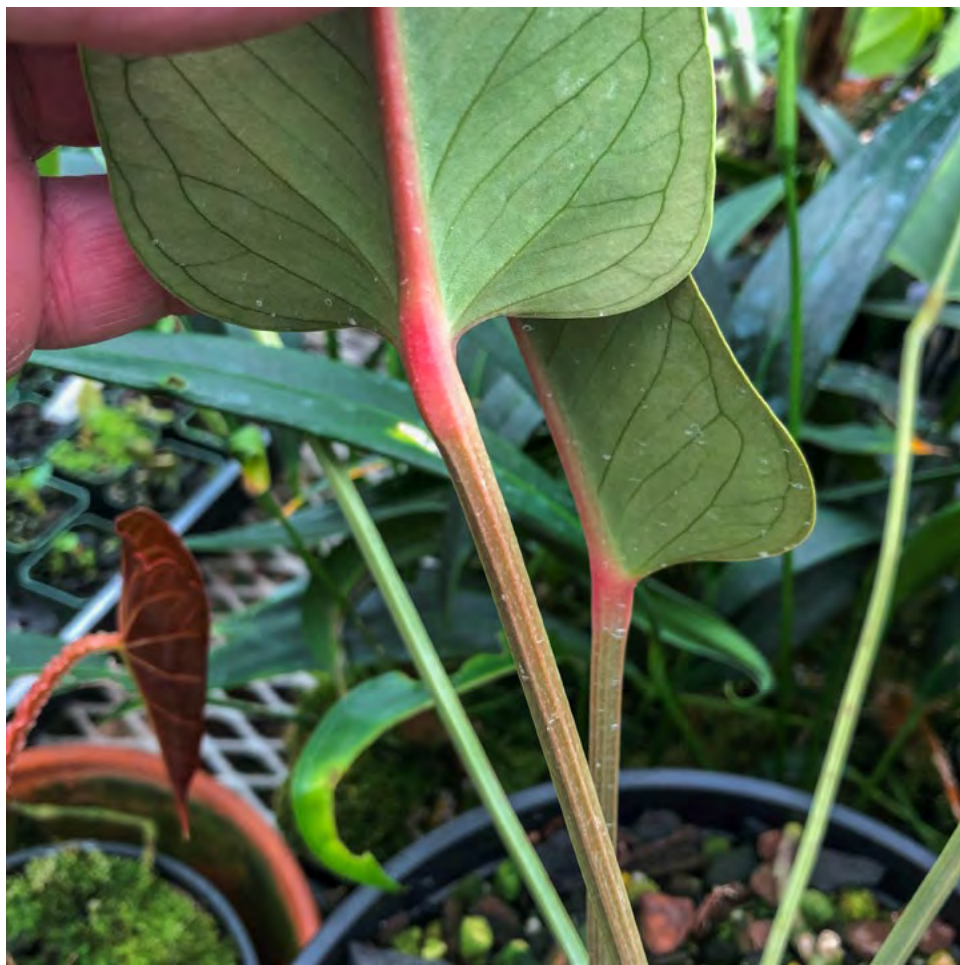




**Figure 30.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Habit showing abaxial leaf surfaces.



**Figure 31.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Juvenile leaves, abaxial surface left, adaxial surface right.



**Figure 32.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Juvenile leaf showing reddish geniculum.





**Figure 33.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Abaxial leaf surface.



**Figure 34.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Petioles.





**Figure 35.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Showing petiole cross-sectional shape.



**Figure 36.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Showing ribbing on petioles.



**Figure 37.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Inflorescence showing purplish violet spadix and green spathe.





**Figure 38.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Spadix at anthesis with small bees.



**Figure 39.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Two infructescences and one inflorescence.





**Figure 40.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Infructescence.



**Figure 41.** *Anthurium ixtenamense* Croat, Vannini & Cast. Mont. Herbarium type specimen (J. J. Castillo Mont 3049).

ly and narrowly V-sulcate adaxially, sharply acute to 7-ribbed abaxially, sheathed 2.5 cm at base; geniculum 2.5 cm long (to 1.5 cm long and tinged pinkish red on younger plants), sharply and broadly sulcate adaxially, narrowly rounded abaxially, pale green; blades more or less ovate-oblong, 38–62.5 cm long, 7 cm wide, 8.9 times longer than wide, broadest near the base at in the lower 1/3 of the blade, about 13 cm above base with a weak constriction in lower 1/4 of blade, gradually tapered to apex, acute at apex, more or less truncate to weakly subcordate at base, thinly coriaceous, dark green and semiglossy above, moderately paler and weakly glossy below; midrib narrowly rounded and weakly paler above, acute and paler below, tinged pinkish red on younger plants; primary lateral veins 8–10 per side, departing midrib at a 35–40° angle, etched and concolorous above, flat distinct and darker below; basal veins 2 pairs; collective veins, 1 pair arising from the lowermost pairs of basal veins, etched and equal to primary lateral veins above, distinct and moderately loop-connected below; tertiary veins seemingly lacking. Inflorescence with peduncle 44–48 cm long, subterete, 2.5–3.0 mm diam., the side below the abaxial surface of the spathe with a bluntly acute rib; spathe green, 3.8–9.2 cm long, 1.5–3.1 cm wide at base, ca. 2 cm wide near apex, acuminate-apiculate at apex (apical 1 cm tightly rolled into a cone, the apiculum 6 mm long), tightly coiled under with apex directed back toward the base; spadix green to purplish violet, 6.3–10.7 cm long, 6–10 mm diam. midway, 8 mm diam. in apical 1/3; flowers 5(6) visible per spiral, 2.6–2.7 mm long, 2.8–3.0 mm wide, square to sub-4-lobed, margins parallel and straight to sigmoid, the side perpendicular to spirals sinuate, drying brownish, matte; tepals smooth, inner margin broadly rounded, outer margins 3-sided to shield-shaped and 4-sided; lateral tepals 1.6–2 mm wide; stamens held at level of tepals; anthers 0.5 mm long and wide; thecae weakly divaricate; pollen pale yellow, moist and sticky. *Infructescence* 10–15 cm long, sometimes curved; berries orange, obovate to 1.3 cm long, 1 cm diam., somewhat flattened apically with a brownish rectangular area surrounding the stigma; seeds 1 or 2 per berry, large, more than 1 cm long.

*Anthurium ixtenamense* flowers sporadically year-round, with ripe berries observed in cultivation in April through July.

**Distribution and ecology** — *Anthurium ixtenamense* is endemic to Guatemala, known until recently only from the type locality in pine-oak habitat in the Department of Huehuetenango just outside Aldea Ixtenam at 1647 m in a *Montane wet forest* life zone. In December 2021, both junior authors discovered a new population growing as lithophytes on limestone in the vicinity of Jacaltenango, Huehuetenango at a similar elevation to that of the type locality.

**Etymology** — *Anthurium ixtenamense* is named for the type locality near Aldea Ixtenam, San Sebastián Coatán Municipality in the Guatemalan Department of Huehuetenango. Aldea Ixtenam is surrounded by steep limestone cliffs and its place name translates to “the crag’s base” in the Chuj Mayan language. Note: The place name and species are pronounced “ISH ten ahm” or “EESH ten ahm”.

**Comments** — *Anthurium ixtenamense* is visually similar and closely related to *Anthurium seleri* Engl., another sect. *Andiphilum* occurring in western Guatemala and eastern Chiapas. It also

bears a strong resemblance to *Anthurium guatemalense* Croat, Cast.Mont & Vannini, another Guatemalan endemic species. That species differs by being a generally larger plant and typical member of sect. *Pachyneurium* with the leaf blades narrowly oblanceolate and 43–110 cm long, 5–20 cm wide with a spadix 5.5–11.5 cm, 6–10 mm diam. whereas *A. ixtenamense* is a member of sect. *Andiphilum* and lacks a rosulate habit with more or less oblong leaves only 38 cm long and 7 cm wide with the spadix 6.3 cm long and 6–7 mm diam. More importantly while members of sect. *Pachyneurium* have involute ptyxis with the leaf blades rolled inward from both margins while in bud, members of sect. *Andiphilum* have supervolute ptyxis with one margin of the leaf in bud rolled inward and the other rolled around it in the same direction. Its conspicuously ribbed petioles and lightly ribbed peduncles appear to be unique in sect. *Andiphilum* and are a key diagnostic character that differentiates it from individuals of *Anthurium seleri* with subcordate leaf lobes.

***Anthurium ustupoense*** Croat, Fred Mull. & Vannini **sp. nov.** — Type: PANAMA: Comarca Guna Yala: Mainland opposite Isla Ustupo, 09°08'21" N, 77°55'23"W, 5 m, cultivated in California by Jay Vannini, vouchered 4 Sep. 2020, T. B. Croat & J. Vannini 107901 (holotype, MO-6939302; isotypes, COL, K, PMA, US). **Figures 42–45.**

*Diagnosis:* *Anthurium ustupoense* is a member of sect. *Cardiolonchium* and is characterized by its terrestrial habit, short internodes, sharply U-shaped, broadly and sharply sulcate petioles, subtriangular-hastate, narrowly acuminate bicolorous blades with flaring posterior lobes and with anterior lobes broadly convex and broadly confluent onto posterior lobes as well as by the short-pedunculate inflorescence with a linear-lanceolate narrowly long-acuminate spathe and the short-stipitate green, semiglossy to glossy, sub-cylindroid to cylindroid-tapered green to yellowish brown spadix.

Terrestrial; internodes short, 1.5 cm diam.; cataphylls 5 cm long, 3 cm wide at base, then markedly constricted above the base to 9 mm, drying gray-brown, matte with a subapical apiculum to 5 mm long. *Leaves* with petioles 7.0–18.3 cm long, sharply U-shaped, broadly and sharply sulcate; blade subtriangular-hastate, 17.4–22.0 cm long, 9.7–21.0 cm wide, 1.6–2.5 times longer than wide, 1.1–2.5 times longer than petioles, subcoriaceous, semiglossy, dark green above, moderately paler below, drying semiglossy above, weakly glossy below; anterior lobe broadly concave in its lower half, broadly convex toward middle, narrowly acuminate at apex, nearly truncate at base with the spreading lateral lobes; lateral lobes 4.5–11.0 cm long, 2–4 cm wide, spreading at a nearly 90° angle, narrowly rounded at apex; sinus absent or broadly arcuate and 7–20 mm deep; basal veins 3 pairs, 1st and sometimes 2nd pairs free to base; 3rd pair marginal to sinus; posterior ribs 0.7–3.0 cm long, naked throughout; midrib narrowly raised to bluntly acute and concolorous above, narrowly rounded to bluntly acute and nearly concolorous, matte and weakly side-ribbed below; primary lateral veins 3–4(5) per side, departing midrib at a 20° angle, narrowly rounded and concolorous on both surfaces; collective veins arising from the 1st or 2nd pairs of basal veins; tertiary veins moderately raised; upper surface faintly and sparsely short pale-lineate; lower surface faintly pale-speckled, lacking punctations. *Inflorescence* erect with faint medicinal scent at anthesis; peduncle 10.0–12.5 cm long, dark green; spathe



Figure 42. *Anthurium ustupoense* Croat & Vannini. Habit of potted plant.





**Figure 43.** *Anthurium ustupoense* Croat & Vannini. Petiole showing flattened adaxial surface.



**Figure 44.** *Anthurium ustupoense* Croat & Vannini. Petiole showing ribbed sides and abaxial rib.



**Figure 45.** *Anthurium ustupoense* Croat & Vannini. Showing inflorescences with spathe constricted above newly opening inflorescence.

5–7 cm long, 8–10 mm wide, (drying 4.3 cm long, 6 mm wide), linear-lanceolate, spreading-reflexed, green to yellow-green, sometimes weakly tinged brownish purple, semiglossy outside, paler and medium green, matte inside, nearly twice as long as spadix in early stages with the spathe somewhat inrolled about the end of the spadix; spadix medium green, brownish yellow to bright yellow, 4.0–5.5 cm long 4–6 mm diam., subsessile with stipe to 2 mm long, short tapered-cylindroid to oblong-tapered, bluntly and narrowly rounded at apex; flowers (2)3–4 visible per spiral, the margin parallel to the spiral moderately straight to jaggedly sigmoid, those perpendicular to the spiral prominently and jaggedly sigmoid, 2.1–2.3 mm long, 1.4–1.6 mm wide on drying; tepals smooth and moderately glossy; lateral tepals 0.8–1 mm wide, subovate to 4-sided and shield-shaped; stamens held at level of tepals, anthers 0.1 mm long, 0.5 mm wide; thecae, broadly divaricate, pollen pale yellow, loose. *Infructescence* unknown.

**Distribution and ecology** — *Anthurium ustupoense* is endemic to Panama, known only from the type locality on the mainland adjacent to Isla Ustupo in the Comarca de Guna Yala near sea level in a *Tropical moist forest* life zone.

**Etymology** — *Anthurium ustupoense* is named for the type locality adjacent to Isla Ustupo in the Comarca de Guna Yala in Panama.

**Comments** — *Anthurium ustupoense* is similar to the polymorphic *A. ochranthum* K. Koch, because both share the same terrestrial habit, short internodes, and semi-intact and persistent cataphylls. *Anthurium ustupoense* differs from *A. ochranthum* in having U-shaped petioles, markedly subtriangular-hastate blades, few pairs of basal veins (up to 3 pairs), and a short-stipitate green, sub-cylindroid to cylindroid-tapered green to yellowish brown spadix with usually 3–4 visible per spiral. Flowering not observed in nature. Flowers year-round in cultivation.

## New taxonomic reconsiderations

### *Anthurium pacificum* (Croat & Grayum) Vannini & Croat, **stat. nov.**

Basionym: *Anthurium clidemioides* Standl. ssp. *pacificum* Croat & Grayum, *Phytologia* 82(1): 31. 1997. — Type: COSTA RICA: Puntarenas: Cantón de Golfito, Jiménez, Alto de Carbonera, camino a Cerro Osa, 08°25'30"N, 83°19'00"W, 200–350 m, 18 Sep. 1990, *A. Chacon* 1062 (holotype, MO-5096171; isotypes, CR-164143, INB).

Appressed climbing epiphytic; internodes elongate, 4–7 cm long, 2–3 mm diam., drying greenish gray, matte, finely and irregularly ridged; roots intermodal, slender, smooth except for portions densely covered with root hairs; cataphylls absent. *Leaves* spreading; petioles 3.3–7.3 cm long, sheathed 0.3–0.6 their length or less, the base encircling the stem, matte, subterete, sharply and narrowly sulcate; geniculum less than 5 mm long, sulcate with a medial rib; blades narrowly ovate-subcordate, to ovate, thinly coriaceous, gradually short-acuminate to almost acute, rounded-truncate to subcordate at base, 10–19 cm long, 6.0–10.5 cm wide, (1.3)1.6–3.0 times longer than wide, 2.3–4.8 times longer than petioles, broadest 2.0–5.5 cm above point of petiole attachment; the anterior lobe 9.5–17.5 cm long; the posterior lobes when present

rounded, 1–2 cm long; dark green and subvelvety, smooth to weakly bullate, matte above, slightly paler and matte below; major veins sunken above; sinus when present arcuate, 3–6(15) mm deep, 1.0–1.5 cm wide; basal veins 3 or 4 pairs, major veins sunken above, drying flattened with 1–3 low ribs; midrib paler and acutely raised below, drying 3-ribbed, moderately paler, densely granular; surfaces densely areolate. *Inflorescence* spreading; peduncle 1.0–1.3 cm long, drying 1.5 mm diam., conspicuously warty and short-pale-lineate; spathe green, 8 cm long, 1 cm wide, reflexed-spreading; spadix 5–8 cm long, 6–7 mm diam., dark green tinged purplish, becoming purplish violet at anthesis; flowers 4–5 visible per spiral, 4.0–4.6 mm long and wide; tepals drying dark, sparsely pale-glandular; lateral tepals 2.4–2.6 mm wide; broadly rounded on inner margin, 2-sided on outer margin; pistils green, soon protruding purplish; berries 1.2–1.6 cm long, drying 6–9 mm diam., tapered to a mammiliform tip. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium pacificum* is known from the Atlantic and Pacific lowlands of Costa Rica and on the Atlantic lowlands of adjacent Panama in Bocas del Toro Province in a *Tropical wet forest* life zone from sea level to 800 m elevation.

**Comments** — *Anthurium pacificum* is a member of sect. *Polyphyllum*, one of the smaller sections of *Anthurium* with only six species, four of which are restricted to Mexico and Central America, which will be enumerated in a forthcoming revision of the section. It is characterized by its lack of cataphylls, internodal roots on slender, wiry stems, short petiolate leaves, subterete, sharply and narrowly sulcate petioles which are sheathed to about the middle, moderately smooth, narrowly ovate-subcordate to ovate, mostly gradually short-acuminate, subvelvety, greenish drying blades which are rounded-truncate to subcordate at base with 3 or 4 pairs of basal veins, short-pedunculate inflorescences with a green lanceolate spathe and a short tapered spadix with early-emergent pistils. In addition to making a new combination, the species is completely redescribed as well owing to the availability of more information.

This taxon has long been considered a subspecies of *Anthurium clidemioides*, but both entities have markedly distinct morphological characteristics, therefore, a new combination is made to consider *A. clidemioides* subsp. *pacificum* as a distinct taxon at the species level. *Anthurium clidemioides* differs from *A. pacificum* by having proportionately broader more conspicuously bullate ovate-cordate leaf blades with a typically narrowly V-shaped sinus and the blades length to width ratio ranging from 1.1 to 1.6 times longer than broad and with the total blade length 4.6–7.5 times longer than the depth of the sinus. It also differs by having a green spadix. In contrast, *Anthurium pacificum* has a purple spadix and typically larger (10.0–18.7 cm long) more narrowly ovate leaf blades which are rounded to subtruncate at the base or if they are lobed have a broadly arcuate sinus and the length/width ratio is 1.6–3.0 times longer than wide and the blades are 15–30 times longer than the depth of the sinus.

***Anthurium andreslovinense*** Matuda, Acta Botánica Anales Inst. Biol. Univ. Nac. México 36: 108, f. 2. 1966. — Type: MEXICO. Oaxaca: San Andrés Lovene, Miahuatlán, [16°02'22"N, 96°12'17"W, 1200 m], on rocks, *T. MacDougal* 384, 9 Nov. 1959 (holotype, MEXU-224916). **Figure 46.**





**Figure 46.** *Anthurium andrelovinense* Matuda. Herbarium specimen (M. Dougal 384). On left leaf blade, adaxial surface, on right leaf blade, abaxial surface.

Epiphytic habit, erect; caudex unknown. *Leaves* moderately long-petiolate; petioles 40–45 cm long, subterete, drying 2.5–3.0 mm diam., drying yellowish brown, weakly glossy, smooth, finely ribbed on magnification; blades narrowly triangular-sagittate, 29 cm long, 10.8 cm wide, 2.6 times longer than wide, 0.6–0.7 times longer than petioles, broadest across the tips of posterior lobes, subcoriaceous, drying scarcely bicolorous, brownish gray and matte above, slightly paler and grayish green and weakly glossy below, narrowly pointed at apex, prominently lobed at base; anterior lobe 20.5 cm long, 6.8 cm wide, broadest just above petiolar plexus, concave to straight along margins; posterior lobes 2.8–3.4 times longer than broad, 9.3–10.5 cm long, 3.0–3.4 cm wide midway; sinus spatulate-triangular, 8.4 cm deep, 2.5–3.0 cm wide; basal veins 4 pairs, the first pair of which are free to the base and spreading at ca. 90°; 2nd pair 1.3–2.0 cm long, 3rd and 4th pairs fused 3.0–3.5 cm, naked 1.3–3.0 cm; posterior ribs naked ¼ to ½ its length. *Inflorescence* erect; peduncle terete, 28.7 cm long, drying 2 mm diam., spathe lanceolate, 4.3 cm long, 1.3 cm wide, green, spreading-reflexed; spadix tapered-cylindroid, green, stipitate 5 mm (stipe 3 mm diam.), 7.8 cm long, drying 0.7 mm diam.; flowers 3.2–3.8 mm long, 2.6–3.0 mm wide; lateral tepals 2.1–2.3 wide; inner margins rounded, outer margin 2-sided; stamens clustered around the stigma; anthers 0.5 mm long, 0.6 mm wide; thecae ovoid, weakly divaricate. *Infructescence* not seen.

**Distribution and ecology** — *Anthurium andreslovinense* is endemic to Mexico, known only from the type locality in southern Oaxaca at ca. 1200 m elevation in subtropical moist regions.

**Comments** — *Anthurium andreslovinense* is recognized by its epiphytic habit, moderately long-petiolate leaves, subterete, slender petioles which dry yellowish brown, narrowly triangular-sagittate, greenish, drying scarcely bicolorous, narrowly pointed leaves, which are brownish gray matte-drying above, slightly paler and grayish green and weakly glossy below, 4 pairs of basal veins, the first pair of which are free to the base and spreading at ca. a90° angle, posterior ribs naked ¼ to ½ its length, slender posterior lobes with spatulate-triangular sinus, anterior lobes which are straight to shallowly concave as well as an erect inflorescence, green spreading-reflexed spathe and a stipitate green spadix.

*Anthurium andreslovinense* was considered a synonym of *A. seleri* in the revision of *Anthurium* of Mexico and Middle America by Croat (1983), but the species is now considered to be isolated from *A. seleri* and distinct based on its blade shape, petiole profile and mature size. *Anthurium seleri* is more coriaceous and while the leaf blades are somewhat variable in shape, the posterior lobes of that species are either, proportionately much shorter and directed somewhat outward, or if the posterior lobes are longer, they are not directed toward the base as in *A. andreslovinense* but rather they are prominently directed outward. *Anthurium seleri* has sharply sulcate, D-shaped petioles and narrow leaf blade to almost 100 cm in length. In contrast, the posterior lobes of *Anthurium andreslovinense* are much longer than broad and directed toward the base and the petioles are subterete in cross-section.

*Anthurium andreslovinense* has also been confused with *A. cerrobaulense* Matuda, which occurs in dry forest ecosystems on the Pacific versant of eastern Oaxaca and southwestern Chiapas

but that species, like *A. seleri* Engl., has sharply sulcate, D-shaped petioles and attains a much larger overall size when mature.

In his description, Matuda commented on the similarity between *Anthurium andreslovinense* and the terrestrial-epipetric *A. berriozabense* from Chiapas but noted the much longer and narrower anterior lobes evident in this species.

As the mixed collections of Thomas MacDougall (384, 384A) suggest, *Anthurium andreslovinense* appears closely related to *A. ocotepecense* Matuda, which Croat (1983) erroneously placed in synonymy with *A. ovandense* Matuda (a more recently published name). While outside the scope of this description, their respective ranges suggest that *Anthurium ovandense* and *A. ocotepecense* may also prove to be distinct species.

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# Studies on Monstereae (Araceae) of Borneo III — Two new *Rhaphidophora* species with perforated leaf blades

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## ABSTRACT

Two new species of *Rhaphidophora* with perforated leaf blades are described from Borneo and illustrated from living plants. An identification key to the five morphologically similar Bornean species is provided.

**Keywords:** *Rhaphidophora*, Mulu, Karst limestone, Sarawak, Sabah, Borneo.

## INTRODUCTION

*Rhaphidophora* Hassk. was last revised for Borneo by Boyce (2001), recognizing 13 species. Subsequently, *Rhaphidophora typha* P.C.Boyce has been described from NC Sarawak (Boyce, 2005) and *R. crassifolia* Hook.f. has been newly recorded for Borneo (Boyce, 2006). Additionally, two species, *R. tenuis* Engl. and *R. fluminea* Ridl. have been reinstated from synonymy respectively of *R. korthalsii* Schott and *R. beccarii* (Engl.) Engl. (Boyce, 2006; Wong & Jyloerica, 2021) taking to 17 the number of species on Borneo.

Fieldwork since 2001 has made it apparent that there are numerous Bornean *Rhaphidophora* species yet to be named, although available material is inadequate to permit description largely because plants are mostly encountered sterile in the field. It was with considerable surprise during fieldwork in 2018 on a trail that we have investigated on numerous occasions in Mulu National Park that we encountered flowering within two kilometres of one another two previously unnoticed, highly distinctive, and very obviously undescribed species of *Rhaphidophora*.

## KEY TO THE BORNEAN SPECIES OF *RHAPHIDOPHORA* WITH PERFORAT-

ED, ENTIRE-MARGINED LEAF BLADES

- 1a. Leaf blades abaxially indumentose, matte ..... 2
- 1b. Leaf blades abaxially glabrous, glossy ..... 3
- 2a. Leaf blade abaxially entirely yellow-puberulent (especially noticeable on younger leaves); blade perforations large and evenly distributed along both sides of the midrib; active shoot tips with copious black mucilage; blooms on clinging shoots ..... *R. foraminifera*
- 2b. Leaf blades abaxially with the midrib grey-pubescent, the remainder glabrous, matte; blades with a row of ragged pin-holes running along both sides of the midrib; blooms carried on short free sympodial branches ..... *R. microperforata*
- 3a. Leaf blades with irregular perforations on both sides of the midrib; blooms solitary blooms on rather elongated lateral branches. Sarawak: Mulu in peatswamp forest over inundated Karst ..... *R. muluensis*
- 3b. Leaf blades with irregular perforations only on one side of the midrib; blooms three or more together on very congested lateral branches. Widespread in Borneo and extending to Peninsular Malaysia, not Karst-associated ..... *R. megasperma*

THE NEW SPECIES

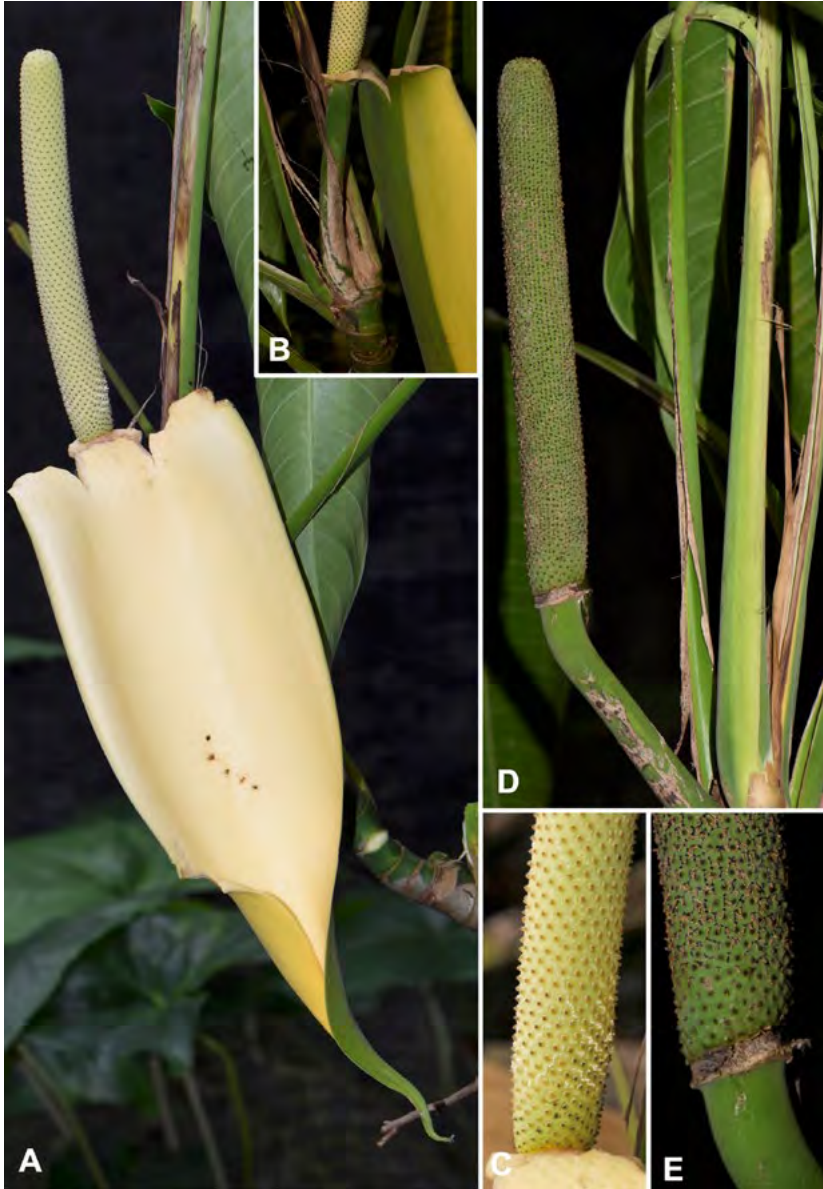
*Rhaphidophora microperforata* S.Y.Wong & P.C.Boyce, **sp. nov.** — Type: MALAYSIAN BORNEO. Sarawak, Miri, Marudi, Long Lama, Mulu N.P., trail to Deer Cave, 4°02'23.8"N 114°48'54.6"E, 60 m asl., 9 December 2018, *Wong S.Y. & P.C. Boyce AR-2914* (holotype, SAR! + spirit!; isotype SING! + spirit!). **Figures 1 & 2.**

*Diagnosis:* *Rhaphidophora microperforata* is distinguished from all other described species by the presence of a row on each side  $\frac{1}{2}$ –1 cm from the midrib, of numerous pellucid dots, later jagged pin-holes.

Moderate to large, robust but semi-leptocaul, probably homeophyllous nomadic vines to 15 m; seedling stage not observed; pre-adult plants forming extensive terrestrial colonies giving rise to stout climbing stems; adult shoot architecture comprised of elongated, clinging, monopodial, leafy, non-flowering stems and short, free, sympodial, densely leafy flowering stems; stems smooth, terete in cross section, medium green with soon-falling sparse prophyll, cataphyll and petiolar sheath remains, internodes to 13 × 1.5 cm on adherent shoots, shorter on free shoots, separated by conspicuous oblique leaf scars, older stems tending to be woody; flagellate foraging stems absent; clasping roots sparsely arising from the nodes of clinging stems, stout, pubescent; feeding roots abundant, either attaching to suitable surfaces or hanging in



**Figure 1.** *Rhaphidophora microperforata*. (A) Plant in habitat. (B) Leaves viewed from below, pin-holes clearly visible. (C) Leaf blades in full sun. (D) Detail of leaf blade abaxial surface showing pubescent mid-rib and pin-holes. E & F. Feeding roots. Note the texture of the root (E) and the active root-tip (F). A & B from AR-2914; C from AR-3234; D–F from AR-2951.



**Figure 2.** *Rhabdophora microperforata*. (A) Bloom at staminate anthesis. (B) Detail of lower part of bloom. Note the splitting of the spathe at its insertion on the spadix/peduncle and the demarcated coloration of the spathe. (C) Lower part of spadix at staminate anthesis. Note the anthers are not exerted and that the lowermost six whorls of flowers lack stamens. (D) Shoot tip with post-anthesis spadix. (E) Lower part of spadix post-anthesis. The sterile nature of the lowermost six whorls of florets is clear. All from AR-2951.

the manner of bell-ropes, active tips with abundant clear mucilage, tissues leading to the active tip with a spongy-slimy texture, remainder of root smoothly corky, older segments producing slim adventitious rootlets. *Leaves* spiro-distichous on adherent and free shoots; cataphylls and prophylls membranous, quickly drying and degrading into sparse fibres, and these soon falling; petiolar sheath membranous, extending to the distal geniculum, initially pale yellow, soon marcescent a then degrading into slender papery strips; petioles 25–37 cm long (climbing shoots), 17–28 cm long (flowering shoots), canaliculate to the tip, the angles sharp, distally minutely sinuate-alate, with adhering fragments and strips of marcescent-degrading petiolar sheath, in older petioles angles becoming minutely erose and later corky-scarred; climbing shoots with proximal geniculum stout, ca  $4 \times 1.3$  cm, with the angles corky-scarred; flowering shoots with proximal geniculum rather ill-defined, those of senescent leaves usually becoming yellow before the remainder of the petiole, ca  $2.5 \times 0.7$  cm; distal geniculum well-defined on all leaves, dorsally broadly channelled, with the edges sharp, those of flowering shoots usually strongly deflexed with the leaf blade pendulous; leaf blades up to  $40 \times 16$  cm (climbing shoots),  $30 \times 13$  cm (flowering shoots), thinly coriaceous, medium semi glossy green adaxially, matte medium green to faintly glaucous abaxially, becoming glossy yellowish in full sun, oblong-elliptic with two rows, one on each side of the midrib, of numerous pellucid dots, later becoming jagged pin-holes  $\frac{1}{2}$ –1 cm from the midrib, often slightly falcate, blade base unequal one side acute the other obtuse to weakly truncate, apex acute with a brief (1.5 mm) mucro; midrib rounded-raised abaxially, slightly sunken adaxially, puberulent, especially in leaves in full sun; primary lateral veins conspicuous, about 21 on each side, regularly alternating with less conspicuous interprimaries, arising at ca  $60^\circ$ , abaxially rounded-raised with the distal portion paler than the surrounding blade tissue, higher order venation difficult to discern (flowering shoots) or (climbing shoots) forming a slightly sinuous/weakly branching series of veins running more-or-less parallel to the primary laterals. *Bloom* solitary, terminal on free lateral shoot, subtended by a fully developed but somewhat undersized foliage leaf, smelling of overripe fruit; peduncle strongly compressed-cylindric,  $4\text{--}9 \times 0.4\text{--}0.6$  cm.; spathe ca 28 cm long, stoutly rostrate, rostrum to ca 10 cm, gaping at pistillate anthesis, opening and reflexing to reveal the spadix with the margins later strongly in-rolling post staminate anthesis, the exterior glaucous pale green in bud, externally dull rich yellow at anthesis with a strongly demarcated green area from where the outer margin was convolute over the inner in bud, interior dirty cream, much of the rostrum save the distal 4 cm darkening, spathe partially separating from the spadix/peduncle insertion late in anthesis, with the lowermost part of the spathe darkening; spadix cylindrical, sessile, slightly obliquely inserted onto peduncle, longer side 15 cm, shorter 14.5 cm, ca 1.4 cm in diam., creamy white; stylar region mostly hexagonal,  $1.5\text{--}2 \times 2.1\text{--}2.5$  mm, truncate; stigma punctiform on a conical stigmatophore (*sensu* Cedeño-Fonseca et al. 2022), lowermost ca 6 spirals of florets functionally sterile; anthers exerted at anthesis; infructescence not observed.

**Distribution and ecology** — Restricted to NE Borneo where apparently widespread and overlooked. The three known collections occur at minimum of 235 km distance from one to the next and circumscribe an area approaching 32,000 km<sup>2</sup>. Ecology is diverse. At Mulu plants occur on well-drained domes in peat swamp forest over inundated Miocene Karst at about 60 m asl. The Tawau Hills population is in damper areas of *Shorea argentifolia* and *Tristania*-dominated lowland kerangas over Pleistocene volcanics, between 200 and 320 m asl. The



collection from along the road from Kota Kinabalu to Tambunan occurs in permanently wet seepages of up-lifted Oligocene deepwater sediments in almost full sun, at about 1,500 m asl, with the plants forming extensive terrestrial colonies with the occasional stem climbing onto exposed wet rocks.

**Etymology** — The species epithet alludes to the tiny holes running beside both sides of the midrib.

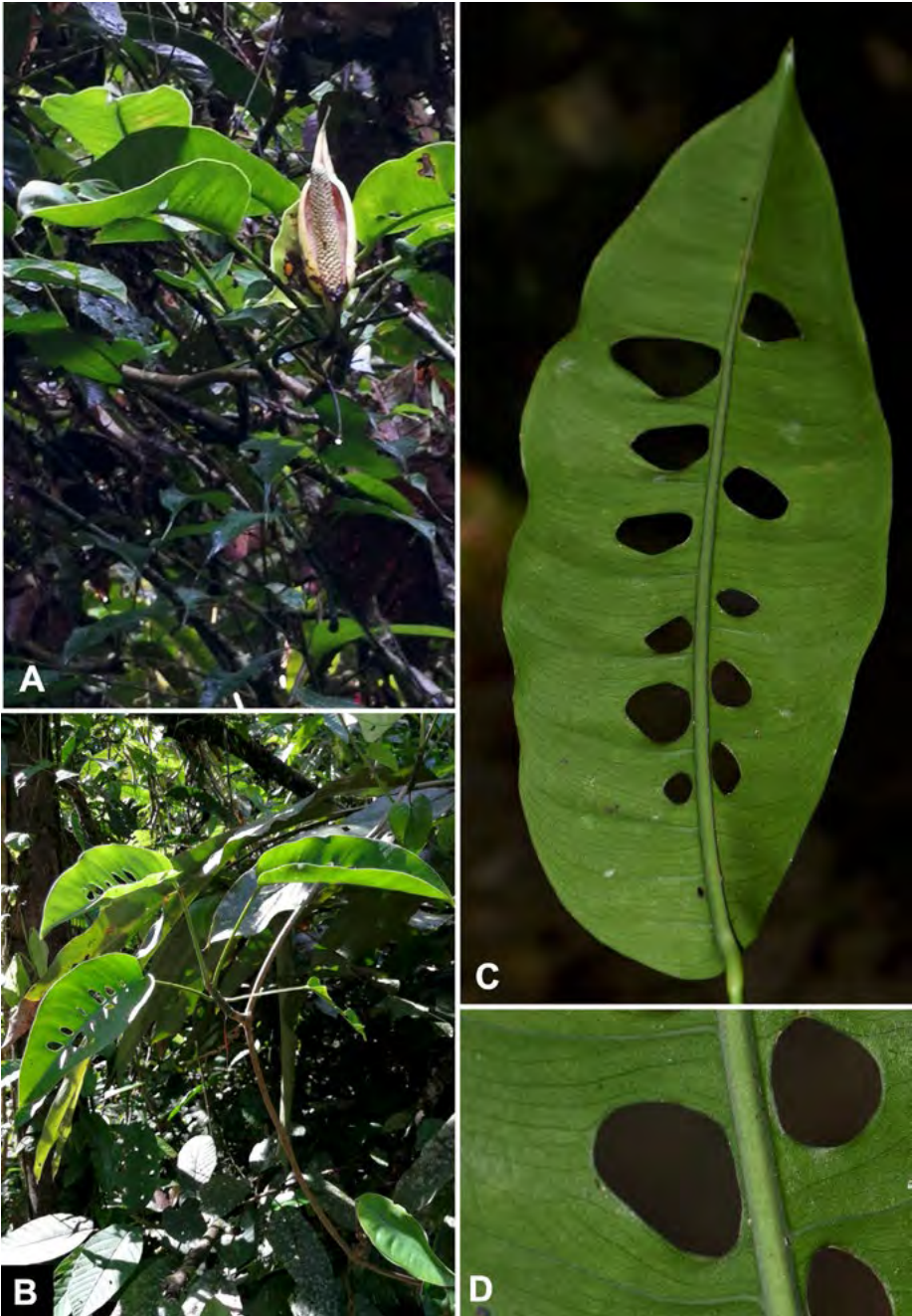
**Comments** — *Rhaphidophora microperforata* is immediately identifiable by the row of pin-holes running along both sides and parallel to the midrib. Examination of numerous leaves never resulted in finding these holes enlarging in the manner of those of *Rhaphidophora foraminifera*. From a distance *Rhaphidophora microperforata* could easily be confounded with some of the larger *Scindapsus* species such as *S. glaucescens* Alderw. or *S. latifolius* M. Hotta (the former is abundant and co-occurring at Mulu), or with the similarly scattered or rare but widespread *Epipremnum* [*Anthelia*] *falcifolium* Engl. Similar pin-holes occur in *Epipremnum pinnatum* which differs, among other characteristics, by the adult leaf blades pinnatifid to pinnatisect.

**Additional specimens seen** — MALAYSIAN BORNEO. **Sabah.** Tawau, Lahad Datu, Tawau Hills N.P., trail to Sulphur Spring Pool, 4°24'37.0"N 117°53'38.8"E, 320 m asl., 30 Dec 2018, *Wong S.Y. & P.C. Boyce AR-2951* (SAN, SAR). West Coast, Tuaran, Kota Kinabalu to Tambunan road, 5°50'38.7"N 116°19'37.8"E, 1508 m asl., 11 Oct 2019, *Wong S.Y., A. Hay & P.C. Boyce AR-3234* (SAN, SAR).

***Rhaphidophora muluensis*** S.Y.Wong & P.C.Boyce, **sp. nov.** — Type: MALAYSIAN BORNEO. Sarawak, Miri, Marudi, Long Lama, Mulu N.P., Kenyalang Trail, Bukit Kenyalang, 4°01'23.5"N 114°48'50.6"E, 88 m asl., 9 Dec 2018, *Wong S.Y. & P.C. Boyce AR-2917* ((holotype, SAR! + spirit!; isotype SING! + spirit!)). **Figures 3 & 4.**

**Diagnosis.** *Rhaphidophora muluensis* is immediately distinguished by the single row of large somewhat irregular perforations on both sides of the midrib. The glabrous, glossy dark green leaf blades are most like those of *Rhaphidophora megasperma*, from which *R. muluensis* differs by solitary blooms (vs blooms three or more together) on rather elongated (vs very congested) lateral branches, and by its Karst obligation.

Moderately robust, semi-leptocaul, probably homeophyllous nomadic vine to 5 m; seedling stage not observed; pre-adult plants forming extensive terrestrial colonies; adult shoot architecture comprised of elongated, clinging or scandent, monopodial, leafy, non-flowering stems and short, loosely-branched, free, sympodial, sparsely leafy flowering stems; stems smooth, terete in cross section, glossy dark green with sparse prophyll, cataphyll and petiolar sheath remains, older sections smoothly corky pale brown, internodes to 10 × 1 cm on adherent shoots, shorter on free shoots, separated by conspicuous oblique leaf scars, older stems tending to be woody; flagellate foraging stems absent; clasping roots sparsely arising from the nodes of clinging stems, stout, pubescent; feeding roots few, attaching to suitable surfaces,



**Figure 3.** *Rhaphidophora muluensis*. (A) Flowering plant in habitat. (B) Climbing shoot with perforated leaf blades. (C). Leaf blade, abaxial view. (D). Detail of leaf blade perforations. Note the way that the veins are curved. All from AR-2917.



**Figure 4.** *Rhaphidophora muluensis*. (A) Bloom in bud. (B). Bloom at late staminate anthesis. (C). Developing infructescence. All from AR-2917.

the active tip mucilaginous, remainder of root corky. *Leaves* spiro-distichous on adherent and free shoots; cataphylls and prophylls membranous, quickly drying and degrading into sparse fibres, and these soon falling; petiolar sheath membranous, extending to the distal geniculum, soon falling; petioles 13–21.5 cm long (climbing shoots), 10–15 cm long (flowering shoots), shallowly canaliculate to the tip, the angles blunt, with adhering fragments and strips of marcescent-degrading petiolar sheath, in older petioles angles corky-scarred, genicula well-defined on all leaves; proximal geniculum ca  $2.5 \times 1$  cm; distal geniculum ca  $2 \times 0.7$  cm; leaf blades up to  $28 \times 10$  cm (climbing shoots),  $15 \times 8$  cm (flowering shoots), thinly coriaceous, glabrous, dark glossy green adaxially, slightly paler abaxially, oblong-lanceolate or oblong-elliptic, often slightly falcate, single row of large somewhat irregular perforations on both sides of the midrib, base unequal with one side acute the other rounded to weakly truncate, apex acute with a brief (1.5 mm mucro); perforations round to rhombic, large, extending ca  $1/3$ – $1/2$  of lamina width on each side of the midrib; midrib rounded-raised abaxially, slightly sunken adaxially; primary lateral veins conspicuous, about 8 on each side, regularly alternating with less conspicuous interprimaries, arising at ca  $60^\circ$ , curving around the larger perforations; higher order venation forming a sinuous/weakly branching series of veins running more-or-less parallel to the primary laterals. *Bloom* solitary, subtended by a fully developed but undersized foliage leaf, smelling of stale beer; peduncle cylindric,  $5$ – $6 \times 1$  cm; spathe ca 13 cm long, stoutly rostrate with the rostrum to ca 3 cm long, wide-gaping at pistillate anthesis, opening and falling at late staminate anthesis, exterior very pale green in bud, medium yellow at anthesis, interior paler yellow, partially splitting from the spadix/peduncle insertion late in anthesis; spadix stoutly cylindrical, sessile, obliquely inserted onto peduncle, longer side 10 cm, shorter 9 cm, ca 1.6 cm in diam., creamy white; stylar region rounded-hexagonal,  $1.5$ – $2 \times$  ca 2.5 mm, stigma linear to almost punctiform on a conical stigmatophore (*sensu* Cedeño-Fonseca et al. 2022), lowermost ca 4 spirals of florets functionally sterile; anthers hardly exerted at anthesis; ripe infructescence not observed; developing infructescence with stylar plates rather swollen and rounded, white with black stigmatic remains.

**Distribution and ecology** — Known from a single population at Mulu, where the plants occur along the margins of open peat swamp forest over inundated Miocene Karst at about 90 m asl.

**Etymology** — From the type locality plus the Latin suffix, *-ensis*, to indicate ‘originating from’.

**Comments** — *Rhaphidophora muluensis* cannot be easily confused with any other Bornean species owing to the glabrous glossy dark green perforated leaf blades and straggling vining habit.

**Acknowledgements**

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# Taxonomic And Nomenclatural Notes On Malesian Araceae I — Resolving *Homalomena ovata*, and a new name in *Homalomena* for *Chamaecladon ovatum*

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## ABSTRACT

Corrections and updates are made to the taxonomy and nomenclature of *Homalomena ovata* Engl., *Homalomena borneensis* Ridl, and *Chamaecladon ovatum* Schott. *Homalomena hostifolia* Engl. is treated as a homotypic superfluous name for *H. ovata* Engl. *Homalomena ovatum* (Schott) Hook.f., an illegitimate name, is renamed *Homalomena nathanielii* and treated as a Singapore endemic in the *Homalomena Griffithii* complex.

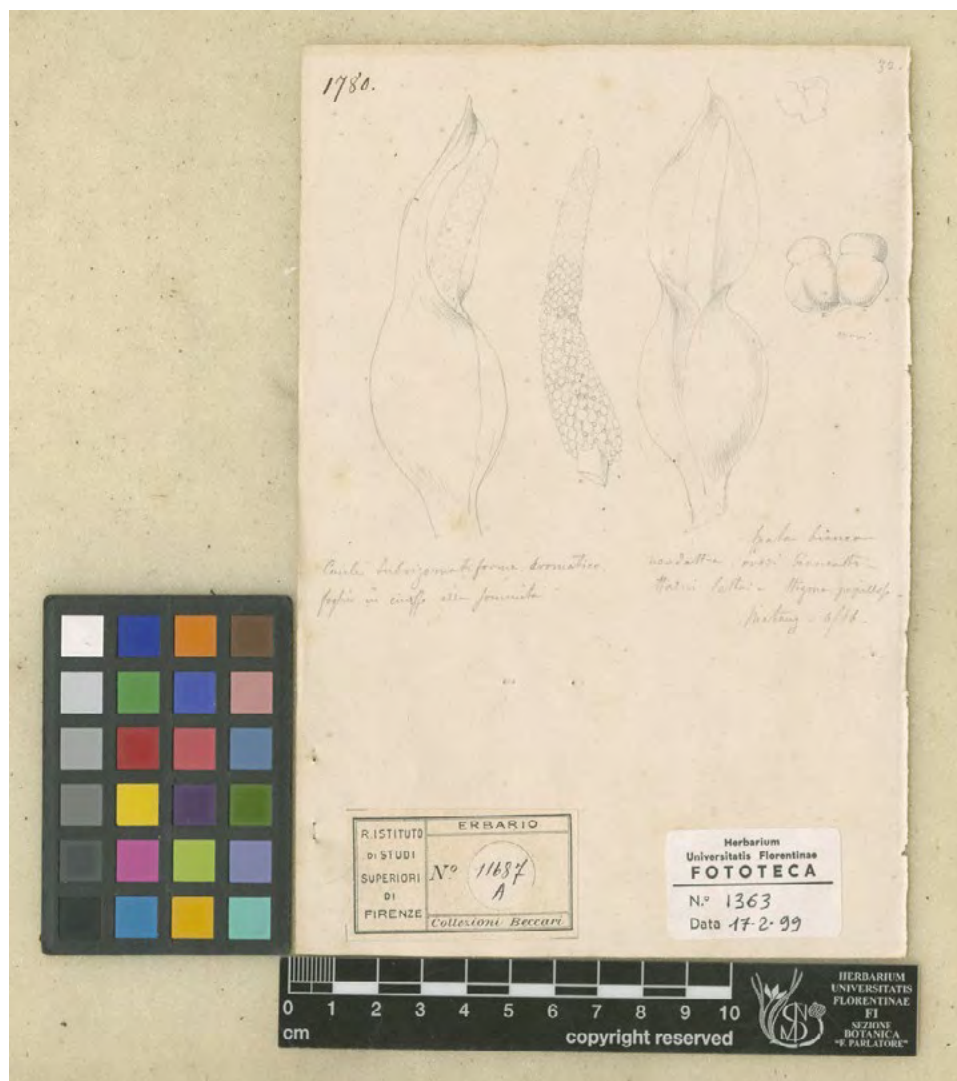
**Keywords:** *Homalomena*, *Chamaecladon*, Singapore, Sarawak, Borneo.

***Chamaecladon ovatum* Schott, *Homalomena ovata* Engl. (1879) and *Homalomena ovata* (Schott) Hook.f. (1893).**

When transferring Schott's *Chamaecladon ovatum* (Schott, 1859), based on a Nathaniel Wallich collection from Singapore, to *Homalomena*, Hooker (1893: 536) was apparently unaware of Engler's earlier *Homalomena ovata* (Engler, 1879), based on an Odoardo Beccari collection from Matang, Kuching, Sarawak, with the consequence that *H. ovata* (Schott) Hook.f. is illegitimate. However, Engler evidently took the view that the earlier date of the basionym in *Chamaecladon* of Hooker's combination conferred on it priority in *Homalomena*. He therefore renamed his *Homalomena ovata* Engl. as *H. hostifolia* Engl. (Engler, 1912: 70), thereby creating a superfluous homotypic name under modern nomenclatural rules. *Homalomena ovata* Engl. therefore stands, as follows:



**Figure 1.** Holotype of *Homalomena ovata*. O. Beccari p.b. 1780 in the Herbarium Beccarianum-Malesia (FI-B), of the Natural History Museum of the University of Florence



**Figure 2.** Beccari's field sketch of the bloom on the holotype of *Homalomena ovata*. O.Beccari p.b.1780 in the Herbarium Beccarianum-Malesia (FI-B), of the Natural History Museum of the University of Florence



Figure 3. Spadix of (A) *Homalomena ovata* & (B) *Homalomena borneensis* compared, each 9.5 cm long.





**Figure 4.** Holotype of *Homalomena borneensis*. H.N.Ridley s.n. in the Singapore Herbarium Holotype SING. — Reproduced with the kind permission of the Singapore Herbarium, Singapore Botanic Gardens.



***Homalomena ovata*** Engl., Bull. Reale Soc. Tosc. Ort. 4: 296 (1879). — [*Homalomena hostifolia* Engl., Pflanzenr., IV, 23Da: 70 (1912), nom. superfl. (*H. ovata* Engl. in synonym.)]. — Type: MALAYSIAN BORNEO. “Ragiato di Sarawak., Mte Mattang”, June 1866, O. Beccari p.b. 1780 (holotype, FI!). **Figures 1–3A.**

**Comments** — Govaerts et al. (2002: 333) treats *Homalomena ovata* Engl. and *H. hostifolia* as synonyms of *Homalomena insignis* N.E.Br. (a distinct species in a different clade – Wong et al., 2013) while accepting *H. borneensis* Ridl. (Ridley, 1905) (**Figure 4**) but wrongly attributing it to Jawa (and Borneo) and with a spurious synonym, *H. submarginata* Alderw, a species allied to *H. insignis*. In ‘The World Checklist of Selected Plant Families (WCSP)’ *Homalomena borneensis* is included in the synonymy of *H. ovata* Engl. — [https://wcsp.science.kew.org/namedetail.do?name\\_id=99910](https://wcsp.science.kew.org/namedetail.do?name_id=99910), although *Homalomena borneensis* and *H. ovata* are distinct species separable not only by the spadix morphology (**Figure 3**) but also by ecology, with *H. borneensis* a NW Bornean Karst limestone obligate while *H. ovata* is restricted to the Matang Massif of Kuching Division on Palaeogene sandstone-derived soils.

***Chamaecladon ovatum*** Schott still lacks a legitimate species name in *Homalomena*. Engler (1912: 44) reduced the illegitimate *Homalomena ovata* (Schott) Hook.f. to varietal status as *Homalomena griffithii* (Schott) Hook.f. var. *ovata* (Schott) Engl. However, he did not adequately address the circumscription of *Homalomena griffithii* which was based on three syntypes, of which two from Melaka in Peninsular Malaysia are possibly conspecific with each other, and the other from Labuan, NW Borneo is most certainly of a different species. Wong & Boyce (2020) noted that the taxonomy of *Homalomena griffithii* and its allies has been historically poorly served and is furthermore burdened with an unwieldy infraspecific taxonomy imposed by Furtado (1939) wherein species’ delimitation appears to have been reached solely by examining the nomenclatural types. Uncritically merging taxa is undesirable until the Griffithii species complex is properly studied throughout its range in the wild, since it is now very clear to us that there are numerous locally restricted taxa, many yet to be described, which are next to impossible to resolve when examined from preserved specimens alone despite being clearly distinct when observed living. The ecology of the Singapore plant is unique for any described species of the Griffithii complex and combined with the below-noted leaf blade characteristics leaves us confident to transfer *Chamaecladon ovatum* to *Homalomena* with a new species name.

***Homalomena nathanielii*** S.Y.Wong & P.C.Boyce, **nom. nov.**

*Chamaecladon ovatum* Schott, Bonplandia (Hannover) 7(3): 30 (1859). — [*Homalomena ovata* (Schott) Hook.f., Fl. Brit. Ind. 6 (1893) 536, nom. illeg., non *H. ovata* Engl.]. — *Homalomena griffithii* var. *ovata* (Schott) Engl., Pflanzenr., IV, 23Da: 44 (1912). — Type: SINGAPORE. 1822, N. Wallich 8964 (holotype, K – K000675798!; isotype, K-W – K001131933!). **Figures 5 & 6.**

**Distribution and ecology** — So far known with certainty only from Singapore and there restricted to drier portions of the last fragment of the once extensive Nee Soon freshwater swamp forest (Corner, 1978; Turner et al., 1996; Chong et al., 2018; Clews et al., 2018).



**Figure 5.** Holotype of *Homalomena nathanielii*. N.Wallich 8964, in the Kew Herbarium (K), (<http://specimens.kew.org/herbarium/K000675798>). — © copyright of the Board of Trustees of the Royal Botanic Gardens, Kew.



**Figure 6.** Isotype of *Homalomena nathanielii*. N.Wallich Cat. no 8964, in the East India Company Herbarium at Kew (K-W), (<http://specimens.kew.org/herbarium/K001131933>). — © copyright of the Board of Trustees of the Royal Botanic Gardens, Kew.

**Eponymy** — For Nathaniel Wallich (1786–1854), surgeon and botanist who started his professional life in 1807 as the Danish Medical Attaché at Serampore in Bengal and was from 1815–1846 Superintendent of the East India Company's Garden at Calcutta. He laid out the first, later abandoned, Botanic Garden in Singapore in 1822.

**Comments** — As noted, *Homalomena nathanielii* belongs to the Griffithii complex, species of which are often highly similar in external appearance, separated largely on characteristics of the spadix. However, *H. nathanielii* is distinct on Singapore by the deep green glossy leaves with rounded bases — See <https://singapore.biodiversity.online/species/P-Angi-000037> and <https://www.nparks.gov.sg/florafaunaweb/flora/7/2/7232>

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# A Review of *Arisaema* (Araceae) in North America: Nine species instead of two?

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## ABSTRACT

The most recent treatment of North American *Arisaema* recognizes only two species: *A. triphyllum* and *A. dracontium*. Much of the variation, especially in the *triphyllum* complex is attributed to rampant hybridization, for which there is little to no evidence. We provide arguments for recognizing at least nine species, though some of these taxa need verification involving additional fieldwork and DNA sequencing. We arrived at our conclusions based on examination of herbarium specimens (including critical collections made during two never-published doctoral studies), field observations of the species, recent data reported by contributors to iNaturalist, and critical examination of the literature. Within the *triphyllum* complex, we recognize six species: *A. triphyllum*, *A. pusillum*, *A. stewardsonii*, *A. quinatum*, *A. acuminatum*, and *A. sp. nov.* *A.* Most authors have treated these as subspecies, varieties, or forms, if they have been recognized at all. All are diploid with  $n = 28$  except for *A. triphyllum*, which is a tetraploid with  $n = 56$ . Within the *dracontium* complex, we recognize three species: *A. dracontium*, *A. macrospathum*, and *A. sp. nov.* *B.* Again, there has been much confusion surrounding these taxa, but only *A. dracontium* is known to be tetraploid with  $n = 56$ .

**Keywords:** *Arisaema*, distribution, ecology, hybridization, North America, phylogeny, sex switching, systematics.

## INTRODUCTION

*Arisaema* Mart. is one of the larger genera in the Araceae with about 220 described species (Manudev et al., 2019). The center of diversity is warm temperate Asia, but the genus provides one of the best examples of Oligocene/Miocene floristic links between East Africa, Arabia, the Himalayan region, China, and North America (Renner et al., 2004). The number of species in North America has been the subject of much discussion, with various authors recognizing as few as two or as many as six distinct taxa. The most recent treatment for *Flora North America* by Thompson (2000) returned to much earlier thinking and recognized only two species (*A. triphyllum* (L.) Schott, Common Jack-in-the-pulpit and *A. dracontium* (L.) Schott, Green Dragon).



**Figure 1.** Purple-spathed morph of *Arisaema triphyllum* from Niquette Bay State Park, Vermont, USA. Note the well-defined light-colored stripes. All photos, except Figures 9 and 13, are courtesy of iNaturalist and used under the Creative Commons Attribution-Non-Commercial (CC BY-NC) license.



**Figure 2.** Green-spathed morph of *Arisaema triphyllum* from Central Elgin, Ontario, Canada. Note the stout sterile spadix and wide flanges at the top of the spathe tube.





**Figure 3.** Purple-spathed morph of *Arisaema pusillum* from Lancaster County, South Carolina, USA. Note the sharply defined purple-black interior of the spathe and narrow flanges



**Figure 4.** Green-spathed morph of *Arisaema pusillum* from Great Falls, Virginia, USA. Note the abrupt transition to darker green on the spathe and narrow flanges.





**Figure 5.** *Arisaema quinatum* from Birmingham, Alabama, USA. Note the five leaflets and the curved, slender spadix.





**Figure 6.** Green-spathed morph of *Arisaema stewardsonii* from Rochester, New York, USA. Note the ridged or fluted white stripes on the back of the spathe.



**Figure 7.** Purple-spathed morph of *Arisaema stewardsonii* from Glastonbury, Connecticut, USA.





**Figure 8.** *Arisaema acuminatum* from Ichetucknee Springs, Florida, USA. Note the extremely long acuminate tip of the spathe.



**Figure 9.** *Arisaema* sp. nov. *A* from Argillite, Kentucky, USA. Note the dark purple interior of the spathe with short stripes of white in the throat.



It is surprising there have been few studies of the systematics and phylogeny of these forest perennials, as these plants represent some of the most readily recognizable flowering plants in eastern North America. Moreover, there have been many studies of the population ecology and reproductive biology of these plants focusing on their unusual labile sex determination that enables switching sex from year to year based on size. So rare is this phenomenon that it is estimated to occur in less than 0.01% of known plant genera (Richardson & Clay, 2001).

Working at Cornell University, Donald G. Huttleston completed an M.S. in 1948 and a Ph.D. in 1953 studying *Arisaema*. The principal data from this work, however, were never published. Only a couple of papers recognizing three (Huttleston, 1949) and, later, four subspecies (Huttleston, 1981) appeared, plus a summary and key with photos in *Aroideana*, a publication that focuses on Araceae (Huttleston, 1984).

A similar situation holds for a doctoral dissertation done at the University of North Carolina at Chapel Hill by Miklos Treiber, completed in 1980. This 355-page work includes field observations over the range of three recognized subspecies, uniform garden and growth chamber comparisons of selected morphological characters, crossing experiments, phenological studies, chromosome counts, pollinator observations, and analyses of sexual and asexual reproduction. None of this voluminous information was ever published, though many authors have cited the dissertation (Treiber, 1980).

We believe the relative obscurity of Huttleston's and Treiber's research is part of the reason there is confusion and uncertainty regarding the number of taxa and their relationships, especially within the *triphyllum* complex. Based on our recent field observations, study of herbarium specimens, critical review of reports on iNaturalist, and careful examination of the relevant literature, we have formulated a set of working hypotheses regarding the taxonomy of these plants. Our list of recognized taxa is shown in Table 1. Most of these coincide with the most recent provisional treatment by Weakley (2020) in his online *Flora of the Southeastern United States*.

These hypotheses need to be tested using modern DNA sequencing, which has been applied with success to resolve relationships among other species of *Arisaema* (Renner & Zhang, 2004; Renner et al., 2004; Ohi-Toma et al., 2016). Unfortunately, all these studies used only one sample of *A. triphyllum* without noting further the species or subspecies to which their samples belonged. Recently, Cai et al. (2019) have published the complete plastome sequence of *A. ringens* (Thunb.) Schott, a species known from China, Japan, and Korea that belongs to the same section of the genus as members of the *triphyllum* complex. Here we explain why we propose that nine, rather than two, species of *Arisaema* exist in North America, setting the stage for testing hypotheses regarding the number of species and relationships within the group.

## Materials and Methods

Our initial fieldwork has entailed study of local populations of five species: *A. triphyllum*, *A. quinatum* (Nuttall) Schott, *A. pusillum* Nash, *A. stewardsonii* Britton, and *A. dracontium*. We have

carefully noted the habitats in which each occurs and have looked especially for places where the species ranges overlap, indicating that hybridization might be possible. We have also taken a broader look at the occurrence of these plants through examination of herbarium specimens posted online by SERNEC, CNH, and other regional consortia of herbaria. Especially useful in this case, however, was special access to critical vouchers collected by Huttleston (1949, 1981) and held at BH. Similarly, staff at NCU scanned for us voucher specimens associated with the doctoral work of Treiber (1980).

We have also made extensive use of more recent data, primarily images, reported by many contributors to iNaturalist (Heberling & Issac, 2018). Though nearly all these reports are lumped under either *A. triphyllum* or *A. dracontium*, we were able to determine the identity of the taxa using our own set of key characters. These observations were extremely useful in gaining insight into the distribution and ecology of the taxa on a larger scale. Finally, we examined with a critical eye all available literature regarding *Arisaema* in North America, including the unpublished doctoral dissertations of both Huttleston (1953) and Treiber (1980).

## RESULTS

We have taken a fresh look at all existing evidence regarding the systematics of *Arisaema* in North America and conclude there are strong arguments for recognizing nine or more species that Thompson (2000) reduced to two in her treatment for *Flora North America*. She argued that numerous intermediate forms exist, but there is little to no evidence for this view, first promulgated by Huttleston (1949, 1981, 1984). Her concern about sympatric ranges is also questionable. Our fieldwork has shown that, even when two species occur at the same site, they are in distinctly different habitats. And her statement that putative hybrid populations exist between the subspecies with  $2n = 42$  is based on very few chromosome counts and questionable determinations by Huttleston (1949, 1981).

We do agree with Thompson (1995, 2000) that these taxa should not be treated as subspecies as suggested by Huttleston (1949, 1981, 1984), Treiber (1980), and Gusman & Gusman (2002). We are unsure why previous treatments did not consider the sets of populations distinct species. Except for a questionable wide cross involving *A. stewardsonii* and *A. dracontium* reported by Sanders and Burk (1992), there are no documented cases of hybridization involving any of the species in the *triphyllum* complex. Moreover, Treiber (1980) was unable to produce any hybrids from artificial crosses between these taxa except for *A. stewardsonii*  $\times$  *A. pusillum*. The offspring from that cross were weak, and none survived to flowering size. Differences in habitat preferences and flowering phenology also serve as pre-pollination barriers to crossing in natural populations. It is likely that these species are completely reproductively isolated.

Moreover, there are stable, genetically based characters that can be used to identify these plants to species, especially in the fresh state. Taxonomists have placed too much emphasis on the difficulty of identifying herbarium specimens, as three-dimensional and color-related characters that are diagnostic in the field are lost. Nonflowering specimens cannot be identified with certainty in any case.

The nine species we suggest should be recognized can be grouped into two complexes: the *triphyllum* complex with five named species (and one which we informally label *A. sp. nov. A* pending further study) and the *dracontium* complex with two named species (and one which we informally label *A. sp. nov. B* again pending further study). These are shown in Table 1 along with comparisons to Treiber's (1980), Huttleston's (1981), Thompson's (2000), Gusman & Gusman's (2002), and Weakley's (2020) taxonomies. Below we offer descriptions of each of the species that we recognize, along with information related to chromosome numbers, habitat, and range. A diagnostic key is also provided.

**KEY TO THE SPECIES OF *ARISAEMA* IN NORTH AMERICA**

- 1a.** Leaf with 3–5 leaflets, arranged palmately; sterile spadix 3.5–8 cm long, cylindrical or clavate, included in the spathe [Section *Pedatisecta*] ..... **2**
- 1b.** Leaf with (5–) 7–15 leaflets, arranged pedately on a semicircular axis; sterile spadix 10–30 cm long, S-shaped, attenuate, long-exserted beyond the spathe [Section *Tortuosa*] ..... **7**
- 2a.** Leaflets glaucous beneath at maturity; spathe flange 2–10 mm broad; spathe apex acute to acuminate ..... **3**
- 2b.** Leaflets green beneath at maturity; spathe flange 1–5 mm broad; spathe apex long-acuminate ..... **5**
- 3a.** Leaves (3–) 5-foliolate; spadix slender, 1–2 mm in diameter, curved; spathe hood green, abruptly acute ..... *Arisaema quinatum*
- 3b.** Leaves 3-foliolate; spadix thicker, 4–10 mm in diameter, not curved; spathe hood purple with white stripes or green with white stripes ..... **4**
- 4a.** Spathe hood purple or green with white stripes reaching well above the spadix; spathe flange 5–10 mm broad; spadix clavate ..... *Arisaema triphyllum*
- 4b.** Spathe hood purple with white stripes reaching just above the spadix, with the median stripe extending farther; spathe flange 2–6 mm broad; spadix cylindrical ..... *Arisaema sp. nov. A*
- 5a.** Spathe hood solid purple or green, without stripes; spadix 2–3 mm in diameter; spathe apex acuminate to long-acuminate ..... *Arisaema pusillum*
- 5b.** Spathe hood green or purple with white stripes; spadix 3–5 mm in diameter; spathe apex long-acuminate ..... **6**
- 6a.** Spathe hood strongly fluted, 4–7 cm long; spathe hood green or purple with distinct white stripes ..... *Arisaema stewardsonii*

**6b.** Spathe hood not fluted, 6–8 cm long; spathe hood green with greenish- white stripes.....  
..... *Arisaema acuminatum*

**7a.** Spathe tightly enclosing the spadix, 1–1.5 cm broad when unrolled; spathe tube 2–3 cm  
long; spathe hood 2.5–3.5 cm long ..... *Arisaema dracontium*

**7b.** Spathe not tightly enclosing the spadix, 2–8 cm broad; spathe tube 2–7 cm long; spathe  
hood 3–11 cm long..... **8**

**8a.** Spadix 15–30 cm long, projecting symmetrically from the spathe; spathe tube 6–7 cm  
long; spathe hood 8–12 cm long ..... *Arisaema macrospathum*

**8b.** Spadix 12–20 cm long, projecting asymmetrically from the spathe; spathe tube 2–4 cm  
long; spathe hood 3–5 cm long ..... *Arisaema* *sp. nov.* **B**

### SPECIES DESCRIPTIONS

*Arisaema triphyllum* Common Jack-in-the-pulpit

Plants 4–9 dm tall. Leaves 1–2 (–3), glaucous beneath at maturity. Leaflets 3 (the lateral leaflets undivided, rarely lobed), arranged palmately. Spathe tube length 4–6 cm. Spathe hood purple with white stripes or green with white stripes, 4–7 mm long, apex acute to somewhat acuminate. Spathe flange 5–10 mm broad, horizontal. Spadix thick, 4–10 mm in diameter, clavate, straight. Stomatal guard cell length > 40  $\mu$ m.

**Comments** — There is little disagreement that the most common and wide-ranging species of *Arisaema* in North America is *A. triphyllum*, and that it expresses two color morphs: a purple-spathed variant (Fig. 1) and a green-spathed variant (Fig. 2). Commonly, both occur within the same population, and the trait likely has a simple genetic basis. Plants are typically robust, with a clavate spadix overarched by an expanded spathe. Tissue near the veins of the spathe is lighter in color and especially prominent in the purple-spathed morph, which is clearly striped. Populations range from New Brunswick west to southeastern Manitoba and south to the Panhandle of Florida, Louisiana, and east Texas. The species is known to be tetraploid with  $2n = 56$  and is most common in mesic forests and bottomlands along, but not in, streams.

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*Arisaema acuminatum* Florida Jack-in-the-pulpit

Plants 6–9 dm tall. Leaves 1–2, green beneath at maturity. Leaflets 3, arranged palmately. Spathe tube length 4–5 cm. Spathe hood green with lighter stripes, 6–8 cm long, apex long-acuminate, outer surface dull green. Spathe flange 1–5 mm broad, revolute. Spadix 4–8 mm in diameter, cylindrical to somewhat clavate, straight.

**Comments** — Until very recently, *A. acuminatum* Small has been ignored by virtually all plant taxonomists since its description by Small (1903, 1933) more than 100 years ago. Ward (2012),

however, argued that it deserves to be recognized at least at the level of a subspecies or variety, though his reasons seem to make an even stronger case for species status. This species resembles both *A. triphyllum* and *A. pusillum*, differing in having a very long-acuminate spathe, the upper surface of which is dull green and darker than the inner or lower portions (Fig. 8). It occurs in swamps and very wet woods, commonly on basic substrates from at least southeastern Georgia to the southern Florida peninsula and west to east Texas. It is diploid with  $2n = 28$ . Huttleston (1949, 1981) considered these plants to represent a widely dispersed hybrid swarm produced by extensive crossing of *A. triphyllum* and *A. pusillum*. This seems highly unlikely.

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***Arisaema pusillum*** Small Jack-in-the pulpit

Plants 1.5–3 dm tall. Leaves 1–2, green beneath at maturity. Leaflets 3, arranged palmately. Spathe tube length 3.5–5 cm. Spathe hood solid purple or solid green (never striped), 4–5 cm long, apex acuminate. Spathe flange 1–3 mm broad, revolute. Spadix slender, 2–3 mm in diameter, cylindrical, straight. Stomatal guard cell length  $< 40 \mu\text{m}$ .

**Comments** — A much smaller and more delicate species, *A. pusillum*, also occurs in two color morphs. In this case, however, the inside of the upper portion of the spathe of the purple-spathed morph is solid and not interrupted with stripes (Fig. 3), whereas the spathe of the green-spathed morph is uniformly green or green with white or light purple stippling (Fig. 4). The spathe is less robust, as is the spadix, which is more cylindrical. Populations range from southeastern Canada west to Minnesota and south to Georgia, Louisiana, and east Texas. All chromosome counts of this species show it to be diploid with  $2n = 28$ . It is restricted to swamps and very wet forests.

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***Arisaema quinatum*** Southern Jack-in-the-pulpit

Plants 4–8 dm tall. Leaves 1–2 (–3), glaucous beneath at maturity. Leaflets (3–) 5, arranged palmately. Spathe tube length 4–5 cm. Spathe hood uniformly green, 3.5–4 cm long, apex obtuse to abruptly acute. Spathe flange 2–5 mm broad, horizontal. Spadix slender, 1–2 mm in diameter, cylindrical, curved toward the mouth of the tube.

**Comments** — *Arisaema quinatum* is a more southern species with uniformly green coloration of the flowers. The spadix is conspicuously thin and arched compared to other species, though the plants overall may be as robust as *A. triphyllum*. A distinctive feature of most flowering-age plants is the production of five, rather than three leaflets (Fig. 5). It tends to occur in slightly drier upland forest than other species and ranges from southwestern North Carolina and southeastern Tennessee south to Panhandle Florida and east Texas. It is known to be diploid with  $2n = 28$ .

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***Arisaema stewardsonii*** Bog Jack-in-the pulpit

Plants 3–6 dm tall. Leaves 1–2, green beneath at maturity. Leaflets 3, arranged palmately. Spathe tube length 4–7 cm, strongly fluted. Spathe hood green or purple with white stripes,



4–6 cm long, apex long-acuminate. Spathe flange 1–3 mm broad, revolute. Spadix 3–5 mm in diameter, cylindrical, straight. Stomatal guard cell length  $< 40 \mu\text{m}$ .

**Comments** — *Arisaema stewardsonii* is a more northern species with a strongly ridged or fluted spathe tube and a spathe hood that is green with white stripes (Fig. 6) or purple with green stripes (Fig. 7). A plant of bogs and peaty swamps, this species ranges from Nova Scotia west to Minnesota and south to western North Carolina, eastern Tennessee, and northern Indiana. It is diploid with  $2n = 28$ .

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### *Arisaema*. *sp. nov.* *A*

Plants 3–7 dm tall. Leaves 1–2, glaucous beneath at maturity. Leaflets 3, arranged palmately. Spathe tube length 4–5 cm. Spathe hood purple with white stripes reaching just above the spadix with only the median stripe sometimes reaching the apex, 4–5 cm long, apex acuminate, outer surface dull green. Spathe flange 2–6 mm broad, horizontal. Spadix 4–8 mm in diameter, cylindrical, straight

**Comments** — The final species of the *triphyllum* complex is what we are informally referring to as *A. sp. nov. A* pending further study and formal description of the species. It has been considered a form of *A. triphyllum* by Fernald (1940), who based his name, *A. atrorubens* Blume forma *zebrinum* (Sims) Fernald, on *Arum triphyllum* L. var. *zebrina* (Sims, 1806). Unfortunately, examination of Sims's plate illustrating this variety reveals the plant is the common purple-spathed morph of *A. triphyllum* and not the form figured by Fernald (1940) in his Plate 1940-2. This taxon has not been recognized by other authors at any taxonomic level. In our view it differs from the typical purple-spathed morph of *A. triphyllum* in lacking the distinctive stripes within the purple portion of the spathe (Fig. 9). Instead, the upper region is nearly solid purple, as in *A. pusillum*, which the plants also resemble in having more delicate floral structure. In some specimens the central stripe may continue to the tip, but the other stripes are shorter. Originally described by Fernald (1940) from a population in Virginia, we have now seen plants from southern Canada and Michigan south to Georgia, Louisiana, and east Texas. Its habitat includes dripping springs and waterfalls, often associated with sandstone or limestone, along rocky creeks or in swampy ground. Again, this species is diploid with  $2n = 28$  (based on counts done by Huttleston of specimens he identified as *A. triphyllum* and Treiber identified as *A. triphyllum* ssp. *pusillum* : e.g., D. G. Huttleston 4 at BH).

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### *Arisaema dracontium* Green Dragon

Plants 0.6–1.2 m tall. Leaf 1, with (5–) 7–15 leaflets arranged pedately on a semicircular axis. Spathe tube length 2–3 cm. Spathe hood light green, 2.5–3.5 cm long, tightly enclosing the spadix, 1–1.5 cm broad when unrolled. Spadix 10–17 cm long, attenuate, S-shaped, long-exserted from the spathe.

**Comments** — Turning to the *dracontium* complex, it has long been assumed that there is only a single species involved, *A. dracontium*, which is easily separated from any member of the



**Figure 10.** *Arisaema dracontium* from Biddle, Kentucky, USA. Note the large number of leaflets and the spathe tightly enclosing the lower portion of the long spadix.



**Figure 11.** *Arisaema macrospathum* from Parque Nacional El Tepozteca, Morelos, Mexico. Note the many leaflets and the very large, open spathe from which the long, attenuate spadix emerges symmetrically.





**Figure 12.** *Arisaema* sp. nov. B from Barton Creek, Austin, Texas, USA. Note the many leaflets and the more open spathe from which the long, solid spadix emerges asymmetrically.

*triphyllum* complex. Leaves of this species typically are comprised of 7 to 15 leaflets arranged pedately, rather than palmately, on a semicircular axis. Moreover, the spadices are very long, attenuate, and strongly exserted from the tightly enclosing spathe (Fig. 10). Plants grow in bottomlands and floodplains from southern Quebec, Michigan, and Wisconsin south to northern peninsular Florida and east Texas. This species is tetraploid with  $2n = 56$ .

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***Arisaema macrospathum*** Mexican Green Dragon

Plants 6–9 dm tall. Leaf with (5–) 7–12 leaflets, arranged pedately on a semicircular axis. Spathe tube length 6–7 cm. Spathe hood light green, 8–12 cm long, not enclosing the spadix, 6–8 cm broad when unrolled. Spadix 15–30 cm long, attenuate, S-shaped, projecting symmetrically from the spathe.

**Comments** — Ward (2012) concluded, as we have, that diploid plants of *A. dracontium* from peninsular Florida are distinct from true *A. dracontium* and described them as a new variety of that species. Unfortunately, he based the name on the specific epithet of a species that occurs in Mexico (*A. macrospathum* Benth.), which is superficially similar in having a reduced number of leaflets and a more open spathe that loosely covers the lower portions of the long, slender, curved spadix (Fig. 11). In contrast, we agree with most taxonomists (e.g., Gusman & Gusman 2002) that *A. macrospathum* is a distinctive species that is endemic to Mexico. It ranges from the border of northern Mexico to its southern border, mostly on mountains above 1,700 m in moist and moderately cool temperate cloud forest. Its chromosome number is  $2n = 28$  (Sousa et al., 2014).

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***Arisaema* sp. nov. B**

Plants 3–5 dm tall. Leaf with (5–) 7–15 leaflets arranged pedately on a semicircular axis. Spathe tube length 2–4 cm. Spathe hood green, 3–5 cm long, not enclosing the spadix, 2–4 cm broad when unrolled. Spadix 12–20 cm long, solid, S-shaped, projecting asymmetrically from the spathe.

**Comments** — There has been controversy regarding the ploidy level of *A. dracontium* ever since Huttleston (1949) reported some unexpected counts of  $2n = 28$  for some plants from Florida (e.g., *D. G. Huttleston 1022-1* at BH). Boles et al. (1999) also found that plants they sampled from a Florida sinkhole were diploid in contrast to 18 other populations sampled along a transect from Ontario to Louisiana. In our view, these diploid populations represent a second species we are informally designating *A. sp. nov. B* pending more thorough study of these plants from throughout the range. This diploid species tends to be associated with limestone-derived soils and ranges from north-central Florida, where it is most abundant in association with sinkholes, to east Texas. Morphologically, the plants differ from *A. dracontium* in having a more open spathe from which a very long spadix emerges (Fig. 12).



## ISSUES NEEDING RESOLUTION

### Lack of vegetative characters

*Arisaema* plants typically produce only one or two leaves per growing season, so there are few vegetative characters for taxonomists to use compared to most other flowering plants. The single leaf of species in the *dracontium* complex is very different in architecture from other North American species, being arranged pedately and divided into many leaflets. These species are most closely related to a group that is primarily Asian (Ohi-Toma et al., 2016). In the *triphyllum* complex, leaves are usually trifoliate, the three leaflets constituting a terminal and two laterals. There are few differences between species, and even these are subtle for the most part (Weakley, 2020). The contrast between the upper and lower surface is often used to separate *A. triphyllum* and *A. quinatum* from *A. pusillum* and *A. stewardsonii*, the former being described as glaucous (though there is no actual waxy bloom) and the latter as green or lustrous. Sometimes this character is not obvious in dried herbarium specimens or in leaves that are not fully mature.

Five species in the *triphyllum* complex are almost invariably trifoliate, but occasionally produce a few lobes on the lateral leaflets. But mature flowering *A. quinatum*, as the name implies, typically has five leaflets, one clearly the terminal and the laterals with lobes giving the appearance of additional leaflets. This is complicated, however, by the fact that all of these plants go through a set of ontogenetic stages from unifoliate as seedlings to trifoliate as adults. It is not uncommon to find even *A. quinatum* flowering while still in the trifoliate stage. And it is possible to observe all of the intermediate stages in a single clump of plants of this species growing from the cormlets of a single genet. We have also seen very large two-leaved flowering plants of both *A. triphyllum* and *A. pusillum* that appeared to have five leaflets on the primary leaf. It seems that *A. stewardsonii* is least inclined to deviate from being strictly trifoliate, as observed also by Treiber (1980).

It is unclear why Treiber (1980) decided not to include *A. quinatum* in his study, as earlier collectors had probably regarded it as a separate species more often than any of the other subspecies. Apparently, he observed early in his fieldwork occasional lobes in *A. triphyllum* that approached a quinquefoliate condition (e.g., *Treiber 902* and *Treiber 914* at NCU). He lumped *A. quinatum* in with *A. pusillum*, though his reason for doing so was never explicitly stated. More surprisingly, there are specimens dated as late as 6 June 1978 that Treiber annotated as *Arisaema quinatum* (e.g., *Demaree 52023* at NCU). Perhaps he simply relied on Huttleston (1949), who himself did not formally recognize *A. quinatum* as a subspecies (though he had recognized it at the species level in his dissertation) until after Treiber (1980) had finished his dissertation research (Huttleston, 1981). It is unclear why Thompson (1995) agreed with Treiber (1980) and rejected Huttleston's (1981) recognition of *A. quinatum* as a subspecies. Gusman & Gusman (2002) also followed Treiber (1980), though they never succeeded in getting living 5-foliate specimens. Ward (2012) in his amplified keys to the flora of Florida, recognized *A. quinatum* as a distinct but rare species.

In any case, leaf characters are also problematic because they may differ depending on the status of the plant as nonflowering, staminate, or pistillate. In his studies, Treiber (1980) did not indicate whether plants he measured for seven morphological characters were sorted by flowering phase. If pooled, this would have artificially increased variability and could be the reason he found no statistically significant differences between the taxa for any of the seven quantitative characters he measured. This is discouraging because in all populations the most common plant sexual phase is nonflowering. Another issue that could have artificially inflated variability is inclusion of plants of *A. quinatum* and *A. acuminatum* in with measurements of *A. pusillum*, given that Treiber (1980) considered these plants to comprise a single subspecies.

### Misidentifications based on herbarium material

Fortunately, there are many diagnostic characters of the inflorescences of these species that can be used to separate them, and Treiber's (1980) growth chamber and common garden experiments showed them to be genetically based. These include spathe hood color and striping, spathe tube fluting, spathe tube flange width, and sterile spadix (appendix) shape. A problem arises, however, once fresh inflorescences are pressed and dried for herbarium specimens. The three-dimensional configuration of these structures is lost, as is color. Huttleston (1981) used virtually the same characters as Treiber (1980) and noted plants of the four subspecies are very distinctive and readily identified, at least in living condition. He conceded, however, it is not always possible to identify herbarium specimens to subspecies. This may explain many specimens in herbaria that he assumed might be hybrids and that he annotated with question marks (e.g., *Duncan 9311* at GEO). Later, he stated, most of the distinguishing characteristics are obscured or destroyed by pressing (Huttleston, 1984). Thompson (1995) echoed this view, noting that these morphological forms may be recognizable in the field, but distinguishing these differences on herbarium specimens is often difficult.

### Mismatch of ploidy level and identification

It seems likely that both Huttleston and Treiber, like Thompson (1995, 2000), were overly concerned about the impossibility of naming every specimen of *Arisaema* in herbaria. Of Huttleston's work, Treiber (1980) said, although based primarily on herbarium material, Huttleston did consider some ecological factors and provided some cytological data. Unfortunately, some of his chromosome counts and identifications do not match up. For *A. triphyllum* Huttleston (1949) reported that he had made chromosome counts for about 50 plants from various parts of the range. These counts were  $2n = 56$  except those for two plants collected at Big Gully, Cayuga County, New York, which had  $2n = 28$ . Treiber (1980) examined the vouchers for these counts and found that one (*Huttleston 4* at BH) is *A. pusillum*, while the other (*Huttleston 25* at BH) is *A. stewardsonii*. We agree with Treiber's identifications. For the latter two species, Huttleston (1949) reported  $2n = 28$  based on 7 and 15 counts, respectively. Later, he reported  $2n = 28$  for *A. quinatum* based on counts of 27 plants from Alabama and one from Tennessee (Huttleston, 1981).

Treiber's (1980) own chromosome counts for the *triphyllum* complex were quite extensive and consistent: for *A. triphyllum*, he reported  $2n = 56$  based on 64 counts from 25 populations; for *A. pusillum*,  $2n = 28$  based on 38 counts from 15 populations; and for *A. stewardsonii*,  $2n = 28$  based on 17 counts from 7 populations. As is often the case, stomatal guard cell length was closely associated with ploidy level, averaging  $44.5\ \mu\text{m}$  for *A. triphyllum*,  $33.5\ \mu\text{m}$  for *A. pusillum*, and  $34.0\ \mu\text{m}$  for *A. stewardsonii*. Treiber (1980) speculated that an original ancestral population differentiated into a northern race (*A. stewardsonii*) and a southern race (*A. pusillum*) that hybridized in a remnant area of overlap to give rise to allotetraploid *A. triphyllum*. Huttleston (1949) had proposed this same scenario earlier but rejected it on the grounds that *A. triphyllum* does not combine the characters of the two diploids. Instead, he suggested that the ancestral nexus spawned three separate populations and that the chromosomes in one of them were or became doubled. Being more vigorous, the tetraploid spread more rapidly and more widely than the diploids, according to Huttleston.

A very different story has been told about *A. dracontium*, which also has a wide range in eastern North America (Boles et al., 1999). Chromosome counts from a total of 30 plants revealed that 18 populations were tetraploid with  $2n = 56$ , but one population from a large sinkhole in Gainesville, Florida was diploid, with  $2n = 28$ . Boles et al. (1999) concluded that the tetraploid is likely an autopolyploid based on the failure to observe fixed heterozygosity at any of the allozyme loci studied and morphological similarity between plants of the two cytotypes. Plants from the Florida population were highly differentiated genetically (Nei's genetic distance  $> 0.75$ ) from all other populations sampled along a transect from Ontario, Canada, to Baton Rouge, Louisiana. For all other pairs of populations, genetic distances were  $< 0.25$ . Moreover, the diploid Florida plants were fixed or nearly fixed for unique alleles at two loci (*Skd* and *Pgm*).

Our examination of these diploid plants from Alachua County, Florida, indicates there are morphological differences, such as a larger and more open spathe that does not enclose the spadix, associated with ploidy level and occurrence on limestone. We conclude these plants are an overlooked species that Ward (2012) mistakenly assumed to be identical to a Mexican species and treated as *A. dracontium* var. *macrospathum* (Benth.) D. B. Ward. The first indication these plants might represent a new species can be dated to 1950, when Huttleston obtained unexpected counts of  $2n = 28$  for collections from Alachua County. Unfortunately, he never published these observations. Our examination of his voucher specimens (*Huttleston 1019-2* and *1022-1* at BH) revealed plants that match other collections from this site and other sites in Florida. We have also seen plants of similar morphology associated with limestone areas on the Edwards Plateau near Austin, Texas.

### Extent of hybridization

In her treatment for *Flora North America*, Thompson (2000) recognized only one taxon in the *triphyllum* complex: *A. triphyllum*. While admitting that different morphological forms may be recognizable in the field, she noted the difficulty of naming herbarium specimens and argued

that there is much overlap in the distinguishing characters. Citing Huttleston (1949, 1953), she stressed the existence of numerous intermediate forms, including hybrids. But the evidence on this issue is extremely thin. Weakley (2020) argued the species are broadly sympatric and sometimes occur together in mixed populations with little sign of introgression or hybridization and seem to behave as biological species.

The only documented study of hybridization involves a wide cross between *A. stewardsonii* and *A. dracontium* at two sites about 1 km apart in floodplain forest along the Connecticut River in Massachusetts (Sanders & Burk, 1992). There are 1,800 putative hybrids at this site, yet such plants have never been seen elsewhere in the broadly overlapping ranges of these two species in the northeastern United States and Canada. Except for height, in which the hybrids outstripped both parents, plants were intermediate for leaflet number, spathe length, and appendix length. Flowering plants of both *A. dracontium* and the hybrids were monoecious, whereas those of *A. stewardsonii* were strictly staminate or pistillate. Sanders & Burk (1992) found staminate hybrids to be sterile and obtained chromosome counts of  $2n = 42$  as expected for a triploid.

More recently, Lee et al. (2011) sequenced chloroplast and nuclear ribosomal DNA attempting to confirm the hybrid origin of these plants, but their results were inconclusive. Assuming maternal inheritance of the chloroplast genome, there is some indication that *A. stewardsonii* would have been the maternal parent in this cross. Nevertheless, the overall pattern from the genetic markers did not seem to indicate involvement of *A. dracontium*. It seems odd too that this wide cross should have happened in only one location and only one subspecies of the *triphyllum* complex, especially since *A. stewardsonii* is perhaps the most habitat-specific of these taxa. Still, it is certainly possible that these sterile plants could have spread by asexual means over many years to form very large populations at these two sites.

Huttleston (1949) discussed the possibility of hybridization between *A. stewardsonii* and *A. triphyllum* at a site along the Clyde River in New York first mentioned by Wiegand & Eames (1926). Six chromosome counts from putative hybrids showed  $2n = 28$  for four and  $2n = 42$  for the other two, which would be expected of a triploid hybrid, but nothing is known of the fertility of these plants. Revisiting this subject, Huttleston (1981) did chromosome counts in two populations in northern New York where plants appeared to intergrade. Of 20 plants, three gave counts of  $2n = 42$  in the first population. In the second, two of 15 appeared to be triploids.

In discussing *A. quinatum*, Huttleston (1981) pointed out that this taxon should not be confused with Buckley's (1843) *Arum polymorphum*, subsequently transferred to *Arisaema* by Chapman (1860). He believed the latter to represent the product of hybridization between *A. quinatum* and *A. pusillum*, although these plants ranged rather widely from Tennessee to western North Carolina, northern Georgia, and central Alabama. We have examined several of Buckley's specimens, including the holotype (*S. B. Buckley s.n.* at NY), all of which seem to fit clearly into *A. quinatum*. In fact, the specimen cited was annotated by Huttleston himself in 1952 as *A. quinatum*.

Huttleston (1981) also rejected Small's (1903) *A. acuminatum* on the grounds that the populations represented a widely dispersed hybrid swarm involving crosses between *A. triphyllum* and *A. pusillum*. Plants occur along the coast of Georgia and throughout peninsular Florida. Chromosome counts of these plants, however, showed four plants with  $2n = 56$  in Georgia and 19 plants from Florida with  $2n = 28$ . Were these plants actually hybrids, they should be triploids with  $2n = 42$ . It seems more likely that *A. acuminatum* is a distinct diploid species. We have examined the holotype (*S. M. Tracy 6781* at NY) and additional specimens from Florida and Georgia and think that the plants deserve species status. In any case, it is highly unlikely that these plants represent a hybrid swarm that stretches over two states and achieved this wide distribution spreading by asexual means. Ward (2012) reached a similar conclusion, but treated the Florida plants as *A. triphyllum* var. *acuminatum* (Small) Engl.

It appears to us that the concern with hybridization has been greatly overblown in assessing the taxonomy of *Arisaema*. Even Huttleston (1981) admitted, in spite of apparent hybridization, plants of the four subspecies are very distinctive and readily identified. Treiber (1980) attempted all possible crosses within and among the three subspecies he recognized. His crosses within species gave high fruit-set, ranging from 86 to 90%, but crosses of *A. triphyllum* with either *A. pusillum* or *A. stewardsonii* were completely unsuccessful. Of 245 crosses involving *A. pusillum* as the pollen parent on *A. stewardsonii*, 105 (42.9%) led to fruit-set. Of 343 reciprocal crosses, 159 (46.4%) were successful. Germination of the F1 seeds from these crosses was low, however, averaging 10.6%, and after the first year of growth only 18 corms were recovered. At that point, his growth chambers malfunctioned, ending the experiment prematurely. Treiber (1980) concluded that hybridization between any of these species is very unlikely.

While it is true the ranges of species in the *triphyllum* complex overlap broadly, we reject the view that they intergrade due to hybridization. In our experience, even at sites where two species occur, they are separated ecologically. *Arisaema pusillum* seems to be restricted to the wettest habitats, occurring in swampy areas in deciduous forest, often associated with native species of river cane (*Arundinaria*) in the South. It ranges far to the north, but remains at lower elevations. Although *A. triphyllum* also is associated with moist sites, the plants are generally on streambanks or associated with rich deciduous forest, not in flooded areas. Perhaps the most distinctive habitat is that of *A. stewardsonii*, which occurs in acidic coniferous woods, most often in areas with peat bogs. Its range is more northern than the other species, coming south at higher elevations in the mountains only to North Carolina and Tennessee. Within its more southern range, *A. quinatum* typically is found on drier sites than the other species, though still within deciduous forest. The only species we have regularly found growing in sympatry are *A. pusillum* and "*A. sp. nov. A*," but we have not seen any evidence of introgression. Small's (1903) *A. acuminatum* also grows in wet areas similar to *A. pusillum* and "*A. sp. nov. A*," but in hardwood hammocks dominated by a mixture of palmettos and evergreen hardwoods and on organic soils. *Arisaema dracontium* is most abundant in sandy floodplains of rivers and streams, often under a canopy of deciduous trees. And *A. sp. nov. B* (= *A. dracontium* var. *macrospathum* of Ward (2012)) seems to be associated with limestone soils and especially with sinkholes in Florida. We strongly disagree with Treiber's (1980) characterization of these taxa as ecologi-



cally quite similar.

In contrast, in Asia where species diversity of *Arisaema* is many times greater than in North America, there have been many well-documented reports of hybridization (e.g., at least 15 in Japan *vide* Hayakawa et al. (2010)). And interspecific hybridization has been confirmed in several cases by sequencing of nuclear and chloroplast DNA (e.g., Hayakawa et al., 2011).

### Phylogenetic relationships

Studies attempting to clarify the phylogeny of *Arisaema* and related genera in the Araceae have reached similar conclusions. Renner & Zhang (2004) examined biogeography of the *Pistia* clade based on chloroplast and mitochondrial DNA sequences and Bayesian divergence time inference. They included in their sampling *A. dracontium* and *A. triphyllum*, though we are unsure of the exact identity of the latter as the specimen used (*T. Barkman 351* at WMU) was collected in fruit late in the season. It is most likely *A. triphyllum*, but *A. pusillum* also occurs in western Michigan. In any case, it seems that *Arisaema* diversified early enough for two lineages to attain trans-Beringian ranges. *Arisaema triphyllum* groups with *A. amurense* from a predominantly Sino-Japanese clade, whereas *A. dracontium* and *A. macrospathum* group with *A. heterophyllum* from a predominantly Chinese clade. A molecular clock was calibrated based on an 18 million-year-old fossil from the Latah Formation near Spokane, Washington. This fossil was similar to members of the *triphyllum* complex in diameter, shape and striation of the petiole. The resulting timeline suggests that *A. dracontium* and *A. macrospathum* diverged from Asian stock much earlier, perhaps in the Oligocene, and probably arrived in North America long before *A. triphyllum* (Renner et al., 2004).

Ohi-Toma et al. (2016) presented a genus-wide (150 accessions) phylogenetic analysis based on four non-coding regions of the chloroplast genome. They concluded, as Renner et al. (2004) had, that *Arisaema* is monophyletic, but they found serious problems with the sectional classification. Their trees showed *A. triphyllum* in a polytomy within the large Sect. *Pistillata*, and both *A. dracontium* and *A. macrospathum* in a polytomy within Sect. *Flagellarisaema*. It is possible that inclusion of other species of the *triphyllum* complex might prove useful in clarifying relationships within the genus.

### Complications related to studies of sex switching

Much attention has been paid to the rare phenomenon of sex switching in populations of *Arisaema* since it was first reported by Schaffner (1922) and most recently reviewed by Lovett Doust & Cavers (1982a). There was an explosion of interest in the 1980s with many studies conducted in the northeastern United States and Canada (e.g., Policansky, 1981; Lovett Doust & Cavers, 1982a; Ewing & Klein, 1982; Bierzychudek, 1982a, 1982b, 1984; Lovett Doust et al., 1986). All of these came to similar conclusions about the basic fact that plants can shift between nonflowering, staminate, and pistillate phases from year to year. The probability of being in a particular phase is related to plant size, regardless of how it is measured, and switching can be altered by manipulation of the resource status of the plant (e.g., removing leaves or

increasing light). Some differences among the studies were apparent, however, in issues such as pollination limiting fruit-set and numbers of seeds per plant. Treiber (1980) found significant differences among the three subspecies he examined with respect to asexual, as well as sexual, reproduction. It has been assumed that all of the studies cited above were done using *A. triphyllum*, but some of the disparities between studies could be due to inclusion of other species of the *triphyllum* complex. This is especially likely, for example, in a study like that of Vitt et al. (2003) where the two populations chosen for comparison were purposely selected because of the contrasting habitats: one from a swamp and the other from a drier deciduous forest.

Because it also exhibits sex switching, *A. dracontium* has also been the subject of several studies. In this case, however, flowering plants are either staminate or monoecious (but with varying numbers of staminate and pistillate flowers (Lovett Doust & Cavers, 1982b)). In both of the populations they studied in southwestern Ontario, there were three times as many staminate as monoecious plants, and the latter averaged twice the size of the former. Clay (1993) also studied size-dependent gender change in this species at the southern limit of its range in Louisiana coming to similar conclusions. He did find, however, that variation in the number of staminate and pistillate flowers of monoecious plants was substantial but generally ranged from 45 to 70% pistillate. Richardson and Clay (2001) surveyed the literature and did extensive field surveys of *A. dracontium* and *A. triphyllum* in southern Indiana. They concluded that species with a sex change pattern like *A. triphyllum* (staminate or pistillate) have more male-biased (79.9%) population sex ratios than do those with a sex change pattern like *A. dracontium* (staminate or monoecious), with population sex ratios averaging 67.3% male. Again, it is possible that some of the disparities between studies is due to inclusion of *A. sp. nov. B*, especially those done in the southern extreme of the range (e.g., Louisiana).

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Table 1. List of taxa in <i>Arisaema</i> to be evaluated for possible species status. Comparisons to other taxonomies since 1980 are included. Treiber (1980) and Huttleston (1981) are unpublished doctoral dissertations; Thompson (2000) is the treatment from <i>Flora North America</i> ; Gusman and Gusman (2002) is a book-length revision of the genus on a worldwide basis; and Weakley (2020) is from an online provisional <i>Flora of the Southeastern United States</i> .					
Our List	Treiber (1980)	Huttleston (1981)	Thompson (2000)	Gusman & Gusman (2002)	Weakley (2020)
<i>triphyllum</i> complex					
<i>A. triphyllum</i> (2n = 56)	ssp. <i>triphyllum</i>	ssp. <i>triphyllum</i>	<i>A. triphyllum</i>	ssp. <i>triphyllum</i>	<i>A. triphyllum</i>
<i>A. pusillum</i> (2n = 28)	ssp. <i>pusillum</i>	ssp. <i>pusillum</i>	<i>A. triphyllum</i>	ssp. <i>pusillum</i>	<i>A. pusillum</i>
<i>A. stewartsonii</i> (2n=28)	ssp. <i>stewartsonii</i>	ssp. <i>stewartsonii</i>	<i>A. triphyllum</i>	ssp. <i>stewartsonii</i>	<i>A. stewartsonii</i>
<i>A. quinatum</i> (2n=28)	ssp. <i>pusillum</i>	ssp. <i>quinatum</i>	<i>A. triphyllum</i>	ssp. <i>pusillum</i>	<i>A. quinatum</i>
<i>A. acuminatum</i> (2n=28)	ssp. <i>pusillum</i>	ssp. <i>triphyllum</i> × ssp. <i>pusillum</i>	<i>A. triphyllum</i>	ssp. <i>triphyllum</i>	<i>A. acuminatum</i>
<i>A. sp. nov. A</i> (2n=28)	Not Included	Not Included	Not Included	Not Included	Not Included
<i>draconium</i> complex					
<i>A. draconium</i> (2n=56)	<i>A. draconium</i>	<i>A. draconium</i>	<i>A. draconium</i>	<i>A. draconium</i>	<i>A. draconium</i>
<i>A. macrospathum</i> (2n=28)	Not in Range	<i>A. macrospathum</i>	Not in Range	<i>A. macrospathum</i>	Not in Range
<i>A. sp. Nov. B</i> (2n=28)	Not Included	Not Included	Not Included	Not Included	Not Included

