



New Species of *Anthurium* section *Calomystrium* from Costa Rica and Panama

ORLANDO O. ORTIZ^{1*} & THOMAS B. CROAT²

¹Herbario PMA & Programa de Maestría en Ciencias Biológicas, Universidad de Panamá, Estafeta Universitaria, Panama City, Panama. e-mail: ortizopma@gmail.com

²Missouri Botanical Garden. P.O. Box 299. St. Louis, MO 63166-0299, USA.

*author for correspondence

Abstract

Five new species of *Anthurium* section *Calomystrium* from Central America are described here: *A. flamatamaense* sp. nov. from Costa Rica and *A. lasabanetaense* sp. nov., *A. roseonaviculare* sp. nov., *A. solanoi* sp. nov. and *A. suffusum* sp. nov. from Panama. The new Panamanian taxa increase the number of species in *Anthurium* section *Calomystrium* to forty-two, of which 35 are endemic to the country. In the case of Costa Rica, the number of species increases to nine, of which, three are endemic.

Key words: Flora of Panama, Flora of Costa Rica, Taxonomy, Fila Matama, Santa Fe National Park, Reserva Forestal Fortuna, Cerro Jefe, La Amistad National Park

Introduction

The genus *Anthurium* Schott (1829: 828) is monophyletic (Carslen & Croat 2013), represented by 950 species, but now it is estimated that there are about 2000 species (Boyce & Croat 2014). The species diversity of *Anthurium* is greatest in the low and middle elevations of northern South America, Panama, and Costa Rica (Croat 1983). There are about 88 species described for Costa Rica (Grayum 2003, Carslen & Croat 2004). However, in Panama, there are about 182 species described (Carslen & Croat 2004, Correa *et al.* 2004, Croat 2005, Rodríguez *et al.* 2011, Croat *et al.* 2013, Ortiz & Croat 2015a, Ortiz & Croat 2015b, Ortiz *et al.* 2015), representing the most diverse species group of the genus in Central America (Croat 1986).

The section *Calomystrium* (Schott, 1860: 496) is mainly characterized by short, thick internodes, reddish brown and intact cataphylls, leaf blades usually ovate-sagittate to ovate-cordate, moderately coriaceous, often with the presence of short pale-lineations and dark diffuse punctations on the surfaces, inflorescences with thick, often erect, colorful spathes and glossy spadices with thick tepals (Croat *et al.* 2013).

Croat & Sheffer (1983) mention that section *Calomystrium* is one of the most natural groups within *Anthurium*. A recent phylogenetic study of Carslen & Croat (2013) placed eight species of section *Calomystrium* [*Anthurium antioquiense* Engler (1905: 174), *A. curvispadix* Croat (1986: 83), *A. formosum* Schott (1858: 181), *A. hoffmannii* Schott (1858: 181), *A. huixtlense* Matuda (1950: 91), *A. obtusilobum* Schott (1858: 181) and *A. veitchii* Masters (1876: 772)] in a highly supported clade, forming a monophyletic group, supported by molecular characters and the presence of intact persisting cataphylls (Carslen 2011).

In the Revision of *Anthurium* for Mexico and Central America (excluding Panama) (Croat 1983), nine species are recognized in section *Calomystrium* in which six are reported for Costa Rica [*A. clavatum* Croat & R.A. Baker (1979: 39), *A. formosum*, *A. hoffmannii*, *A. monteverdense* Croat & R.A. Baker (1979: 62), *A. obtusilobum* and *A. ravenii* Croat & R.A. Baker (1979: 75)]. Croat (1983, 1986) classified *Anthurium ravenii* within section *Calomystrium*, but Croat *et al.* (2013) mentions that this species is apparently more related to those included in section *Cardiolonchium* (Schott 1860: 526), because *A. ravenii* has cataphylls that remain intact but which are soon deciduous, moderately thin leaf blades as well as weak and brittle spathes. Presently, with the new species described here, Costa Rica has nine species of section *Calomystrium*, of which, 3 are endemic (Table 1).

On the other hand, with the revision of *Anthurium* for Panama (Croat 1986), 18 species are recognized in section *Calomystrium*. Later, the works of Croat (2005), Croat *et al.* (2007), Rodríguez *et al.* (2011) and Croat *et al.* (2013), increased the number of species of this section to 38. With the new Panamanian species described there are 42 species of section *Calomystrium* for Panama, of which 35 are endemic (Table 1).

TABLE 2. Synopsis of *Anthurium* section *Calomystrium* in Central America. Data according to Croat (1983, 1986), Croat & Stiebel (2001), Pérez-Farrera & Croat (2001), Grayum (2003), Correa *et al.* (2004), Croat (2005), Croat *et al.* (2007), Rodríguez *et al.* (2011), Croat *et al.* (2013), TROPICOS (2015) and Croat (unpubl. data).

Taxon	Distribution
<i>A. alturaense</i> Croat (in Croat <i>et al.</i> 2013: 31)	Panama (Endemic)
<i>A. amnicola</i> Dressler (1980: 55)	Panama (Endemic)
<i>A. armenianse</i> Croat (1983: 250)	Guatemala, Mexico
<i>A. beltianum</i> Standley & L.O. Williams (1952: 103)	Nicaragua (Endemic)
<i>A. bittneri</i> Grayum (1992: 40)	Costa Rica, Panama
<i>A. brevipiculum</i> Croat (in Croat <i>et al.</i> 2013: 33)	Panama (Endemic)
<i>A. cascajalense</i> Croat (in Croat <i>et al.</i> 2013: 34)	Panama (Endemic)
<i>A. churchilleorum</i> Croat	Panama (Endemic)
<i>A. clavatum</i> Croat & R.A. Baker	Costa Rica (Endemic)
<i>A. colonense</i> Croat (1986: 60)	Panama (Endemic)
<i>A. cucullispathum</i> Croat (1986: 77)	Costa Rica, Panama
<i>A. curvispadix</i> Croat	Panama (Endemic)
<i>A. darcyi</i> Croat (2005: 354)	Panama (Endemic)
<i>A. deminutum</i> Croat (in Croat <i>et al.</i> 2013: 37)	Panama (Endemic)
<i>A. erythrostachyum</i> Croat (1986: 89)	Colombia, Costa Rica, Panama
<i>A. faustomirandae</i> Pérez-Farrera & Croat (2001: 88)	Mexico (Endemic)
<i>A. filamatamaense</i> Croat & O. Ortiz	Costa Rica (Endemic)
<i>A. foreroanum</i> Croat (1986: 96)	Panama (Endemic)
<i>A. formosum</i> Schott	Colombia, Costa Rica, Ecuador, Nicaragua, Panama, Peru, Venezuela
<i>A. fusiforme</i> Croat	Panama (Endemic)
<i>A. globosum</i> Croat	Panama (Endemic)
<i>A. granulinea</i> Croat (in Croat <i>et al.</i> 2013: 38)	Panama (Endemic)
<i>A. guanghuae</i> Croat (in Croat <i>et al.</i> 2013: 40)	Panama (Endemic)
<i>A. haltonii</i> Croat (in Croat <i>et al.</i> 2013: 41)	Panama (Endemic)
<i>A. hammelii</i> Croat (1986: 109)	Panama (Endemic)
<i>A. henryi</i> Croat (in Croat <i>et al.</i> 2013: 42)	Panama (Endemic)
<i>A. hoffmanii</i> Schott	Costa Rica, Panama
<i>A. horridum</i> Croat (in Croat <i>et al.</i> 2013: 44)	Panama (Endemic)
<i>A. huixtlense</i> Matuda	Belize, El Salvador, Guatemala, Honduras, Mexico, Nicaragua
<i>A. ingramii</i> Croat (in Croat <i>et al.</i> 2013: 46)	Panama (Endemic)
<i>A. kamemotoanum</i> Croat	Panama (Endemic)
<i>A. kareniae</i> Croat	Panama (Endemic)
<i>A. laminense</i> Croat (in Croat <i>et al.</i> 2013: 48)	Panama (Endemic)
<i>A. lasabanetaense</i> Croat & O. Ortiz	Panama (Endemic)
<i>A. lilafructum</i> Croat (in Croat <i>et al.</i> 2013: 49)	Panama (Endemic)
<i>A. luteospathum</i> Croat (in Croat <i>et al.</i> 2013: 50)	Panama (Endemic)
<i>A. monteverdense</i> Croat & R. Baker	Costa Rica (Endemic)
<i>A. obtusilobum</i> Schott	Colombia, Costa Rica, Ecuador, Panama
<i>A. penonomense</i> Croat (in Croat <i>et al.</i> 2013: 51)	Panama (Endemic)
<i>A. roseonaviculare</i> Croat & O. Ortiz	Panama (Endemic)
<i>A. roseospadix</i> Croat	Panama (Endemic)
<i>A. roubikii</i> Croat (in Croat <i>et al.</i> 2013: 53)	Panama (Endemic)
<i>A. sanctifidense</i> Croat	Colombia, Panama
<i>A. sapense</i> Croat	Panama (Endemic)
<i>A. solanoi</i> Croat & O. Ortiz	Panama (Endemic)
<i>A. suethompsoniae</i> Croat (in Croat <i>et al.</i> 2013: 54)	Panama (Endemic)
<i>A. suffusum</i> Croat & O. Ortiz	Panama (Endemic)
<i>A. sytsmae</i> Croat (1986: 185)	Panama (Endemic)
<i>A. tysonii</i> Croat (1986: 193)	Panama (Endemic)

Materials and methods

This is a herbarium research project based on collections of *Anthurium* at MO, PMA, SCZ, and UCH. The descriptions are of fertile material and all new species were keyed out with the Lucid *Anthurium* Key (Haigh *et al.* 2009). The descriptive terminology is according to Croat & Bunting (1979).

Taxonomy

Anthurium filamatamaense Croat & O.Ortiz, *sp. nov.* (Fig. 1)

Species characterized by its epiphytic habit, moderately long stems, short internodes, semi-persistent cataphylls, terete dark brown-drying petioles, ovate-sagittate dark brown-drying prominently long-acuminate blades with a narrowly hippocrepiform sinus, 6 pairs of basal veins, 1 pair of which is free to the base, a moderately curved slender posterior rib which is naked throughout its length, 3 pairs of primary lateral veins, collective veins arising from the third pair of basal veins and extending to the apex close to the margins as well as by the moderately long-pedunculate inflorescence with an erect white to weakly lavender spathe and a lavender cylindroid spadix.

Type:—COSTA RICA. Limón: Parque Nacional La Amistad, Cuenca de Estrella. Limón, Valle de la Estrella, Fila Matama, cerca de 11 km SW de pueblo de Aguas Zarcas, bosque nuboso primario, 1300–1400 m, 9°48'07"N, 83°10'39"W, 28 October 2007, *D. Santamaría, A. Monro, D. Solano, M. Moraga, A. Rodríguez & B. Gamboa R. 6663* (holotype, MO!; isotype, INB).

Epiphytic; **internodes** short, ca. 1 cm, ca. 1.5 cm diam.; **cataphylls** persisting semi-intact, dark brown decaying to light brown parallel fibers. Leaves with **petioles** 71 cm long, 4.0 mm diam. midway, broadly and acutely sulcate, drying dark brown, matte; petiolar sheath 13 × 2 cm; geniculum 2.5 cm long, darker than petiole; **blades** ovate-sagittate, 44 × 28 cm, widest ca. 4 cm above petiolar plexus, abruptly caudate-acuminate (acumen 2.5 cm long), 1.6 longer than wide, 0.6 as long as petiole, thinly coriaceous, drying dark brown above and somewhat paler below, weakly glossy above and semi-glossy below; **upper surface** pale short-lineate; **lower surface** weakly and moderately dark-dotted; **anterior lobe** 31.5 cm long, margin convex; **posterior lobes** 12.5–14.0 × 10.0 cm, lobes turned somewhat inward; **mibrib** narrowly raised above, narrowly rounded with a very pronounced medial ridge below, concolorous above, slightly darker below; **primary lateral veins** 3–4 pairs, arising at a 46–60° angle, narrowly raised and sometimes in sunken valleys above, narrowly raised below; **tertiary veins** slightly raised above, more prominently raised below, concolorous above and below; **collective veins** arising from the 3rd pair of basal veins, 1.5–2.0 mm from margin; antimarginal veins present; **basal veins** 6 pairs, first pair free to base the remainder coalesced to 5 cm, the second pair branching off at 0.5 cm, the third pair branching at 2 cm, the fourth at 4 cm, the fifth and sixth branching at 5 cm, narrowly rounded with a prominent medial rib on the upper surface, becoming narrowly raised in the lower veins on lower surface; **posterior ribs** 5 cm long, entirely naked, strongly and smoothly curved for entire length; **sinus** hippocrepiform, 12 cm deep. **Inflorescence** erect; **peduncle** 20 cm long, 3 mm diam. midway, noticeably tapered, significantly shorter than petiole, drying broadly and acutely sulcate, mid reddish-brown, matte; 2.4 longer than spathe; **spathe** 8.5 × 2.5 cm, oblanceolate, papyraceous, erect, white to weakly lavender, drying to mid reddish-brown; **spadix** sub-sessile (stipe ca. 2 mm), 4.5 cm long, 0.8 cm diam., cylindrical, lavender, drying mid reddish-brown; **flowers** 7 visible in the principal spiral, drying 1.3 mm long and wide; tepals minutely granular on drying; lateral tepals 1 mm wide, the inner margin rounded, outer margins 3-sided; stamens not exerted. Berries not seen.

Eponymy:—The species is named for the type locality on Fila Matama in the Valle de la Estrella in Limón Province of Costa Rica.

Distribution:—This species is known only from the type locality in Limón Province.

Habitat and Ecology:—*Anthurium filamatamaense* grows at 1300–1400 m in a *Premontane rainforest life* zone according to the classification of zones proposed by Holdridge *et al.* (1971).

Phenology:—Flowering in October. Further investigations are required to determine exact flowering and fruiting seasons.

Conservation status:—According to the IUCN List (2001), *Anthurium filamatamaense* is considered as Data Deficient (DD).



FIGURE 1. *Anthurium filamatamaense* Croat & O. Ortiz. Holotype specimen: Costa Rica. Limón: Parque Nacional La Amistad, Cuenca de Estrella. Limón, Valle de la Estrella, Fila Matama, cerca de 11 km SW de pueblo de Aguas Zarcas, bosque nuboso primario, 1300–1400 m, 9°48'07"N, 83°10'39"W, 28 October 2007, D. Santamaría, A. Monro, D. Solano, M. Moraga, A. Rodríguez & B. Gamboa R. 6663 (Photo MO Herbarium).

Discussion:—*Anthurium filamatamaense* is probably closest to *A. churchilleorum* Croat (in Croat *et al.* 2013: 36) which shares a similar blade shape with a long-acuminate apex, but the latter species differs by having leaf blades with a narrowly parabolic sinus (vs. sinus hippocrepiform for *A. filamatamense*), drying dark green to slightly lighter green (vs. dark brown), the upper surface densely and conspicuous granular and more densely short pale-lineate, a more conspicuously glandular-punctate lower surface, basal veins with posterior rib 1.0 cm long (vs. 5 cm long) as well as by its maroon spadix (vs. lavender spadix).

Anthurium filamatamaense is also similar to *A. formosum* which differs in being a much more robust plant, having many persistent intact cataphylls (vs. with persisting semi-intact cataphylls for *A. filamatamaense*), blades prominently granular on both surfaces as well as by having usually 2–3 pairs of basal veins free to the base (vs. 1 pairs of basal veins free to the base).

Another species in the region of the type in adjacent Panama that is similar is *Anthurium kareniae* Croat (in Croat *et al.* 2013: 47), which differs by having light brown-drying leaves (vs. dark brown) with closed sinus, 2 pairs of free basal veins (vs. 1 pairs of basal veins free to the base) and collective veins arising from the 1st pair of basal veins (vs. collective veins arising from the 3rd pair basal veins).

In the **Lucid Anthurium Key** (Haigh *et al.* 2009) *A. filamatamense* tracks to *A. huixtlense* which ranges from Mexico to Nicaragua which differs by having shortly acuminate blades (vs. abruptly caudate acuminate blades for *A. filamatamense*) with the collective vein arising from one of the lowermost primary lateral veins or from the first basal vein (vs. collective veins arising from the 3rd pair basal veins); *A. kamemotoanum* Croat (1986: 120) which differs by having blades with the collective veins arising from the 1st pair of basal veins (vs. collective veins arising from the 3rd pair basal veins), inflorescences with prominently navicular spathe (vs. oblanceolate spathe) and red-violet spadix at anthesis (vs. lavender spadix) and *A. obtusilobum* which differs by having a pale green to white spreading to reflexed oblong-elliptic spathe (vs. a white to weakly lavender erect oblanceolate spathe) and cream-colored spadix at anthesis (vs. lavender spadix).

Anthurium lasabanetaense Croat & O.Ortiz, *sp. nov.* (Figs. 2–3)

Species characterized by its terrestrial habit, cataphylls 10–12.5 cm long and promptly deciduous, subterete petioles which are typically longer than the blades, thick ovate cordate-sagittate, acuminate down-turned blades with a parabolic to spatulate sinus, 4–5 pairs of basal veins, 5–6 pairs of primary lateral veins, collective veins arising from first pair of basal veins, upper surface drying wrinkled-ridged with pits, densely pale punctate and pale short-lineate throughout, lower surface conspicuously pustular, minutely and faintly reddish brown speckled, inflorescence long-pedunculate with a cupuliform, white, broadly ovate-subcordate spathe with reddish veins, a spadix creamy-white to red, cylindroid, infrutescence with a green spathe and a broadly cylindroid spadix with red berries.

Type:—PANAMÁ. Veraguas: Parque Nacional Santa Fe, La Sabaneta, Bosque de aproximadamente 6–8 m de alto, con palmeras (*Colpothrinax aphanopela* R. Evans), 1000 m, 8°41'01"N, 80°59'09"W, 16 Julio 2009, Alicia Ibáñez, Fermín Hernández, José Guerra & Victor Concepción 5767 AI (holotype, PMA!).

Terrestrial herb to less than 1 m tall; **internodes** 1.5 cm diam., slightly longer than broad, drying gray-brown, semiglossy, irregularly ribbed; **cataphylls** 8.0–12.5 cm long, turning moderately coriaceous, initially reddish brown, turning pale gray-brown, promptly deciduous; **petioles** subterete, 14.0–23.5 cm long, drying 3–4 mm diam., semiglossy, drying sulcate, matte, finely many-ribbed, the area between the ribs finely and minutely granular; **blades** narrowly ovate-sagittate 16.0–17.5 × 10–13.2 cm, 1.3–1.7 times longer than broad, 0.59–0.78 times as long as petioles, gradually acuminate at apex, deeply lobed at base, coriaceous, dark green and semiglossy above, slightly paler below, drying gray-brown and matte above, moderately paler, slightly paler, obscurely dark-punctate and yellow-brown, sparsely pustular below; **anterior lobe** 13.0–15.5 × 12.1 cm, broadly rounded on margins; **posterior lobes** 5.0–6.3 × 4.1–5.5 cm; **basal veins** 4–5 pairs, 1st pair free to the base, 2nd pair fused 1.2 cm, 3rd & 4th pairs fused 3 cm, both 1st and 2nd pairs arising to the apex, the innermost, 0.5–0.7 mm from margins; **posterior rib** nearly straight, naked nearly ½ its length; **sinus** parabolic to spatulate 4.5 cm deep, 2.5–5.0 cm wide; **midrib** narrowly rounded, drying nearly concolorous, irregularly acute-ribbed above, drying darker brown and acute below with a medial rib and many small finer ribs on the sides; **primary lateral veins** 3–6, departing midrib 45–60° angle; **collective veins** from 1st pair of basal veins, 5 mm from margins; **tertiary veins** moderately prominent below; **upper surface** drying wrinkled-ridged with pits, densely pale punctate and pale short-lineate throughout; **lower surface** conspicuously pustular, minutely and faintly reddish brown speckled. **Inflorescence** markedly long-pedunculate, peduncle reddish, 44.0–53.5 cm long, 4–5

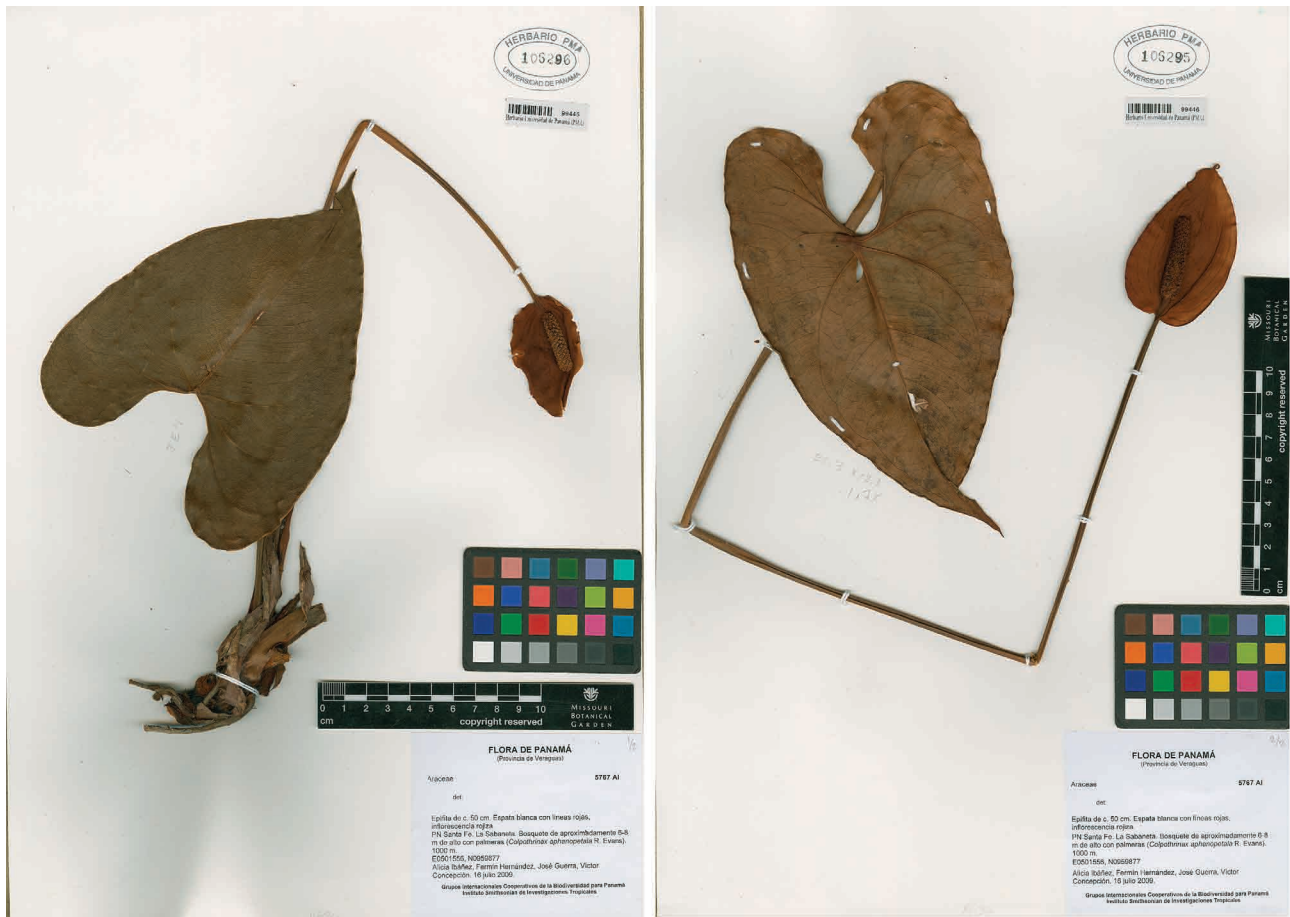


FIGURE 2. *Anthurium lasabanetaense* Croat & O. Ortiz. Holotype specimen: Panama. Veraguas: Parque Nacional Santa Fe, La Sabaneta, Bosque de aproximadamente 6–8 m de alto, con palmeras (*Colpothrinax aphanopela* R. Evans), 1000 m, 8°41'01"N, 80°59'09"W, 16 Julio 2009, Alicia Ibáñez, Fermín Hernández, José Guerra & Víctor Concepción 5767 (Photo MO Herbarium).

mm diam., drying dark brown; **spathe** 5.5–7.8 × 3.5–5.0 cm, broadly ovate-subcordate, conspicuously naviculiform, abruptly acuminate, white and moderately glossy inside, with many red veins; **spadix** cylindroid, creamy-white at anthesis, red in post-anthesis, 2.8–3.9 cm long, 7–10 mm diam., 4 times longer than wide, rounded at apex, stipitate ca. 10 mm; **flowers** 5–7 visible per spiral; 2 mm long and wide; tepals smooth; stamens held at the level of the tepals; anthers 0.4 × 0.6 mm. **Infructescence** sometimes reclining; **spathe** light green with many dark longitudinal veins with cross-veins between; **spadix** oblong-ellipsoid, 5 cm long, 2.3 cm diam., 2.3 times longer than wide, rounded at apex, tepals minutely granular; berries 5 mm diam., red.

Eponymy:—The species is named for the type locality at La Sabaneta in the Santa Fe National Park in Veraguas Province of Panama.

Distribution:—This species is endemic to Panama, known only from the type locality in Veraguas province, Santa Fe, Panama.

Habitat and Ecology:—*Anthurium lasabanetaense* grows at 1100 m in a *Montane rain forest* life zone according to the classification of Holdridge *et al.* (1971). According to Cáceres-González & Ibáñez (2014), the vegetation of La Sabaneta resembles a highland savanna, dominated by *Colpothrinax aphanopetala* Evans (2001: 189) and abundant trees of the families Clusiaceae, Myrsinaceae, Ericaceae and Araliaceae.

Phenology:—Two specimens examined flowered in February and October, but two other specimens were fruiting in July and September. This species maybe flowers and fruits throughout the year, but further investigations are required to determine exact flowering and fruiting times.

Conservation status:—This species is notable for its reduced geographical range. Cáceres-González & Ibáñez (2014) mention that compared to other sites throughout the country, the La Sabaneta region in Santa Fe National Park is a place with special and unusual ecological characteristics. We suggest this species be considered in the CR B2ab(iii) category according to the IUCN Red List Criteria (IUCN 2001).

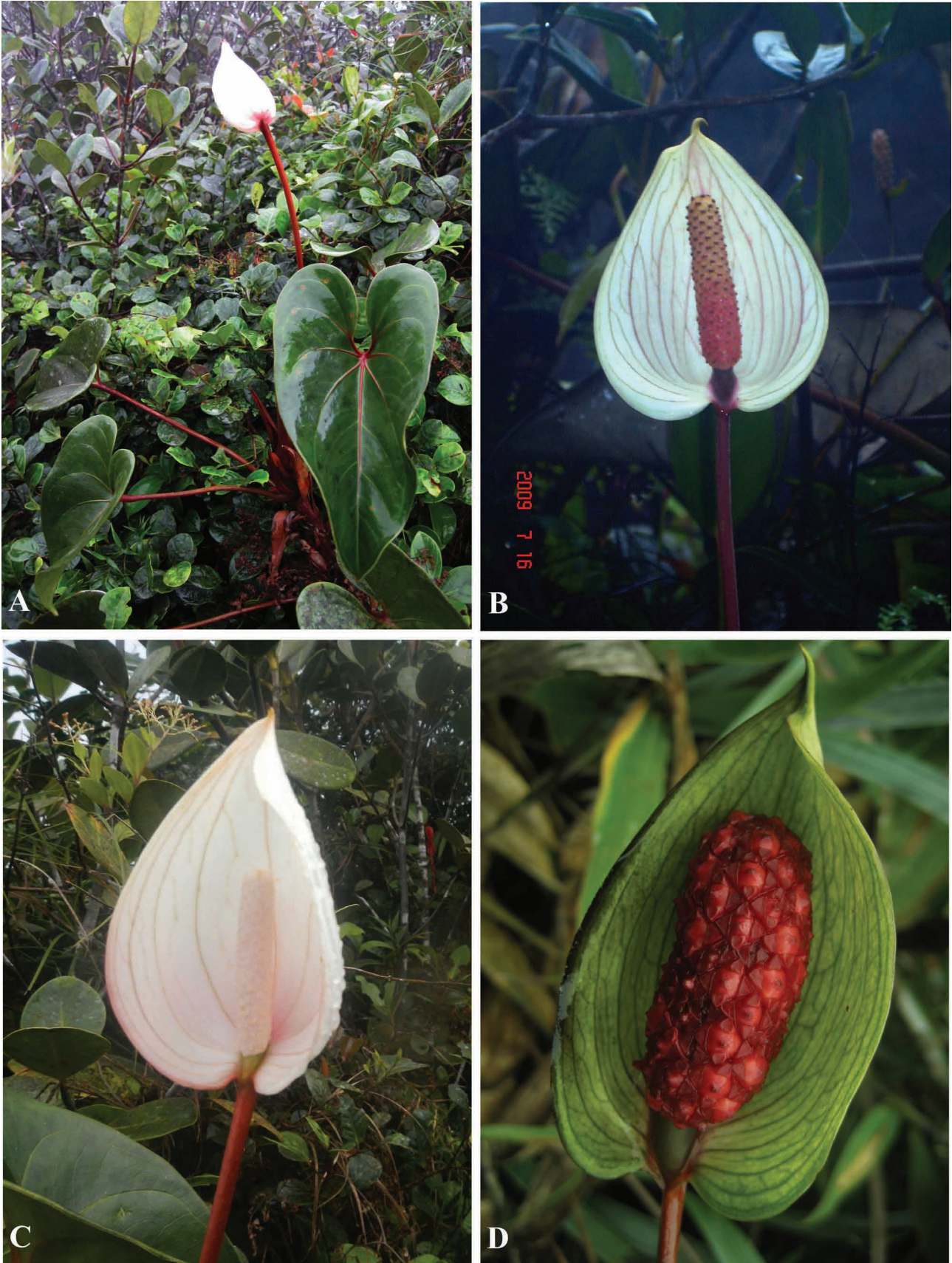


FIGURE 3. *Anthurium lasabanetaense* in its habitat at the type locality (Veraguas province, Santa Fe National Park, around La Sabaneta). A. In its habitat, Ibáñez, Flores, Concepción & Ábrego 6086 (Photo Alicia Ibáñez). B. Flowering spatix (post anthesis), Ibáñez, Hernández, Guerra & Concepción 5767 (Photo Alicia Ibáñez). C. Flowering spatix at anthesis, Batista, Cano, Perret & Rodríguez 1190 (Photo Juvenal E. Batista). D. Infructescence spatix, Ibáñez, Hernández, Guerra & Concepción 5743 (Photo Alicia Ibáñez).

Discussion:—In Panama *Anthurium lasabanetaense* could be confused only with *A. obtusilobum* Schott, *A. sanctifidense* Croat (1981: 334), *A. sapense* Croat (1986: 178) and *A. globosum* Croat (1986: 105), all of which have similar blade shapes and whitish spathes. *Anthurium obtusilobum* also differs by blades with collective veins arising from one of the lowermost basal veins (vs. collective veins from first pair of basal veins), basal veins ca. 8 pairs (vs. 4–5 pairs of basal veins) and inflorescences with reflexed, oblong-elliptic spathes at anthesis (vs. erect, ovate-subcordate and naviculiform spathes); *A. sanctifidense* differs by broadly ovate blades with lower surfaces moderately paler and glaucous when fresh (vs. ovate-sagittate blades, not glaucous on lower surface for *A. lasabantense*), ovate to lanceolate spathes at anthesis (vs. ovate-subcordate, naviculiform spathes) and infructescences with purplish spadices and violet purple or orange berries (vs. infructescences with reddish spadices with red berries); *A. sapense* differs by ovate-triangular blades (vs. ovate-sagittate blades), entirely white spathes without red veins at anthesis (vs. white spathes with many red veins), purplish berries (vs. red berries) and *A. globosum* differs by inflorescences at anthesis with green spathes (vs. white spathes) and globose spadices (vs. cylindroid spadices).

In the **Lucid Anthurium key** (Haigh *et al.* 2009) *A. lasabanetaense* tracks to *Anthurium roseospadix* Croat (1986: 170) which differs by inflorescences with shorter, 7.5–18.0 cm long peduncles (versus peduncles 44.0–53.5 cm long), violet-purple spadices at anthesis (vs. creamy-white spadices) and whitish berries (vs. red berries).

Additional specimens examined (paratypes):—PANAMÁ. Veraguas: Parque Nacional Santa Fe. La Sabaneta, entrando por Piragual, trocha que atraviesa el parque, desde Piragual al río Concepción, 8°40'16"N, 80°59'30"W, 5 Octubre 2008, *Hernández 1066* (PMA); Área abierta con palmeras (*Colpothrinax aphanopela* R. Evans), 1100 m, 8°40'38"N, 80°59'31"W, 15 Julio 2009, *Ibáñez, Hernández, Guerra & Concepción 5743 AI* (PMA); Área abierta con palmeras (*Colpothrinax aphanopela* R. Evans), 1100 m, 8°40'33"N, 80°59'28"W, 18 Febrero 2010, *Ibáñez, Flores, Concepción & Ábrego 6086 AI* (PMA); Bosque achaparrado, dominado por *Colpothrinax aphanopela* (Arecaceae), vertiente Caribe, 1240 m, 8°40'34"N, 80°59'31"W, 30 Septiembre 2014, *Batista, Cano, Perret & Rodríguez 1190* (MO, PMA).

Anthurium roseonaviculare Croat & O.Ortiz, sp. nov. (Figs. 4–5)

Species characterized by its consistently terrestrial habit, occurring always in open wind-swept areas, short internodes, long intact persistent cataphylls, subterete narrowly sulcate petioles with a maroon geniculum, narrowly ovate-sagittate, semiglossy prominently acuminate blades with a hippocrepiform to closed sinus, 8(9) pairs of basal veins, the first usually free to the base, a moderately curved posterior rib which is naked most of its length, 3–7 pairs of primary lateral veins, collective veins arising from the first pair of basal veins or one of the primary lateral veins and close to the margin, as well as by its long, lanceolate, rosy red spathe and short strongly tapered cream-yellow-colored spadix.

Type:—PANAMÁ. Chiriquí: Distrito Gualaca, Reserva Forestal Fortuna, Sendero en la Quijada del Diablo que va hacia el Río Hornito, 1229 m, 8°41'32"N, 82°13'40"W, 7 Noviembre 2013, *Orlando O. Ortiz, Juvenal Batista & Fredy Miranda 1793* (holotype, PMA!; isotypes, FT!, MO!, UCH!).

Terrestrial herb to ca. 1 m tall; **internodes** short, to 4 cm diam.; **cataphylls** to 23 cm long, coriaceous, drying dark brown, matte, persisting intact; **petioles** 49–69 cm long, narrowly and deeply sulcate, the margins prominently and narrowly raised, medium green, semiglossy; geniculum, 3.5 cm long, dark violet-purple, deeply sulcate with the margins prominently raised; **blades** narrowly ovate-sagittate, 40–63 × 27–36 cm, 1.4–1.7 times longer than wide, 0.8–0.9 times as long as petioles, prominently acuminate, deeply lobed at base, dark green and semiglossy above, paler and semiglossy below; **anterior lobe** 31.5–41.0 cm long, broadly rounded on margins; **posterior lobes** 14.0–19.5 × 9.3–13.5 cm; **sinus** usually closed with lobes overlapping, then circular to ovate, sometimes hippocrepiform, 5.5–16.7 cm deep, 2.4–3.5 cm wide; **basal veins** 7–8(9) pairs, 1st pair usually free to the base, sometimes weakly fused into the posterior lobes; 2nd pair sometimes free to the base, sometimes fused to 5 mm, 3rd pair fused 1.5 cm, 4th pair fused 2.4–4.0 cm, 5th pair fused to 4.7–5.0 cm; 6th and 7th pairs fused to 7–9 cm; **posterior rib** prominently curved, naked most of its length; **midrib** narrowly raised above, usually drying more or less acute and concolorous, broadly angular and slightly darker below with a distinct medial rib; **primary lateral veins** 3–7 pairs, arising at 35–40° angle, narrowly rounded to narrowly raised and acute and concolorous above, acutely raised and darker below; **collective veins** arising from the first pair of basal veins or one of the primary lateral veins, 2–4 mm from the margin; **tertiary veins** fine and close but only weakly raised; **upper surface** sometimes finely granular, lacking short pale lineations or punctations; **lower surface** finely granular, lacking dark punctations. **Inflorescence** erect, short-pedunculate; **peduncle** 2–4 cm long; **spathe** rosy-red, 16 × 10 cm, ovate-lanceolate, naviculiform, erect, greatly prolonged beyond spadix and

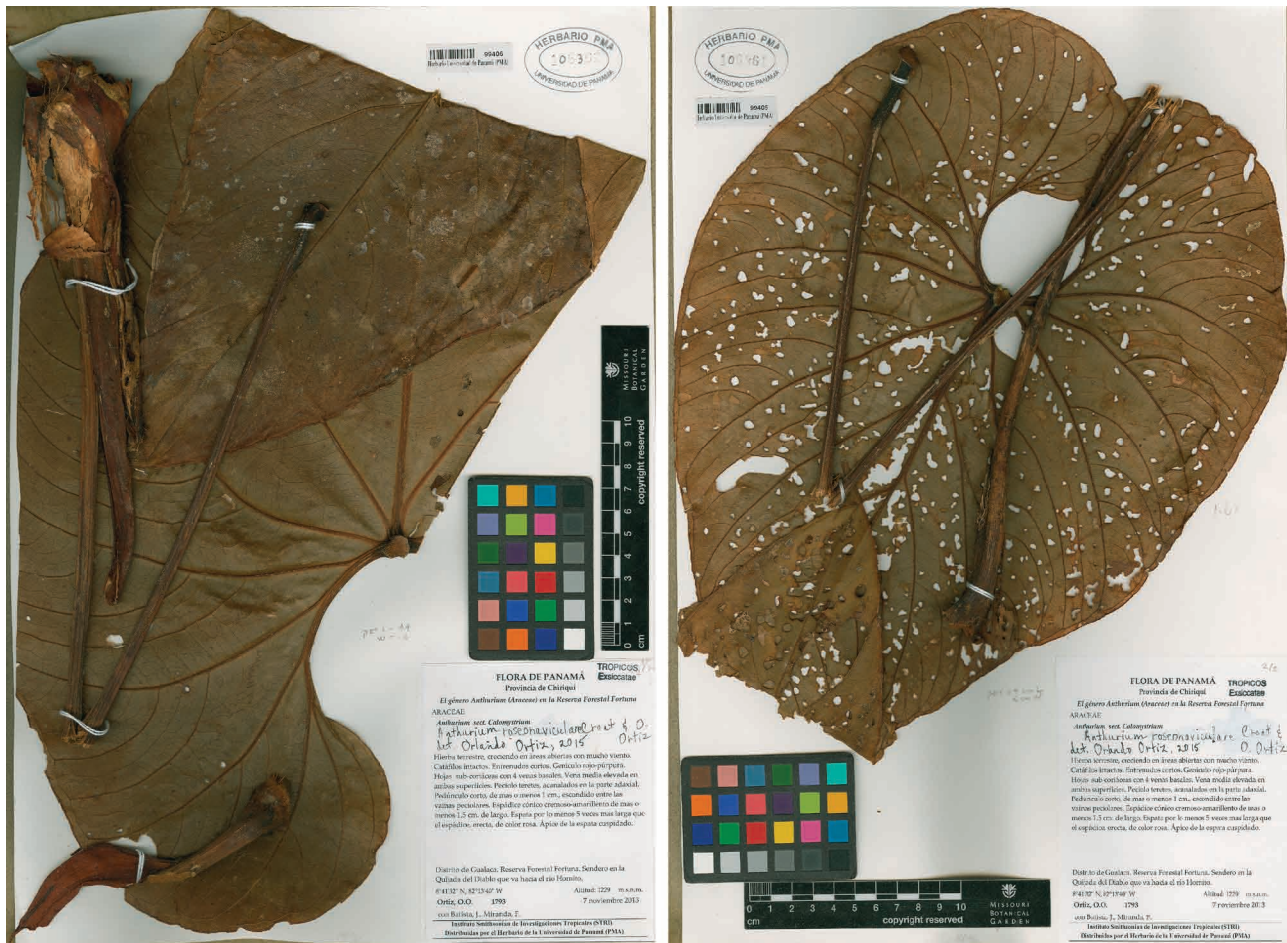


FIGURE 4. *Anthurium roseonaviculare* Croat & O. Ortiz. Holotype specimen: Panama. Chiriquí: Distrito Gualaca, Reserva Forestal Fortuna, Sendero en la Quijada del Diablo que va hacia el Río Hornito, 1229 m, 8°41'32"N, 82°13'40"W, 7 Noviembre 2013, Orlando O. Ortiz, Juvenal Batista & Fredy Miranda 1793 (Photo MO Herbarium).

enshrouding it, ca. 5 times longer than spadix; **spadix** cream to creamy yellow, cylindroid-tapered, strongly tapered to a blunt apex, matte, 0.8 cm long, 1 mm diam., 1.5 cm long and 0.6 cm diam. when fresh; **flowers** 8–11 per spiral; stamens not exerted. Berries not seen.

Eponymy:—The species epithet *roseonaviculare* is from the Latin “*navicularis*” (boat-shaped) and “*roseolus*” (pink, pale rose) referring to the pink boat-shaped spathe.

Distribution:—This species is endemic to Panama, known only from the type locality in Chiriquí province, Reserva Forestal Fortuna, Panama.

Habitat and Ecology:—The species grows at 1229 m in a *Premontane rainforest* life zone according to Holdridge *et al.* (1971). The vegetation of Quijada del Diablo resembles an elfin forest, dominated by small trees of about 6 m high and with many herbaceous species, including other aroid species such as *Anthurium formosum*, *A. obtusilobum* and *A. lentii* Croat & R.A. Baker (1979: 56).

Phenology:—The specimens examined flowered in November. Further investigations are required to determine exact flowering and fruiting time.

Conservation status:—*Anthurium roseonaviculare* should be listed as Data Deficient (DD) according IUCN Red List criteria (IUCN 2001).

Discussion:—By the resemblance of their leaves, *Anthurium roseonaviculare* appears to be related to *A. formosum*, a species which differs by its 21–47 cm long peduncles (versus peduncles 2–4 cm long), more broadly ovate-elliptic, whitish-lilac spathes (vs. ovate-lanceolate, naviculiform and rosy-red spathes) and more generally cylindroid spadix (vs. prominently tapered spadix).

In the **Lucid *Anthurium* key** (Haigh *et al.* 2009) *A. roseonaviculare* tracks to *A. atramentarium* Croat & Oberle (2004: 67) which differs by its longer (42–60 cm long) peduncles (versus peduncles shorter, 2–4 cm long), as well as by the black spathe (vs. rosy-red spathe) and cylindroid yellowish orange spadix (vs. prominently tapered creamy-



FIGURE 5. *Anthurium roseonaviculare* in its habitat at the type locality (Chiriquí province, Fortuna Reserve), Ortiz, Batista & Miranda 1793. A. Leaf blades. B. Cataphylls and inflorescence. C. Spathe and spadix. D. Cylindroid-tapered spadix (Photo Orlando O. Ortiz).

yellow spadix), and to *A. silverstonei* Croat & Oberle (2004: 80) which differs by having blades drying greenish gray (vs. blades drying reddish-brown), spathes which dry greenish or whitish (vs. spathes drying reddish-brown) and a spadix pinkish or purplish (vs. creamy-yellow spadix).

Anthurium solanoi Croat & O. Ortiz, sp. nov. (Fig. 6)

Species characterized by its epiphytic habit, short internodes, short dark brown intact cataphylls, terete dark brown-drying petioles, narrowly ovate-sagittate dark brown-drying scarcely bicolorous blades with 5 pairs of basal veins, the first pair of which are free to the base, a spatulate sinus, collective veins arising from the first pair of basal veins, 4 pairs of primary lateral veins, dark-dotted lower blade surfaces as well as by the long-pedunculate inflorescence, weakly angular peduncle, green spreading lanceolate spathe, cylindroid-tapered spadix and red infructescences.

Type:—PANAMÁ. Bocas del Toro: Changuinola. PILA, márgenes de la quebrada Yobo, afluente del río Urí, 1452 m, 9°03'25"N, 82°42'23"W, 16 abril 2008, Daniel Solano & Alejandro De Sedas 5381 (holotype, PMA!).

Epiphytic herb; **internodes** short, 1.5–2.0 cm diam.; **cataphylls** 7–13 cm long, persisting dark brown and intact. Leaves 80.5 cm long with blades directed in the same direction as the petioles; **petioles** terete, 33.5 cm, drying 3 mm diam., to 5 mm diam. midway, geniculum 3 cm long, slightly thicker and darker than petiole; **blades** narrowly ovate-sagittate, 33.5 × 18.8 cm, 1.8 times longer than broad, broadest 6–7 cm above petiolar plexus, prominently lobed at base, drying dark gray-brown and matte above, dark brown and weakly glossy below; **sinus** spatulate, 6.5 cm deep, 2.8 cm wide; **basal veins** 5 pairs, 1st pair free to the base, 2nd pair fused 6–15 mm, 3rd pair fused 1.7–2.0 cm; **midrib** weakly raised above, narrowly rounded and slightly darker below; **primary lateral veins** 5–6 pairs, arising at 55° angle, narrowly rounded and darker below; **collective veins** arising from 1st pair of basal veins, moderately loop-connected to primary lateral veins, 7–10 mm from margins; **upper surface** eglandular, densely granular, sparsely short pale-lineate; **lower surface** drying smooth densely and minutely dark-speckled, weakly moderately densely dark-dotted. **Inflorescence** 77.5 cm long, long-pedunculate; **peduncle** 82.5 cm long, weakly angular, drying dark brown; **spathe** green, 9.3 × 1.7 cm, erect-spreading; **spadix** cylindroid-tapered, red, weakly stipitate (ca. 2 mm), 14 cm long, 1.2 cm diam., post-anthesis, and dark brown on drying; **flowers** 5–6 visible in the principal spiral, 1.8–2.2 mm long and wide; tepals granular; lateral tepals 1.0–1.4 mm wide, inner margins broadly rounded on inner margins, 2-sided on outer margins. Berries not seen.

Eponymy:—The species is named in honor of Costa Rican botanist Daniel Solano, who along with Alejandro De Sedas collected the type specimen.

Distribution:—*Anthurium solanoi* is endemic to Panama, known only from Bocas del Toro, Panama.

Habitat and Ecology:—According to the classification of life zones proposed by Holdridge *et al.* (1971), *Anthurium solanoi* grows in a *Lower montane rain forest* life zone, at 1452 m. According to label information of the holotype, this species grows in the forest edges dominated by emergent trees of *Ficus crassiuscula* Warburg ex Standley (1917: 12), *Cedrela tonduzii* Casimir de Candolle (1905: 427), *Ulmus mexicana* Planchon (1873: 156) and *Quercus* Linnaeus (1753: 994).

Phenology:—April. Further investigations are required to determine exact flowering and fruiting time.

Conservation status:—According IUCN Red List criteria (IUCN 2001), *Anthurium solanoi* should be listed as Data Deficient (DD).

Discussion:—*Anthurium solanoi* could be confused with *A. curvispadix*, but the latter species has leaf blades ovate-triangular to broadly ovate which lack any dark punctations on the lower surface (vs. narrowly ovate-sagittate blades densely and minutely dark-speckled and weakly moderately densely dark-dotted on the lower surface), sinus hippocrepiform (vs. spatulate sinus), inflorescences with longer spathes (13–24 cm long) versus spathes shorter (9.3 cm long) and cream-colored spadix (vs. red spadix).

In the **Lucid Anthurium Key** (Haigh *et al.* 2009) *A. solanoi* tracks to *A. delannayi* Croat (in Croat *et al.* 2010: 77), differing by having narrower leaf blades, 1.9–2.6 times longer than broad, dark brown-drying with a narrower sinus (vs. broader leaf blades, to 1.8 times longer than broad, drying dark gray-brown with a spatulate sinus) and inflorescences with whitish spadix (vs. reddish spadix); to *A. esmeraldense* Sodiro (1905: 337), differing by its much broader 10–19 × 4–6 cm spathe (versus narrower 9.3 × 1.7 cm spathe) and white spadix (vs. red spadix); to *A. fusiforme*, differing by its prominently fusiform (vs. cylindroid-tapered) and shorter 6–9 cm long spadix (versus spadix longer 14 cm long); *A. kamemotoanum*, differing by having a broad 6.5–8.0 × 4–5 cm reddish spathe (versus narrower 9.3 × 1.7 cm green spathe); to *A. limonense* Grayum (1997: 32), differing by having grayish drying blades with a short peduncle, to 7.5 cm long (vs. drying dark gray-brown blades with peduncle longer, to 82.5 cm long); to *A. recavum* Croat (in Croat *et al.* 2010: 99), differing by its very prominently quilted primary lateral veins, shorter 19–40 cm long peduncle (versus peduncles longer, 82.5 cm long) and purplish spathe (vs. green spathe); to *A. sanctifidense*, differing by its much paler brown-drying leaf blades (vs. drying dark gray-brown blades), shorter 7–36 cm long peduncle (versus peduncle longer



FIGURE 6. *Anthurium solanoi* Croat & O. Ortiz. Holotype specimen: Panama. Bocas del Toro: Changuinola. PILA, márgenes de la quebrada Yobo, afluente del río Urí, 1452 m, 9°03'25"N, 82°42'23"W, 16 abril 2008, Daniel Solano & Alejandro De Sedas 5381 (Photo MO Herbarium).

82.5 cm long) and a more nearly cylindroid creamy-white spadix (vs. cylindroid-tapered reddish spadix) and to *A. yarumalense* Engler (1898: 441), differing by its parabolic sinus (vs. sinus spatulate) and the peduncle shorter than the petioles.

***Anthurium suffusum* Croat & O.Ortiz, sp. nov. (Figs. 7–8)**

Species characterized by its terrestrial habit, short internodes, persisting semi-intact brownish red cataphylls, completely terete petioles, ovate-sagittate brownish green-drying prominently acuminate blades with a parabolic sinus, 5–6 pairs of basal veins, the 1st and sometimes 2nd pair free to the base, a curved posterior rib which is naked throughout most of its length, 5 pairs of primary lateral veins, collective veins usually from the 1st pair of basal veins as well as by a short-pedunculate inflorescence with a white, somewhat hooded spathe with a lavender band along both margins inside as well as by a cylindroid cream-colored spadix.

Type:—PANAMÁ. Provincia de Panamá: Cerro Jefe, carretera hacia los Altos de Pacora, 700 m, 9°13'N, 79°21'W, 16 Mayo 2013, Orlando O. Ortiz, Laurencio Martínez, Alvin Zapata & Samuel Valdés 2399 (holotype, PMA!; isotype, MO!).

Terrestrial herb; **internodes** short, to 3 cm diam.; **cataphylls** 8–10 cm long, persisting semi-intact, brownish red; **petioles** 47 cm long, 7 mm diam., totally terete, lacking sulcus or ribs; **geniculum** 2 cm long; **blades** ovate-sagittate, 45 × 30 cm, 1.5 times longer than wide, 0.95 times as long as petioles, acute to narrowly rounded and abruptly long-acuminate at apex, deeply lobed at base, subcoriaceous, semiglossy on both surfaces, drying brownish green on both surfaces, drying weakly glossy above, semiglossy below; **anterior lobe** 27–35.5 cm long, broadly convex in lower ½ of blade, concave or straight toward the apex; **posterior lobes** 8.5–12.5 × 8.5–10.5 cm, narrowly rounded; **sinus** parabolic, 8.7 cm deep, 12 cm wide; **basal veins** 5–6 pairs, 1st pair free to the base, 2nd free to the base or sometimes fused 1 cm; 3rd pair fused to 2.2–3.5 cm; 4th & 5th fused 3.5–5.0 cm; **posterior rib** curved, naked 5.5 cm long; **midrib** prominently raised and triangular and concolorous above, round-raised and paler below, drying with an acute medial rib and 1–2 additional marginal ribs below; **primary lateral veins** 5 pairs, arising at 50° angle, weakly sunken above, drying narrowly rounded, weakly raised, concolorous above, acute and darker on the lower surface; **collective veins** 0.2–0.4 mm from the margin, arising from the 1st pair of basal veins but weakly loop-connected from the 2nd, 3rd and even 4th pairs of basal veins; tertiary veins prominulous, the reticulum close with areoles closely and clearly granular. **Inflorescence** short-pedunculate; **peduncle** 4.0 cm long, drying 4.0 mm diam.; **spathe** 9–10 × 2.5–3.5 cm, naviculiform, somewhat hooded spadix with the apex pointed laterally, matte, creamy white with the inner surface tinged with lavender along the margins, the outer surface pale green; **spadix** 6 cm long, 7 mm diam., cylindroid-fusiforme, cream-colored, matte; **flowers** 7–12 visible in the principal spiral, 7–8 in the alternate spiral, 1.8 × 2.3 mm. Berries not seen.

Eponymy:—The species epithet *suffusum* is from the Latin “*suffusus*” meaning “tinged” referring to the second color tinged along the margins of the inside of the spathe.

Distribution:—*Anthurium suffusum* is endemic to Panama, known only from Cerro Jefe in Panamá Province.

Habitat and Ecology:—This species grows at 700 m in a *Premontane rain forest* life zone according to Holdridge *et al.* (1971).

Phenology:—Found in flower in May. Further investigations are required to determine the exact phenology.

Conservation status:—*Anthurium suffusum* should be listed as Data Deficient (DD) according IUCN Red List criteria (IUCN 2001).

Discussion:—*Anthurium suffusum* could be confused with *A. formosum* and *A. sanctifidense*, all of which have similar leaf blades and spadix shape. *Anthurium formosum* also differs by petioles subterete, sulcate adaxially (vs. petioles totally terete, lacking sulcus), white or violet spathes (vs. spathes creamy white with the inner surface tinged with lavender along the margins) and violet-purple spadix at anthesis (vs. spadix cream-colored); *A. sanctifidense* differs by having blades drying dark brown with short pale-lines in the upper surfaces (vs. blades drying brownish green and lacking short pale-lines in the upper surfaces), longer (7.0–36.0 cm long) peduncles (versus peduncles shorter 4.0 cm long) and totally pale green to greenish white or white spathes (vs. spathes creamy white tinged with lavender).

In the **Lucid *Anthurium* key** (Haigh *et al.* 2009) *A. suffusum* tracks to *A. buganum* Engler (1898: 425), which differs by having all the basal veins free to the base (vs. not all basal veins free to the base, only first or second pairs of basal veins free) and the sinus much narrower; to *A. fusiforme* Croat (1986: 102), differing by its fusiform spadix (vs. spadix cylindroid-fusiforme) and collective veins arising from the primary lateral veins (vs. collective veins arising from the first pair of basal veins); to *A. hoffmannii*, differing by having a pinkish or greenish yellow spadix (vs. spadix cream-colored) and with the upper surface densely paler short-lineate (vs. upper surface lacking pale short-lines) and



FIGURE 7. *Anthurium suffusum* Croat & O. Ortiz. Holotype specimen: Panama. Provincia de Panamá: Cerro Jefe, carretera hacia los Altos de Pacora, 700 m, 9°13'N, 79°21'W, 16 mayo 2013, Orlando O. Ortiz, Laurencio Martínez, Alvin Zapata & Samuel Valdés 2399 (Photo MO Herbarium).

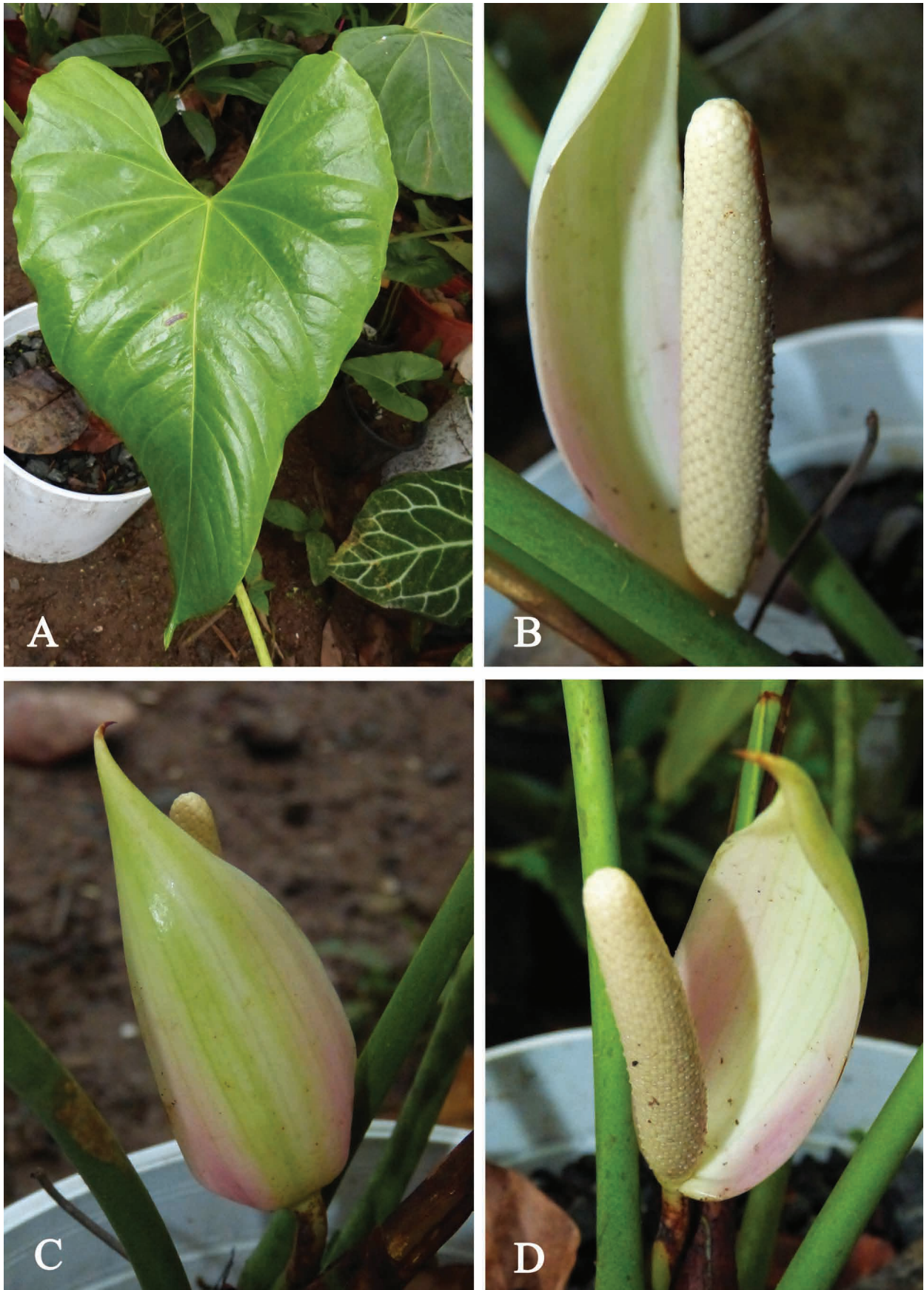


FIGURE 8. *Anthurium suffusum* (Ortiz, Martínez, Zapata & Valdés 2399). A. Leaf blades. B. Flowering spadix. C. Spathe (outer surface). D. Spathe (inner surface) (Photo Orlando O. Ortiz).

to *A. obtusilobum*, differing by having blades which are conspicuously short-pale lineate on the upper surface and have the collective veins arising from the lower basal veins (vs. collective veins arising from the first pair of basal veins).

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