Botanical Sciences 104 (1): 295-302. 2026
DOI: 10.17129/botsci.3782

Received: August 4, 2025, Accepted: November 1, 2025
On line first: December 9, 2025

Taxonomy and Floristics / Taxonomía y Florística

Increasing the diversity of "black-spathed" *Anthurium* (Araceae) in Central America: *Anthurium paradoxum*, a taxonomic novelty from Panama

Orlando O. Ortiz[1,2,3*], Marco Cedeño-Fonseca[1,4,5], Luis Cedeño-Medina[6]

[1] Botanischer Garten und Botanisches Museum Berlin, Freie Universität Berlin, Berlin, Germany.
[2] Universidad de Panamá, Herbario PMA, Estafeta Universitaria, Panama City, Panama.
[3] Coiba Scientific Station (COIBA AIP), Clayton, Ciudad del Saber, Panama.
[4] Centro de Investigación Jardín Botánico Lankester, Universidad de Costa Rica, Cartago, Costa Rica.
[5] Research Associate, Herbario Luis Fournier Origgi (USJ), Centro de Investigación en Biodiversidad y Ecología Tropical, Universidad de Costa Rica, San José, Costa Rica.
[6] Universidad de Panamá, Departamento de Botánica, Facultad de Ciencias Naturales, Exactas y Tecnología, Panama City, Panama.
*Corresponding author: ortizopma@gmail.com

Abstract

Background: *Anthurium* is the largest genus within Araceae, notorious for its diverse spathe coloration, which plays a key role in taxonomy and horticulture. Dark purple to black spathed species are uncommon and highly valued but remain understudied, particularly in Central America.
Question: Does the morphologically distinct population of *Anthurium* from the Ngäbe-Buglé region of Panama represent an undescribed species and how does it differ from other closely morphologically related taxa within the genus?
Studied species: *Anthurium*, *Anthurium paradoxum*.
Study site and dates: Comarca Ngäbe-Buglé, Panama, January and February 2023.
Methods: We prepared herbarium specimens from natural populations and morphological measurements were taken from living plants and herbarium specimens.
Results: We describe *Anthurium paradoxum* O. Ortiz & M. Cedeño, a new species from the humid lowland forests of Panama, distinguished by its deflexed spadices and striking black-purple spathes. Known only from a single locality on the Caribbean slope, this species occupies secondary forest habitat threatened by ongoing degradation and fragmentation.
Conclusions: Given its highly restricted distribution and continuing habitat loss, we classify *A. paradoxum* as Critically Endangered, according to the IUCN Red List Categories and Criteria. This discovery highlights the critical need for continued taxonomic research and conservation efforts in Neotropical ecosystems.
Keywords: Araceae diversity, conservation, Neotropical flora, taxonomy, tropical lowland forests.

Resumen

Antecedentes: *Anthurium* es el género más diverso dentro de Araceae y se caracteriza por la variabilidad en la coloración de sus espatas, un rasgo clave en su taxonomía y valor ornamental. Las especies con espatas de color púrpura oscuro a negro son poco comunes y altamente valoradas, pero han sido escasamente estudiadas, especialmente en Centroamérica.
Pregunta: ¿La población morfológicamente distintiva de *Anthurium* en la región Ngöbe-Buglé de Panamá representa una especie no descrita y en qué se diferencia de otros taxones morfológicamente relacionados dentro del género?
Especies de estudio: *Anthurium*, *Anthurium paradoxum*.
Sitio y años de estudio: Comarca Ngöbe-Buglé, Panamá, enero y febrero de 2023.
Métodos: Se recolectaron ejemplares de herbario de poblaciones naturales y se realizaron mediciones morfológicas tanto en plantas vivas como en ejemplares de herbario.
Resultados: Se describe *Anthurium paradoxum* O. Ortiz & M. Cedeño, una especie nueva proveniente de los bosques húmedos de tierras bajas del Caribe panameño, distinguida por sus espádices reflejos y espatas de un llamativo color púrpura-negruzco. Es conocida únicamente de la localidad tipo en la vertiente caribeña, donde habita en bosques secundarios amenazados por procesos continuos de degradación y fragmentación.
Conclusiones: Debido a su distribución extremadamente restringida y la pérdida continua de hábitat, clasificamos a *A. paradoxum* como en Peligro Crítico, según las categorías y criterios de la Lista Roja de la UICN. Este hallazgo resalta la urgencia de continuar con investigaciones taxonómicas y acciones de conservación en los ecosistemas neotropicales.
Palabras clave: Bosques tropicales de tierras bajas, conservación, diversidad de Araceae, flora neotropical, taxonomía.

Anthurium Schott, the largest genus in the family Araceae, comprises 1,319 species distributed throughout the Neotropics, with the highest diversity found in Central and South America (Croat 1983, Boyce *et al.* 2025). Despite its widespread horticultural use, attributed to its striking foliage and showy spathes, *Anthurium* remains taxonomically complex and underexplored, particularly in montane and tropical forest ecosystems. This complexity arises from high levels of morphological plasticity and cryptic diversity, which complicate species delimitation and classification efforts (Ortiz *et al.* 2018, Croat & Ortiz 2020).

Among the morphological traits of *Anthurium*, spathe coloration stands out as both visually distinctive and taxonomically informative. Naturally occurring colors range from green and white to vibrant shades of red, pink, purple, and nearly black (Croat 1983, 1986, 1991, Coelho & Gonçalves 2009). This phenotypic diversity is driven by a combination of genetic, biochemical, and environmental factors, notably those regulating anthocyanin and flavonoid biosynthesis (Osorio-Guarín *et al.* 2021). In natural systems, spathe coloration may influence pollinator attraction (Méndez-Urbano *et al*. 2022), while in cultivation, extensive hybridization and selection have expanded the color variation considerably (Kamemoto & Kuehnle 1996).

Dark purple to black spathes, although relatively rare, are particularly striking and have high horticultural value (Croat 2014). This color is present sporadically across multiple sections, including *Belolonchium* (Schott) Engl., *Calomystrium* (Schott) Engl., *Pachyneurium* (Schott) Engl., and *Porphyrochitonium* (Schott) Engl., and is primarily associated with humid montane and lowland forests in Central and South America (Croat 2014). Due to its rarity, black-spathed *Anthurium* species are frequently targeted for ornamental trade and illegal collection, highlighting the urgency of their formal documentation and conservation (Ortiz *et al.* 2024).

In Central America, black-spathed *Anthurium* species form an ecologically and taxonomically intriguing group, mainly confined to the humid tropical and cloud forests of Costa Rica and Panama. In this area, species with dark spathes are found primarily within section *Pachyneurium* (Croat 1991). Additional Central American species, including *Anthurium lentii* Croat & R.A.Baker (section *Melastomifolia* Sodiro; Hay 2024), *A. hayanum* O.Ortiz & M.Cedeño (section *Calomystrium*), and members of section *Porphyrochitonium*, also exhibit black-purple spathe pigmentation; however, their distribution and morphological variation remain poorly documented due to sparse collections and limited taxonomic resolution (Croat 1983, 1986, 2014, Croat & Sheffer 1983, Sierra-Giraldo & Duque-Castrillón 2014, Croat *et al.* 2022, Méndez-Urbano *et al.* 2022).

During recent botanical surveys in the tropical lowland forests of Panama, we discovered a previously undocumented, very unusual *Anthurium* species with deflexed spadices and outstanding black-purple, also deflexed spathes, *A. paradoxum* sp nov. This new taxon was collected in the understory of humid forests on the Caribbean slope at ca. 100 m elevation, growing terrestrially in disturbed forests. Morphologically, it does not match any known species within *Anthurium* and extensive comparisons with herbarium specimens and existing taxonomic treatments support its recognition as a novel species.

Material and methods

Field observations and morphological description. Field work was carried out between January and February 2023 in the Comarca Ngäbe-Buglé, Panama. To evaluate the morphological affinities of taxa related to the newly described species, we employed the Lucid *Anthurium* key, a digital multi-access identification tool (Haigh *et al.* 2009). This key encompasses most of the described *Anthurium* species, each characterized by a comprehensive set of diagnostic morphological traits. Its interactive design facilitates the assessment of morphological relationships by allowing users to filter taxa based on a broad array of character states, including geographic distribution, elevation range, and vegetative and reproductive features (Ortiz *et al.* 2020). Species descriptions for the newly identified taxa were prepared following the taxonomic and descriptive guidelines established by Croat & Bunting (1979), ensuring consistency and rigor in the documentation of morphological characters.

Herbarium and specimen examination. Herbarium specimens of *Anthurium* collected from various regions of Central America were examined as part of this study. These specimens are housed in the following herbaria: AGUAT, BIGU, CHIP, CR, CSAT, ENCB, HEM, HNMN, INB, ITIC, LAGU, MEXU, MHES, MO, PMA, SCZ, TEFH, UCH, UJUAT, USCG, USJ, and XAL. The acronyms used for all herbaria cited conform to the standardized nomenclature provided by Thiers (2025).

Conservation assessment. The conservation status of each newly described species was assessed following the criteria outlined by the International Union for Conservation of Nature (IUCN 2018). The area of occupancy (AOO) was calculated using the GeoCAT tool (Bachman *et al.* 2011),

Results

Anthurium paradoxum O. Ortiz & M. Cedeño sp. nov. (Figures 1, 2)

Type. Panamá. Comarca Ngäbe-Buglé: Raizal, Comunidad de Chucara, 133 m, 13 Jan 2023, *L. Cedeño* 618 (Holotype: PMA; Isotype MO).

Diagnosis. Anthurium paradoxum differs from all other known *Anthurium* taxa with black-purple spathes by its terrestrial habit, short stems, intact chartaceous, deciduous cataphylls. The species is further distinguished by its ovate-cordate leaf blades, 1-3 pairs of primary lateral veins, and 4 pairs of basal veins (of which 1-2 are free to the base). The inflorescence comprises dark purple to black spathes and lilac spadices completely deflexed at female anthesis, bearing 4-5 flowers in the principal spiral, and 6 flowers in the alternate spiral.

Morphological description. Terrestrial; roots creamy white; stems short, up to 10 cm long; internodes green, short, 0.2-0.5 cm long, ca. 1 cm diam.; cataphylls 2.5-3 cm long, intact, reddish purple, unribbed, chartaceous, deciduous; prophylls 1-1.5 cm long, reddish, 2-ribbed, deciduous. Leaves with petioles 30-32 cm long, 3-4 mm diam., sulcate adaxially; geniculum 2.5 cm long, slightly darker than petiole; blades ovate-cordate, 20-25 × 12-15 cm, acuminate to caudate, 1.6 times longer than wide, 0.6-1.3 times as long as petiole, chartaceous, green and nearly matte above and matte below (when fresh), drying greenish on both surfaces; anterior lobe 18-20 cm long; posterior lobes 4-5 × 3.5-4 cm; sinus hippocrepiform to spathulate, 2 cm deep, 1.5 cm wide; midrib raised above, concolor but reddish-purple when immature stages of the leaf; primary lateral veins 1–3 pairs, slightly discolorous above, reddish-purple at immature stages of the leaf; tertiary veins conspicuous on both surfaces; collective veins arising from the first primary lateral veins; basal veins 4 pairs, 1-2 free to the base, concolor but reddish-purple when immature stages of the leaf; posterior ribs 1-2.5 cm long. Inflorescence erect; peduncle 28-30 cm long, terete, slightly ribbed, dark-purple at anthesis, green during development; spathe ovate, subcordate, deflexed, 4.5 × 2.8 cm, caudate, dark purple to black at female anthesis, brown purple at male anthesis, reddish during development; spadix sub-sessile, stipe 3 mm long, 3.5-4.0 cm long, 5 mm diam., cylindroid and weakly tapered at the apex, lilac at female anthesis, reddish at male anthesis; flowers 4-5 in the principal spiral, 6 flowers in the alternate spiral; lateral tepals ca. 1 mm wide; stamens yellow. Berries unknown.

Distribution and ecology. Anthurium paradoxum is endemic to Panama, known only from the type locality in Comarca Ngäbe-Buglé.

Phenology. Flowering in January and August.

Etymology. The specific epithet *paradoxum* is derived from the Latin *paradoxus*, meaning “unexpected,” “strange,” or “contrary to expectation.” It alludes to the unusual combination of morphological features exhibited by this spe-

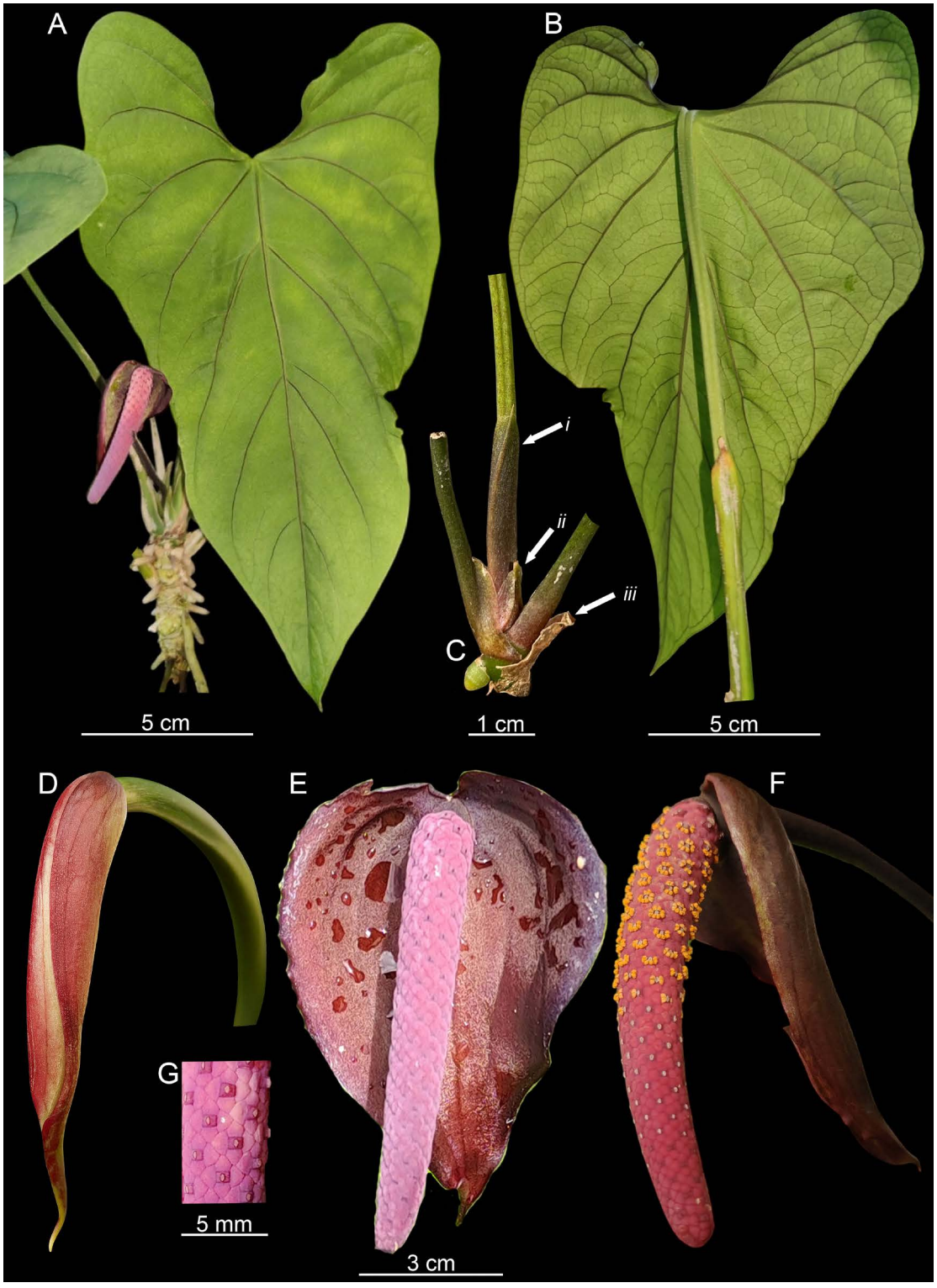

Figure 1. *Anthurium paradoxum*. A. Plant habit showing the stem, inflorescence, and adaxial leaf surface. B. Leaf blade (abaxial surface). C. Portion of the stem; (i) intact cataphyll, (ii) two-ribbed prophyll, (iii) marcescent prophyll. D. Developing inflorescence. E. Inflorescence at female anthesis. F. Inflorescence at male anthesis. G. Flowers at female anthesis A, B, D, F and G by Felipe Chong (Clonotype in cultivation). C by Zuellen Pineda (Clonotype in cultivation). E by Luis Cedeño from the holotype collection. Plate by M. Cedeño-Fonseca.

Figure 2. Habitat of *Anthurium paradoxum*, showing the plant *in situ*. A. Adult plant. B. Erect inflorescence with deflexed, dark purple to black spathe. C. Disturbed forest where *A. paradoxum* occurs naturally. All photographs by L. Cedeño-Medina, taken at the *locus classicus*.

cies (particularly the dark purple to nearly black, deflexed spathe), which diverges markedly from the typical floral traits commonly observed within the genus *Anthurium*.

Conservation status. Anthurium paradoxum is currently known only from a single locality on the Caribbean slope of Panama, where it inhabits the understory of a secondary forest subject to ongoing habitat degradation caused by small-scale agriculture, fragmentation, and limited natural regeneration (Figure 2). Given its highly restricted distribution, with an area of occupancy of 4 km², and the continued decline in habitat quality, we suggest that this species be classified as Critically Endangered [CR B2ab(iii)] following the IUCN Red List Categories and Criteria (IUCN 2012, 2025).

Discussion

Anthurium paradoxum is outstandingly distinguished from all other known species with purple to black spathes by its fully deflexed spathe and spadix (Figure 1). This condition is rare and documented in a few taxa, as *A. andraeanum* Linden ex André (including its cultivars) and *A. vanderknaapii* Croat, both members of section *Calomystrium*. However, *A. paradoxum* is distinguished from these species by its chartaceous, deciduous cataphylls (*vs.* persistent and intact), dark purple spathe (*vs.* reddish), and lilac spadices (*vs.* creamy-yellowish) (Figures 1, 2). Furthermore, within section *Calomystrium*, *A. paradoxum* bears some resemblance to *A. hayanum*, a species with dark-purple spathes, reduced posterior lobes and small size. However, *A. hayanum* is clearly distinguishable by its erect inflorescences, erect spathes, and yellowish-white spadices at anthesis, as opposed to the deflexed spathe and lilac spadix of *A. paradoxum*.

Morphologically, *A. paradoxum* aligns most closely with section *Cardiolonchium*, based on its terrestrial habit, short internodes, intact yellowish-green (dry), chartaceous, deciduous intact cataphylls, and cordate-sagittate leaf blades. Within this section, it shares leaf blade similarities with *A. debile* Croat & D.C.Bay and *A. dressleri* Croat, yet both differ markedly from *A. paradoxum* by their dark brown, marcescent cataphylls, ribbed petioles, green spathes, and yellowish-green spadices. Additionally, *A paradoxum* shares resemblances in habit, size, and general leaf morphology with *A. alvinii* Croat & O.Ortiz; however, the latter is readily distinguished by its erect, pinkish spathes, distinctly stipitate and creamy-white erect spadices, and persistent, fibrous cataphylls. The most relevant characters used to distinguish *A. paradoxum* from its morphological relatives within sections *Cardiolonchium* and *Calomystrium* are summarized in Table 1.

Superficially, *A. paradoxum* also resembles species of section *Pachyneurium*, particularly *A. watermaliense* L.H.Bailey & Nash and *A. ratonense* Croat & O.Ortiz, due to the presence of purplish-black spathes. Nevertheless, both species differ in having dark brown, marcescent cataphylls, purple or yellowish spadices at anthesis, and cordate-triangular sagittate leaves with notably longer posterior lobes.

Table 1. Comparison between *Anthurium paradoxum* and morphologically similar species from sections *Calomystrium* and *Cardiolonchium*.

Taxa	Characters				
	Spathe/spadix orientation	Spathe color at female anthesis	Spadix color at female anthesis	Cataphylls	Petioles
A. paradoxum	deflexed	dark purple	lilac	deciduous	smooth
A. andraeanum	deflexed	reddish	creamy-yellow	persistent	smooth
A. vanderknaapii	deflexed	reddish	creamy-yellow	persistent	smooth
A. hayanum	erect	dark purple	yellowish-white	persistent	smooth
A. debile	erect	greenish	yellowish-green	deciduous	ribbed
A. dressleri	erect	greenish	yellowish-green	deciduous	ribbed
A. alvinii	erect	pinkish	creamy white	persistent	smooth

Acknowledgements

We are deeply grateful to the curators of all the herbaria visited for their invaluable assistance and access to collections. We sincerely thank Felipe Chong and Zuellen Pineda for her valuable contribution in photographing the plant in cultivation.

Literature cited

Bachman S, Moat J, Hill AW, de la Torre J, Scott B. 2011. Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. *ZooKeys* **150**: 117-126. DOI: https://doi.org/10.3897/zookeys.150.2109

Boyce PC, Croat TB, Hay A. 2025. *The **Überlist** of Araceae: Totals for Published and Estimated Number of Species in Aroid Genera*. International Aroid Society. DOI: https://doi.org/10.13140/RG.2.2.24068.64646

Coelho MAN, Gonçalves EG. 2009. O gênero *Anthurium* (Araceae) no Estado do Rio de Janeiro, Brasil. *Rodriguésia* **60**: 801-818.

Croat TB. 1983. A Revision of the Genus *Anthurium* (Araceae) of Mexico and Central America: Part I: Mexico and Middle America. *Annals of the Missouri Botanical Garden* **70**: 211-420. DOI: https://doi.org/10.2307/2399049

Croat TB. 1986. A Revision of the Genus *Anthurium* (Araceae) of Mexico and Central America. Part II: Panama. *Monographs in Systematic Botany from the Missouri Botanical Garden* **14**: 1-204. DOI: https://doi.org/10.5962/bhl.title.102860

Croat TB. 1991. A Revision of *Anthurium* Section Pachyneurium (Araceae). *Annals of the Missouri Botanical Garden* **78**: 539-855. DOI: https://doi.org/10.2307/2399801

Croat TB. 2014. A review of *Anthurium* species with "black" spathes. *Aroideana* **37**: 95-104.

Croat TB, Bunting GS. 1979. Standardization of *Anthurium* descriptions. *Aroideana* **2**: 15-25.

Croat TB, Ortiz OO. 2020. Distribution of Araceae and the diversity of life forms. *Acta Societatis Botanicorum Poloniae* **89**: 8939. DOI: https://doi.org/10.5586/asbp.8939

Croat TB, Sheffer MB. 1983. The Sectional Classification of *Anthurium* (Araceae). *Aroideana* **6**: 85-123.

Croat TB, Grib JJ, Ortiz OO, Tsai J, Engineer C, Grace A. 2022. The current Status of *Anthurium* sect. *Porphyrochitonium* (Araceae) and allies, with many new species from Central and South America. *Aroideana* **45**: 48-436.

Haigh A, Mayo SJ, Croat TB, Reynolds L, Mora Pinto M, Boyce PC, Lay L, Bogner J, Clark B, Kostelac C, Hay A. 2009. Interactive web-taxonomy for the Araceae. *Blumea* **54**: 13-15. DOI: https://doi.org/10.3767/000651909X474032

Hay A. 2024. On the identities of the two *Anthurium latifolium* Sodiro (Araceae), and the correct name for *Anthurium* sect. *Digitinervia* (Sodiro) Engl. *Aroideana* **47**: 25-32.

IUCN [International Union for Conservation of Nature]. 2012. *IUCN Red List Categories and Criteria: Version 3.1*. Gland, Switzerland and Cambridge, UK: IUCN. ISBN: 978-2-8317-1435-6

IUCN [Red List Technical Working Group]. 2018. *Mapping standards and data quality for the IUCN Red List categories and criteria*. Version 1.16. Gland, Switzerland: IUCN. https://nc.iucnredlist.org/redlist/resources/files/1539098236-Mapping_Standards_Version_1.16_2018.pdf (accessed June 10, 2025)

IUCN [Standards and Petitions Committee]. 2024. *Guidelines for using the IUCN Red List categories and criteria*. Version 16. Gland, Switzerland: IUCN. https://www.iucnredlist.org/documents/RedListGuidelines.pdf (accessed June 10, 2025).

Kamemoto H, Kuehnle AR. 1996. *Breeding* Anthuriums *in Hawaii*. USA: University of Hawaii Press. ISBN: 978-0824816452.

Méndez-Urbano F, Sierra-Giraldo JA, Carlsen MM, Rodríguez-Rey GT, Castaño-Rubiano N. 2022. *Anthurium caldasii*: a new species of Araceae from Colombia and its phylogenetic relationships with other black-spathed *Anthurium* species. *Brittonia* **74**: 419-435. DOI: https://doi.org/10.1007/s12228-022-09722-y

Ortiz OO, Cedeño-Fonseca M, Esteban Jiménez J, Hughes JM. 2024. The pendent species of *Anthurium* sect. *Por-*

phyrochitonium from Costa Rica and Panama: synopsis, nomenclatural notes, new species, and conservation status. *Webbia* **79**: 311-350. DOI: https://doi.org/10.36253/jopt-16289

Ortiz OO, Croat TB, Baldini RM. 2018. Current status of aroid species diversity in Panama, including new records for the country. *Webbia* **73**: 141-153. DOI: https://doi.org/10.1080/00837792.2018.1452451

Ortiz OO, Croat TB, Hormell R, Cedeño-Fonseca M. 2020. Advances towards the completion of the *Anthurium* Flora of Central America (Araceae, *Pothoideae*): Contribution of thirty-one new species from Guatemala, Costa Rica and Panama. *Phytotaxa* **467**: 1-61. DOI: https://doi.org/10.11646/phytotaxa.467.1.1

Osorio-Guarín JA, Gopaulchan D, Quackenbush C, Lennon AM, Umaharan P, Cornejo OE. 2021. Comparative transcriptomic analysis reveals key components controlling spathe colour in *Anthurium andraeanum* (Hort.). *Plos One* **16**: e0261364. DOI: https://doi.org/10.1371/journal.pone.0261364

Sierra-Giraldo JA, Duque-Castrillón CA. 2014. Ampliación del área de distribución de *Anthurium atramentarium* Croat & Oberle (Araceae) en Colombia y comentarios sobre las especies de *Anthurium* de espata negra. *Biota Colombiana* **15**: 115-117.

Thiers BM. 2025. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden. https://sweetgum.nybg.org/science/ih/ (accessed June 10, 2025)

Associate editor: Gilberto Ocampo

Author contributions: All authors contributed to and accepted the final manuscript. OOO, conceptualization, field work, data curation, methodology, writing - original draft, writing - review, and editing; MCF, writing - original draft, methodology, writing - review, and editing. LCM, writing - original draft, field work, methodology.

Supporting Agencies: Deutscher Akademischer Austauschdienst (DAAD) Research Grants – Doctoral Programmes in Germany (No. 57507871); Gijs Lamers and Eli Dreyer from the Amazon Garden Thailand plant nursery; Institute for Training and Development of Human Resources (IFARHU); National Secretariat for Science, Technology and Innovation (SENACYT) (Project No. APY-NI-2022-09); Universidad de Costa Rica, Vicerrectoría de Investigación, Centro de Investigación Jardín Botánico Lankester (Project No. C2067).

Conflict of interests: The authors declare that there is no conflict of interest, financial or personal, in the information, presentation of data and results of this article