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TWO NEW REMARKABLE *DENDROPANAX* (ARALIACEAE) FROM COSTA RICA

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Abstract. Morales, J. F. 2022. Two new remarkable *Dendropanax* (Araliaceae) from Costa Rica. *Darwiniana*, nueva serie 10(2): 417-428.

Two new species of *Dendropanax* (Araliaceae) endemic to Costa Rica are described. *Dendropanax aberrans* J.F. Morales resembles *D. grandiflorus* but differs by the inflorescence structure (panicle of umbels vs. single umbel), and the smaller sizes of both the hypanthium and the petals. *Dendropanax zarratu* J.F. Morales is unique among Central America and West Indian taxa. It is recognized by its panicle of umbels, with the peduncles agglomerate, flowers 8-9-merous, hypanthium 7-8 mm long, and fruits 1.2-1.4 cm long. Illustrations of the new species and a key to the four *Dendropanax* having elongated hypanthia (≥ 4 mm long) in Mexico, Central America, the West Indies, and Colombia are provided.

Keywords. Apiales; Central America; Mesoamerica; Monteverde; Tarrazú; taxonomy.

Resumen. Morales, J. F. 2022. Dos singulares especies nuevas de *Dendropanax* (Araliaceae) de Costa Rica. *Darwiniana*, nueva serie 10(2): 417-428.

Se describen dos nuevas especies de *Dendropanax* (Araliaceae) endémicas de Costa Rica. *Dendropanax aberrans* J.F. Morales se parece a *D. grandiflorus* pero difiere por la estructura de la inflorescencia (panícula de umbelas vs. umbela simple), hipantio y pétalos más pequeños. *Dendropanax zarratu* J.F. Morales se reconoce por sus panículas de umbelas, con los pedúnculos aglomerados, flores 8-9-meras, hipantio 7-8 mm de largo y frutos de 1,2-1,4 cm de largo. Se proveen ilustraciones y una clave parta las cuatro especies de *Dendropanax* con hipantio elongado (≥ 4 mm long) en México, Centro América, el Caribe y Colombia.

Palabras clave. Apiales; Centroamérica; Mesoamérica; Monteverde; Tarrazú; taxonomía.

INTRODUCTION

In Costa Rica, Araliaceae has about 56 species, with *Dendropanax* and *Oreopanax* the most diverse genera, having 19 and 15 taxa respectively (Morales et al., 2020). *Dendropanax* Decne & Planch. comprises an uncertain number of species (estimated between 50 to 100) distributed in tropical and subtropical regions of Asia and the neotropics (Zimmermann & Morales, 2001; Fiaschi, 2005, 2016; Morales et al., 2020; Morales & Idárraga, 2022). Central America and Jamaica are remarkably diverse, with many endemic species (Idárraga et al., 2015). The genus is represented by small shrubs, treelets, and emergent canopy trees, glabrous, with short and inconspicuous stipules, usually small and poorly branched inflorescences (umbels are simple or arranged in single branched

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inflorescences), and with mature fruits usually less than 1 cm long, and can be found growing from sea level up to 3200 m a.s.l.

In the neotropics, the taxonomy of *Dendropanax* has been chaotic due to the presence of andromonoecious sexual systems, high levels of phenotypic plasticity in some taxa, and the lack of a comprehensive synopsis or monograph. Few regional treatments are available, and of these, most are outdated with discordant synonymies (e.g., Smith, 1944; Cannon & Cannon, 1989). The most significant issues are the presence of andromonoecious inflorescences and the lack of detailed studies documenting this feature. Morales et al. (2020) provided a provisional description of this character for the Costa Rican species, but further studies across the neotropics are necessary.

Morales & Idárraga (2022) cited several helpful characters to separate species in the genus, including the number of floral parts (e.g., sepals, petals, locules), the number of styles in fruits, and the shape and length of the stylar column. Additional characters that could be helpful include the shape and size of primary bracts and bracteoles along the pedicles. Morales & Idárraga (2022) provided a circumscription of *D. arboreus* (L.) Decne. & Planch. based on type specimens and material from the Caribbean. As currently circumscribed, *D. arboreus* is also found along the Caribbean coast of Central America, from sea level up to middle elevations (less than 600 m a.s.l.). The taxonomic status of all the synonyms of *D. arboreus* and current distribution in Central and South America will be elucidated in a subsequent paper.

In *Dendropanax*, the hypanthium of flowering specimens is usually very short (less than 3 mm in length). In Mexico, Central America, the Caribbean, and Colombia, only *D. grandiflorus* Britton (endemic to Jamaica) and *D. macrocarpus* Cuatrec. (Colombia to Ecuador) have a hypanthium exceeding this length (4-8 mm) (Smith, 1944; Cuatrecasas, 1946). In Costa Rica, *Dendropanax* is highly diverse, growing from sea level to 2900 m a.s.l. in most forested habitats across the country (the notable exception are dry forests). Standley (1938) accepted only four species for Costa Rica (under *Gilibertia*). He reported that *D. arboreus* had been segregated into different species based "…in large part upon foliage characters", which had not been accepted by Smith (1944). Leaf characters are very variable within the genus and are typically useless for species recognition, except for a few species that have consistently deeply lobate leaves when mature (e.g., *D. latilobus* M.J. Cannon & Cannon). Morales et al. (2020) reported 19 species of *Dendropanax* for Costa Rica. Reviewing material for a revision of *Dendropanax* in Mexico, Central America, and the West Indies, an unusual species was identified from the Cordillera de Tilarán and Cordillera Central in Costa Rica. Previously identified as *D. arboreus*, it is characterized by having large hypanthia and fruits (up to 1.6 cm long), among other morphological features that distinguish this species from the circumscription of *D. arboreus* proposed by Morales & Idárraga (2022). A second species from an emergent canopy tree with a large hypanthia and 8-9-merous flowers, was collected from the Pacific watershed of the Cordillera de Talamanca in Los Santos region. These two taxa are remarkable because *Dendropanax* species with elongated hypanthia (more than 5 mm long) and big fruits (usually more than 10 mm long) are unusual and rare. Currently, around 35 species are known in Mexico, Central America, and the West Indies (Morales, in prep.), and only in three taxa, these characters are reported (these two new species and *D. grandiflorus* from Jamaica). Rivera-Diaz & Celis (2015) accepted 19 *Dendropanax* from Colombia, but only *D. macrocarpus* has the same type of characters described before. These two taxa from Costa Rica are described here, along with formal descriptions, illustrations, maps, and a list of specimens examined. Relationships with morphologically similar species are discussed. A key to the species with conspicuous hypanthia ($\geq$ 4 mm long) in Mexico, Central America, the Caribbean, and Colombia is provided.

MATERIALS AND METHODS

This paper is part of an ongoing revision of *Dendropanax* in Mexico, Central America, and the Caribbean. In the last two decades, type materials and additional specimens of all the Mexican,

Central American, and Caribbean taxa (including synonyms) of *Dendropanax* have been examined physically. Fieldwork has been completed over a 17-year period (2005 to 2022), providing an opportunity to record variation among *Dendropanax* taxa found in Honduras, El Salvador, Costa Rica, Panama, and Trinidad and Tobago. The following digital herbaria were consulted: JSTOR Global Plants (http://plants.jstor.org), MEXU (https://datosabiertos.unam.mx/biodiversidad/), and Tropicos (https://www.tropicos.org/Home.aspx). Descriptions were made based on herbarium specimens (CR, MO, USJ), rehydrated flowers, and fresh material. Data on geographic distributions and phenologies were retrieved from the collections available. The terminology for the morphological description follows Radford et al. (1974) and Stearn (2004). The parts of the inflorescence are described according to the model presented by Morales & Idárraga (2022), but with the following amends: the peduncle comprises from where the inflorescence is borne up to where the first pedicle is arising (Fig. 1Aa). Inflorescences with the pedicles arranged in fascicles or clusters may lack the main axis or peduncle. The main axis comprises from the point where the first pedicle is born up to the final fascicle of pedicels (Fig. 1Ab). The part of the inflorescence designated by Morales & Idárraga as "peduncle/secondary axis" must be described as "pedicles." (Fig. 1Ac). Regarding the description of a raceme vs. a fascicle (cluster) of umbels, a raceme includes at least one additional pedicle below the terminal whorl of pedicles with a visible peduncle, while in a fascicle or cluster, only the terminal whorl of pedicles is present and the peduncle, is inconspicuous or not present.

The two species described here, only showed hermaphrodite inflorescences, while in other species andromonoecious and hermaphrodite inflorescences are reported. In the descriptions and key, inflorescence refers to the entire structure. Herbaria acronyms are cited according to Thiers (2022, continuously updated). The map was made with DIVA-GIS, version 5.2 (Hijmans et al., 2005).

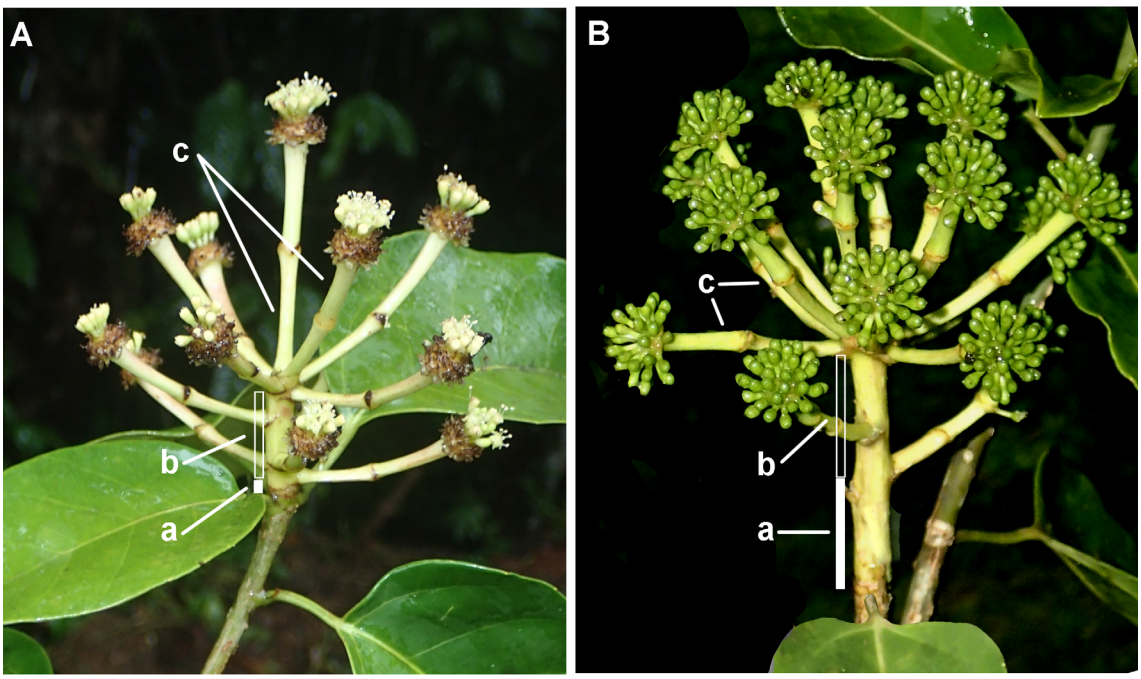

Fig. 1. Inflorescence structures in *Dendropanax.* **A,** *D. sessiliflorus* (Standl. & A.C. Sm.) A.C. Sm. **B,** *D.* sp. **a,** peduncle. **b**, main axis. **c**, pedicles. A from *Hammel & Morales 19893* (MO); B from *Morales 23212* (USJ). Color version at http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/1060/1268

RESULTS

Taxonomic treatment

Dendropanax aberrans J.F. Morales, **sp. nov**. TYPE: Costa Rica. Alajuela, Reserva Biológica Monteverde, río Peñas Blancas, 820 m, 23-III-1988 (fl), *W. Haber & E. Bello 8306* (holotype, CR! [135398]). Figs. 2, 3.

Diagnosis. *Dendropanax aberrans* resembles *D. grandiflorus* but differs by its inflorescence, which has fascicles of umbels (vs. in a single umbel), a hypanthium of 5-6 mm long (vs. 6-8 mm), and petals 1.9-2.2 mm long (vs. 6.5-8 mm).

Tree 3-30 m; branchlets slightly striate longitudinally when dry, lenticels not evident. Leaves alternate, spirally arranged, spaced in old stems and rarely grouped at the end of the branchlets, young leaves not lobed, stipules inconspicuous; petioles 1.7-4.5 cm, slightly canaliculate adaxially; leaf blades 6.5-15 × 3-6.5 cm, elliptic to elliptic-obovate, usually symmetric, the base cuneate to obtuse, the margin entire to obscurely crenate distally, not revolute, without punctations on the abaxial surface; apex acute, obtuse to rounded, tip acute to rounded; venation pinnate, without conspicuous suprabasal veins, eucamptodromous, looping close to the margin; midvein prominent abaxially, slightly visible adaxially; secondary veins 6-9 pairs, barely visible adaxially, impressed and visible abaxially; intersecondary veins present, sometimes inconspicuous; tertiary veins inconspicuous or conspicuously abaxially. Inflorescence a fascicle of umbels 4-6.5 cm long, usually terminal; peduncle absent or 0.3-0.6 cm when present, with inconspicuous bracts less than 1.3 mm long at the base of the pedicles; pedicles 3-9, terminal, densely agglomerate, 1-3.5(-4) cm, glabrous, straight or slightly arched, not articulated or geniculated, with 0-2 bracteoles 1-3 mm long, free, arranged more or less on the midpoint of the pedicle length; umbels few-flowered (with five or less flowers), with hermaphrodite flowers only; receptacle 4-6 mm in diameter, outer bracts ca. 1 mm long, broadly ovate, internal bracts (at the base of the pedicels) up to ca. 0.6 mm long, oblong; pedicels 3-10 mm long. Flowers 5-merous, hypanthium 5-6 mm long, more or less campanulate, sepals up to ca. 0.3 mm long, broadly ovate, petals 5, green, ovate, 1.9-2.2 × 1-1.3 mm, the apex somewhat thickened, but not cucullate; stamens 5; ovary 5-carpellate. Fruits globose to subglobose, green when immature, black, purplish-black to dark purple when mature, 1.2-1.6 × 1.2-1.7 cm, disc 4-5 mm in diameter, stylar column 1.1-1.6 mm long, conical, styles five, apically free, apices moderately reflexed, not covering the stylar column.

Etymology. The epithet "aberrans" refers to the unusual size of flowers and fruits, an uncommon character in *Dendropanax*.

Distribution and habitat. Endemic to Costa Rica, growing in tropical lowland forest, premontane, and montane forest along the Cordillera de Tilarán, Cordillera Central, and Cordillera de Talamanca, at 300-1400 m a.s.l.

Observations. Flowering in March and fruiting in February and October. In Mexico, Central America, and the West Indies, almost all species of *Dendropanax* have fruits that are commonly less than 1 cm long when mature and hypanthia less than 2.5 mm long at anthesis. Only *D. grandiflorus* (endemic to Jamaica) has flowers with hypanthia greater than 6 mm long and fruits greater than 10-12 mm long fruits. *Dendropanax aberrans* differs by its inflorescence of fascicles of umbels (vs. a single umbel), hypanthium 5-6 mm long (vs. 6-8 mm long), petals 1.9-2.2 mm long (vs. 6.5-8 mm long). *Dendropanax aberrans* has been identified in herbaria as *D. colombianus* Cuatrec., but it differs by the presence of hermaphrodite inflorescences only (vs. andromonoecious or hermaphrodite), flowers with hypanthia 5-6 mm long (vs. less than 1.5 mm long), and fruits 1.2-1.7 cm long (vs. 0.8-0.9 cm). This species was treated by Morales et al. (2020) as *Dendropanax* sp. D. *Dendropanax macrocarpus* is also similar to *D. aberrans*, but if differs by its hermaphrodite inflorescences with pedicles 1-5 mm long (vs. 10-35(-40) mm), many flowered inflorescences, with more than10 flowers (vs. few flowered with less than 5 flowers), and the presence of andromonoecious inflorescences (raceme of umbels) (vs. absent).

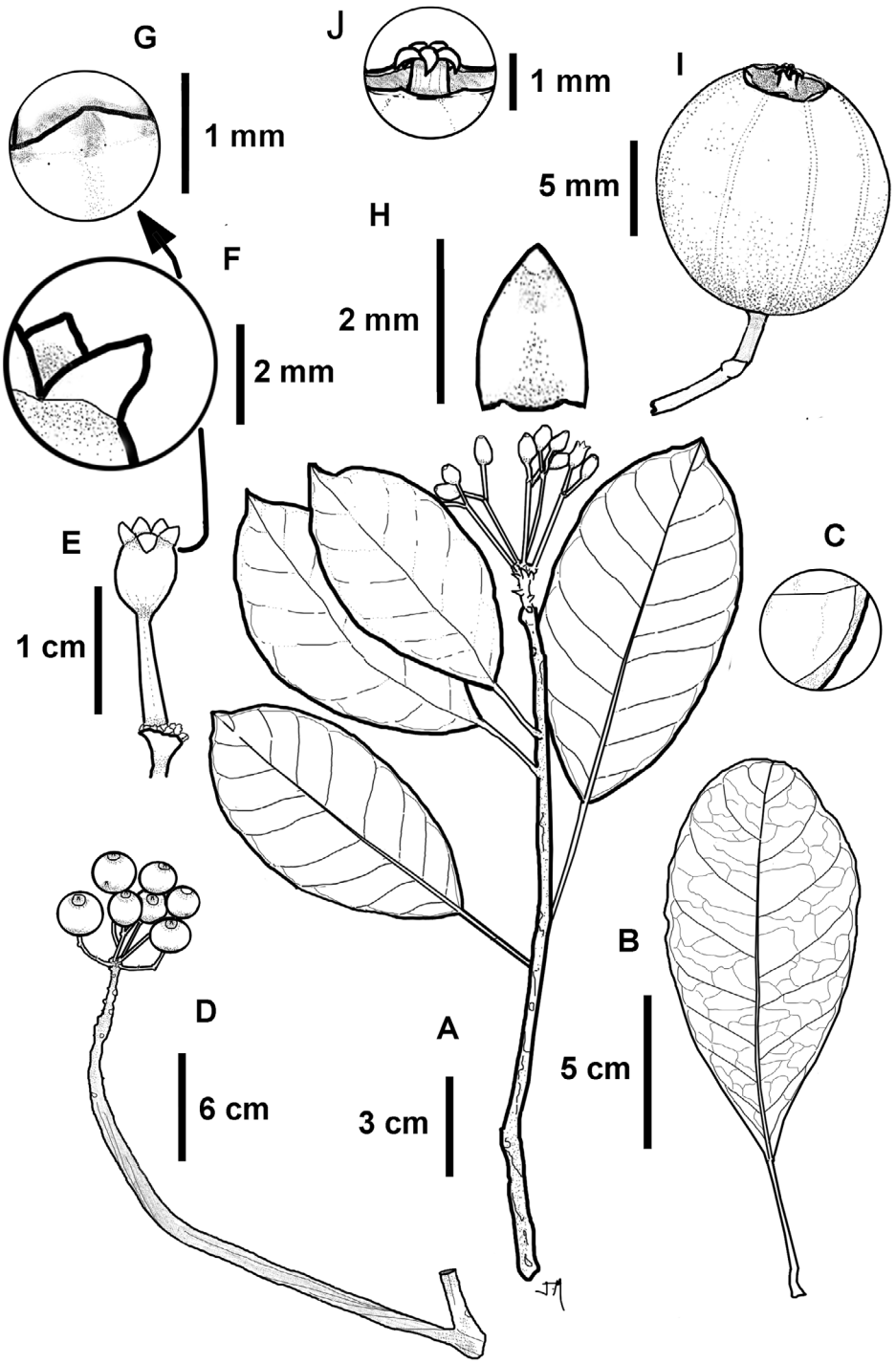

Fig. 2. *Dendropanax aberrans.* **A,** branch with inflorescence. **B,** abaxial surface of the leaf blade, showing the veins. **C,** detail of the marginal vein. **D,** branchlet with fruits. **E,** Flower. **F,** detail of petal and sepal. **G,** sepal. **H,** petal, adaxial view. **I,** fruit **J,** detail of the stylar column and styles. A-C, E-H from *Sánchez 433* (CR); D, I-J from *González 2061*(CR).

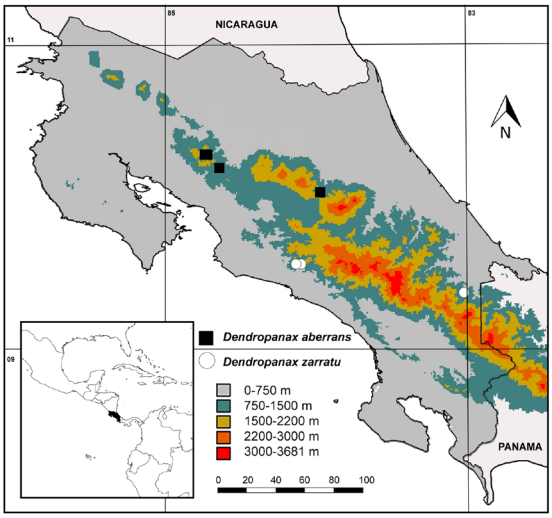

Fig. 3. Distribution map of *Dendropanax aberrans* and *D. zarratu***.** Color version at http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/1060/1268

Specimens examined.

COSTA RICA. **Alajuela**: Reserva Biológica de San Ramón, fila Cedral, 28-X-1997 (fr), *González 2061* (CR); Reserva Biológica Monteverde, río Peñas Blancas, finca Beto, 13-IX-1987 (fr), *Haber & Bello 7593* (CR, MEXU). **Heredia**: Parque Nacional Braulio Carrillo, La Montura, 14-III-1984 (fl), *Sánchez et al. 433* (CR).

Dendropanax zarratu J.F. Morales, **sp. nov**. TYPE: Costa Rica. San José, cantón de Tarrazú, cabeceras del río Negro, comenzando la bajada hacia Fila Chonta, casi junto a la cárcava del diablo, 9° 36' 15'' N 84° 06' 26'' W, 1379 m, 1-XI-1993 (fl), *J. F. Morales 21632* (holotype, USJ!). Figs. 3, 4, 5.

Diagnosis. *Dendropanax zarratu* resembles *D. aberrans, D. grandiflorus,* and *D. macrocarpus* by the size of flowers and fruits, but it is recognized by the following combination of characters: inflorescence a panicle of umbels, with the peduncles agglomerate, and flowers 8-9-merous.

Tree 6-20 m; branchlets slightly striate longitudinally when dry, lenticels not evident. Leaves alternate, spirally arranged, spaced in old stems and grouped at the end of the branchlets, young leaves not lobed, stipules inconspicuous; petioles 1-4.5 cm long, slightly canaliculate adaxially; leaf blades 12-14.9 × 4-6.5 cm, elliptic to elliptic-obovate, somewhat symmetric, the base cuneate to obtuse, the margin entire, not revolute, without punctations on the abaxial surface; apex acute, tip obtuse; venation pinnate, without conspicuous suprabasal veins, eucamptodromous, looping close to the margin; midvein prominent abaxially, slightly visible adaxially; secondary veins 6-10 pairs, barely visible adaxially, impressed and visible abaxially; intersecondary veins present, inconspicuous; tertiary veins inconspicuous or conspicuously abaxially. Inflorescence a panicle of umbels 6-10.5 cm long, terminal; peduncle 0.8-1.7 cm long, with inconspicuous bracts < 1.5 mm long; pedicles 8-14, of which 5-6 are terminal, agglomerate 1.6-4.6 cm long, glabrous, arched, not articulated or geniculated, usually without bracteoles or, if present, 1-2, free, attached ca. to the mid of the peduncle length, 1-1.6 mm long; umbels 3-5-flowered, with flowers hermaphroditic; receptacle 4-6 mm in diameter, outer bracts ca. 1 mm long, broadly ovate, inner bracts (at the base of the pedicels) 1.2-1.6 mm long, very narrowly ovate; pedicels 8-10 mm long. Flowers 8-9-merous, hypanthium 7-8 mm long, globose to subglobose, sepals 0.4-0.6 mm long, broadly ovate, petals 8-9, pale green, triangular-ovate to narrowly ovate, 4.5-6 × 1.3-1.5 mm, the apex thickened, appearing hooded (cucullate); stamens 8-9, ovary 8-9-carpellate. Fruits globose to subglobose, green when immature, greenish-yellow when mature, 1.2-1.4 × 1.5-1.7 cm, disc 4-5 mm in diameter, stylar column 1.1-1.2 mm long, conical, styles 8-9, apically free, apices firmly to moderately reflexed, covering the stylar column.

Etymology. The name zarratu is an anagram of the type locality Tarrazu.

Distribution and habitat. Endemic to Costa Rica, growing in tropical lowland forest, premontane, and montane forest in the Cordillera de Talamanca and Los Santos Region, at 300-1400 m a.s.l.

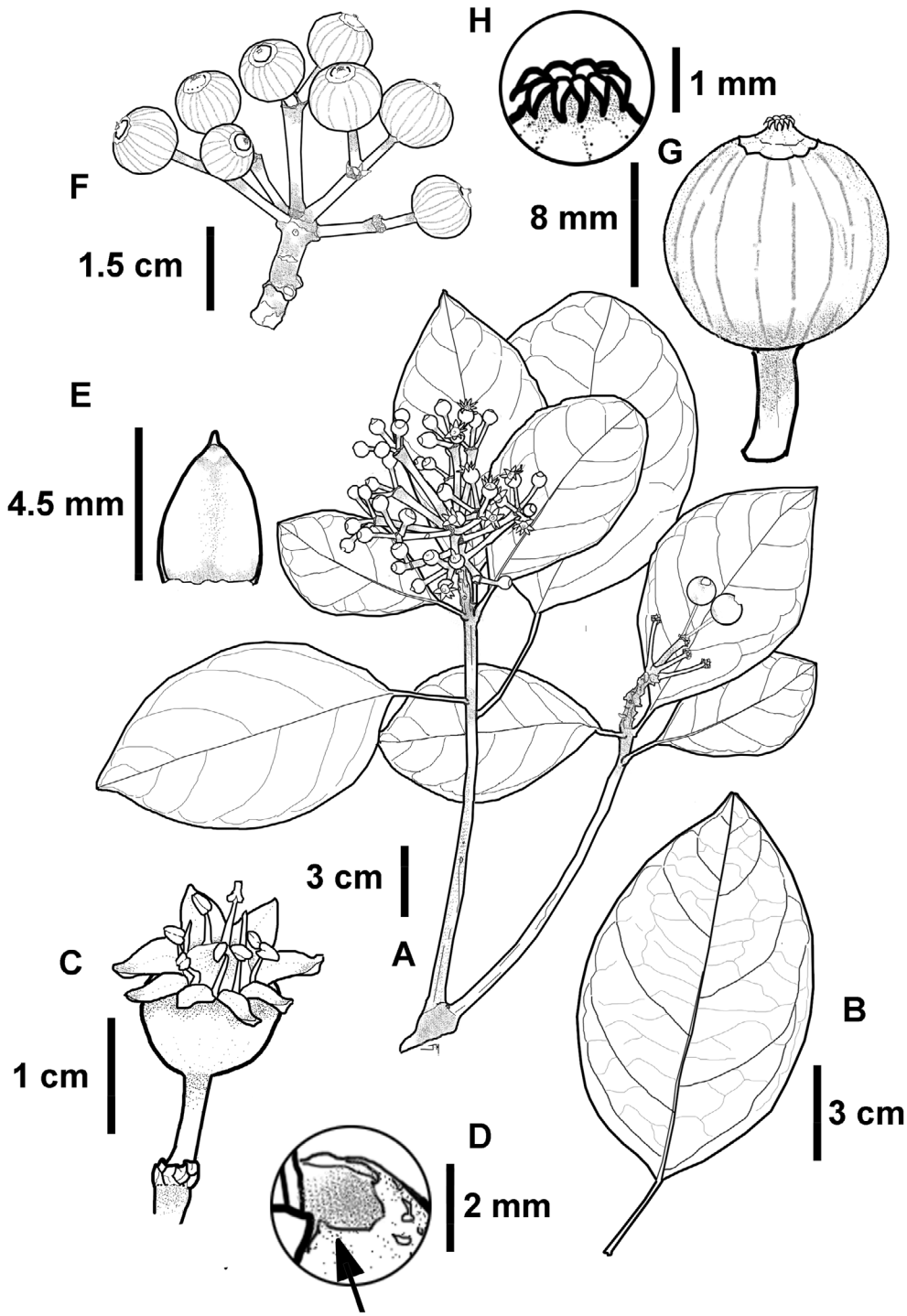

Fig. 4. *Dendropanax zarratu*. **A,** branch with inflorescence and two fruits. **B,** abaxial surface of the leaf blade, showing the veins. **C,** flower. **D,** details of the sepals. **E,** Petal, adaxial view. **F,** infrutescence. **G,** fruit. **H,** detail of the stylar column and styles. A-E from *Morales 21632* (USJ); F-H from *Morales et al. 13729* (USJ).

Observations. Flowering in November and December and fruiting in February. *Dendropanax zarratu* is unique among the Central American and West Indian species of *Dendropanax*. It is distinguished by its inflorescence, a panicle of umbels, with the peduncles agglomerate, 8-9-merous flowers, the hypanthium 7-8 mm long, and fruits 1.2-1.4 cm long. Around 35 species are known in Mexico, Central America, and the West Indies (Morales, in prep.), and large hypanthia are restricted to *Dendropanax aberrans* (Costa Rica) and *D. grandiflorus* (Jamaica). Rivera-Diaz & Celis (2015) reported 19 *Dendropanax* from Colombia, but only *D. macrocarpus* has the same type of characters described before. *Dendropanax zarratu* can be separated by its 8-9-merous flowers (vs. 5-merous). This species was treated by Morales et al. (2020) as *Dendropanax* sp. C.

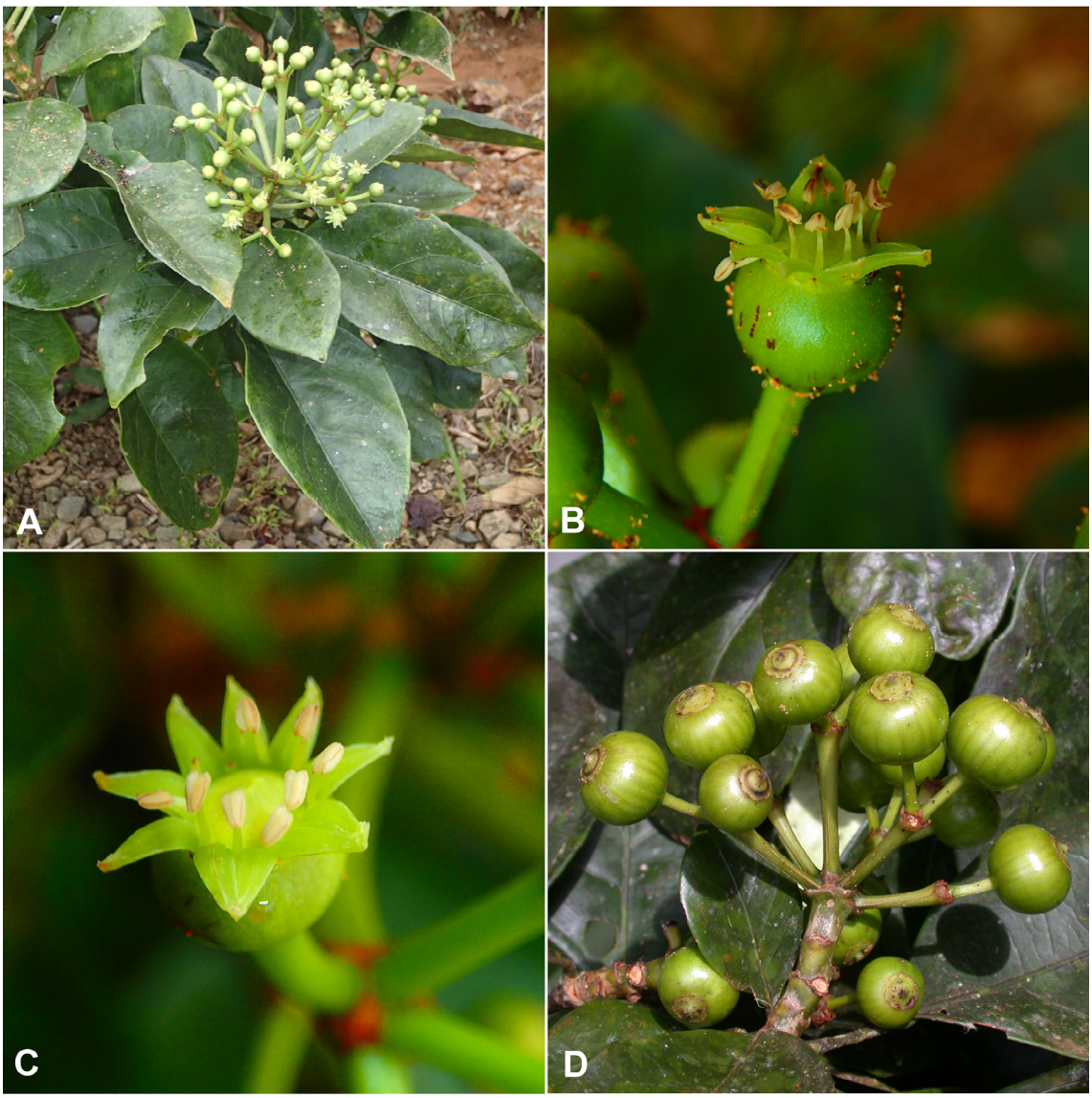

Fig. 5. *Dendropanax zarratu.* **A,** branch with inflorescence. **B,** flower, lateral view. **C,** flower, transversal view. **D,** fruits. A-C from *Morales 21632* (USJ); D from *Morales 13730* (CR). Color version at http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/1060/1268

Dendropanax zarratu is known from four collections, three of them collected in the Pacific slopes of the Cordillera of Talamanca, in "Los Santos" (Dota, León Cortez, and Tarrazú cantons). In the last decades, forests in this region, between 1000-1700 m a.s.l., have been strongly impacted and slowly destroyed by coffee plantations and paddocks for cattle (Cedeño et al., 2020; Jiménez & Jairo-Hidalgo, 2021). Los Santos and surrounding areas (Valle del Candelaria) are a diversity hotspot, with many narrowly endemic species described in the last two decades (e.g., Morales, 1997, 1999, 2003, 2006, 2007, 2008, 2018a, 2018b; Berrie, 2004; Estrada & Cascante, 2004; Gonzales & Morales, 2004; Rodríguez, 2004; Rodríguez & Morales, 2004; Hammel & Zamora, 2005; Hammel, 2006; Estrada & Santamaria, 2010; Kennedy & Hammel, 2011; Jiménez et al., 2016; Morales & Stevens, 2020; Cedeno et al., 2021; Jiménez & Mora-Hidalgo, 2021; Juárez & Morales, 2021). The Candelaria valley is highly deforested, with only a few remnants of disturbed forest remaining, but in some areas, a slow recolonization process has begun, mostly in abandoned pastures. However, in Los Santos, the destruction of small remnants around coffee plantations is very active nowadays. A critical example is *Pleurothyrium amissum* (Lauraceae) (Fig. 6A), for which the tree from which the type was made has been cut down for a new coffee plantation before the species had been described (Juárez & Morales, 2021). Additional threats include selective logging, suppression of forest areas for small-scale agriculture, erosion gullies resulting from forest destruction, and construction of small roads within private estates. Extensive gullies are encountered widely, accelerating the loss and destruction of forest fragments (Fig. 6B).

Specimens examined.

COSTA RICA. **Limón**: Cantón de Talamanca, Bratsi, Alto Lari, entre Surayo y Dapari, 50 m al S de la desembocadura del río Dapari junto al río Lari, 25-II-1992 (fr), *Aguilar & Schmidt 937* (CR, MO). **San José**: Tarrazú, inicio del camino a Fila Chonta, San Ramón, 1350 m, 17-II-2006 (fr), *Morales et al. 13729* (CR), *Morales et al. 13730* (CR).

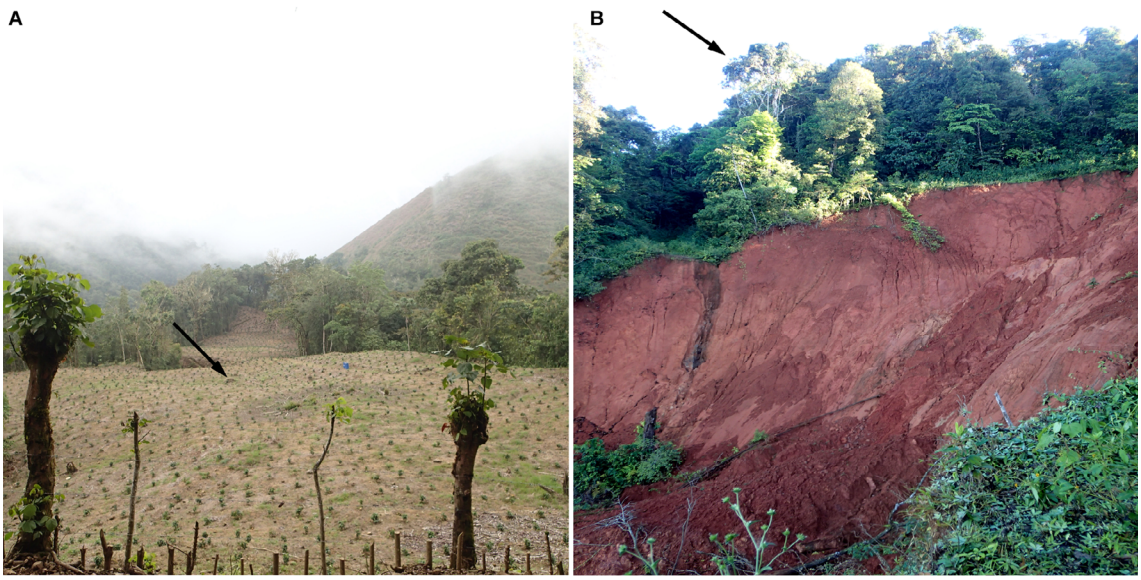

Fig. 6. Destruction of forest in Los Santos Region, Costa Rica. **A,** a coffee plantation in the type locality of *Pleurothyrium amissum* (Lauraceae), showing where the tree that was the source of the type specimen was growing (marked with an arrow) before the land was cleared. **B,** active guilly at the type locality of *D. zarratu* showing the tree that was the source of the type specimen (marked with an arrow). Color version at http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/1060/1268

Key to the species of *Dendropanax* with elongated hypanthium (4-8 mm long) in Mexico, Central America, the Caribbean, and Colombia

1. Inflorescences with > 20 flowers; flowers 8-9-merous ..... *D. zarratu*
1. Inflorescences with 1-9 flowers; flowers 5-6-merous 2
2(1). Leaf-blade obovate; hermaphrodite inflorescence a single umbel; hypanthium 6-8 mm long; petals 6.5-8 mm long; Jamaica ..... *D. grandiflorus*
2. Leaf-blade elliptic to elliptic-obovate; hermaphrodite inflorescence of fascicles of umbels; hypanthium 4-6 mm long; petals 1.9-2.3 mm long 3
3(2). Pedicles of hermaphrodite inflorescences 10-35(-40) mm long, with few-flowered umbels (≤ 5 flowers); andromonoecious inflorescences absent; Costa Rica …..... *D. aberrans*
3. Pedicles of hermaphrodite inflorescences 1-5 mm long, with many-flowered umbels (≥ 10 flowers); andromonoecious inflorescences present; Colombia and Ecuador ..... *D. macrocarpus*

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