



Three decades to connect the sexes: *Calatola microcarpa* (Icacinaceae), a new species from the Southwestern Amazon

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Abstract

A new species of *Calatola* (Icacinaceae), *C. microcarpa*, from the departments of Loreto and Madre de Dios, Peru, and the state of Acre, Brazil, is described and illustrated. The new taxon is well documented with staminate and pistillate flowers, and fruits. Its small leaves and fruit are similar to those found in *Calatola laevigata* and *C. uxpanapensis*. It is also compared with *Calatola costaricensis*, with which it sometimes grows sympatrically in Brazil and Peru. The conservation status of the new taxa is assessed against IUCN criteria.

Key words: Brazil, IUCN, Peru

Introduction

The genus *Calatola* Standley (1923: 688), including *C. mollis* Standley (1923: 689) and *C. laevigata* Standley (1923: 689), was referred to Icacinaceae. Standley used the generic name to evoke the vernacular name of the plant as it is known in Mexico, “nuez de calatola” or “calatolazno.” Since then, five additional species were added to the genus: *C. costaricensis* Standley (1926: 416), *C. venezuelana* Pittier (1938: 360), *C. colombiana* Sleumer (1940: 247), *C. pastazana* Sleumer (1940: 248), and *C. sanguinensis* Cuatrecasas (1949: 220). Two classical treatments of the genus (Sleumer 1940; Howard 1942) were complemented by a comprehensive, fully documented monograph by Vera-Caletti (1999), followed by the description of another new species, *C. uxpanapensis* Vera-Caletti & Wendt (2001: 40).

Calatola is a poorly understood genus because of its dioecious condition and its small flowers. A unique feature of genus is the presence in all parts of the plant of a flavonoid compound that oxidizes to a blue-violet color upon exposure to air (Vera-Caletti 1999).

The dioecious condition and tetramerous flowers are elsewhere found only in Paleotropical genera of the family. The staminate inflorescence is a conspicuous, long pendulous spike with many small flowers (1–2 mm long), but the pistillate inflorescence is a shorter, compound dichasium with few flowers. Herbarium collections of *Calatola* are well represented by specimens bearing staminate flowers or fruits, but because they are inconspicuous and few-flowered, pistillate inflorescences are only known from a limited number of collections. As a result, some species descriptions remain incomplete, with the exception of those of Standley (1923, 1926), and Vera-Caletti & Wendt (2001).

The most recent phylogenetic analysis of the family Icacinaceae suggests that the sister group of *Calatola* is the Asiatic genus *Platea* Blume (1826: 646) and these two genera are part of the *Emmotum* Desv. ex Hamilton (1825: 29) group in Icacinaceae s.str. (Kärehed 2001). It is not surprising that the closest affinity of a member of this family is geographically far disjunct, as this is a phenomenon characteristic of other

members of the family, such as the sister genera *Notaphodytes* Blume (1850: 248) (Asia) and *Mappia* Jacquin (1797: 22) (Mexico, Central America, and the Caribbean), and the sister genera *Icacina* Jussieu (1823: 174) (Africa) and *Leretia* Jussieu (1823: 174) (Central and South America). Members of this family are first known from the Late Cretaceous (Pigg *et al.* 2008) when landmasses configuration was quite different from today, with the Indian subcontinent near to Africa, and the latter closest to South America.

In 1977, R. B. Foster and J. Terborgh collected a peculiar *Calatola* in Peru that they labelled “*Calatola* sp. nov.” (as it appears in the specimen *Foster & Terborgh 6334* at MO). Richard Howard, then at the Harvard University Herbaria, also considered another specimen of Foster’s (collected few years later in the same area, *Foster 9627*) an undescribed species. In 1993 Alwyn H. Gentry suggested a potential name for the plant, *Calatola microcarpa* (in an annotation label attached to the first specimen at MO cited above), but unfortunately he passed away in August of the same year. The new species is finally described here.

Materials and Methods

Herbarium specimens of *Calatola* from A, AAU, BRIT, MO, MOL, and NY were studied (herbarium acronyms according to Thiers 2010 and onwards). Flowers from herbarium material were soaked in concentrated ammonium hydroxide for about one minute, rinsed in water until rehydrated, soft, and ready for study under a dissecting microscope. The rehydrated flowers were temporarily preserved in a 70:25:5 ethanol:water:glycerine solution for further study and eventually returned to herbarium sheets. Distribution maps were produced by plotting locality data extracted from available herbarium specimens onto a DIVA-GIS base map (Hijmans *et al.* 2004) using ArcView 3.2 (ESRI 1999). Conservation status according to the IUCN (2010) criteria was evaluated based upon an estimation of the extent of occurrence (EOO) and the area of occupancy (AOO) using the tool GeoCAT (Bachman *et al.* 2011).

Taxonomy

Calatola microcarpa Gentry ex Duno & J. Janovec, *sp. nov.* (Figs 1–3)

The new species resembles *Calatola laevigata* and *C. uxpanapensis* but the fruit has almost smooth endocarp and yellow exocarp (versus the endocarp with slightly developed equatorial and secondary rib and green exocarp). It is sympatric with *Calatola costaricensis* but has smaller leaves, 6–17 x 3–6.5 cm (versus 16–22 x 8–11 cm), shorter staminate inflorescence, 5–12 mm long (versus 9–25 cm long), and smaller fruits, 2.5–2.8 x 1.4–1.6 cm (versus 5–6 x 4–5 cm), lacking a main crest and secondary ribs (versus fruits with a conspicuous equatorial crest and many secondary conspicuous ribs).

Type:—PERU. Loreto: Province Ucayali, Sapuena, Jenaro Herrera, Quebrada Supay, 04° 55' S, 73° 45' W, 120 m, 7 June 1989 (fr.), R. Vásquez 12300 (holotype CICY!, isotype MO!, MOL!).

Tree to 20 m tall, dioecious. Trunks to 10 cm diameter (dbh). Branches cylindrical, puberulent when young, becoming glabrous with time, hairs short, adpressed. Leaves simple, alternate, without stipules, subcoriaceous to membranaceous, turning black when dry; petiole to 1.5(–2) cm long, deeply sulcate, without a nitid line of abscission in the base, glabrous; blades elliptic to narrowly elliptic, 6–17 cm long, 3–6.5 cm wide, apex generally acute, but also rounded or slightly acuminate, margin entire, base attenuate to almost rounded, mostly glabrous in the abaxial surface, but sparsely puberulent along the secondary veins area; glabrous in the adaxial surface; venation penninerved, brochidodromous, main veins conspicuous in the abaxial surface, slightly conspicuous in the adaxial surface; 6–8 pairs of secondary veins, alternate; tertiary veins perpendicular to the secondary ones, conspicuous. Staminate inflorescence a spike to 12 cm long, laxly flowered, peduncle up to 1 cm long, glabrous or with few small scattered, adpressed hairs, axis of the inflorescence sericeous, bracts narrowly triangular, 0.7–0.8 x 0.2 mm, apex narrowly acuminate, sericeous in the abaxial surface, glabrous on the adaxial surface; flower about 2 mm long; calyx 0.8–0.9 mm long, lobes

triangular, 0.5–0.6 x 0.3–0.4 mm, sericeous in the abaxial surface, glabrous in the adaxial surface, corolla tetramerous, lobes ovate, 1–1.2 x 0.6 mm, apex acute, slightly inflexed, margin entire, glabrous to sericeous in the abaxial surface, densely pilose in the adaxial surface, stamens 0.8 mm long, filament cylindrical, very short, inconspicuous, joined to the base of the corolla, anther basifixed, dehiscent longitudinally, connective linear, barely developed. Pistil absent. Female inflorescence a compound dichasium, 1.5–2 cm long, axillary, with 12–20 flowers, peduncle 4–8 mm long, diminutely sericeous; bracts ovate, slightly concave, 0.9–1.1 mm long, 0.6–0.7 mm wide, apex acute, margins ciliate, diminutely sericeous with white hairs on the abaxial surface, glabrous on the adaxial surface. Calyx with 4 sepals, free, ovate, slightly concave, 0.8–1 mm long, 0.6–0.8 mm wide, apex acute, margins ciliate, diminutely sericeous with white hairs in the abaxial surface, glabrous on the adaxial surface. Corolla with 2 petals free, early caducous, broadly ovate, 1.3–1.5 mm long, 1.3–1.5 mm wide, apex acute, margins entire, glabrous with the exception of two lines of white hairs near the margins. Stamens absent. Disk absent. Ovary subcylindrical, 2.5–3 mm long, 1.5–1.7 mm wide, shortly yellow-sericeous, style short, stigma lacinate, the short prolongation reflexed, 1 mm long. Fruit a drupe, ellipsoid, 2.5–2.8 cm long, 1.4–1.6 cm wide, apex acute, base rounded; endocarp hard, with a poorly developed equatorial rib, and poorly developed secondary ribs, the surface appearing verrucose smooth; mesocarp fleshy; exocarp thin, green when immature, yellow when mature, glabrous; seed solitary.

Etymology:—From the Greek *micro*, small, and *carpus*, fruit, in reference to the peculiar small fruits. As mentioned above, the new species and specific epithet were originally proposed by A. Gentry in 1993 but never published.

Additional material examined (paratypes):—PERU. **Loreto:** Requena, Jenaro Herrera, 04° 55' S, 73° 40' W, 125 m, 5 December 1985 (♂ fl.), *L. Freitas 154* (AAU); same locality (♂ fl.), *J. Ruiz et al. 8684* (AAU); along the lower Ucayali River, approx. 7 km west of the Jenaro Herrera village. Zona de Braga, 04° 55' S, 73° 45' W, 120 m, 01 October 1993–12 February 1994 (♂ fl.), *J. Ruiz et al. 4328* (AAU); Provincia Requena, Centro de Investigaciones de Jenaro Herrera, 200 km de Iquitos, margen derecha del Río Ucayali, a 3 km del distrito Jenaro Herrera, 04° 55' S, 73° 45' W, 120 m, 24 October 1988 (♂ fl.), *Anonymous s.n.* (MOL). **Madre des Dios:** Provincia Tambopata, Santuario Nacional Pampas del Heath, Río Heath, 12° 39' 23" S, 68° 44' 13" W, 210 m, 18 May 1996 (fr.), *M. Aguilar & D. Castro 724* (CICY, MO); Provincia Manu, Los Amigos Conservation Concession, Centro de Monitoreo 1 (CM1), Trocha C, 12° 32' 26" S, 70° 04' 58" O, 17 April 2007 (fr.), *A. Balarezo 226* (BRIT); Parque Nacional del Manu, Rio Manu, Cocha Cashu Station, 400 m, 17 May 1977 (fr.), *R. B. Foster & J. Terborgh 6334* (MO); Provincia Manu, Parque Nacional Manu, río Manu, Cocha Cashu Station, 11° 50' S, 71° 25" W, 350 m, 13 July 1984 (fr.), *R. B. Foster 9627* (A, MO), Cocha cashu Camp, Manu National Park, Río Manu, 380 m, 24 October 1979 (♂ fl.), *A. Gentry et al. 27231* (AAU, MO); Río Heath, Peru, 12° 40' S 68° 45' W, 200 m 2 March 1990 (fr.), *A. Gentry & P. Núñez V. 69795* (MO); Provincia Manu, Los Amigos Conservation Concession & Biological Station, Trocha Cocha Lobo, 12° 32' 26" S, 70° 04' 58", 30 January 2008 (ster.), *A. P. Maceda 2912* (BRIT); Provincia Tambopata: Las Piedras, Madama, 12° 31' 41" S, 69° 04' 59" W, 168 m, 19 October 2004 (♀ fl., fr.), *L. Valenzuela et al. 4202* (CICY, MO). BRAZIL. **Acre.** Bujari. Basin of Rio Purus, Rio Antimari, Floresta Estadual do Antimari, left bank, inland from river. 09° 24' 40" S, 68° 07' 26" W, 08 March 1997 (fr.), *D. C. Daly et al. 9312* (NY).

Discussion:—*Calatola costaricensis* is the *Calatola* commonly reported in Peru. *Calatola microcarpa* is easily differentiated by its leaves, staminate inflorescence, flowers, and fruits: *Calatola costaricensis* generally has longer leaves (16–25 x 8–12 cm vs. 6–17 x 3–6.5 cm) and the staminate inflorescence is a conspicuous long spike, 9–25 cm long (versus 5–12 mm long). The fruit is a globose drupe 5–6 x 4–5 cm (versus ellipsoidal, 2.5–2.8 x 1.4–1.6 cm in *C. microcarpa*) with a conspicuous equatorial crest and many secondary conspicuous ribs (versus lacking this main crest and secondary ribs; see Figure 3a & 3b). Although the flowers are small in both cases, there is a conspicuous difference in the size of the staminate and pistillate flowers and all their parts. In *C. costaricensis* the flowers are 2.2–2.7 mm long (versus 2 mm long), with calyx lobes 1.3–1.5 mm long (versus ca. 0.5 mm long) and the corolla lobes 2–2.5 mm long (versus 0.8–0.9 mm long). In addition the fruit pericarp of *C. costaricensis* becomes black when mature, but turns yellow in *C. microcarpa*.



FIGURE 1. Type specimen of *Calatola microcarpa* Duno & J. Janovec (R. Vásquez 12300, CICY).

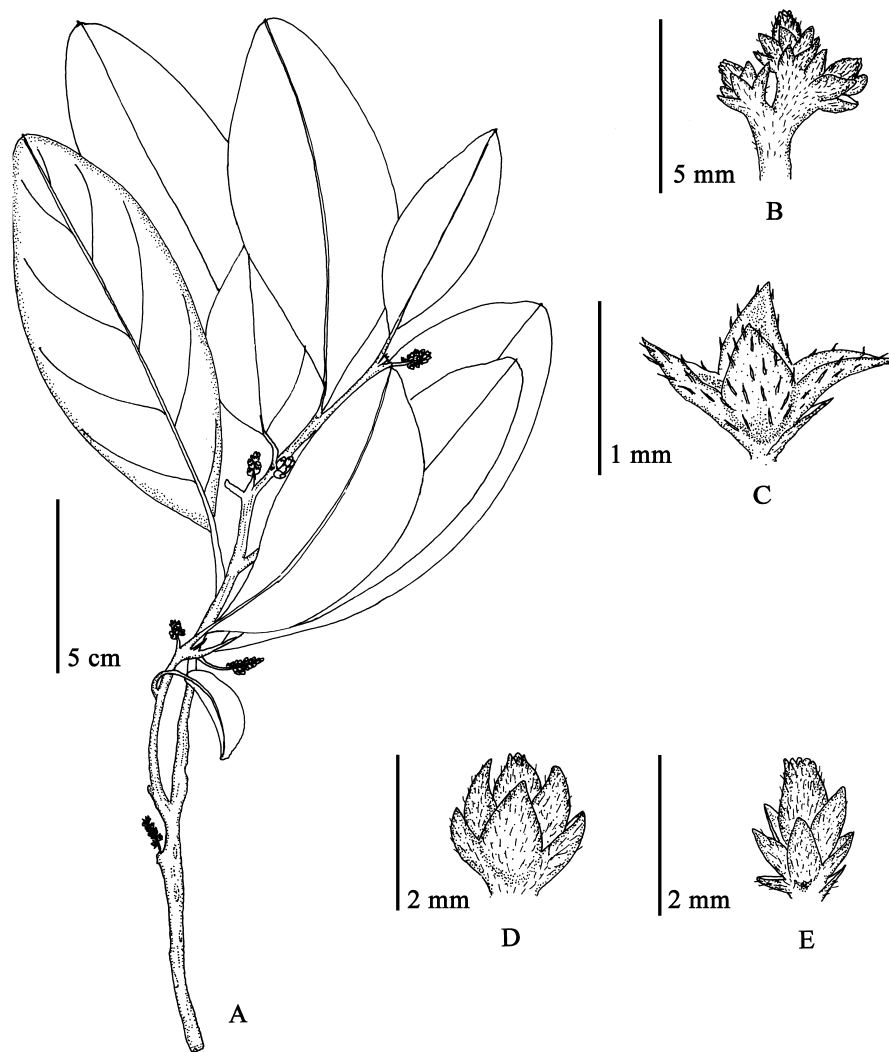


FIGURE 2. A–E. Female specimen of *Calatola microcarpa* Duno & J. Janovec. A) Floriferous female branch. B) Details of female inflorescence. C) Details of calyx and bract. D) Details of flower showing calyx, corolla and ovary. E) Details of flower showing the ovary and the stigma (*L. Valenzuela 4202*, CICY)

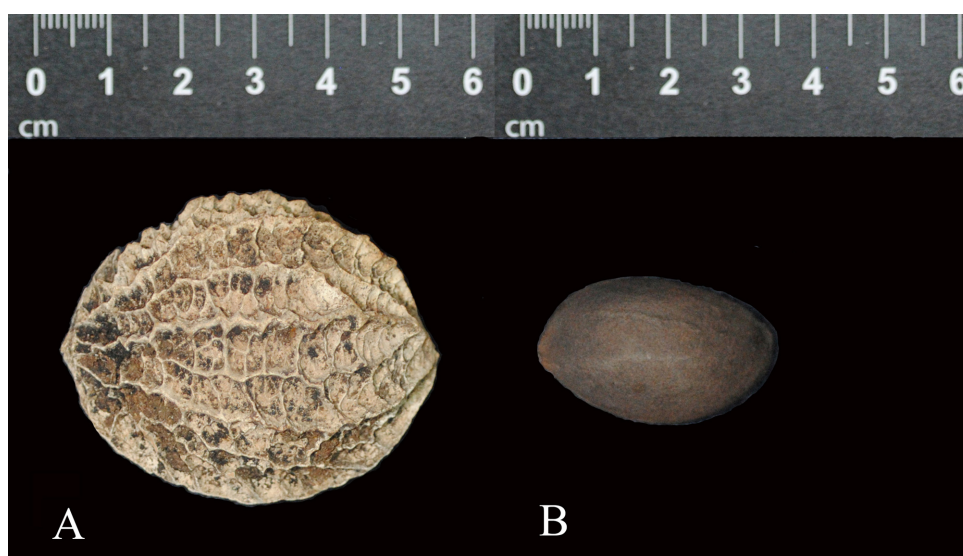


FIGURE 3. Fruits of *Calatola costaricensis* Standl. and *Calatola microcarpa* Duno & J. Janovec. A) Fruit of *Calatola costaricensis* with the exocarp and mesocarp removed, showing the main and secondary ribs (*R. Duno s.n.*, CICY). B) Fruit of *Calatola microcarpa* with exocarp, showing a verrucose smooth surface without conspicuous main and secondary ribs (*R. Vásquez 12300*, CICY).

Calatola costaricensis has a broad distribution from Mexico to South America (Colombia, Venezuela, Ecuador, Peru, and Brazil) and exhibits ample morphological variation that has been used to divide the species into four morphotypes (Vera-Caletti 1999). The small leaves and small fruits with poorly developed equatorial crest and secondary ribs of *C. microcarpa* resemble *C. laevigata* and *C. uxpanapensis* from Mexico and Belize. However *C. laevigata* grows between 700 and 1900 meters, flowering during September to November and fruiting during December to March. *Calatola uxpanapensis* grows between 100–500 meters, flowering during May to June and fruiting during August to November.

Distribution and ecology:—*Calatola microcarpa* is only known from the departments of Loreto and Madre de Dios, Peru, and the state of Acre, Brazil (Fig. 4), where it prefers moist upland and floodplain forest at elevations of 120–400 m. It is sympatric with *C. costaricensis* in Peru. The new species grows near the border between Peru, Brazil and Bolivia, and it is expected in the department of Pando or La Paz (Bolivia).

Conservation status:—The extent of occurrence (EOO) of *Calatola microcarpa* is 264,662 km². Based on its range of distribution this species can be rated as a least concern (LC). The area of occupancy (AOO) is deeply influenced by the number of records and the grid cell size (default value = 2 km²). If a value of 10 km² is applied, a tenth of the diameter of the EOO polygon as Willis *et al.* (2003) recommend, the AOO is 800.00 km². Based on its distribution range the species can be rated as vulnerable but without the two complementary data necessary to determine this threatened category. In conclusion, the new specie does not meet the threshold for a threatened category and can be rated as least concern (LC) according to the IUCN (2010).

Vernacular name:—“sacha ushum” in Peru (Vásquez 12300), and genipaparana in Brazil (Daly *et al.* 9312).

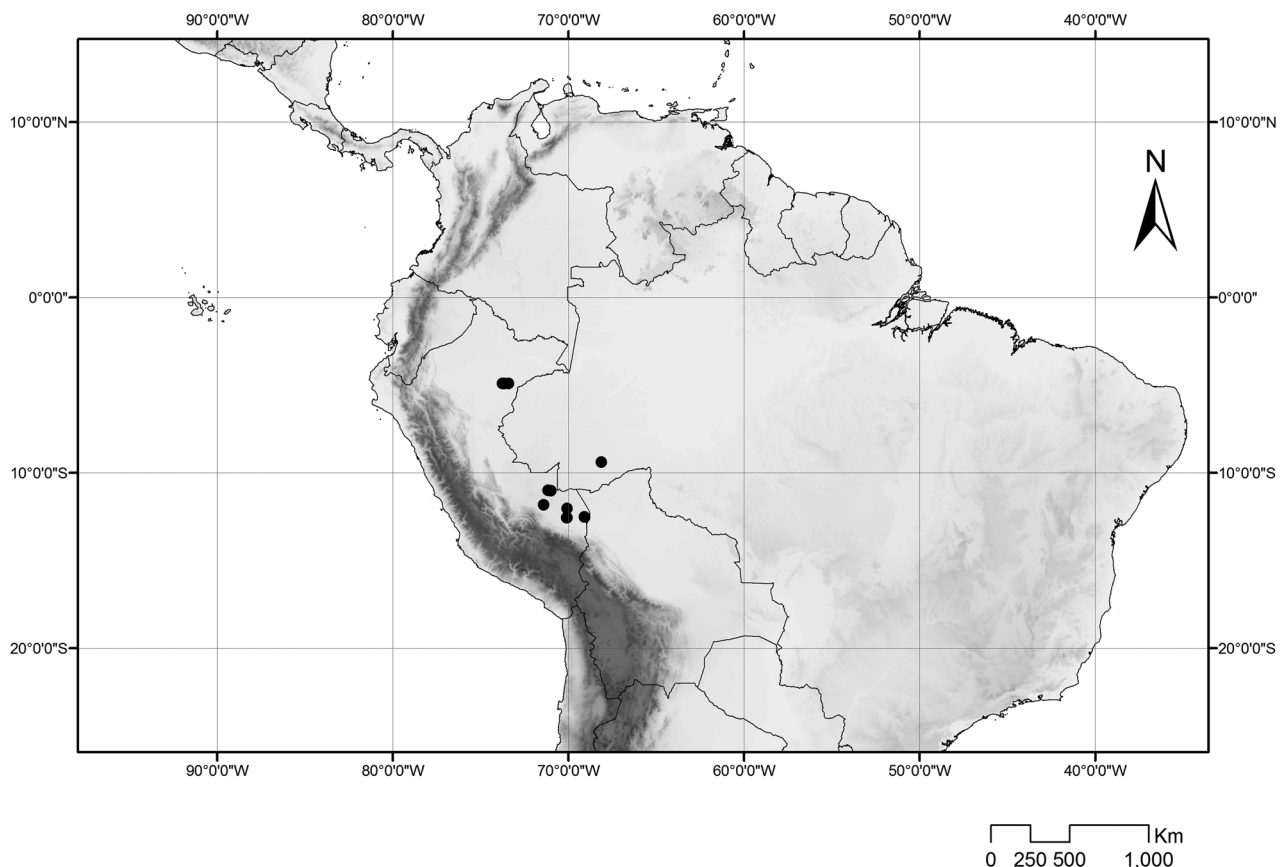


FIGURE 4. Distribution map of *Calatola microcarpa* Duno & J. Janovec (●).

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