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OURATEA YAMAMOTOANA (OCHNACEAE), A NEW SPECIES FROM THE BRAZILIAN ATLANTIC FOREST

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The new species *Ouratea yamamotoana* (Ochnaceae) from the Brazilian Atlantic Forest biodiversity hotspot is described and illustrated. The new species resembles *Ouratea camposportoi*, from which it differs by the persistent stipules, chartaceous leaves with cordate or slightly auriculate base, flowers with smaller pedicels, spathulate or elliptic petals, longer gynophore, and fruit with a subterete to clavate carpophore. It is assessed as Vulnerable (VU) using IUCN Red List criteria and highlights the threats to the highly endemic plant diversity of the Atlantic Forest.

Keywords. Brazil, Malpighiales, morphology, taxonomy.
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Introduction

The pantropically distributed family Ochnaceae comprises 33 genera and c.550 mostly woody species of small to large trees but also shrubs or herbs, with one climbing species [*Krukoviella disticha* (Tiegh.) Dwyer] (Schneider *et al.*, 2021a). The family has been consistently supported as monophyletic by the results of both early phylogenetic analysis of individual DNA sequence data (Angiosperm Phylogeny Group, 2009; Schneider *et al.*, 2014) and recent phylogenomics of plastome and nuclear genomic data (Schneider *et al.*, 2021a, 2021b). All these molecular studies support the subfamily classification into the monotypic Medusagynoideae, the Quiinoideae, and the species-rich Ochnoideae.

The Ochnaceae is highly species-rich in Neotropical regions (Amaral, 1991) and particularly in Brazil, where 17 genera and 242 species (13/207 in Ochnoideae, 4/35 in Quiinoideae) have been recorded according to the most recent catalogue of the Brazilian flora (Flora do Brasil, 2020; Rocha, 2020). The Atlantic Rain Forest, a global biodiversity hotspot (Myers *et al.*, 2000), is home to 57 species of the family, 38 of which are endemic and mostly found in the species-rich genus *Ouratea* Aubl. (31 species), and the remainder are in *Elvasia* DC. (4), *Luxemburgia* A.St.-Hil. (2) and *Quiina* Aubl. (1) (Flora do Brasil, 2020; Rocha, 2020).

Ouratea is a Neotropical monophyletic genus comprising more than 300 species (Schneider *et al.*, 2021a, 2021b). It includes shrubs and trees that grow in lowland or highland rain forests, in fire-prone savannas, and sometimes in maritime thickets

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(Yamamoto *et al.*, 2008). The most recent taxonomic revision of Brazilian *Ouratea* was carried out by Engler (1876), who recognised 85 species. In the past 30 years, with the intensification of fieldwork throughout Brazil and increased study of herbarium collections, many new species of Ochnaceae have recently been described from different biomes. Among these, there are 17 species of *Ouratea*: five from the Atlantic Forest (Sastre, 1981, 2001; Fraga & Saavedra, 2014; Marinho *et al.*, 2018; Silva *et al.*, 2018); six from the Cerrado (Sastre, 1981; Yamamoto, 1995; Salvador *et al.*, 2006; Yamamoto *et al.*, 2008; Chacon *et al.*, 2011; Marinho *et al.*, 2018); and six from the Amazon (Sastre, 1994, 1995, 2001, 2005).

Despite such contributions to our taxonomic knowledge of the Brazilian *Ouratea*, identification of more widespread and morphologically variable species is often rather difficult. The high species numbers and existence of many species complexes may explain the high number of unidentified specimens of *Ouratea* in Brazilian herbaria; indeed, c.6200 of the c.23,000 herbarium records of *Ouratea* from the SpeciesLink database (https://specieslink.net/search) are identified to genus level only. Many specimens are also found to be wrongly identified, a common occurrence for species-rich genera such as *Ouratea* and tropical collections alike (Goodwin *et al.*, 2015).

The ongoing taxonomic review of the Brazilian Ochnaceae and analysis of type specimens and recently collected materials have enabled a better understanding of species circumscription within *Ouratea* and the discovery of a new species, which until now had been misidentified among herbarium collections. This new species is known only from the Atlantic Forest of southern Brazil and is described and illustrated here.

Species description

Ouratea yamamotoana Fraga, G.H.Shimizu & D.B.O.S.Cardoso, **sp. nov.**

Similar to *Ouratea camposportoi* Sleumer but differs by its persistent stipules (vs caducous in *O. camposportoi*); chartaceous leaves with cordate or slightly auriculate base and slightly revolute (vs leaves rigid chartaceous or coriaceous, with obtuse, truncated or rounded base, and distinctly revolute); flowers with pedicel measuring 6–8 mm long but reaching 7–11 mm long when in fruit, the petals spathulate or elliptic, and gynophore 1.2–1.8 mm long (vs pedicel 9–15 mm long when in flower and 14–16 mm long when in fruit, the petals obovate, and gynophore 0.9–1 mm long); and fruit with a subterete to clavate carpophore of 7–16 × 1.8–4 mm (vs carpophore elongate, piriform, 12–14 × 3.3–6.5 mm). – Type: Brazil, Rio de Janeiro, Paraty, Fazenda Santa Maria, estrada para Praia do Sono, 27 ix 1989, fl., *Freitas, M.F. & Silva, L.C.S.* 116 (holotype RB; isotypes NY, SP). **Figures 1, 2**.

Shrub 1.3–2 m tall, virgate. *Stems* erect to reclining at the apex, branched, glabrous, rugose, light brown; *leaf internodes* short, 6–24 mm long. *Stipules* 4–6 × 2.5–3.5 mm, 2 per leaf node, persistent, triangular, rigid, with slightly revolute margins, apex acute or mucronulate.

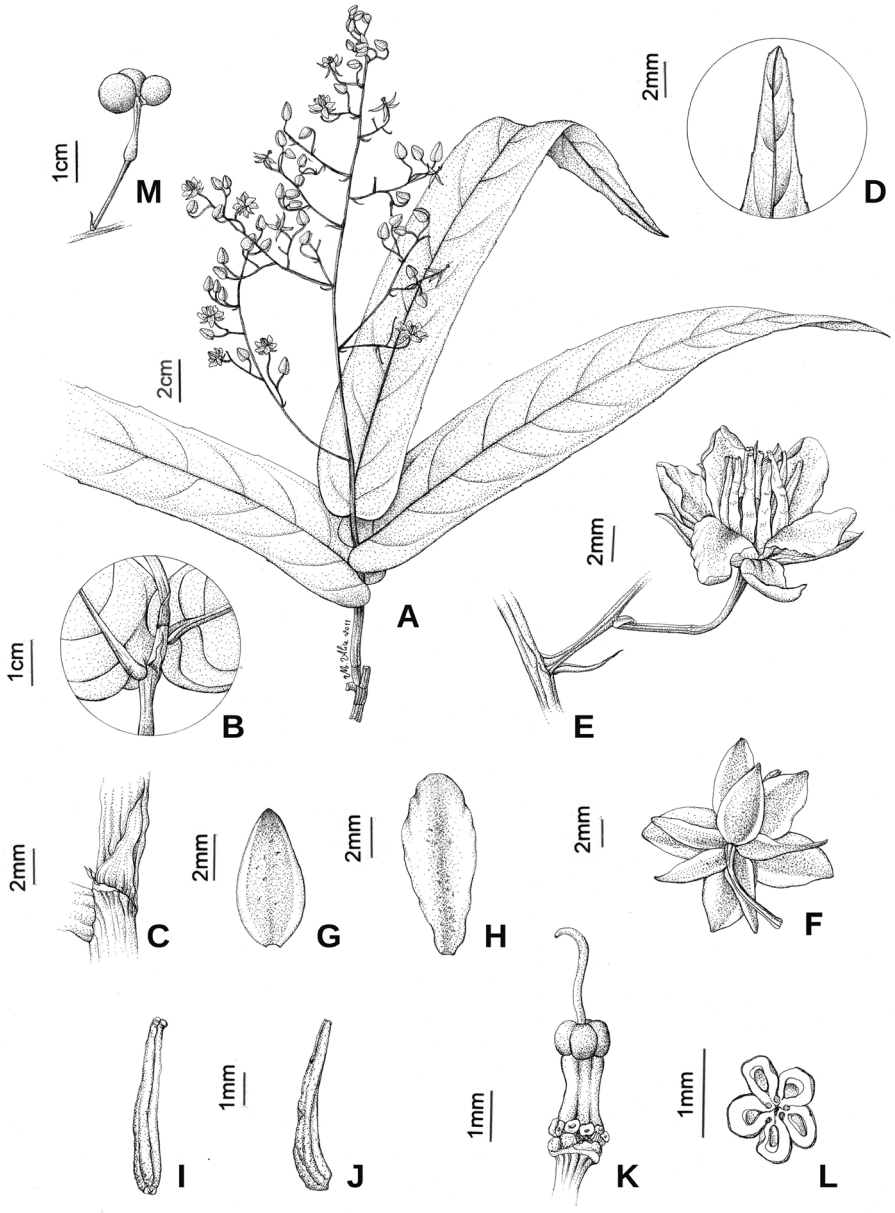

Figure 1. *Ouratea yamamotoana* Fraga, G.H.Shimizu & D.B.O.S.Cardoso, sp. nov. A, Habit and inflorescences; B, detail of the leaf base; C, detail of the stipules; D, detail of the apex on the adaxial side of the leaf; E, branchlets, bracteoles and open flower in side view; F, flower, from the base; G, sepal, abaxial surface; H, petal, abaxial surface; I, stamens, abaxial surface; J, stamens in side view; K, pedicel and gynoecium in side view with sepals, petals and stamens removed; L, ovary, transverse section; M, fruit in side view. Drawn by Maria Alice Rezende from: A–L, the holotype, *Freitas*, *M.F.* 116 (RB); M, the paratype, *Bovini, M.G.* 646 (RB).

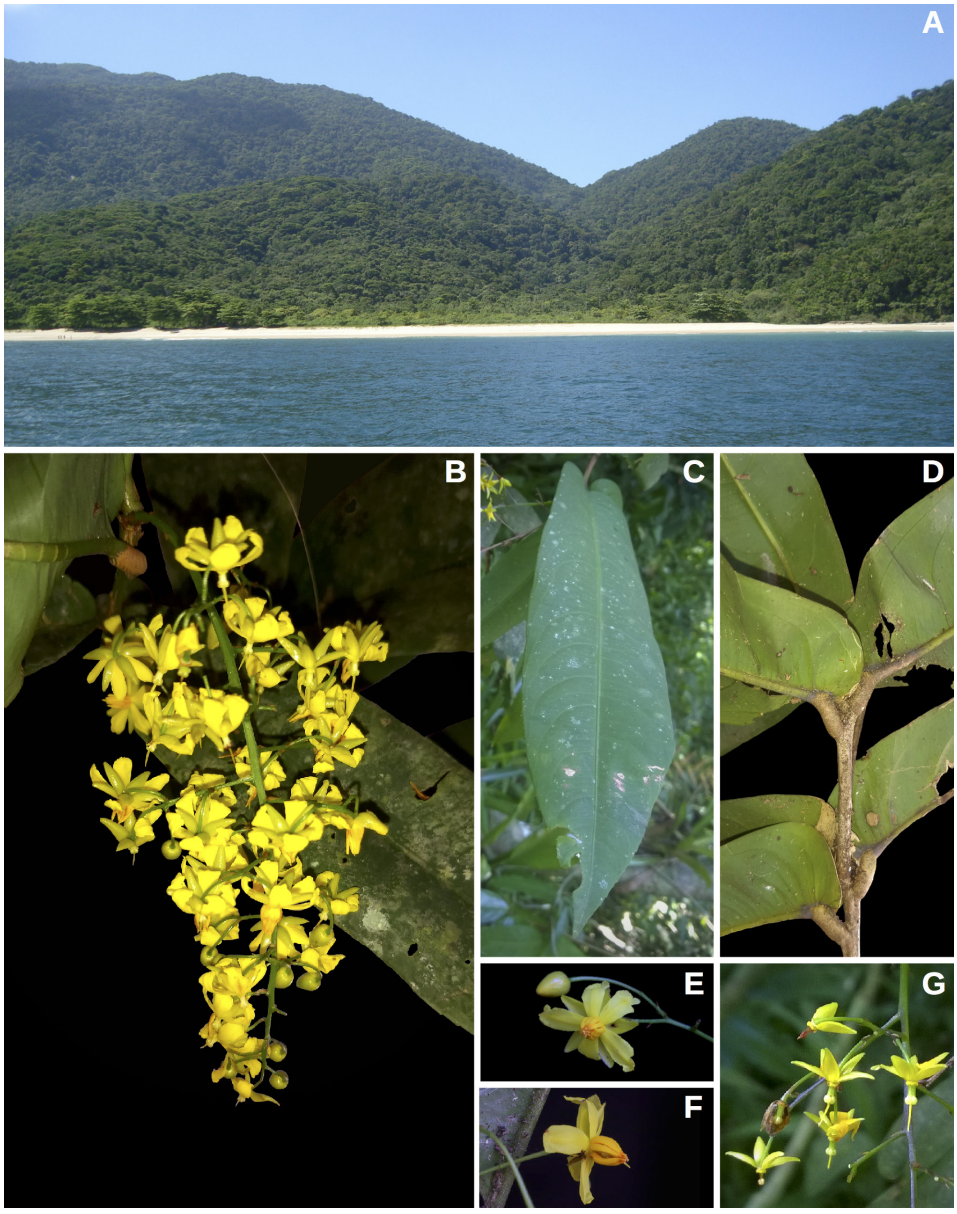

Figure 2. Vegetation physiognomy of the type locality and morphology of *Ouratea yamamotoana* Fraga, G.H.Shimizu & D.B.O.S.Cardoso, sp. nov. A, General view of the Atlantic Forest at Paraty, Rio de Janeiro, Brazil; B, habit and inflorescences; C, leaf; D, detail of a branch, showing the leaf bases; E, flower in frontal view; F, flower in side view; G, partial inflorescence showing flowers without stamens and petals (which have already fallen). Photograph A was taken by Leandro Jorge Telles Cardoso. Photographs B–G are of the paratypes, accession *Miranda, M.R.* 214 (SPSF) and *Campos-Rocha, A. & Volet, D.P.* 1616 (UEC), and were taken by M. R. Miranda (B, D–F) and A. Campos-Rocha (C, G).

Leaves 14.8–30.2 × 3–7.4 cm, congested at the terminal branches, petiolate, alternate; *petiole* 4.5–8.5 mm, canaliculated on adaxial surface, thick; *leaf blade* chartaceous, lanceolate or falcate, base cordate or slightly auriculate, margin entire at the base and serrulate at the apex, slightly revolute, apex acute-acuminate, venation eucamptodromous, midvein sulcate at the base and raised at the apex on adaxial surface and strongly raised abaxially, secondary veins curving strongly near the margin and continuing almost as submarginal veins impressed on adaxial surface and raised on adaxial surface, tertiary veins inconspicuous on both surfaces. *Inflorescence* terminal or rarely subterminal at the distal leaf axils, 16.4–32.5 cm long, panicle, erect to reclining, glabrous, basal bracts similar to the stipules, 4–6 × 2.5–3.5 mm, isolated, distichous and imbricate, generally followed by a pair of smaller bracteoles, 2.5–5 × 1.6–2.5 mm, triangular, rigid, revolute margins, persistent, chestnut brown; *lateral branchlets* 0.5–18 cm long, simple or compound, terete, bracts shallowly triangular to lanceolate, chartaceous 3–5 mm long, chestnut brown; *bracteoles* 0.8–1.5 mm long, shallowly triangular to linear, isolated, chestnut brown; *flower pedicels* 6–8 mm long, reaching 7–11 mm when in fruit, straight to curved, glabrous, regularly slender in bud and flower. *Flowers* pentamerous, radially symmetrical; *sepals* 4.3–6 × 2.1–3 mm, green-yellowish, glabrous, imbricate, elliptical, concave, internally smooth, externally thick in the middle, hyaline in the margin, acute at the apex; *petals* 5.8–8.1 × 2.6–3.4 mm, yellow, glabrous, spathulate or elliptic, reflexed, a few somewhat thick at the base and along the central vein, attenuate to unguiculate base, rounded apex; *stamens* 10, arranged in a circle around the ovary, the anthers 4.8–6.2 mm long, yellow, erect, sessile, transversely rugulose, dehiscing by a terminal pore; *ovary* superior, 5-carpellate; *gynophore* 1.2–1.8 × 0.5–0.9 mm, cylindrical, columnar, thickening near apex; *fertile gynoecium units* 5, 0.5–0.9 × 0.4–0.7 mm, oblong, cream; *style* 2.8–3.2 mm long, single, erect or genuflected at apex, filiform, gynobasic, stigma punctiform, light green. *Fruit* with carpophore 7–16 × 1.8–4 mm, subterete to clavate, straight or slightly curved, rugose near base, red wine-coloured in ripe fruit; *mericarps* 1–3, 6–11 × 5–8 mm, greenish to chestnut brown, suborbicular, erect or obliquely disposed on carpophore head, inflated, pericarp thin.

Distribution and habitat. Restricted to the Brazilian Atlantic coastal rain forest of southern Rio de Janeiro and northern São Paulo states (**Figure 3**). Most specimens are collected outside forest reserves, but the species is recorded from the relatively well-preserved forest reserve of Área de Proteção Ambiental Cairuçu, Rio de Janeiro, and in the municipality of Caraguatatuba and Ubatuba, São Paulo. In São Paulo, this new species is recorded from Núcleo Picinguaba in the northeast region of the Parque Estadual Serra do Mar in São Paulo, one of the most biodiverse and largest preserved portions of the Brazilian Atlantic Forest and a hotspot of biodiversity (Murray-Smith *et al.*, 2009; Colli-Silva *et al.*, 2020). It is also recorded from Pontal de Toninha in the Parque Estadual da Ilha Anchieta, the second largest island of the northern coast of São Paulo.

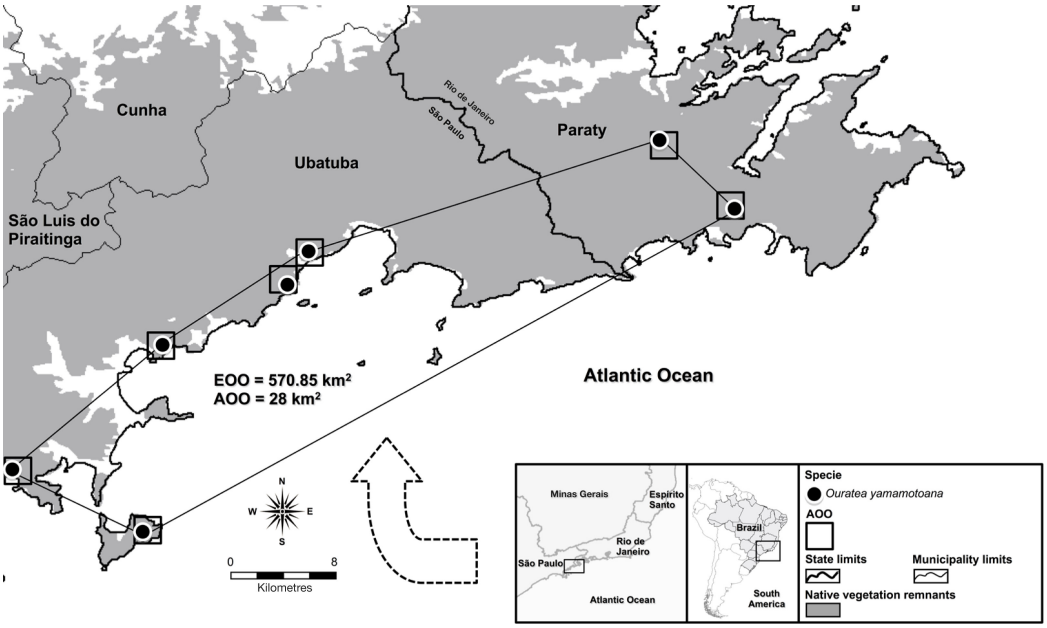

Figure 3. Map showing the distribution and the extent of occurrence (EOO), measured by a minimum convex polygon, and area of occupancy (AOO) of *Ouratea yamamotoana* Fraga, G.H.Shimizu & D.B.O.S.Cardoso, sp. nov. (black dots) in the southern Rio de Janeiro and northern São Paulo states, Brazil. Distribution plotted using the DIVA-GIS program, version 5.2 (Hijmans *et al.*, 2005).

Phenology. Flowering has been recorded from January to May, and fruiting in July.

Etymology. The name pays homage to Professor Kikyo Yamamoto, who has made important taxonomic contributions to neotropical Ochnaceae, and especially *Ouratea*. She carried out an in-depth study of morphological traits to untangle the complex taxonomy of this genus and studied the *Ouratea parviflora* (A.DC.) Baill. species complex in her graduate studies. Kikyo has also played an important role training and guiding generations of plant systematists at Unicamp in São Paulo, Brazil, for over 30 years.

Proposed IUCN conservation category. *Ouratea yamamotoana* is known from nine specimens and seven locations (*sensu* IUCN). Using GeoCAT (Bachman *et al.*, 2011) and a 2 km^2 grid, it has an estimated extent of occurrence (EOO) of 570.85 km^2 and minimal area of occupancy (AOO) of 28 km^2. Although these figures fall within the limits for Endangered (EN) status under criteria B1 (EOO < 5000 km^2) and B2 (< 500 km^2), the number of locations is greater than five and falls within the Vulnerable (VU) category (IUCN, 2012). The species is found in forested areas that are not severely fragmented but are threatened by real estate speculation and urban development, which may lead to a decline in the EOO, AOO and quality of habitat. For this reason, *Ouratea yamamotoana* is assessed as Vulnerable: VU B1ab(i,ii,iii)+2ab(i,ii,iii).

Additional specimens examined. Brazil. **Rio de Janeiro**: Paraty, Área de Proteção Ambiental Cairuçu, Morro do Córrego dos Micos, 100–150 m alt., 26 xi 1994, fr., *Bovini, M.G. & Giordano, L.C.* 646 (RB). **São Paulo**: Caraguatatuba, Captação da SABESP, Alto Rio Claro, margem do rio na estrada de acesso a captação, 25 iv 2020, fl., *Miranda, M.R.* 214 (SPSF); Ubatuba, BR 101, Km 23, 17 iv 1979, fr., *Ferreira, V.F.* 617 (RB); ibid., 17 iv 1979, fl., *Jouvin, P.P.* 494 (CEN, RB); Ubatuba, Ilha Anchieta, Trilha do Guilherme, 15 xii 1994, fl., *Santin, D.A. & Moreira, J.L.A.* 32442 (CEN, UEC); Ubatuba, Estação Experimental de Ubatuba (IAC), 29 i 1980, fl., *Shepherd, G.J.* et al. 10969 (CEN); Ubatuba, Rodovia Rio-Santos, Enseada da Lagoinha ao lado das ruínas da Igreja de Pedra, 6 v 2000, fl., *Amorim, A.M. & Forzza, R.C.* 3387 (CEPEC); Ubatuba, Rodovia Rio Santos, prox. da praia de Prumirim, 3 v 2005, fl., *Campos-Rocha, A. & Volet, D.P.* 1616 (UEC).

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