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Filling a distribution gap: a new record of *Pradosia ptychandra* (Sapotaceae) from eastern Brazilian Amazonia

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ABSTRACT

Based on fertile material collected in January 2019, we report the first record of *Pradosia ptychandra* (Sapotaceae, Chrysophylloideae) to the flora of Amapá state, eastern Brazilian Amazonia. This new record fills a geographical gap between its previously known occurrences in the Guiana Shield and central Amazonia, improving our knowledge of its distribution pattern. We also provide comments on the taxonomy, preliminary conservation status, and current distribution of the species, in addition to an illustrative plate on its morphology and habitat.

KEYWORDS: Chrysophylloideae, flora of Amapá, conservation status, new occurrence, taxonomy

Preenchendo uma lacuna de distribuição: um novo registro de *Pradosia ptychandra* (Sapotaceae) para a Amazônia oriental brasileira

RESUMO

Com base em material fértil coletado em janeiro de 2019, relatamos o primeiro registro de *Pradosia ptychandra* (Sapotaceae, Chrysophylloideae) para a flora do estado do Amapá, Amazônia oriental brasileira. Esse novo registro preenche uma lacuna geográfica entre suas ocorrências anteriormente conhecidas no Escudo das Guianas e na Amazônia central, ampliando nosso conhecimento sobre seu padrão de distribuição. Também fornecemos comentários sobre a taxonomia, o estado preliminar de conservação e a distribuição atual da espécie, além de uma prancha ilustrativa sobre sua morfologia e habitat.

PALAVRAS-CHAVE: Chrysophylloideae, flora do Amapá, estado de conservação, nova ocorrência, taxonomia

Despite being home to the world's most biodiverse tropical forest, the Amazon biome is currently highly threatened by climate change and deforestation (Gomes *et al.* 2019; Stropp *et al.* 2020). Biodiversity studies have increased considerably in this region, but many areas remain scientifically neglected and poorly documented from a floristic perspective (Carvalho *et al.* 2023).

Estimates suggest 6,000 to 16,000 tree species with diameter at breast height ≥ 10 cm in Amazonia (Cardoso *et al.* 2017; ter Steege *et al.* 2020). Approximately 280 tree species can be recorded in a single hectare of *terra-firme* (non-flooded) forest in central Amazonia (Oliveira and Mori 1999). These numbers are impressive and likely underestimated, as new tree species are frequently revealed in the biome (Vasconcelos *et al.* 2021b; Mouzinho *et al.* 2022; Costa *et al.* 2023).

In January 2019, during a field expedition conducted in a remote area in the southern portion of Amapá state, in the extreme northeast of Brazilian Amazonia, we collected samples of a flowering tree of *Pradosia* Liais (Sapotaceae) in a *terra-firme* forest at the confluence of the rivers Maracá-Parú and Igarapé Grande in the municipality of Mazagão. After examining the morphological, ecological, and geographic characteristics of *Pradosia* species, the samples were identified as *Pradosia ptychandra* (Eyma) T.D.Penn., the first record of this tree species for eastern Brazilian Amazonia.

Pradosia forms a monophyletic lineage within the Neotropical Chrysophylloideae, distinguished by a rotate corolla with a short tube, absence of staminodes, a drupaceous fruit with plano-convex cotyledons, an exserted radicle

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below the cotyledons, and the absence of endosperm (Terra-Araujo *et al.* 2015; Faria *et al*. 2017; Swenson *et al.* 2023). It comprises 24 species of trees and shrubs growing in moist and dry tropical forests throughout Central and South America (Pennington 1990; Terra-Araujo *et al.* 2016; Fernández *et al.* 2022). The highest diversity of *Pradosia* is found in Amazonia (10 species) and the Atlantic Forest (6 species) (Alves-Araújo and Alves 2012; Terra-Araujo *et al.* 2016).

Pradosia ptychandra was first recorded in Suriname (Eyma 1936), and its known distribution comprises the Guiana Shield (Guyana, Suriname, and French Guiana) and central Amazonia (Brazil). This sparse and patchy distribution can reflect gaps in botanical sampling, particularly in remote areas (Nelson *et al.* 1990; Hopkins 2007; Schulman *et al.* 2007). Limited knowledge of species distributions results from many factors, including low collection intensity, scarcity of adequate taxonomic studies, and unreliable species identification. Species with narrow distributions or those rarely collected, for example, may result from misidentifications, irregular blooms, or occurrence in areas historically unexplored by botanists (Hopkins 2019).

We deposited the examined material at the INPA herbarium (acronym follows Thiers 2024). We identified the material using a Leica®S8APO stereomicroscope (coupled to a Leica DFC295 camera), following descriptions of Pennington (1990) and Terra-Araujo *et al.* (2016). We used web-based resources such as the Reflora Virtual Herbarium (https://reflora.jbrj.gov.br/reflora/herbarioVirtual/), SpeciesLink (https://specieslink.net/search/), and Global Biodiversity Information Facility (https://www.gbif.org/) to search records of *P. ptychandra*. The pre-processed and geo-referenced dataset (20 unique occurrences) was imported into the ConR package (Dauby *et al.* 2017) using the R environment (R Core Team 2022) to assess conservation status based on IUCN Red List Categories and Criteria (IUCN 2012, 2022). We estimated the extent of occurrence (EOO), area of occupancy (AOO; 2-km^2 grid) and the number of subpopulations. A species distribution model was used to predict the current potential distribution of *P. ptychandra*, following Vasconcelos *et al.* (2021a). We prepared the final map using QGIS v.3.28.1 (QGIS Development Team 2022).

Pradosia ptychandra (Eyma) T.D.Penn.

(Figures 1 and 2)

New record: BRAZIL. Amapá: Mazagão, BR-156, ramal do Assentamento Maracá, Comunidade Caranã do Maracá, confluência entre os rios Maracá-Pacú e Igarapé Grande, floresta de *terra-firme* (submontana), 0°01'23.4"S, 51°56'40.0"W, 70 m alt., 13 Jan 2019 (fl.), *C.C. Vasconcelos* & *B.F. Vasconcelos-Filho 176* (INPA 298002).

Medium-sized tree 11 m tall. Trunk 30 cm DBH, cylindrical. Bark grayish-brown, smooth. Latex whitish, copious. Leaves clustered, spirally arranged, 8.0–16.3 × 2.0–5.5 cm long, predominantly obovate, discolorous, glabrous; base cuneate or attenuate; apex cuspidate; margin entire and non-revolute; venation eucamptodromous, midrib sunken on the upper surface and with appressed indument on the lower surface (visible only with lens); secondaries in 11–13 pairs, parallel (50–60°); intersecondaries absent; tertiaries oblique. Petiole 0.8–2.0 cm long, strongly canaliculate, glabrescent, and without scales. Fascicles many-flowered, ramiflorous (twigs or larger branches). Flowers 5-merous; pedicel 9.9–12.7 mm long, densely appressed-tomentulose. Calyx quincuncial, sepals suborbicular, 1.8–2.3 mm long, sparsely tomentulose outside, glabrous inside. Corolla *ca.* 5.4 mm long, wine-red (in fresh material), densely appressed-tomentulose outside, glabrous inside; tube 1.3–1.8 mm long, lobes narrowly ovate. Stamens fixed near the top of the corolla tube; filaments 1.3–1.9 mm long, glabrous; anthers 1.2–1.5 long, glabrous. Ovary 5-locular, 1.4–2.0 mm long, conical, densely strigose; style 0.8–1.1 mm long, glabrous; stigma simple.

Pradosia ptychandra belongs to the "red-flowered" clade, recognized by non-sweet bark, leaves with sunken midrib, reddish or wine-red flowers, and larger corolla (Terra-Araujo *et al.* 2015). Some species in this clade also have cauliflory, scales attached at the middle of the petiole, and fruits with muricate exocarp as diagnostic features (Terra-Araujo *et al.* 2015, 2016). *Pradosia ptychandra* could be confused with *P. lactescens* (Vell.) Radlk. and *P. lahoziana* Terra-Araujo by the similar foliage, presence of wine-red flowers, and cauliflory; however, they can be distinguished by several characteristics (Table 1).

Considering the currently known range of *P. ptychandra*, 14 subpopulations were identified with EOO = 508,780 km^2, AOO = 68 km^2, and 15 locations (five within protected areas, two in French Guiana, two in Suriname, and one in Brazil). Habitat loss by deforestation, anthropogenic fires, and logging and mining activities are potential threats in this region (Funi and Pase 2012; Dezécache *et al.* 2017; Siqueira-Gay *et al.* 2020; Jébrak *et al.* 2021; Santana *et al.* 2023). Moreover, given the relatively narrow area of occupancy and few locations within protected areas, this species qualifies under the Near Threatened NT [B1a+B2a] conservation status (IUCN 2012, 2022).

When consulting the species-level unidentified specimens of *Pradosia* from Amapá in the SpeciesLink database, we observed that specimen *H. Medeiros et al. 3223* (INPA 282538) collected in the Tumucumaque National Park is likely to be *P. ptychandra* because of its foliage resemblance. However, the specimen is sterile, which currently prevents us from making a definitive identification. In any case, our new record from Amapá contributes to fill a gap in the previously known distribution range of this species. Our ensemble distribution model indicates that the suitable habitat for *P. ptychandra* occurs predominantly in northeastern Pan-Amazonia (Guiana Shield and Amapá in Brazil), as well as patches towards eastern and central Amazonia in Pará and Amazonas states, respectively (Figure 2). The temperature annual range (difference between

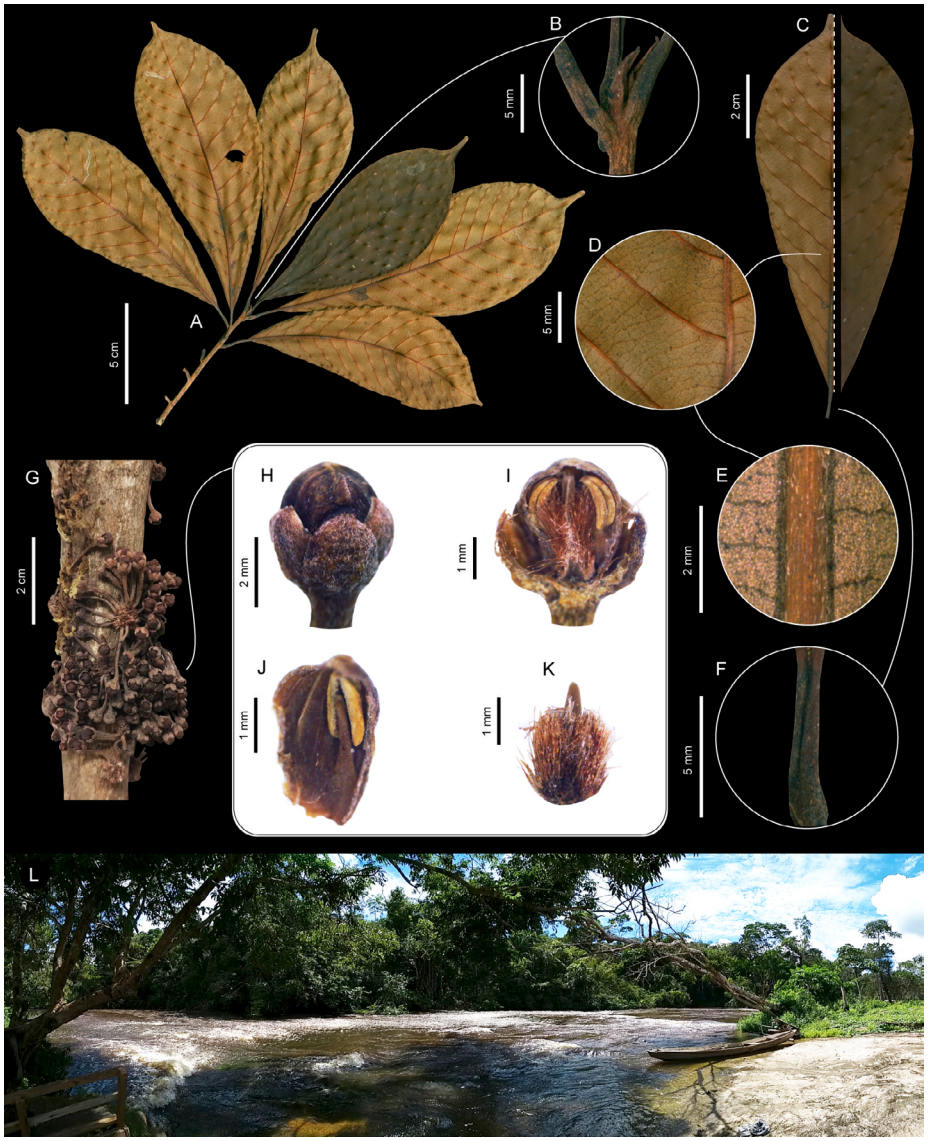

Figure 1. *Pradosia ptychandra*. **A** – Branch; **B** – Apical bud; **C** – Leaf (lower and upper surface); **D** – Tertiary leaf venation; **E** – Midrib (lower surface); **F** – Petiole; **G** – Fascicle of flowers; **H** – Flower bud (oblique-top view); **I** – Flower bud (longitudinal section); **J** – Part of open corolla exposing a stamen; **K** – Gynoecium; **L** – Panoramic view of the Maracá-Pacú River in Amapá state.

Table 1. Comparisons between *Pradosia ptychandra* and its morphologically related species. Information following Pennington (1990) and Terra-Araujo *et al*. (2015, 2016).

Characteristic	*P. ptychandra*	*P. lahoziana*	*P. lactescens*
Known geographic distribution	central and northeastern Amazonia	central Amazonia	Atlantic Forest
Soil type	clayish	sandy or occasionally clayish	clayish
Altitude (m)	70–770	50–125	~980
Buttress roots	usually absent or poorly developed	absent	present
Secondary venation (cross-section)	slightly sunken above	slightly raised or flat above	slightly sunken above
Pairs of secondary veins	10–13	≥ 13	7–12
Scales on the petiole	absent	present	absent
Pedicel length (mm)	≥ 7.0	≥ 7.0	≤ 6.0
Corolla length (mm)	5.0–5.5	≥ 6.4	4.8–6.5
Corolla indumentum	sparsely tomentulose outside	glabrous outside	usually glabrous outside
Fruit length (cm)	2.5–4.0	≤ 3.0	3.0–4.5
Fruit indumentum	glabrous	tomentulose	glabrous

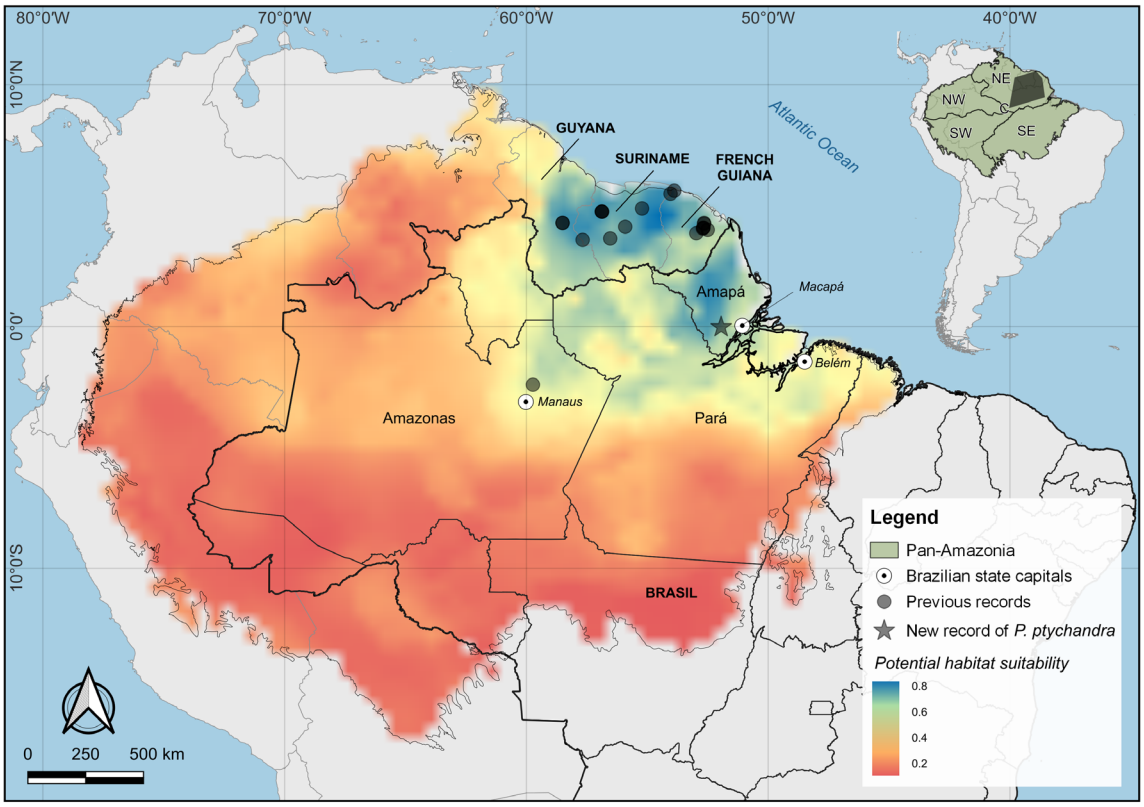

Figure 2. Distribution map of *Pradosia ptychandra*, showing previous records (black transparent circles) and a new record (black transparent star). The color gradient indicates habitat suitability.

maximum temperature of warmest month and minimum temperature of coldest month) (10–11.6 °C), wind speed (1.2–2.5 m s^{-1}), precipitation (104–303 mm), and maximum temperature (29.2–30.1 °C) are important climate parameters affecting the distribution of suitable habitat for *P. ptychandra*.

This study reinforces the importance of targeting botanical collecting efforts in remote and undersampled areas in Amazonia, such as Amapá state. We recommend prioritizing gap regions in species distributions, actively searching areas where the species presence is predicted by models. This strategy has the potential of significantly forwarding our knowledge about species distribution and discovery of new species in the Amazon.

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REFERENCES

Alves-Araújo, A.G.; Alves, M. 2012. Two new species and a new combination of Neotropical Sapotaceae. *Brittonia* 64: 23–29.

Cardoso, D.; Särkinen, T.; Alexander, S.; Amorim, A.M.; Bittrich, V.; Celis, M.; *et al.* 2017. Amazon plant diversity revealed by a taxonomically verified species list. *Proceedings of the National Academy of Sciences* 114: 10695–10700.

Carvalho, R.L.; Resende, A.F.; Barlow, J.; França, F.M.; Moura, M.R.; Maciel, R.; *et al.* 2023. Pervasive gaps in Amazonian ecological research. *Current Biology* 33: 3495–3504.

Costa, D.S.; Rossetto, E.F.S.; Terra-Araujo, M.H. 2023. A new species of *Neea* (Pisonieae, Nyctaginaceae) from central and eastern Amazonia, Brazil, with a note on the typification of *Neea ovalifolia*. *Brittonia* 75: 307–317.

Dauby, G.; Stévart, T.; Droissart, V.; Cosiaux, A.; Deblauwe, V.; Simo-Droissart, M.; *et al.* 2017. ConR: An R package to assist large-scale multispecies preliminary conservation assessments using distribution data. *Ecology and Evolution* 7: 11292–11303.

Dezécache, C.; Faure, E.; Gond, V.; Salles J.-M.; Vieilledent, G.; Hérault, B. 2017. Gold-rush in a forested El Dorado: deforestation leakages and the need for regional cooperation. *Environmental Research Letters* 12: 034013.

Eyma, P.J. 1936. Notes on Guiana Sapotaceae. *Recueil des Travaux Botaniques Néerlandais* 33: 155–210.

Faria, A.D.; Pirani, J.R.; Ribeiro, J.E.L.S.; Nylinder, S.; Terra-Araujo, M.H.; Vieira, P.P.; *et al*. 2017. Towards a natural classification of subfamily Chrysophylloideae (Sapotaceae) in the Neotropics. *Botanical Journal of the Linnean Society* 185: 27–55.

Fernández, R.A.; Santamaría-Aguilar, D.; Monro, A.K. 2022. *Pradosia golfodulcensis* (Sapotaceae) una nueva especie del Pacífico Central y sur de Costa Rica. *Harvard Papers in Botany* 27: 1–13. doi.org/10.3100/hpib.v27iss1.2022.n1

Funi, C.; Paese, A. 2012. Spatial and temporal patterns of deforestation in Rio Cajarí Extrative Reserve, Amapá, Brazil. *PLoS ONE* 7: e51893.

Gomes, V.H.F.; Vieira, I.C.G.; Salomão, R.P.; ter Steege, H. 2019. Amazonian tree species threatened by deforestation and climate change. *Nature Climate Change* 9: 547–553.

Hopkins, M.J.G. 2019. Are we close to knowing the plant diversity of the Amazon? *Anais da Academia Brasileira de Ciências* 91: e20190396.

Hopkins, M.J.G. 2007. Modelling the known and unknown plant biodiversity of the Amazon Basin. *Journal of Biogeography* 8: 1400–1411.

IUCN. 2012. *IUCN Red List Categories and Criteria.* Version 3.1. 2nd ed. (https://portals.iucn.org/library/sites/library/files/documents/RL-2001-001-2nd.pdf). Accessed on 28 Apr 2023.

IUCN. 2022. *Guidelines for Using the IUCN Red List Categories and Criteria.* IUCN Standards and Petition Committee. Version 15.1. (https://nc.iucnredlist.org/redlist/content/attachment_files/RedListGuidelines.pdf). Accessed on 28 Apr 2023.

Jébrak, M.; Heuret, A.; Rostan, P. 2021. The gold, peoples and multiple frontiers of French Guiana. *The Extractive Industries and Society* 8: 8–22.

Mouzinho, T.; Soares, M.L.; Cabral, F.N.; Marinho, L.C. 2022. Nomenclatural and taxonomic novelties in *Garcinia* (Clusiaceae) from Amazonian forest. *Phytotaxa* 548: 91–98.

Nelson, B.W.; Ferreira, C.A.C.; Silva, M.F.; Kawasaki, M.L. 1990. Endemism centres, refugia and botanical collection density in Brazilian Amazonia. *Nature* 345: 714–716.

Oliveira, A.A.; Mori, S.A. 1999. High tree species richness on poor soils. I. A central Amazonian terra firme forest. *Biodiversity and Conservation* 8: 1219–1244.

Pennington, T.D. 1990. *Flora Neotropica Monograph 52: Sapotaceae*. New York Botanical Garden, New York, 770p.

QGIS Development Team. 2022. QGIS Geographic Information System. (https://qgis.org). Accessed on 01 Dec 2022.

R Core Team. 2022. R: A Language and Environment for Statistical Computing. (https://www.r-project.org). Accessed on 06 Jun 2022.

Santana, M.M.M; Vasconcelos, R.N.; Mariano-Neto, E. 2023. Fire propensity in Amazon savannas and rainforest and effects under future climate change. *International Journal of Wildland Fire* 32: 149–163.

Schulman, L.; Toivonen, T.; Ruokolainen, K. 2007. Analyzing botanical collecting effort in Amazonia and correcting for it in species range estimation. *Journal of Biogeography* 34: 1388–1399.

Siqueira-Gay, J.; Sonter, L.J.; Sanchez, L.E. 2020. Exploring potential impacts of mining on forest loss and fragmentation within a biodiverse region of Brazil's northeastern Amazon. *Resources Policy* 67: 101662.

Stropp, J.; Umbelino, B.; Correia, R.A.; Campos-Silva, J.V.; Ladle, R.J.; Malhado, A.C.M. 2020. The ghosts of forests past and future: deforestation and botanical sampling in the Brazilian Amazon. *Ecography* 43: 979–989.

Swenson, U.; Lepschi, B.; Lowry II, P.P.; Terra-Araujo, M.H.; Santos, K.; Nylinder, S.; *et al*. 2023. Reassessment of generic boundaries in Neotropical Chrysophylloideae (Sapotaceae): Eleven reinstated genera and narrowed circumscriptions of *Chrysophyllum* and *Pouteria*. *Taxon* 72: 307–359.

Terra-Araujo, M.H.; Faria, A.D.; Swenson, U. 2016. A taxonomic update of Neotropical *Pradosia* (Sapotaceae, Chrysophylloideae). *Systematic Botany* 41: 634–650.

Terra-Araujo, M.H.; Faria, A.D.; Vicentini, A.; Nylinder, S.; Swenson, U. 2015. Species tree phylogeny and biogeography of the Neotropical genus *Pradosia* (Sapotaceae, Chrysophylloideae). *Molecular Phylogenetics and Evolution* 87: 1–13. doi.org/10.1016/j.ympev.2015.03.007

ter Steege, H.; Prado, P.I.; Lima, R.A.F.; Pos, E.; Souza-Coelho, L.; Lima-Filho, D.A.; *et al*. 2020. Biased-corrected richness estimates for the Amazonian tree flora. *Scientific Reports* 10: 10130.

Thiers, B. 2024. [continuously updated]. Index Herbariorum. A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. (http://sweetgum.nybg.org/science/ih/). Accessed on 13 Jan 2024.

Vasconcelos, C.C.; Amoêdo, S.C.; Ferraz, I.D.K.; Camargo, J.L.C.; Terra-Araujo, M.H. 2021a. Modelagem preditiva da distribuição atual de *Ecclinusa guianensis* Eyma (Sapotaceae, Chrysophylloideae) na bacia Amazônica. Proceedings of the 40th Encontro Regional de Botânicos - Regional MG, BA, ES, 6p. (http://dx.doi.org/10.29327/40ERBOT.302847). Accessed on 01 Nov 2023.

Vasconcelos, C.C.; Ferraz, I.D.K.; Adrianzén, M.U.; Camargo, J.L.C.; Terra-Araujo, M.H. 2021b. *Chromolucuma brevipedicellata* (Sapotaceae, Chrysophylloideae), a new tree species from central Amazonia, Brazil. *Brittonia* 73: 211–219.

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