



<https://doi.org/10.11646/phytotaxa.455.3.1>

Magnolia ottoi (Magnoliaceae) a new species from Purulhá, Baja Verapaz, Guatemala: conservation and Mayan Q'eqchi' ethnotaxonomy

J. ANTONIO VÁZQUEZ GARCÍA^{1,4*}, ERICK TRIBOUILLIER NAVAS^{2,3,5}, FREDY ARCHILA^{2,3,6} & MARIO ESTEBAN VÉLIZ PÉREZ^{3,7}

¹ Herbario IBUG, Laboratorio de Ecosistemática, Instituto de Botánica, Departamento de Botánica y Zoología, Universidad de Guadalajara, Camino Ing. Ramón Padilla Sánchez 2100, Nextipac, Zapopan CP 45221, Jalisco, Mexico.

² Experimental Station of Orchids of Guatemala, 1 Avenida 5-28 Zona 1, Cobán Alta Verapaz 16001, Guatemala C.A.

³ Herbarium BIGU, Escuela de Biología, Facultad de Ciencias Químicas y Farmacia Universidad de San Carlos de Guatemala, Zona 12, Guatemala City, Guatemala.

⁴ ✉ talaumaofeliae@gmail.com; <https://orcid.org/0000-0002-8393-5906>

⁵ ✉ foretribouillier@hotmail.com; <https://orcid.org/0000-0002-5052-0106>

⁶ ✉ archilae@gmail.com; <https://orcid.org/0000-0002-7849-4114>

⁷ ✉ marioeveliz64@gmail.com; <https://orcid.org/0000-0002-3134-2690>

* Corresponding author

Abstract

A new species of *Magnolia* subsect. *Talauma* (“jomcoj”), *Magnolia ottoi*, is described and illustrated. The conservation status of this new species is proposed as critically endangered (CR) according to IUCN criteria. An identification key and a map with the distribution of the new species and other species of *Magnolia* subsect. *Talauma* from Guatemala and neighboring areas (Honduras and Chiapas, México) is also presented. Our field research also unveiled the Mayan Q'eqchi' ancestral taxonomic knowledge which differentiates magnolias of two different subsections, *Magnolia* and *Talauma*, based on wood quality and properties. They consistently distinguished them as “coj” and “jomcoj” respectively.

Resumen

Se describe e ilustra una nueva especie de *Magnolia* subsect. *Talauma* (“jomcoj”), *Magnolia ottoi*. El estado de conservación de la nueva especie se propone como en peligro crítico (CR) de acuerdo con los criterios de la UICN. Además se presenta una clave de identificación y un mapa de distribución de la nueva especie y otras especies de *Magnolia* subsect. *Talauma* de Guatemala y de áreas adyacentes (Honduras y Chiapas, México). El trabajo de campo reveló que parte de la relevancia para la supervivencia de los mayas q'eqchi' depende en su conocimiento taxonómico ancestral, ya que en función de la calidad y las propiedades de la madera, pueden relacionar magnolias de dos diferentes secciones, *Magnolia* y *Talauma*, y distinguirlas de manera consistente como “coj” y “jomcoj” respectivamente.

Keywords: *Magnolia* subsect. *Talauma*, *Magnolia steyermarkii*, *Magnolia quetzal*, *Magnolia ottoi*, *Magnolia atlantida*, *Magnolia cochraneyi*, *Magnolia lacandonica*, *Magnolia perezfarrerae*, Mayan Q'eqchi'

Introduction

For nearly a century only three species of *Magnolia* Linnaeus (1753: 535) were known from Guatemala: *Magnolia guatemalensis* Donnell Smith (1909: 253), *M. mexicana* De Candolle 1817: 451), traditionally treated as *Talauma mexicana* (DC.) Don (1831: 85), and one species treated as *M. aff. yoroconte* Dandy (1930: 147), the latter still undetermined since the fruits of the cited populations are unknown (Standley & Steyermark 1946, Vázquez-García 1990, 1994); however, in the last decade, the number of species has increased to eight (Vázquez-García *et al.* 2109).

Talauma Jussieu (1789: 281), has been considered by many authors as a separate genus within Magnoliaceae Jussieu (1789: 280) (Dandy 1927, Lozano-Contreras 1994, Sima & Lu 2012), however, other authors treat it as a section or subsection of the genus *Magnolia* (Baillon 1866, Figlar & Nooteboom 2004, Wang *et al.* 2020).

A key step in understanding the great diversity of the Neotropical subsect. *Talauma*, now acknowledged as the largest subsection in the family (Vázquez-García *et al.* 2016, Wang *et al.* 2020) was determining that *Magnolia mexicana* is endemic to central Mexico and that many specimens from Mexico and Central America identified as such included over ten new species, which were subsequently segregated and described as new species, many of them based on herbarium material (Vázquez-García *et al.* 2012a, 2013b, 2019). Similarly, in Costa Rica, the name *Magnolia gloriensis* (Pittier 1910: 94) Govaerts in Frodin & Govaerts (1996: 71) was misapplied to ten of the new species of subsect. *Talauma*, recently described for Costa Rica and Panamá (Vázquez-García *et al.* 2012a, 2013b).

In Guatemala, the names *Magnolia mexicana* or its synonym *Talauma mexicana* (Juss.) Don (1831: 85), have been often misapplied to two species of subsect. *Talauma*: *Magnolia steyermarkii* A.Vázquez in Vázquez-García *et al.* (2012a: 122) (Standley & Steyermark 1946) and *M. quetzal* A.Vázquez, Véliz & Tribouillier in Vázquez-García *et al.* (2013d: 2), as labeled in the specimens Tribouillier 332, 339, 355, 549 (BIGU); also to one species of subsect. *Magnolia*: *Magnolia mayae* A.Vázquez & Pérez-Farr. in Vázquez-García *et al.* (2012b: 109), as labeled in the specimen Soto 1502 (MO, USCG). In neighboring areas north and south of Guatemala the name *Magnolia mexicana* has also been misapplied to *M. altantida* A.Vázquez in Vázquez-García *et al.* (2012a: 92) and to *M. cochraney* A.Vázquez in Vázquez-García *et al.* (2012a: 96) from Honduras and to *M. lacandónica* Vázquez-García *et al.* (2013c: 31) and *M. perezfarrerae* Vázquez-García *et al.* (2012a: 3) from Chiapas, México

Methods

In the last couple of years we have conducted several expeditions to study trees of the genus *Magnolia* and orchids in montane, pre-montane, or very humid rainforests (see Archila *et al.* 2018). During these trips, we have been assisted by members of the ancient Q'eqchi' Mayan culture who have lived in these regions for thousands of years and have an important connection with magnolia trees (Vázquez-García *et al.* 2019). Their involvement in these expeditions was very important as it allowed us to document their ancestral taxonomic understanding of the two major groups of Magnoliaceae in the country.

A recent expedition to the very humid forests of Baja Verapaz (Guatemala) led to the discovery of a new species *Magnolia* of sect. *Talauma*. An outstanding feature of this plant was the presence of stipular scars covering the entire length of the petiole and the circumscissile dehiscence. Also, its floral segments were very thick (some reaching 7 mm thick at the base) which did not match with any of the known species of this section found in Guatemala and adjacent areas of Chiapas, Mexico, or Honduras (Fig. 1). After contrasting this species with the morphologically and geographically closest species, *M. steyermarkii* and with other Mesoamerican species of *Magnolia* of Sect. *Talauma* (Table 1), we concluded that we were dealing with a new species.



FIGURE 1. Distribution of species of *Magnolia* sect. *Talauma* in Guatemala and adjacent countries.

TABLE 1. Differences between *Magnolia ottoi* and its morphological and geographically closest species, *M. steyermarkii*. DBH= Diameter at breast height.

Character	<i>M. ottoi</i>	<i>M. steyermarkii</i>
Tree height (m)	35.0–40.0	20.0
DBH (m)	1.0–1.5	0.3–0.4
Petiole length (cm)	11.0–13.0	4.0–7.5
Petiole base diameter (cm)	0.6–0.7	0.4–0.5
Leaf blade size (cm)	40.0–42.0 × 18.0–23.0	20.0–22.5 × 12.0–12.5
No. of bracts	2	1
Diameter of flower (cm)	20.2–22.2	12.0–13.0
No. of stamens	102–108	75–78
No. of carpels	38–50	30–32

Specimens were examined from pertinent herbaria BIGU, BM, EAP, F, HEH, IBUG, MEXU, MO, NY, TCD, TEFH and WIS. The herbarium acronyms follow Thiers (2020). Morphological descriptions and illustrations were based on fresh material. Leaf description and general shapes of reproductive structures follow Vázquez-García *et al.* (2016). Names of plants follow the International Plant Name Index, IPNI (2019) and we considered as accepted species names those listed in Plants of the World Online, POWO (2019). The conservation status of the new species was assessed following the criteria of IUCN (2019). We consulted the electronic database of the Global Biodiversity Information Facility (GBIF): <https://www.gbif.org/> for the different collection localities for other species of the sect. *Magnolia*. Some taxonomic literature was located and accessible using Tropicos: <http://www.tropicos.org/> and the Biodiversity Heritage Library <http://biodiversitylibrary.org>

Results

Taxonomic treatment

Magnolia ottoi A. Vázquez, Tribouillier & Archila **sp. nov.** (Figs. 2, 3)

Type: GUATEMALA. Baja Verapaz: Purulhá. 2 km south of Purulhá, 1600 m, moist-subtropical cloud forest, July 2015 (fl), Otto Alvarado (recorded by Tribouillier & Archila MG-005) (holotype BIGU; Isotype IBUG).

Magnolia ottoi is similar in leaf shape to *M. steyermarkii* but it differs from the latter in the size of its leaves (leaf length to width ratio: 1.83–2.22 vs. 1.50–1.76) and flowers (20.2–22.2 cm vs. 12.0–13.0 cm in diameter) and the number of bracts (2 vs. 1); stamens (102–108 vs. 75–78) and carpels (38–50 vs. 30–32). Also the carpels of *M. ottoi* are beaked vs. acute in *M. steyermarkii*.

Trees 35–40 m high and 1.5 m at breast height, very branched. Leaf stipules unknown. Petioles 11.0–13.0 cm long, 0.6–0.7 cm wide at the base; leaf blades 40.0–42.0 × 18.0–23.0 cm, elliptical with retuse apex; lateral leaf veins per side 12–13. Bracts 2, glabrous, the outer globose hard of 6.5 × 7.5 cm, apically slightly apiculate, the soft inner orbicular of 5.0 × 8.0 cm. Flowers 20.2–22.2 cm in diameter, cantarophilous, yellowish-white, with 3 sepals and 6 petals; sepals heteromorphic, obovate-elliptical to orbicular 7.5–10.0 × 6.0–8.5 cm, with a thickness of 0.4–0.5 cm at the base; petals 8.0–9.0 × 4–5.7 cm, 0.4–0.7 cm thick at the base, heteromorphic, more or less cymbiform, elliptical or orbicular, spatulate to spatulate-obovate, rounded apex, obtuse to inconspicuously cleft; stamens 102–108, 0.1 × 0.2 cm. Fruit ovoid, 13.0–15.0 × 7.5–8.5 cm wide, the base of fruit axis 1.6–2.2 cm in diameter, with two types of pubescence (seen under a microscope), solitary and scattered hairs along the carpels and caespitose, some of them flaky with the hardened black apices. Carpels 38–50, the basal one dorsally curved and prominently convex-gibbose with the curved apex, the middle and upper carpels primarily straight, also with the curved apex. Seeds 95, 1.1 × 1.1 cm, and 0.7 cm thick, suborbicular. In mature seeds, the sarcotesta is red and in immature seeds, the sarcotesta is whitish.



FIGURE 2. *Magnolia ottoi*. Material from the holotype, except O, collected by *Otto Alvarado* (recorded by *Tribouillier & Archila MG-007*). A. Sepals. B. Outer petals. C. Inner petals. D. Stamens. E. Gynoecium. F–G. Spathaceous bracts. H. Leaf. I. Inner fleshy petal, top view. J. Inner fleshy petal, side view. K. Developing gynoecium. L. Icon of *M. ottoi* (with flattened whorls). M. Bract of inner floral bud. N. Fruit pubescence. O. Fruit, P. Fruit axis, without seeds. Photographs by Fredy Archila.

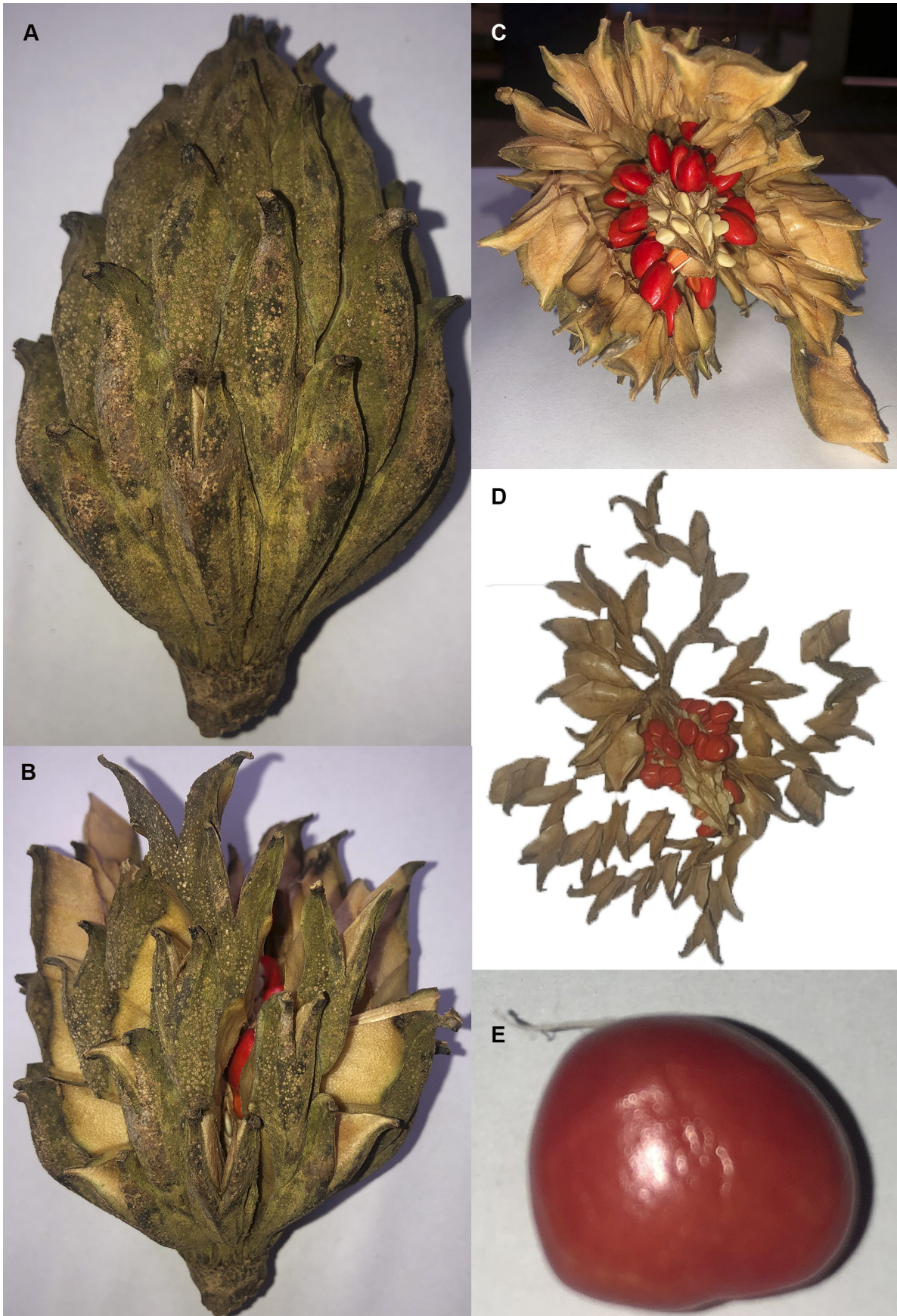


FIGURE 3. *Magnolia ottoi*. A. Fruit in the process of drying. Material collected by *Otto Alvarado* (recorded by *Tribouillier & Archila MG-007*). B. Inner side of the Fruit during dehiscence. C. Dorsal side of fruit. D. Carpels splitting and leaving the fruit axis with seeds still attached. E. Seed with red sarcotesta. Photographs by *Fredy Archila*.

Etymology and ethnobotany:—The species epithet honors Otto Alvarado, collector of the species. The ancestral Mayan (Q'eqchi') understanding of Magnoliaceae includes recognizing species of different sections classifying them as Coj (sect. *Magnolia*) and Jomcoj (sect. *Talauma*). When visiting one of the ranches one of the companions proceeded to show us two wood planks indicating that the trees of the subject. *Magnolia* (Coj) had a high-quality wood, while the trees of the subject. *Talauma* (Jomcoj) was considered bad wood for construction because its fibers are not strong enough and it was easily cracked, so they rather use them as firewood for cooking.

Distribution and ecology:—*Magnolia ottoi* is endemic to Purulhá, Baja Verapaz, Guatemala (Fig. 1). Only known from the type locality. Although 5 km from the type locality, in the Biotope of the Quetzal Mario Dary-Rivera, Fredy Archila and Erick Tribouillier observed several juvenile plants of *Magnolia*, these had very large leaves and possibly correspond to this new species. The only known trees (3) inhabit very humid forests at three different elevations 1550–1650 m, pp 2284 mm, t 16–23°C; wavy topography. Common species include: *Liquidambar styraciflua* Linnaeus (1753: 999), *Persea donnell-smithii* Mez (1892: 113), *Pinus pseudostrabus* Brongniart (1828: 46), *Persea schiedeana* Nees von Esenbeck (1836: 130), *Rapanea ferruginea* (Ruiz López & Pavón 1798: 280) Mez (1901: 429), *Clethra* spp., *Morella cerifera* (L.) Small (1903: 337), *Eurya seemanniana* Pittier (1922: 480), *Pouteria viridis* (Pittier 1914: 84) Cronquist (1946: 290) and *Magnolia archilana* A.Vázquez, Tribouill. & Véliz in Vázquez-García *et al.* (2019: 222). Flowering in March, and fruiting from March to April.

Conservation assessment:—*Magnolia ottoi* was ranked as critically endangered (CR) meeting criteria A3, B1, B2(a), C2(a)(ii) and D. of IUCN (2019). A3: A population reduction is inferred and meets criterion (d) actual or potential levels of exploitation since the locality is at risk of destruction as most of the cloud forests have been cleared to cultivate the leather leaf fern *Rumohra adiantiformis* (Forster 1786: 82) Ching (1934: 70) and agriculture. B1. The extent of occurrence <100 km², endemic to Purulhá, B2. Area of occupancy <10 km², and meets criterion (a) severely fragmented habitat and only 1 population. C. Mature individuals <250 and C2. Inferred continuing decline and meets criterion (a) (ii) number of mature individuals in one subpopulation 90-100%. D. The number of mature populations <50.

Additional specimens examined:—GUATEMALA. Baja Verapaz: Purulhá, 1550 m, March 2018 (sterile), *Otto Alvarado* (recorded by Tribouillier & Archila MG-006) (BIGU). Same location, 1650 m, March 2019 (fr), *Otto Alvarado* (recorded by Tribouillier & Archila MG-007) (BIGU).

Key to sections of Guatemalan *Magnolia*

- 1 Follicles free to mature, persistent, longitudinally dehiscent along the dorsal and ventral suture, or strictly the dorsal suture..... *Magnolia* sect. *Magnolia*
- Follicles commonly connate at maturity, dehiscent in irregular masses of a central axis with circumscissile dehiscence, open or not along the dorsal suture..... *Magnolia* sect. *Talauma*, subject. *Talauma*

Key to species of *Magnolia* subject. *Talauma* from Guatemala and adjacent areas of Chiapas, Mexico and Honduras.

- 1 Abaxial portions of carpels detaching from the fruit axis and falling mostly in large irregular many-carpelled (> 15) masses, Chiapas, México..... *M. perezfarrerae*
- Abaxial portions of carpels detaching from fruit axis and falling mostly singly, occasionally in few-carpelled (<8) masses..... 2
- 2 Carpels 7–12..... 3
- Carpels 30–96..... 4
- 3 Stamens 40–44, from north of El Quiché, Guatemala..... *M. quetzal*
- Stamens 78–82, from western highlands of Honduras..... *M. cochraney*
- 4 Carpels 94–96, stamens 304–310, from northeastern lowlands in Honduras..... *M. atlantida*
- Carpels 30–70, stamens 75–248..... 5
- 5 Stamens 198–248, carpels 61–70, Chiapas, México..... *M. lacandonica*
- Stamens 75–108, carpels 30–42..... 6
- 6 Flowers 12.0–12.5 cm in diameter, leaves 20–22.5 × 12.5–12.5 cm, stamens 75–77, carpels 30–32, from Huehuetenango, Guatemala..... *M. steyermarkii*
- Flowers of 20.2–22.2 cm in diameter, leaves 40.0–42.0 × 18.0–23.0 cm, stamens 102–108, carpels 38–42, from Baja Verapaz, Guatemala..... *M. ottoi*

Discussion

Despite the recent publication of a conspectus of *Magnolia* in Guatemala (Vázquez-García *et al.* 2019), three other species of *Magnolia* are to be added to the flora of the country. One from the Quiché Department, *Magnolia* sp. (subsect. *Talauma*) currently under study. A second species, *M.* sp. nov. ined. (sect. *Magnolia*) already submitted to *Phytotaxa* and the third one here described as a new species. Guatemala now with 11 species of Magnoliaceae is tied with Costa Rica as the two countries with highest diversity of Magnoliaceae in Central America (Vázquez-García *et al.* 2016). Furthermore, the fact that the countries do not share any of the species illustrate the high beta diversity and narrow endemism of *Magnolia* in Central America. While Guatemala has more species of sect. *Magnolia* (7 out of 11) Costa Rica has more species of sect. *Talauma* (8 out of 11), this difference represent a stronger Holarctic affinity in Guatemala vs. a stronger Neotropical affinity in Costa Rica.

Beaked carpel, in large fruits such as those of *Magnolia ottoii*, is a distinctive character, which is uncommon in Mesoamerica species of *Magnolia*. Few species such as *M. inbioana* A.Vázquez in Vázquez-García *et al.* (2012a: 106) share this character and in lesser extent *M. gloriensis*; this feature may help protect the seeds from predation by rodents and parrots, making more difficult to handle the fruit.

Advancement and development of social groups are usually linked to technological progress, and this is often originated from small ancestral discoveries (Diamond 1997). For instance, ancestral drinks of the Mayan culture, particularly the study of the ethnotaxonomic elements of the milkshake or cocoa called “kakao” (Archila & Lancerio 2010) or atole (Sánchez Cuahua 2016) help us understand ancient manufacturing processes of highly nutritious beverages, that nowadays have become alternatives for peasant communities with nutrition problems. Likewise, Mayan Q’eqchi’ ethnotaxonomic knowledge of the *Magnolias* of sections *Magnolia* and *Talauma* and their relation to the wood quality and properties may eventually guide appropriate silvicultural and wood management practices and help achieve technological progress.

Since *Magnolia ottoii* does not occur inside any area of the Guatemalan System of Protected Areas (SIGAP) (CONAP 2011). Given its scarcity, we recommend INAB (National Forest Institute) and CONAP (National Council of Protected Areas) to secure the survival of this new species, through an integrated conservation management plan including other endemic species of this genus.

Conclusions

A new and narrow endemic species of *Magnolia*, *Magnolia ottoii*, is added to the flora of Guatemala. Using IUCN criteria, the species was ranked as critically endangered and we recommend its immediate protection. The presence of beaked carpels is a distinctive and uncommon character among Mesoamerican species of *Magnolia*. Our study also showed that advanced ethnotaxonomic and ethnobotanical knowledge of *Magnolias* is preserved in the Mayan Q’eqchi’ culture.

Acknowledgments

We thank Stefania Archila for helping us collect data here presented and suggestions on an earlier draft of this article; Otto Alvarado for facilitating his botanical collections, assistance from the curators from BIGU, and Michelle Catalán (Escuela de Biología de la Universidad de San Carlos) for his help creating the distribution map. Support from the University of Guadalajara-CUCBA (PRO-SNI and p3E programs), PRODEP-SEP and SNI-CONACyT in Mexico is also acknowledged. We are also grateful for the comments of reviewers and Mark Chase, the subject editor of *Phytotaxa*, whose advice greatly improved our manuscript.

References

- Archila, F., Chiron, G., Szlachetko, D., Lipinska, M., Bertolini, V. & Mystkowska, K. (2018) *Orchid genera and species in Guatemala*. Koeltz Botanical Books, Germany, 724 pp.
- Archila, F. & Lancerio, J. (2010) EL batido o kakao, la bebida de los dioses. *Guatemalensis* 13 (1): 1–14.
- Baillon, H.E. (1866) Mémoire sur la famille des Magnoliacées. *Adansonia* 7: 65–69.
- Brongniart, M.A. (1828) Notice sur les plantes d'Armissan, pres Narbonne. *Annales des Sciences Naturelles (Paris)* 15: 43–51.
- Ching, R.C. (1934) A revision of the compound leaved *Polysticha* and other related species in the continental Asia including Japan and Formosa. *Sinensia* 5: 23–91.
- Cronquist, A. (1946) Studies in Sapotaceae 2, Survey of the North American genera. *Lloydia* 9: 2241–292.
- IUCN Standards and Petitions Committee (2019) Guidelines for Using the IUCN Red List Categories and Criteria. Version 14. Standards and Petitions Committee, 113 pp. Available from: <http://www.iucnredlist.org/documents/RedListGuidelines.pdf> (accessed 7 July 2020)
- CONAP (2011) *The Guatemalan System of Protected Areas: fundamental basis for the fundamental development of the well-being of Guatemalan society*. CONAP / ZOOTROPIC, Guatemala, 360 pp.
- Dandy, J.E. (1927) The genera of Magnoliaceae. *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)* 1927: 257–264. <https://doi.org/10.2307/4107601>
- Dandy, J.E. (1930) A new *Magnolia* from Honduras. *Journal of Botany* 68: 146–147.
- De Candolle, A.P. (1817) *Regni vegetabilis systema naturale* 1. Treuttel & Würtz, Paris, 745 pp.
- Diamond, J. (1997) *Guns, germs, and steel: the fates of human societies*. W.W. Norton & Company, New York, 480 pp.
- Don, G. (1831) *A general history of the dichlamydeous plants* 1. Gilbert & Rivington, London, 818 pp.
- Figlar, R.B. & Nootboom, H.P. (2004) Notes on Magnoliaceae IV. *Blumea* 49: 87–100. <https://doi.org/10.3767/000651904X486214>
- Forster, G. (1786) *Florulae Insularum Australium Prodrromus*. Typis Joann. Christian Dieterich. Göttingen, Germany, 114 pp. <https://doi.org/10.5962/bhl.title.10725>
- Frodin, D.G. & Govaerts, R. (1996) *World checklist and bibliography of Magnoliaceae*. Kew Publishing, London, 79 pp.
- Jussieu, A.L. (1789) *Genera plantarum* 1. Herissant et Barrois, Paris, 498 pp.
- Linnaeus, C. (1753) *Species plantarum*. Salvius, Stockholm, 560 pp.
- Lozano-Contreras, G. (1994) *Dugandiodendron y Talauma (Magnoliaceae) en el Neotrópico*. Academia Colombiana de Ciencias Exactas, Bogotá, 147 pp.
- Mez, C.C. (1892) Arbeiten aus dem Königl. Botanischen Garten zu Breslau 1: 113–114.
- Mez, C.C. (1901) IX, Myrsinaceae. *Symbolae Antillanae seu Fundamenta Florae Indiae Occidentalis* 2: 389–433.
- Nees von Esenbeck, C.G.D. (1836) *Systema Laurinarum*. Sumptibus Veitii et Sociorum, London, 720 pp.
- Pittier, H.F. (1910) New or noteworthy plants from Colombia and Central America–2. Magnoliaceae. The Costa Rican species of *Talauma*. *Contributions from the United States National Herbarium* 13: 93–94.
- Pittier, H.F. (1914) New or noteworthy plants from Colombia and Central America–4. *Contributions from the United States National Herbarium* 18: 69–76.
- Pittier, H.F. (1922) New or noteworthy plants from Colombia and central America–8. *Contributions from the United States National Herbarium* 20: 453–491.
- POWO (2019) Plants of the world online. Facilitated by the Royal Botanic Gardens, Kew, published on the internet, Kew Sciences. Available from: <http://www.plantsoftheworldonline.org/> (accessed 13 April 2019)
- Ruiz López, H. & Pavón, J.A. (1798) *Systema Vegetabilium Florae Peruvianaet Chilensis*, Typis Gabrielis de Sancha, Madrid, 456 pp.
- Sánchez-Cuahua, R. (2016) *Magnolia mexicana* (DC.) G. Don, en la Sierra de Zongolica, Veracruz: estudio poblacional y conocimiento tradicional. Thesis, Instituto Tecnológico Superior de Zongolica, Veracruz, México, 84 pp.
- Sima, Y.K. & Lu, S.G. (2012) A new system for the family Magnoliaceae. In: Xia, N.H., Zeng, Q.W., Xu, F.X. & Wu, Q.G. (Eds.) *Proceedings of Second International Symposium on the Family Magnoliaceae*. Huazhong University of Science & Technology Press, Wuhan, China, pp. 55–71.
- Small, J.K. (1903) *Flora of the southeastern United States*. New York, 1370 pp.
- Standley, P.C. & Steyermark, J.A. (1946) Magnoliaceae. In: Standley, P.C. & Steyermark, J.A. (Eds.) *Flora of Guatemala—Part IV. Fieldiana, Botany* 24: 266–269.
- The International Plant Names Index, IPNI (2019) Published on the Internet. Available from: <http://www.ipni.org> (accessed 13 April 2019)
- Thiers, B. (Ed.) (2019) *Index herbariorum: a global directory of public herbaria and associated staff*. New York Botanical Garden's

Virtual Herbarium. Available from: <http://sweetgum.nybg.org/science/ih/> (accessed 13 April 2019)

- Vázquez-García, J.A. (1990) *Taxonomy of the genus Magnolia (Magnoliaceae) in Mexico and Central America*. M.S. Thesis. University of Wisconsin, Madison, 224 pp.
- Vázquez-García, J.A. (1994) *Magnolia (Magnoliaceae) in Mexico and Central America: a synopsis*. *Brittonia* 46: 1–23.
<https://doi.org/10.2307/2807454>
- Vázquez-García, J.A., Gómez-Domínguez, H., López-Cruz, A., Espinosa-Jiménez, J.A., Sahagún-Godínez, E. & Muñiz-Castro, M.Á. (2013a) *Magnolia perezfarrerae* a new species and a key to Mexican species of *Magnolia* section *Talauma* subsection *Talauma* (Magnoliaceae). *Botanical Sciences* 91: 1–9.
<https://doi.org/10.17129/botsoci.38>
- Vázquez-García, J.A., Muñiz-Castro, M.Á., Arroyo, F., Pérez, Á.J., Serna, M. & De Castro-Arce, E. (2013b) Novelty of Conservation Concern in Neotropical *Magnolia* and a proposed addendum to the IUCN Red List of Magnoliaceae. In: Salcedo-Pérez, E., Hernández-Álvarez, E., Vázquez-García, J.A., Escoto-García, T. & Díaz-Echavarría, N. (Eds.) *Recursos Forestales en el Occidente de México, diversidad, manejo, aprovechamiento y conservación*. Serie Fronteras de Biodiversidad, Vol. 4 (2). Universidad de Guadalajara CUCEI-CUCBA, Guadalajara, pp. 461–496.
- Vázquez-García, J.A., Muñiz-Castro, M.Á., De Castro-Arce, E., Murguía-Araiza, R., Nuño-Rubio, A.T. & de J. Cházaro-B., M. (2012a) Twenty new Neotropical tree species of *Magnolia* (Magnoliaceae). In: Salcedo Pérez, E., Alvarez, E.H., Vazquez Garcia, J.A., Escoto Garcia, T., Diaz Echabarría, N. (Eds.) *Recursos forestales del occidente de México: diversidad, manejo, aprovechamiento y conservación*. Serie Fronteras de Biodiversidad, Vol. 4 (1). Universidad de Guadalajara CUCEI-CUCBA, Guadalajara, pp. 91–131.
- Vázquez-García, J.A., Neill, D.A., Asanza, M., Pérez, A.J., Arroyo, F. Dahua-Machoa, A. & Merino-Santi, R.E. (2016) *Magnolias de Ecuador: en riesgo de extinción*. Universidad Estatal Amazónica, Universidad de Guadalajara-CUCBA, Pontifical Catholic University of Ecuador, Universidad Nacional Agraria La Molina, Puyo, Ecuador, 128 pp.
- Vázquez-García, J.A., Pérez-Farrera, M.A., Martínez-Camilo, R., Muñiz-Castro, M.Á. & Martínez-Meléndez, N. (2013c) *Magnolia lacandonica* (subsect. *Talauma*, Magnoliaceae), a new rainforest species from Chiapas, Mexico. *Phytotaxa* 79: 30–36.
<https://doi.org/10.11646/phytotaxa.79.1.2>
- Vázquez-García, J.A., Pérez-Farrera, M.A., Martínez-Meléndez, N., Nieves-Hernández, G. & Muñiz-Castro, M.A. (2012b) *Magnolia mayae* (Magnoliaceae), a new species from Chiapas, Mexico. *Botanical Sciences* 90: 109–112.
<https://doi.org/10.17129/botsoci.478>
- Vázquez-García, J.A., Tribouillier-Navas, E., Archila, F. & Véliz-Pérez, M.E. (2019) A conspectus of *Magnolia* (Magnoliaceae) in Guatemala: novelties and conservation concern. *Phytotaxa*: 427 (4): 221–238.
<https://doi.org/10.11646/phytotaxa.427.4.1>
- Vázquez-García, J.A., Véliz-Pérez, M.E., Tribouillier-Navas, E. & Muñiz-Castro, M.Á. (2013d) *Magnolia quetzal* and *Magnolia mayae*, a new species and a new record, respectively, for the flora of Guatemala. *Phytotaxa* 76: 1–6.
<https://doi.org/10.11646/phytotaxa.76.1.1>
- Wang, Y.B., Liu, B.B., Nie, Z.L., Chen, H.F., Chen, F.J., Figlar, R.B. & Wen, J. (2020) Major clades and a revised classification of *Magnolia* and Magnoliaceae based on whole plastid genome sequences via genome skimming. *Journal of Systematics and Evolution*.
<https://doi.org/10.1111/jse.12588>