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Magnolia poqomchi, a new species of subsection *Magnolia* (Magnoliaceae) from San Cristóbal Verapaz, Alta Verapaz, Guatemala

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Abstract

In the last decade, several species of magnolias have been described for Guatemala, five of which are found in Alta Verapaz, where, during an exploratory survey, we found a specimen that did not correspond morphologically to any previously reported species. To obtain material and determine phenology, several individuals were monitored for a year. Here, we describe this as a new species of *Magnolia* subsection *Magnolia* (Magnoliaceae). It is distributed in the cloud forest of San Cristóbal Verapaz, Alta Verapaz, and is culturally important for the local villagers. It differs from other similar species, *M. montebelloensis* and *M. tribouillierana*, in having an abruptly acuminate leaf apex (drip tip), larger flowers, purple staminophores and more stamens, among other traits. According to IUCN criteria, *M. poqomchi* is critically endangered [B1ab (iii), B2ab (iii)]. Additionally, we include a dichotomous key and distribution map for the genus in Guatemala. Taking this record into account, there are a total of ten native species reported for Guatemala, making it an important centre of species diversity for magnolias.

Resumen

En la última década se han descrito varias especies de magnolias para Guatemala, de las cuales cinco se encuentran en Alta Verapaz. Durante un muestreo exploratorio en este departamento, se encontró un espécimen cuyas características no correspondían a las especies previamente reportadas. Para obtener material y determinar la fenología, se monitorearon varios individuos a lo largo de un año. En este documento, se describe una nueva especie de *Magnolia* subsección *Magnolia* (Magnoliaceae). Esta se distribuye en el bosque nuboso de San Cristóbal Verapaz, Alta Verapaz y es culturalmente importante para los pobladores de la región. Se diferencia de otras especies similares, *M. montebelloensis* y *M. tribouillierana*, por tener el ápice de las hojas abruptamente acuminado (punta de goteo), flores de mayor tamaño, estaminóforos púrpuras y mayor número de estambres, entre otras. *Magnolia poqomchi* se encuentra críticamente amenazada [B1ab(iii), B2ab(iii)] según los criterios de la IUCN. Adicionalmente, se incluye una clave dicotómica y un mapa de distribución para el género dentro del país. Tomando en cuenta este registro, Guatemala suma 10 especies de *Magnolia* siendo un importante centro de diversidad para estas.

Introduction

Magnoliaceae has over 350 species distributed in the tropical to temperate regions of Asia and the Americas (Simpson 2010, Vázquez-García *et al.* 2016). Biogeographic processes resulted in the diversification of the family in tropical latitudes (Shalisko *et al.* 2015), which is illustrated by a large number of endemic species in the mountains of Mexico,

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Central América and South America (Vázquez-García 1994, Vázquez-García *et al*. 2017, 2019, Dominguez-Yescas & Vázquez-García 2019).

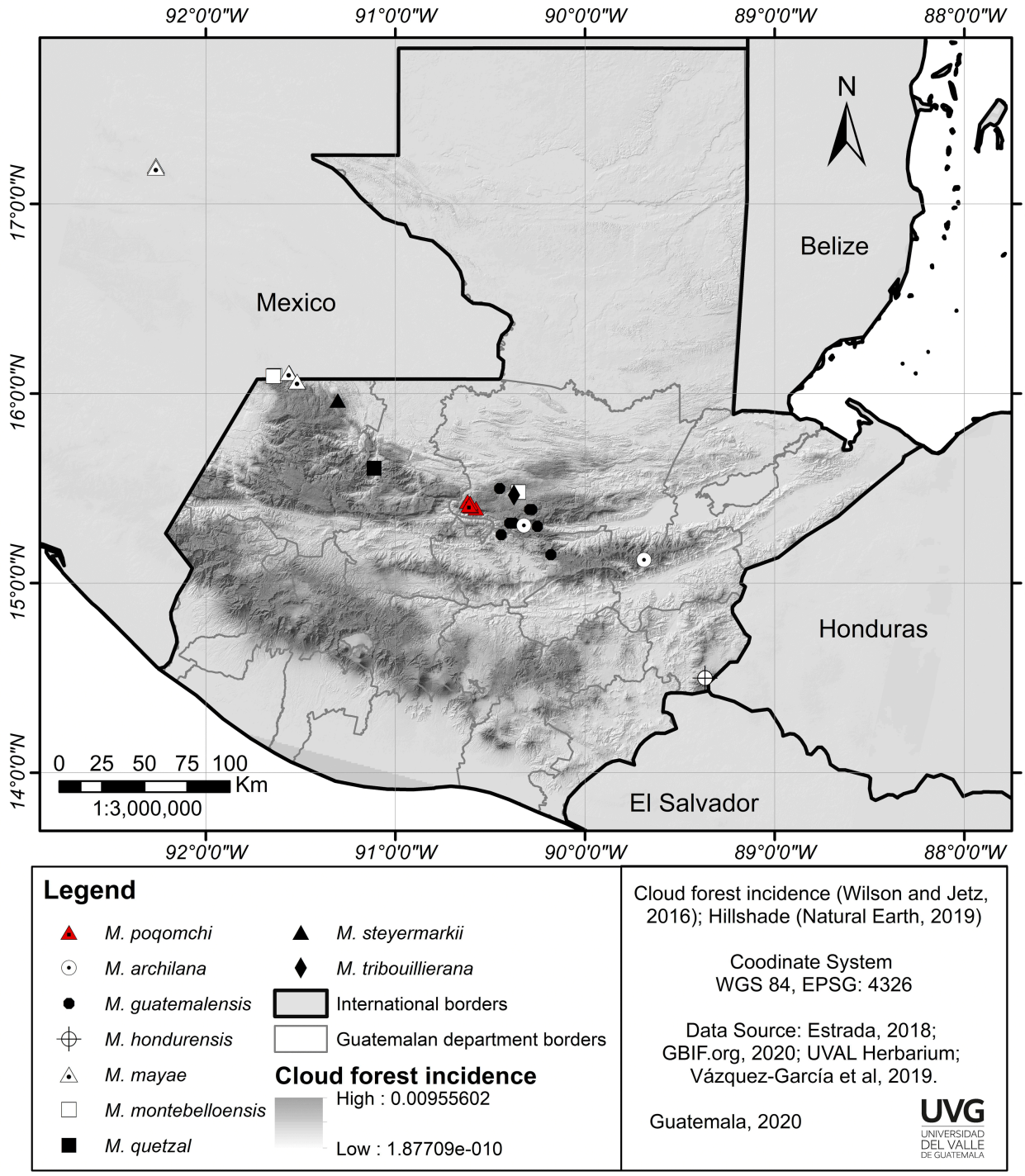

FIGURE 1. Distribution of *Magnolia* species in Guatemala in relation to the cloud forest incidence.

In 2008, Parker listed three species as native to Guatemala, of which *M. yoroconte* Dandy (1930: 147) and *M. mexicana* Candolle (1817: 451) are no longer considered present. Many species have been described in the last decade for this country (Vázquez-García *et al*. 2012a, 2012b, 2013, 2017, 2019). In 2019, Vázquez-García *et al.* reported two species of *M*. section *Talauma* (1789: 281): *M. steyermarkii* Vázquez (2012a: 122) and *M. quetzal* A.Vázquez, Véliz & Tribouillier in Vázquez-García *et al.* (2013: 2), and six of *M.* section *Magnolia*: *M. guatemalensis* Donnell Smith (1909: 253), *M. montebelloensis* A.Vázquez & Pérez-Farrera in Vázquez-García *et al*. (2017: 104), *M. mayae* A.Vázquez & Pérez-Farrera in Vázquez-García *et al*. (2012b: 109), *M. hondurensis* Molina-Rosito (1974: 95), *M. archilana* A.Vázquez, Tribouillier & Véliz in Vázquez-García *et al*. (2019: 222) and *M. tribouillierana* A.Vázquez,

Archila & Véliz in Vázquez-García *et al*. (2019: 228). Additionally, it is also common to find *M. grandiflora* Linnaeus (1759: 1082) and *M. champaca* (Linnaeus 1753: 536) Baillon ex Pierre (1880: pl. 3) cultivated as ornamentals (Parker, 2008). Another new species of *M.* section *Talauma* from Baja Verapaz has been proposed (Vázquez-García *et al*. in press). Here, we describe *Magnolia poqomchi*, a new species of *M.* section *Magnolia* from the mountains of San Cristóbal Verapaz, Alta Verapaz. Taking these records into account, there are a total of ten native species reported for the country (Fig. 1). Six of these are present in Alta Verapaz, making this Department an important centre of species richness for the family.

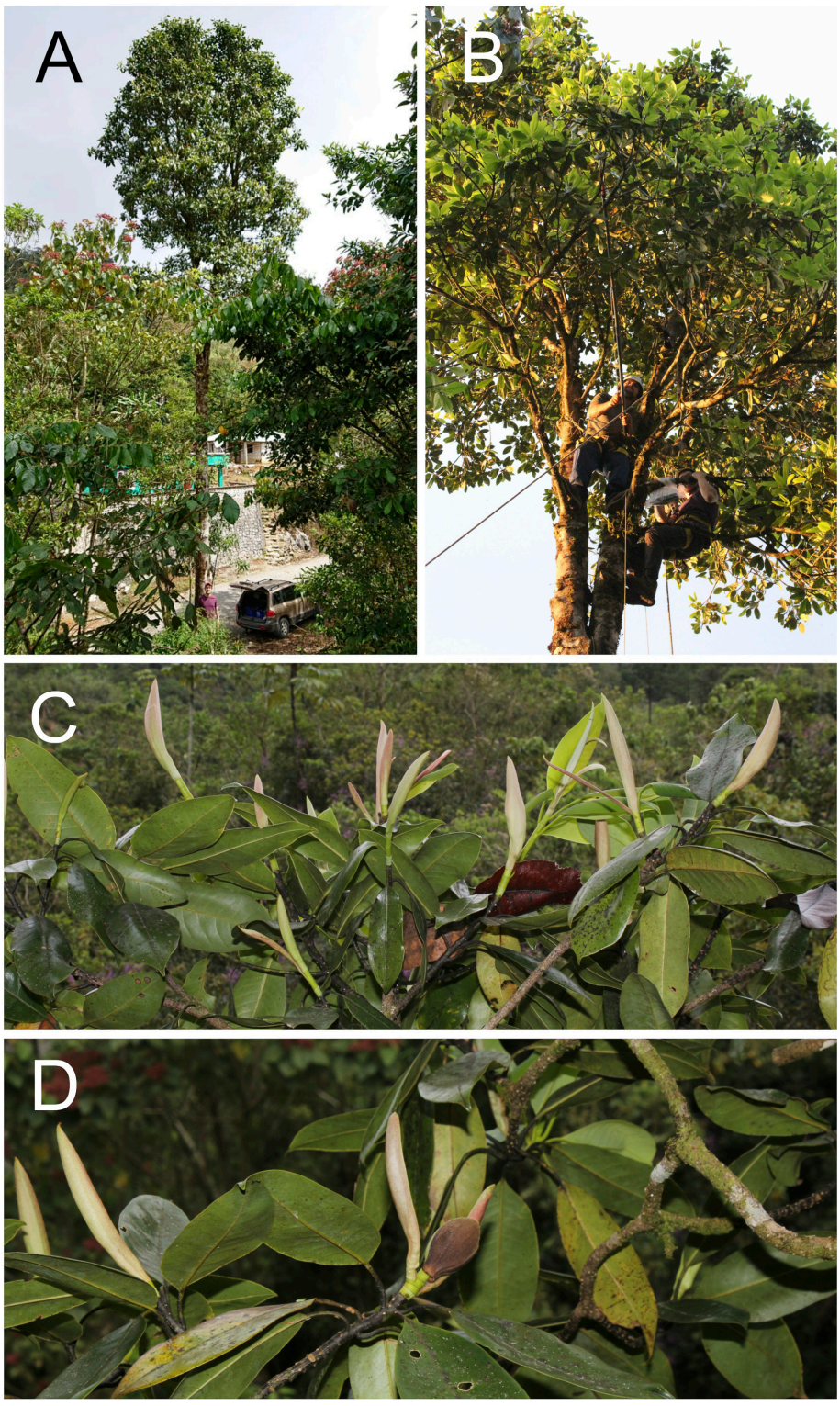

FIGURE 2. *Magnolia poqomchi.* A. Tree, standing below is Rafael Grajeda-Estrada. B. Andrés Villalobos & Marcelo J. Serrano collecting flowering material. C. Leaves and stipules at the treetop. D. Flower bud with spathaceous bract and axillary stipules. Photographs by Rafael Grajeda-Estrada of the holotype individual.

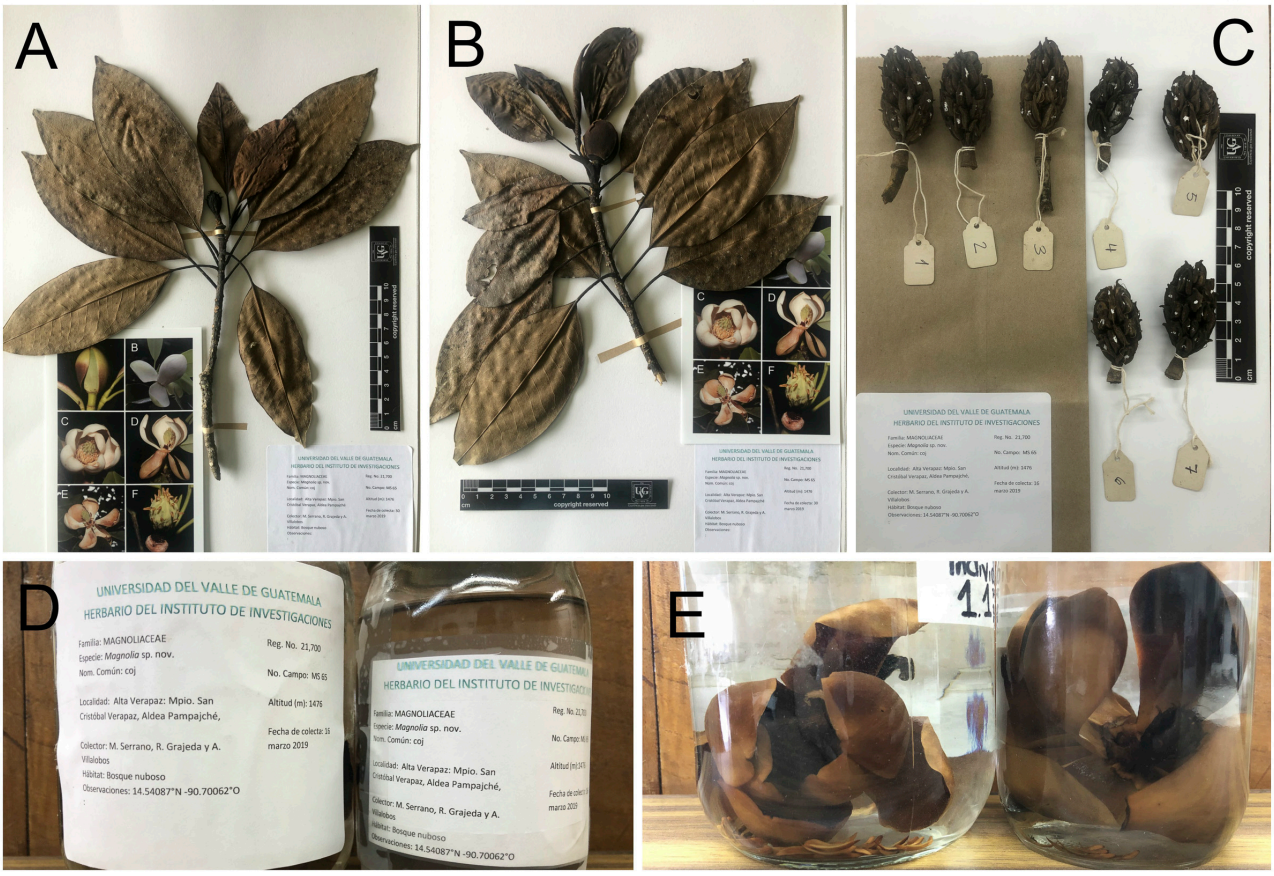

FIGURE 3. Preserved material of the holotype of *Magnolia poqomchi.* A–B. Pressed and mounted material. C. Stored material of mature fruits without seeds. D–E. Flowers in spirit collection. Photographs by María Renée Álvarez-Ruano.

The first individual of *M. poqomchi* was found on August 2018 with the help of local guides during an exploratory survey in a broadleaf cloud forest at Finca Pamac II, San Cristóbal Verapaz. Only leaves and fruits were collected and preserved for the classification of the species.

According to Figlar & Nooteboon (2004), the species belongs to *M.* section *Magnolia*. Adopting Cronquist´s morphological species concept (Cronquist 1978, Lozano 1994) and using the keys to species of *Magnolia* in Guatemala (Vázquez-García *et al*. 2019), Mexico and Central America (Vázquez-García 1994), we readily realized that it did not match any of the Mesoamerican species. Based on these keys, specimens examined at pertinent herbaria (BIGU, ENCB, F, MEXU, MO, IBUG, MO, NY, WIS and UVAL) and high-resolution images of type material (Tropicos. org 2020, JSTOR 2020) we concluded that we were dealing with an undescribed species. The morphologically most similar species is *M. montebelloensis.*

Over a year (August 2018 to June 2019), we visited several sites in San Cristóbal Verapaz, covering a 686 m elevational gradient (1476–2162 m) in order to obtain fertile material. With the help of local guides, we located other populations and sufficient individuals to understand morphological variability of the species. Vegetative and reproductive material from the tree crown were collected using the single rope climbing technique (Fig. 2B). Habitat and phenology data were obtained from sampling various individuals at different seasons, and local field guides, carpenters and villagers provided the ethnobotanical information.

Magnolia tepals usually deteriorate and lose shape when pressed dry. These floral parts and stamens also tend to fall off with this preservation method. Therefore, the first flowers we found where stored in a spirit solution (75% ethanol, 20% distilled water and 5% glycerin) to keep their shape and size. Leaf stipules and floral buds were also stored with this method since their size decreases when pressed. The vegetative structures and reproductive material collected afterward were pressed dry and mounted (Fig. 3).

Fresh material and pictures were the basis for the morphological description of this species. All measurements were made from living material, and fine observations and measurements of reproductive structures were made with the aid of a dissecting microscope (Leica Wild MZ8) (Table 1). The key to the species was generated from protologues and descriptions of all nine published Guatemalan species of *Magnolia.* The drawing was based on the type material.

TABLE 1. Morphological differences between *Magnolia poqomchi*, *M. montebelloensis*, *M tribouillierana* and *M. guatemalensis*.

	M. poqomchi	*M. montebelloensis*	*M. tribouillierana*	*M. guatemalensis*
Distal youngest internodes	Glabrous	Glabrescent to pubescent	Glabrous	Glabrous
Stipule length (cm)	8.0–10.0	7.0–11.1	N/A	8.0–15.0
Leaf shape, apex and abaxial pubescence	Elliptic to oblong elliptic, abruptly acuminate (drip tip), glabrous	Oblong lanceolate, acute, glabrous	Lanceolate-oblong or lanceolate-obovate, acute, glabrous	Broadly ovate-elliptic to obovate to suborbicular, subacute to almost rounded, ferruginous sericeous when young
Leaf size (cm)	(13.5–)15.7–22.5 × 5.0–8.2	(9.0–)15.3–20.2(–22.0) × (3.5–)6.6–8.5(–10.8)	6.0–10.0 × 3.0–5.0	12.0–16.0 × 5.5–11.0
Lateral leaf veins per side	13–17	11–12	14–16	13–16
Length (cm) of largest peduncular internode in mature polyfollicles	1.8–2.6	1.0–1.5	2.4–2.6	2.8–3.2
No. and pubescence of spathaceous bracts	2; covered with long golden yellowish hairs	3; densely covered with long golden yellowish hairs	2; glabrous	N/a; glabrous
Length and width of Sepals (cm)	4.7–5.8 × 3.7–4.6	4.2–4.3 × 2.7–2.8	4.0–4.5 × 3.0–3.3	5.8–6.0 × 2.1–2.2
Length and width of outer petals (cm)	(4.8–)5.6–7.4 × 3.5–5.7	5.3–5.4 × 2.6–2.7	4.5–4.9 × 2.3–2.8	6.5–7.0 × 2.8–3.0
Length and width of inner petals (cm)	4.7–5.6(–6.6) × 3.0–3.7(–4.7)	4.4–4.5 × 2.0–2.3	2.3–3.6 × 2.0–2.3	N/a
Basal diameter (mm) and color of staminal axis	6.7–7.6; purple	8.0–9.0; reddish	N/a; reddish	3.9–4.4; brown
No. of stamens	92–94	(53–)60–66(–85)	80–90	92–98
Carpel indumentum	Glabrous	Pubescent	Glabrous	Glabrous
Size of mature polyfollicles (cm)	3.8–5.2 × 2.2–2.8	5.4–6.3 × 2.5–2.7	5.0–7.5 × 2.3–2.7	3–5.7 × 1.9–2.1
No. and pubescence of follicles	26–32; glabrous	(22–) 24–34 (–35); glabrescent to pubescent	42–46; n/a	22–38; pubescent

Taxonomy

Magnolia poqomchi M.J.Serrano & A.Vázquez, *sp. nov.* (Figs 2–6)

Type:—GUATEMALA. Alta Verapaz: Municipio de San Cristóbal Verapaz, Aldea Pampajche, near roadside, 14.54087°N-90.70062°W, 1476 m, 16 Mar 2019, *Serrano MS-065* w/*Grajeda-Estrada & Villalobos* (fl bud, fr) (holotype: UVAL!; isotype: IBUG!).

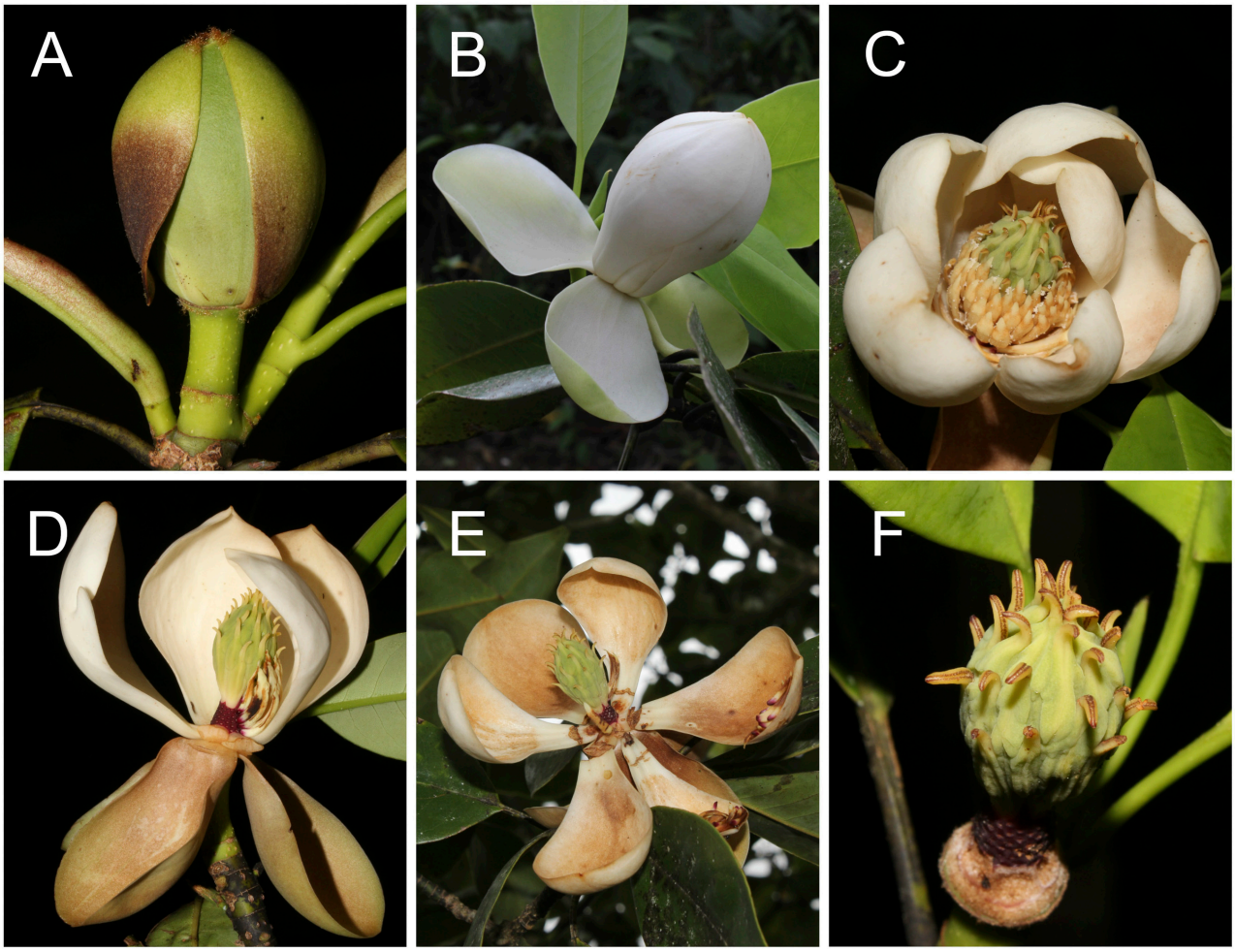

FIGURE 4. *Magnolia poqomchi.* A. Flower bud with hirsute spathaceous bract. B. Closed flower. C. Flower during male phase. D. Flower after male phase, dropping the stamens. E. Late flower, after male phase. F. Gynoecium with yellowish green stigmas. Photographs by Rafael Grajeda-Estrada from holotype.

Magnolia poqomchi resembles *M. montebelloensis* in the size of their leaves, similar stipules and the number of carpels in the fruit. However, it differs from the latter in having an abruptly acuminate a leaf apex (drip-tip) vs. acute; more numerous lateral leaf vein pairs, 13–17 vs. 11–12; longer peduncular internodes in mature polyfollicles, 1.9–2.6 vs. 1.0–1.5 cm; spathaceous bracts 2 vs. 3; wider sepals, 3.7–4.6 vs. 2.7–2.8 cm, and tepals, 3.0–5.7 vs. 2.0–2.7 cm; staminophores purple vs reddish, more numerous stamens, 92–94 vs. (53)60–66(85) and shorter polyfollicles, 3.8–5.2 vs. 5.4–6.3 cm. It also differs from *M. tribouillierana* in having a leaf apex abruptly acuminate (drip tip) vs. acute; larger leaves, 15.7–22.5 × 5–8.2 vs. 6.0–10.0 × 3.0–5.0 cm; spathaceous bracts pubescent vs. glabrous; longer sepals, 4.7–5.8 vs. 4.0–4.5 cm, and tepals, 4.7–7.4 vs.4.4–5.4 cm, more numerous stamens, 92–94 vs.80–90; shorter polyfollicles 3.8–5.2 vs.5.0–7.5 cm and fewer follicles 22–38 vs. 42–46.

Evergreen trees, 15.0–22.0 (30.0) m tall, 0.3–0.7 (1.0) m dbh; bark greyish brown and smooth; twig width 0.4–0.8 cm, twig internodes glabrous, lenticellate; petioles 1.0–3.8 × 0.2 cm, glabrous, stipular scar absent; stipules free from petioles, 8.0–10.0 × 0.9–1.3 cm, pinkish, densely pubescent; early leaf buds densely pubescent, pubescence beige; leaves elliptic to oblong elliptic, (13.5–) 15.7–22.5 × 5.0–8.2 cm, base slightly attenuate to obtuse, apex abruptly acuminate (drip tip), adaxially and abaxially glabrescent; largest peduncular internodes 1.9–2.6 × 4.1–6.4 cm; flower buds ovoid to oblongoid, 21.5–30.4(–35.3) × 17.8–21.0(–25.3) mm, consisting of two spathaceous, densely hirsute

bracts with golden yellowish hairs; flowers terminal, solitary, 7.3–11.0 cm in diameter when open, creamy white, turning brown; sepals 3, 4.7–5.8 × 3.7–4.6 cm, greenish white; petals 6, outer ones (4.8) 5.6–7.4 × 3.5–5.7 cm, obovate, gradually narrowing toward the base, creamy white; inner petals 4.7–5.5(6.6) × 3.0–3.7(4.7) cm, obovate, creamy white, fragrant; staminophore 0.7–0.8 × 0.5–0.7 cm, purple; stamens 92–94, (14.7–)16.0–17.8 × 2.7–3.4 mm, laminar, creamy white, purple at base, the connective obtuse to acute, strongly arched; stigmas 2–3 mm, slightly curled and beaked, persistent, yellowish green; fruit a polyfollicle, ellipsoid-oblongoid, 3.8–5.2 × 2.2–2.8 cm, green turning dark brown, glabrous; carpels 26–32, basal carpels (13.9–)15.0–20.2 × (5.0–)5.9–7.5(–9.5) mm, acute at the apex, the beaks 2–3 mm, glabrous; seeds 1–2 per carpel, 0.7–0.9 × 0.6–0.8 × 0.4 cm, scarlet red.

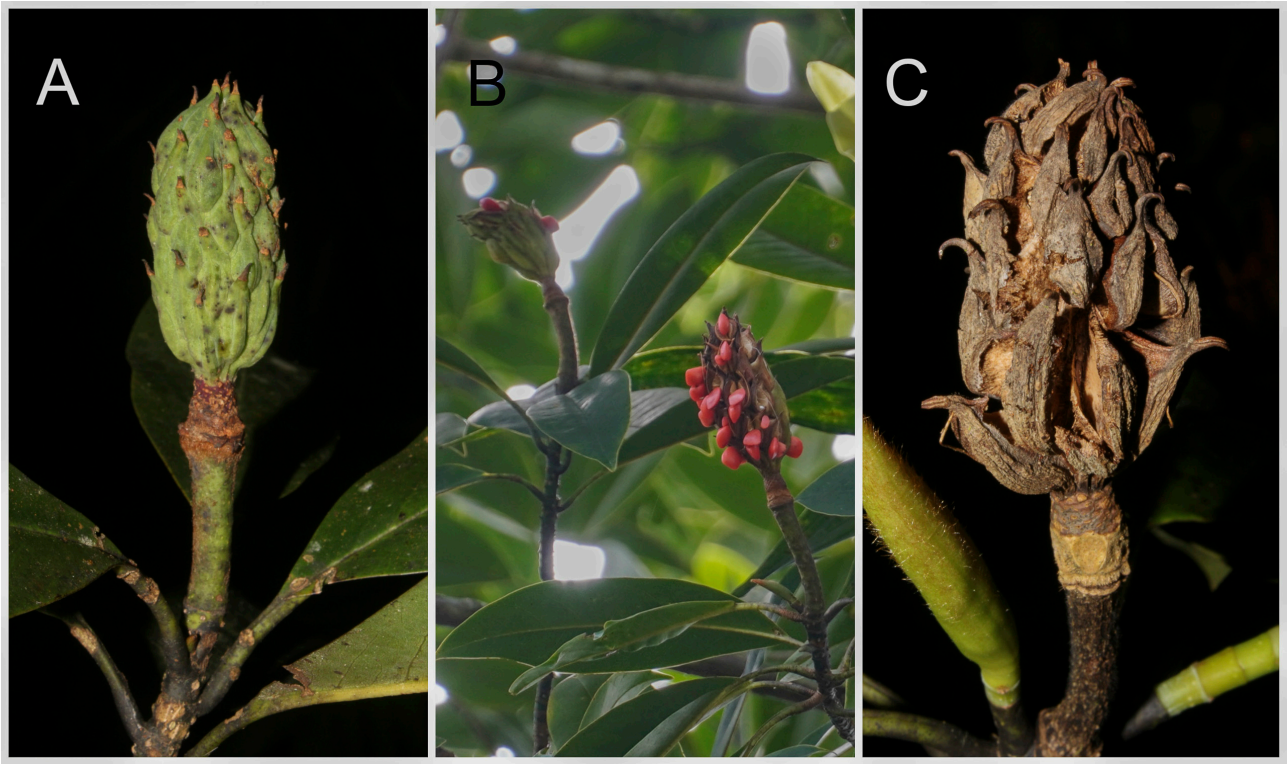

FIGURE 5. *Magnolia poqomchi.* A–F. Fruit maturation to dehiscence. Photographs by Rafael Grajeda-Estrada & Marcelo J. Serrano, A & C from the holotype; B from paratype.

Phenology:—Flowering March–July; fruiting July–September.

Distribution, ecology and conservation status:—Known only from the highlands of San Cristóbal Verapaz, Alta Verapaz, where it was first collected in the private reserve, Finca Pamac II. Additional individuals were located in the surrounding areas, some in front of houses in Pampajche. The species is found from 1,450 to 2,200 m elevation at a subtropical lower montane rain forest according to De la Cruz (1982) or tropical lower montane rain forest according to IARNA (2018). Other species commonly found at this location are *Hedyosmum mexicanum* Cordemoy (1863: 307), Chloranthaceae; *Quercus* spp., Fagaceae; *Alfaroa guatemalensis* (Standley 1940: 12) Williams & Molina-Rosito (1970: 208), Juglandaceae; *Dendropanax arboreus* (Linnaeus 1759: 967) Decaisne & Planchon (1854: 107), Araliaceae; *Prunus lundelliana* Standley (1940: 77), Rosaceae; *Amphitecna montana* Williams (1973: 22), Bignoniaceae; and various species of Lauraceae (Fig. 7). This area represents an isolated cloud forest at the border between Alta Verapaz and Quiché Departments, where the habitat is highly fragmented.

It is said by local people from Pampajche', Mexabaj and El Chiborrón villages (October 2019) that *M. poqomchi* used to be abundant and easily found. The tree is known as *coj*, a commonly used name in the north of Guatemala for magnolias (Vázquez-García *et al*. 2019). It is now rare due to unregulated and selective extraction of timber. Finca Pamac II and its surroundings are the last remaining patch of continuous, undisturbed forest in the area that holds the only known population of the species (Fig. 8). The trees are found more frequently at higher elevations away from human settlements. However, traces of its extraction, such as stumps or marked trees, have been found even at remote locations. In addition to exploitation for its valuable timber, the species is also affected by deforestation due to the expansion of crops and forestry plantations. Following the IUCN (2012), *M. poqomchi* is categorized as critically endangered: B1ab(iii), B2ab(iii) [CR B1ab (iii) 2ab(iii)].

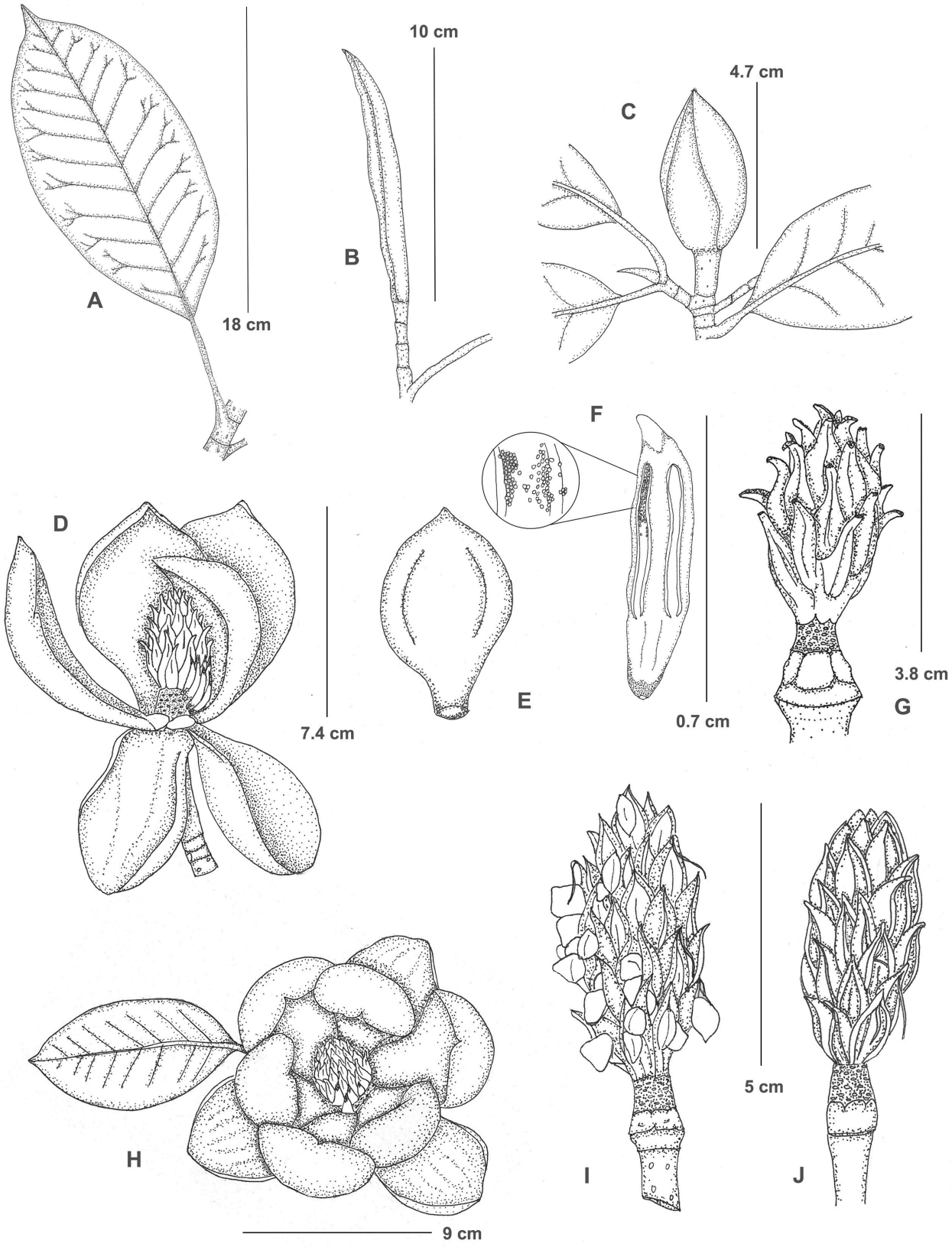

FIGURE 6. *Magnolia poqomchi.* A. Mature leaf with petiole. B. Leaf stipule in late vegetative bud. C. Flower bud with hirsute spathaceous bract, early vegetative buds and leaves. D. Open flower missing two petals and one sepal with some stamens fallen. E. Petal of open flower. F. Stamen with pollen. G. Developing fruit. H. Open Flower with leaf. I–J. Fruits during dehiscence. Illustration by María Renée Álvarez-Ruano and digital plate composition by Ana Isabel García-Ambrosy. A–H from the holotype. I–J from the holotype and paratype.

FIGURE 7. Broadleaf cloud forest where *Magnolia poqomchi* is found abundantly at Finca Pamac II, San Cristóbal Verapaz, Alta Verapaz, Guatemala.

Eponymy:—Named after the Poqomchi' Mayan people, for whom it is culturally important. This ethnic group lives in several municipalities of Alta Verapaz and Baja Verapaz Departments including the complete known distribution of this species. It is traditionally used as ornament, for construction of doors and furniture and as a source of general timber because of its durable wood.

Additional specimens examined:—GUATEMALA. Alta Verapaz: Municipio de San Cristóbal Verapaz, Finca Pamac II, 1882 m, 15.41089°N,–90.61131°W, 18 Aug 2018 (fr), *Serrano MS-063*, *w/Grajeda-Estrada & Villalobos* (UVAL 21746); Finca Pamac II, 2162 m, 15.39483°N,–90.57462°W, surrounded by 5 other young individuals, 15 Mar 2019 (fr), *Serrano MS-064, w/Grajeda-Estrada & Villalobos* (UVAL 21742); Finca Sac Wach Ja, 1500 m, 15.42279°N,–15.42279°W, 29 Jun 2019 (fr), *Serrano MS-066, w/Grajeda-Estrada & Villalobos* (UVAL 21743); Finca Tzunuj, 1949 m, 15.40977°N,–90.60408°W, 30 Jun 2019 (sterile), *Serrano MS-067, w/Grajeda-Estrada & Villalobos* (UVAL 21745); Finca Pamac II, 1990 m, 15.40534°N,–90.60331°W, 30 Jun 2019 (fr), *Serrano MS-068, w/Grajeda-Estrada & Villalobos* (UVAL 21744).

Notes:—The drip tip of this species makes *M. poqomchi* distinct from all other species of *Magnolia* in Guatemala. It has been hypothesized for a long time that drip tips increase the drainage rate of the lamina, reducing establishment of epiphyllic organisms (Richards 1986) and splash erosion around the tree (Williamson 1981). These hypotheses have gained support in the finding that this characteristic is strongly associated with high seasonal precipitation, lower maximum heights and smaller trunk diameters (Malhado *et al*. 2012). Drip tips are a common feature in rainforest species (Givnish 1987), such as the ones found in the cloud forest of Alta Verapaz.

The highly variable topography and climate of Guatemala harbours archipelagos of montane cloud forests (Vázquez-García 1995). These conditions, along with other selective pressures like species interactions and genetic constraints, favour allopatric speciation (Vázquez-García 1994) and diversification of taxonomic groups with Holarctic (*Magnolia*. sect. *Magnolia)* and Neotropical (*M*. sect. *Talauma)* distributions (Rzedowski 1996).

Although several taxonomic updates have been made for the family in Guatemala, there still are some areas that need to be explored. An example of this are the mountains of Visis Cabá in Quiché, which are located just a few kilometres away from the distribution of *M. poqomchi*, separated by the Chixoy River at about 300 m elevation. This

area includes montane cloud forests suitable for *Magnolia*. However, no reports have been made mainly due to its difficult accessibility, nor have reports for *Magnolia* been made for the southern highlands of the country, other than *M. hondurensis* close to the border with Honduras. The volcanic chain in this area includes several montane cloud forests where magnolias could be found.

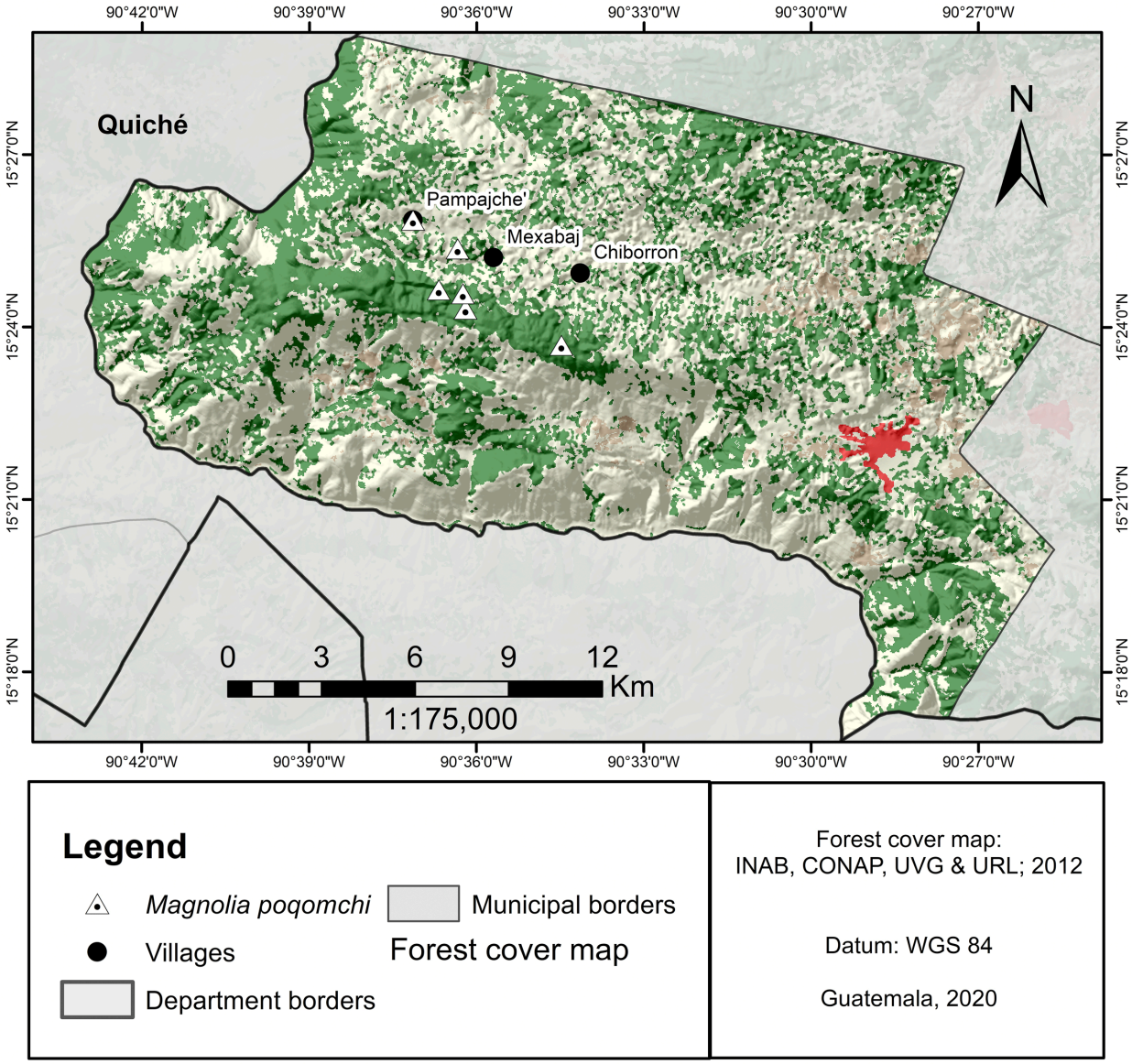

FIGURE 8. *Magnolia poqomchi* occurrences in relation to the forest cover in San Cristobal Verapaz, Alta Verapaz, Guatemala.

Genetic analyses are currently in progress to determine the relationship of *M. poqomchi* with the other species in the region. From Guatemala, only DNA sequences of *M. guatemalensis* have been analyzed using nuclear and plastid DNA (Azuma *et al*. 1999, Nie *et al.* 2008). We suggest that the other recently described species in the country should also be analyzed to better understand relationships among species, their evolutionary history and biogeography in Guatemala.

Key to the native species of Magnoliaceae in Guatemala

1. Petioles with conspicuous stipular scar, polyfollicle dehiscence circumscissile (*Magnolia* sect. *Talauma*) 2
- Stipular absent on petioles, polyfollicle with dorsal dehiscence (*Magnolia* sect. *Magnolia*) 3
2. Leaves 12.0–12.5 cm wide, more than 10 vein pairs; flowers with 72 stamens and 30–32 carpels ..... *M. steyermarkii*
- Leaves 6.9–8.1 cm wide, less than 10 lateral veins; flowers with 42 stamens and 8–10 carpels..... *M. quetzal*
3. At maturity, fruits densely pubescent 4
- At maturity, fruits glabrous to glabrescent 5

4. Polyfollicles 8–10 cm longer about 42–57 carpels per fruit.....*M. mayae*
- Polyfollicles about 5.7 cm or shorter, 23–8 carpels per fruit.....*M. hondurensis*
5. Leaves widely obovate, ferrugineous beneath.....6
- Leaves lanceolate to narrowly obovate, glabrous beneath.....7
6. Flowers with 92–98 stamens and 22–25 carpels; polyfollicle about ≤5.2 cm long ..... *M. guatemalensis*
- Flowers with 73–76 stamens and 34–39 carpels; polyfollicle about 7 cm long.....*M. archilana*
7. Leaves ≤10 cm long or less; polyfollicle with 42–46 follicles.....*M. tribouillierana*
- Leaves ≥10 cm long; polyfollicle with 22–35 follicles.....8
8. Leaf apex acute, lateral veins per side 11–12; spathaceous bracts 3; flowers with reddish staminophore, stamens up to 85, carpel indumentum pubescent; mature polyfollicles 5.4–6.3 cm long.....*M. montebelloensis*
- Leaf apex abruptly acuminate (drip tip), lateral veins per side 13–17; spathaceous bracts 2; flowers with purple staminophore, stamens 92–94, carpel indumentum glabrous; mature polyfollicles 3.8–5.2 cm long.....*M. poqomchi*

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