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NEW MORPHOLOGICAL MEASUREMENTS OF *PSITTACANTHUS ANGUSTIFOLIUS* AND *PSITTACANTHUS PINICOLA* (LORANTHACEAE)

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ABSTRACT

Additional measurements of leaves and flowers are reported for *Psittacanthus angustifolius* and *P. pinicola* from Central America and southern Mexico. Measurements for mature fruits and seeds of *P. angustifolius* are reported for the first time. Additional information on the phenology, host range, and distribution of these mistletoes is also reported.

RESUMEN

Se reportan mediciones adicionales de hojas y flores de *Psittacanthus angustifolius* y *P. pinicola* en Central América y el México del sur. Mediciones de los frutos maduros y las semillas de *P. angustifolius* están reportadas por primera vez. Información adicional sobre la floración, rango de hospederos y distribución de las dichas muérdagos también están reportadas.

Key Words: Central America, Mexico, mistletoes, pines, *Pinus*.

Psittacanthus angustifolius Kuijt and *Psittacanthus pinicola* Kuijt (Loranthaceae) were not described until 1987 from northwestern Nicaragua and central Belize, respectively (Kuijt 1987). These mistletoes are the most common loranthaceous species parasitizing pines in Central America (Mathiasen et al. 2003). They occur on several species of pines (Table 1), but *P. angustifolius* has also been reported on a wild guava (*Psidium guineense* Sw.) in Honduras and on oaks (*Quercus* spp.) in Chiapas, Mexico (Melgar et al. 2001). Thus far, *P. pinicola* has only been reported to parasitize pines (Kuijt 1987; Mathiasen et al. 2003).

Although both mistletoes commonly parasitize pines, they are clearly distinct species (Kuijt 1987). *Psittacanthus angustifolius* has much longer and thinner leaves than *P. pinicola* and its leaves are usually falcate and opposite; whereas leaves of *P. pinicola* are usually whorled and symmetrical. The inflorescences of *P. angustifolius* are terminal and the flowers are produced in triads, while the inflorescences of *P. pinicola* are lateral and the flowers are in dyads. According to Kuijt's original descriptions, the petals of *P. angustifolius* are approximately 8 cm long and bright orange, but those of *P. pinicola* are only 4 cm in length and consistently red with green tips. Other distinguishing characteristics include a distinct, fleshy, ligule-like median crest extending inwards at the top of each petal of *P. angustifolius* and a distinct ligule at the base of each petal of *P. pinicola*. Kuijt (1987) provided excellent line drawings of both taxa (see his Figures 10, 12, and 13).

Even though both of these mistletoes commonly parasitize pines in Central America and *Psittacanthus angustifolius* is associated with mortality and growth loss of economically important species, no additional morphological studies have been completed on these mistletoes since Kuijt's original descriptions. Kuijt (1987) based his description of *P. angustifolius* on only two collections from the same location in Nicaragua and used seven collections as the basis for his description of *P. pinicola*. Therefore, we

TABLE 1. HOST RANGE OF *PSITTACANTHUS ANGUSTIFOLIUS* AND *P. PINICOLA* IN CENTRAL AMERICA AND MEXICO (BZ—BELIZE; ES—EL SALVADOR; GT—GUATEMALA; HN—HONDURAS; NI—NICARAGUA). The classification of *Pinus* is based on Farjon and Styles (1997). The report of infection of *Quercus* spp. by *P. angustifolius* is from an unpublished monograph of the genus *Psittacanthus* in Central America by J. Kuijt.

	Central America	Country	Chiapas, Mexico
Psittacanthus angustifolius	*Pinus caribaea* var. *hondurensis*	HN, NI	*Pinus oocarpa*
			Pinus maximinoi
	Pinus maximinoi	HN	*Pinus tecunumanii*
	Pinus oocarpa	ES, GT, HN, NI	*Quercus* sp.
	Pinus tecunumanii	HN, NI	
	Psidium guineense	HN	
Psittacanthus pinicola	*Pinus caribaea* var. *hondurensis*	BZ, HN, NI	
	Pinus oocarpa	HN, NI	
	Pinus tecunumanii	BZ, NI	

have been collecting additional measurements of key morphological characters since 1999 from throughout Central America for both species and from Chiapas, Mexico, for *P. angustifolius*. Here we report the results of our work, which includes the first measurements of mature fruits and seeds of *P. angustifolius*. We also report additional information on the phenology, host range, and distribution of these mistletoes based on recently completed surveys in Guatemala, Honduras, Nicaragua, and Chiapas, Mexico.

METHODS

Mature leaves were measured from 22 populations of *P. angustifolius* (Fig. 1, populations 1–3, 6, 10–14, 16, 18, 20–26, 30–32, and 36) and from 12 populations of *P. pinicola* (Fig. 2, populations 1, 3–6, 8, 9, and 11–15) sampled from 1998 through 2006. Mature flowers were measured from 13 populations of *P. angustifolius* (Fig. 1, populations 4, 7, 12, 13, 14, 16, 20, 21, 23–26, and 31) and 8 populations of *P. pinicola* (Fig. 2, populations 3, 5, 6, 9, 11, 12, 14, and 15). Mature fruits and seeds were measured for 5 populations of *P. angustifolius* (Fig. 1, populations 2, 5, 10, 16, and 23) and for 7 populations of *P. pinicola* (Fig. 2, populations 3, 5, 6, 9, 11, 12, and 14). Some measurements of leaves (15 total) were made from three herbarium specimens for *P. pinicola* (Fig. 2, populations 17–19), but no measurements of floral or fruit characters were made using herbarium specimens because of shrinkage associated with drying.

Herbarium specimens provided additional information on the distribution of both taxa in Central America. All of the herbarium specimens we examined for species of *Psittacanthus* reported on pines from Central America were either *P. angustifolius* or *P. pinicola*, although many of these collections had been classified as *Psittacanthus schiedeanus* (Cham. & Schlecht.) Blume. Most early reports from Central America of *Psittacanthus* on pines were attributed to *P. schiedeanus* because *P. angustifolius* and *P. pinicola* were not described until 1987 (Kuijt 1987; Mathiasen et al. 2003). We examined specimens of *P. angustifolius* at the following herbaria: EAP, UVAL, TEFH, HNMN, and specimens of *P. pinicola* at: EAP and HNMN. Voucher specimens of *P. angustifolius* and/or *P. pinicola* have been deposited at ASC, EAP, UVAL, HNMN, or at the Herbario, Escuela National de Ciencias Forestales, Siguatepeque, Honduras, C.A.

Morphological characters measured included: leaves—length and width, petiole length, and shape of the leaf, leaf apex and base; inflorescences—length of peduncles and pedicels, length and width of the base of mature buds, length and width of individual petals, length of anthers, length of filaments, and the distance from the base of petals to the point of attachment of the filaments, length and width of ovaries, and length of styles; fruits—length, width, and color; seeds—length, width, color, and number of cotyledons. For each sampled population, measurements were made for each character from ten randomly selected mature leaves, flowers, and fruits. Leaves were sampled from the lower part of plants to assure they were fully developed. Only flowers that had opened and fruits that were dark purple were considered mature. Measurements were made with a Plasti-cal digital caliper accurate to 0.1 cm or a Bausch and Lomb 7× hand lens equipped with a micrometer accurate to 0.1 mm.

MEASUREMENTS OF LEAF AND FLOWER CHARACTERS

Measurements of leaf and flower characters for *Psittacanthus angustifolius* and *P. pinicola* are summarized in Table 2. Leaf sizes (length and width) were larger than those reported by Kuijt (1987) for both taxa. Kuijt reported that leaves of *P. angustifolius* were 17 × 2.5 cm. We found plants of *P. angustifolius* with leaves up to 26 cm in length and 6 cm in width, but leaf length and width were not correlated in that long leaves (>20 cm) were often 2–3 cm in width. In general,

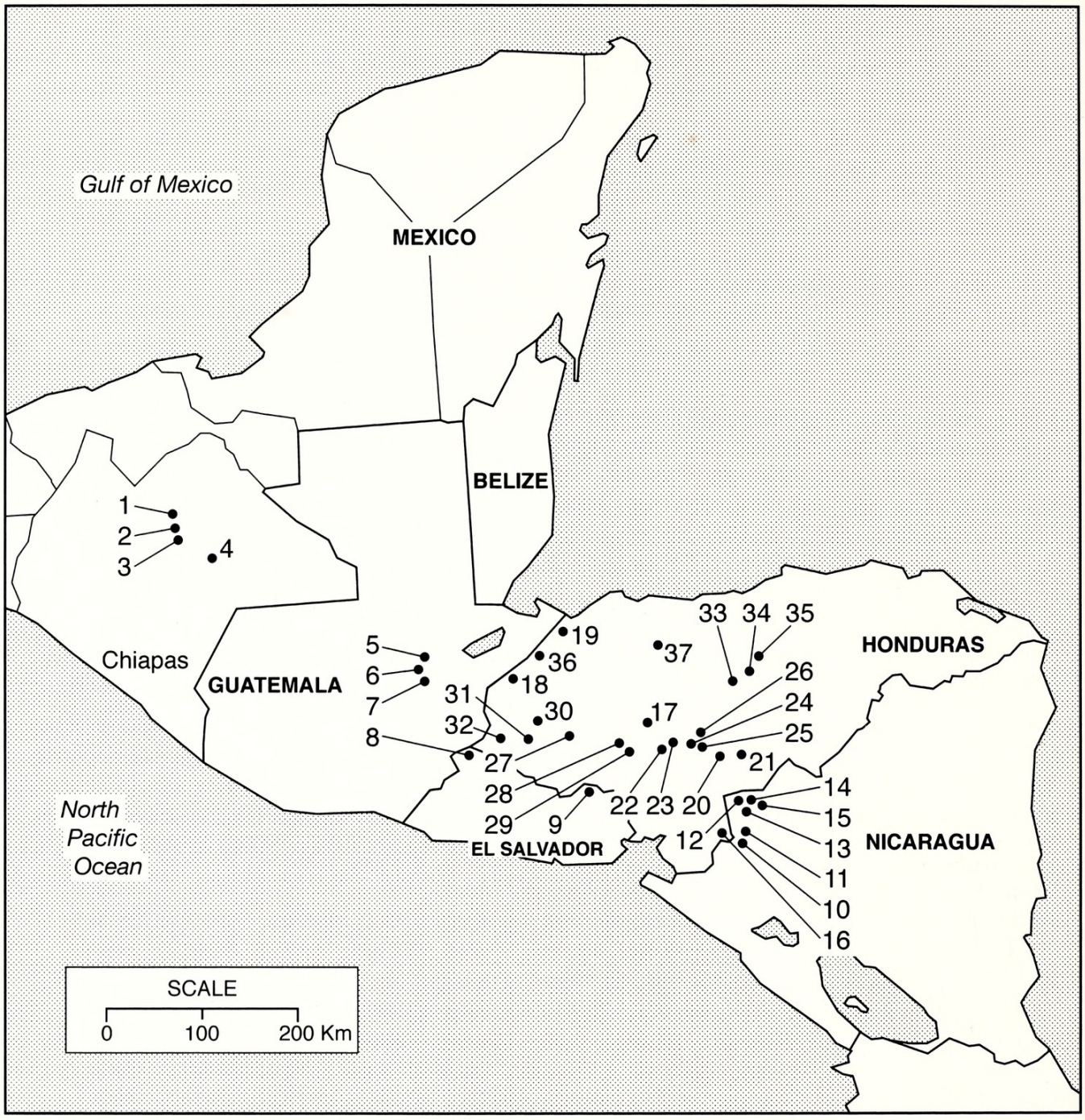

FIG. 1. Distribution of *Psittacanthus angustifolius* in Central America and Mexico based on collections and reports. See text for listing of populations used for leaf measurements, floral measurements, and fruit measurements. All populations on *Pinus oocarpa*, except as noted. MEXICO: Chiapas. **1**—1.2 km south of Pueblo Nuevo on Route 195; **2**—3.3 km north of Jitotol on Route 195; **3**—4 km south of Jitotol on Route 195, on *Pinus tecunumanii*; **4**—11.6 km east of the junction of Route 186 and the road to Altamarano on Route 186, ca. 8 km south of Ocosingo, on *Pinus maximinoi*. GUATEMALA: Department Baja Verapaz. **5**—1 km east of Santa Bárbara; **6**—6 km south of La Cumbre near Los Ramones on highway CA-14; **7**—16 km south of La Cumbre on highway CA-14; EL SALVADOR: Department Santa Anna. **8**—Monte Cristo National Park, ca. 12 km east of the park headquarters; Department Morazan. **9**—On the road from Sabanetas, Honduras to Perquin, El Salvador; NICARAGUA: Department Madriz. **10**—0.5 km south of San Jose de Cusmapa; **11**—3 km north of San Jose de Cusmapa on road to Somoto; Department Nueva Segovia. **12**—4.3 km north of highway NIC-29 on road to Bayuncun; **13**—4.3 km north of Mozonte; **14**—8.4 km north of Mozonte; **15**—5.1 km north of Sabana Grande, on *Pinus caribaea* var. *hondurensis*; HONDURAS. Department Choluteca. **16**—10 km east of San Marcos de Colón near border with Nicaragua; Department Comayagua. **17**—8 km southeast of Siguatepeque; Department Copan. **18**—21 km from highway CA-4 on road to San Agustín; Department Cortes. **19**—15 km northwest of Cofradia on road to Buenos Aires; Department El Paraiso. **20**—5 km southeast of Yuscaran; **21**—0.7 km north of the road to Potrerillos on highway CA-6; Department Francisco Morazan. **22**—1 km southwest of Lepaterique; **23**—4 km east of Lepaterique on road to Tegucigalpa; **24**—2 km east of the main road to Tegucigalpa on road to Tatumbla; **25**—6.5 km north of Zamorano on highway to Tegucigalpa; **26**—7.4 km south of Valle de Angeles on road to

mature leaf length and width were extremely variable, even on the same *P. angustifolius* plant. Leaves of *P. angustifolius* were usually falcate, sometimes strikingly so, but some leaves were straight and symmetrical. The long, narrow, falcate leaves of *P. angustifolius* were indicative of this species and could usually be used to identify this mistletoe on trees, even at some distance. Leaf apexes were typically acuminate, but some leaves had rounded apexes. Leaf bases were attenuate to acute with no clear petiole attached to the stem or with petioles of varying lengths up to 7 mm. Kuijt (1987) indicated that leaves of *P. pinicola* were 11×2.5 cm. We found that leaves were as long as 13 cm and to 7.5 cm in width. The leaves of *P. pinicola* were usually arranged in what Kuijt (1987) referred to as "irregular whorls"; their points of attachment were slightly offset from each node. However, we will refer to the leaves as being in a whorled arrangement. Mature leaves were consistently symmetrical with rounded to acuminate apexes. The leaf base tapered to the petiole which was up to 9 mm in length. The leaves of *P. pinicola* were thick (approximately 0.9–1.2 mm) and leathery in texture, while the leaves of *P. angustifolius* were thin (approximately 0.5–0.7 mm) and pliable. In general, the shape, length, and width of the mature leaves of *P. pinicola* were much less variable than those of *P. angustifolius*. Leaf arrangement (opposite vs. whorled), shape (falcate vs symmetrical), and leaf texture (thin and pliable vs. thick and leathery) would usually distinguish these taxa if flowers and fruits were not available.

On average, the length of petals for both taxa were similar to what Kuijt (1987) reported. But it should be noted that flowers were generally larger for *P. angustifolius* from Honduras than originally described by Kuijt (9–11 vs. about 8 cm). Our measurements from Nicaragua indicated that most of the floral characters of *P. angustifolius* were smaller there. For example, petals of *P. angustifolius* from Honduras averaged 9.6 cm and 1.6 mm in length and width, respectively, but they only averaged 7.3 cm and 1.1 mm from Nicaragua. So our measurements agree with Kuijt's original description of *P. angustifolius*, which used flowers collected from northwestern Nicaragua.

Our measurements of floral pedicels and peduncles were similar to those reported by Kuijt for both species, but we found that the length of the foliaceous bract often associated with the lower triads of *P. angustifolius* may be as long as 5.5 cm. However, usually this foliaceous bract was much shorter or even absent. *Psittacanthus pinicola* does not have a foliacious bract.

Kuijt reported an anther length of 6 mm for *P. angustifolius*, but the average anther length we measured was only 4.4 mm and only the largest anthers were around 6 mm in length. The anther length for *P. pinicola* varied from 3.6 to 4.2 mm; Kuijt reported the anther length was from 3–4 mm. The length of filaments (from the point of attachment on petals to anthers) averaged 3.8 cm for *P. angustifolius*, which is much shorter than the filament length reported by Kuijt (5 cm). Only the longest filaments we observed were around 5 cm long. The length of filaments of *P. pinicola* averaged 1.5 cm and this is the same length reported by Kuijt. Our measurements of the distance from the base of petals to the point of filament attachment averaged 3.8 cm for *P. angustifolius*, differing from Kuijt's of 2.5 cm. Our measurements from Nicaraguan populations were similar to those reported by Kuijt for this character.

The average ovary lengths based on our measurements were approximately the same as what Kuijt reported for both species. But our measurements of ovary width (mean 2.7 mm) were larger than what Kuijt (2 mm) found for *P. pinicola* and smaller (mean 4.3 mm) than what he reported for *P. angustifolius* (5 mm). The length of styles of *P. angustifolius* averaged 7.6 cm; Kuijt did not report information for this character. Our measurements of the styles of *P. pinicola* were much shorter (3.5 cm) than that reported by Kuijt (4.6 cm). We also noted that the base of the style of *P. pinicola* was usually twisted, while it was straight for *P. angustifolius*.

Measurements of fruits and seeds for both taxa are summarized in Table 3. Our measurements of the fruits of *P. pinicola* are larger than what Kuijt reported and our measurements of mature fruits are the first reported for *P. angustifolius*. Seed sizes are the first reported for both taxa. Fruits of both species are initially green, gradually turn red, and are dark purple when mature. Seeds of *P. angustifolius* are dark green to brown while those of *P. pinicola* are consistently light green. The number of cotyledons in seeds varied from

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Tegucigalpa; Department Intibuca. **27**—9 km north of Yamaranguila; Department La Paz. **28**—26 km west of junction with highway CA-5 on road to Marcala; **29**—1 km north of El Tejar, on *Pinus tecunumanii*; Department Lempira. **30**—1.3 km east of El Matazano on road to San Rafael, on *Pinus maximinoi*; **31**—5 km west of Gracias on road to Villa Verde; Department Ocotopeque. **32**—0.2 km east of the junction with the road to Pashapa on highway CA-4; Department Olancho. **33**—11 km northwest of Concordia; **34**—13 km south of Guiamaca; **35**—10 km east of Gualaco on road to San Esteban, on *Pinus caribaea* var. *hondurensis*; Department Santa Bárbara. **36**—4 km east of Pinalejo on road to Buenos Aires; Department Yoro. **37**—20 km north of Yoro on road to La Flores.

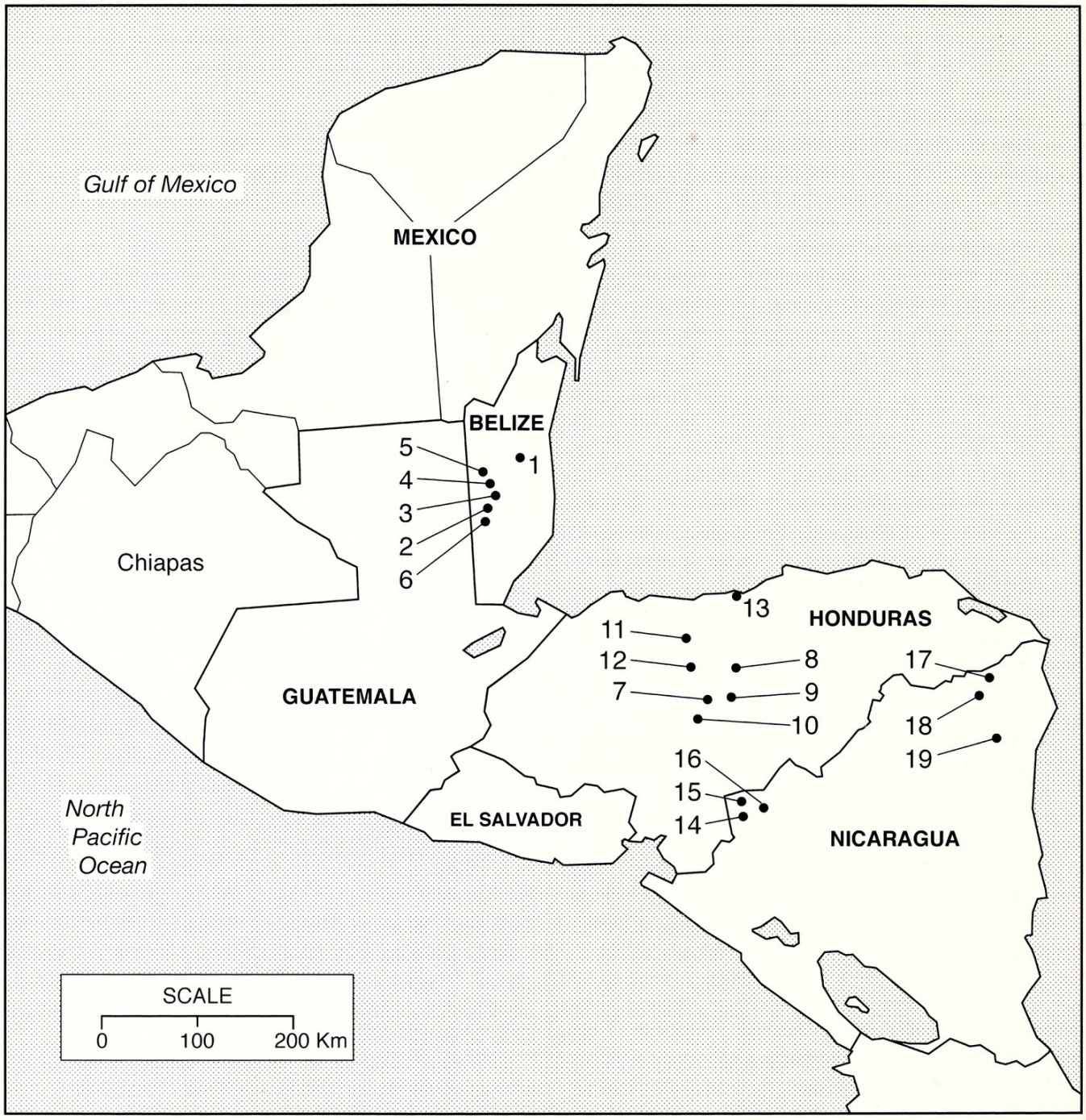

FIG. 2. Distribution of *Psittacanthus pinicola* in Central America based on collections. See text for listing of populations used for leaf measurements, floral measurements, and fruit measurements. All populations on *Pinus caribaea* var. *hondurensis*, except as noted. BELIZE: Belize District. **1**—Manatee Ridge near milepost 31 west of Belize City along the Western Highway (2 km west of the junction to Dangria); Cayo District. **2**—2.4 km south of Cooma Cairn Lookout on Cooma Cairn Road; **3**—1 km south of Cooma Cairn Lookout on Brunton Trail; **4**—0.5 km north of Cooma Cairn Lookout on Cooma Cairn Road; **5**—Junction of Dumbcane Trail and trail to Butterfly Falls, on *Pinus tecunumanii*; **6**—2.5 km south of Cooma Cairn on Brunson Trail; HONDURAS: Department Olancho. **7**—13 km northwest of Concordia; **8**—1.7 km southwest of El Carbon on road to San Esteban; **9**—22 km southwest of El Carbon on road to San Esteban; **10**—At km post 144 on main highway from Juticalpa to Tegucigalpa; Department Yoro. **11**—20 km north of Yoro on road to La Flores; **12**—25 km east of Yoro on the road to Olanchito; Department Colón. **13**—5.5 km east of the junction of the North Coast Highway and the road to Limon along the North Coast Highway; NICARAGUA: Department Nueva Segovia. **14**—4.3 km north of Highway NIC-29 on road to Bayuncun; **15**—7.5 km north of Highway NIC-29 on road to Bayuncun, on *Pinus tecunumanii*; **16**—4.5 km east of San Fernando on Highway NIC-29; Department Zelaya. **17**—Bilwaskarna; **18**—Rio Tranquera at junction with road between Waspam and Puerto Cabezas; **19**—near Tala Has and Puente Mango (over Rio Kisalaya).

TABLE 2. MORPHOLOGICAL CHARACTERISTICS OF THE LEAVES AND FLOWERS OF *PSITTACANTHUS ANGUSTIFOLIUS* AND *P. PINICOLA*. N/n represents the number of populations sampled over the number of individual measurements.

Characters measured	*P. angustifolius*				*P. pinicola*			
	Mean	Std. Dev.	Range	N/n	Mean	Std. Dev.	Range	N/n
Leaf length (cm)	13.8	3.8	6.3–26.1	22/220	8.3	1.5	5.1–13.0	15/135
Leaf width (cm)	2.4	1.0	0.7–6.2	22/220	3.1	1.2	1.0–7.5	15/135
Petiole length (mm)	2.5	1.5	0.0–7.0	22/220	5.6	1.8	0.0–9.0	15/135
Inflorescence peduncle length (mm)	1.3	0.3	0.7–2.0	13/130	0.7	0.2	0.4–1.3	8/80
Diad peduncle length (mm)	N/A	N/A	N/A	N/A	1.0	0.3	0.5–1.6	8/80
Flower pedicle length (mm)	1.7	0.4	0.9–2.8	13/130	0.6	0.1	0.4–0.8	8/80
Foliar bract length (cm)	2.9	1.4	0.8–5.5	13/130	N/A	N/A	N/A	N/A
Bud length (cm)	8.3	1.6	4.8–10.9	13/130	3.6	0.3	3.1–4.4	8/80
Bud base width (mm)	4.2	0.7	2.8–5.6	13/130	3.4	0.3	2.8–4.1	8/80
Petal length (cm)	8.7	1.4	5.8–11.2	13/130	3.8	0.3	3.1–4.4	8/80
Petal width (mm)	1.4	0.3	0.6–2.1	13/130	1.1	0.2	0.6–1.7	8/80
Filament length (cm)	3.8	0.8	1.6–5.1	13/130	1.5	0.1	1.2–1.7	8/80
Attachment of filament length (cm)	3.6	0.8	2.2–4.7	13/130	1.8	0.3	1.3–2.5	8/80
Anther length (mm)	4.4	1.1	2.1–6.1	13/130	3.9	0.2	3.6–4.2	8/80
Ovary length (mm)	6.2	1.5	3.3–10.3	13/130	4.3	0.6	3.3–5.9	8/80
Ovary width (mm)	4.3	1.0	2.4–6.3	13/130	2.7	0.3	2.2–3.3	8/80
Style length (cm)	7.6	1.4	4.6–9.8	13/130	3.5	0.2	2.9–3.9	8/80

four to eight for *P. pinicola*, but seeds of *P. angustifolius* consistently contained six cotyledons. Our measurements of fruits and seeds for *P. angustifolius* included ten measurements from the designated type locality in northwestern Nicaragua (Kuijt 1987) (Fig. 1, population 10). We were unable to make additional measurements of floral characters from this location because none of the many plants we observed there were flowering in March 2006.

OBSERVATIONS OF GROWTH FORM

Plant size in *P. angustifolius* varies depending on age, but we have observed plants as large as 2 m in height. Haustoria of this mistletoe can reach diameters over 15 cm and the basal diameter of stems arising from the haustorium was sometimes over 8 cm. In general, plants of *P. pinicola* are smaller than those of *P. angustifolius*. This species seldom reaches sizes larger than 1 m in height and its haustoria are usually less than 10 cm in diameter. Shoots arising from haustoria are typically less than 6 cm in diameter at their base. Plant age can be estimated by dissection of haustorial connections (Kuijt 1970) and there is a direct correlation with the age of *P. angustifolius* plants, their height, and the size of the haustorium (Howell unpublished data).

OBSERVATIONS OF PHENOLOGY AND REPRODUCTIVE BIOLOGY

In central Hondruas, *P. angustifolius* usually begins flowering in July and lasts until October. Flowering is related to elevation of the population with flowering at higher elevations starting later than at lower elevations (Martinez and Melgar 2000). Peak flowering occurs from August to September in Honduras and from June to August in Guatemala and Chiapas for *P. angustifolius*. Fruits of *P. angustifolius* are mature in March to April in central Honduras (Martinez and Melgar 2000). Flowering of *P. pinicola* begins in March and extends into December in western Belize. However, we have observed a few plants of both species flowering in March in Nicaragua and eastern Honduras. Flowers and fruits are often at different stages of development, even on the same plant, and mature flowers and fruits can frequently be found on the same *P. pinicola* plant from March to October. However, *P. pinicola*

TABLE 3. MORPHOLOGICAL CHARACTERISTICS OF THE FRUITS AND SEEDS OF *PSITTACANTHUS ANGUSTIFOLIUS* AND *P. PINICOLA*. N/n represents the number of populations sampled over the number of individual measurements.

Characters measured	*P. angustifolius*				*P. pinicola*			
	Mean	Std. Dev.	Range	N/n	Mean	Std. Dev.	Range	N/n
Fruit length (mm)	20.2	3.0	15.0–24.2	5/50	13.7	1.1	11.1–15.2	7/70
Fruit width (mm)	14.8	1.9	11.0–18.1	5/50	7.0	0.5	6.2–8.0	7/70
Seed length (mm)	15.1	1.3	12.7–17.8	5/50	12.9	0.8	10.9–14.1	7/70
Seed width (mm)	9.0	1.1	7.2–12.0	5/50	4.4	0.2	4.0–4.9	7/70

peak flowering occurs from May through October.

While these mistletoes are sympatric at several locations in Honduras and Nicaragua, we have not observed any evidence that they hybridize at these locations, even though we have observed them flowering at the same time. Although hummingbirds have been reported as key pollinators of other species of *Psittacanthus* in Mexico (Azpeitia and Lara 2006), we have only on a few occasions observed hummingbirds at *Psittacanthus angustifolius* flowers in Honduras and at *P. pinicola* flowers in Belize. Bats may be involved in the pollination of these species as well, but further research is clearly needed to confirm this hypothesis. Additional research is also needed on the animals involved in seed dispersal of these mistletoes.

Distribution of Species

Our recent studies in Nicaragua have confirmed that these mistletoes are present in the pine forests of the Cordillera Depilto and the Cordillera Jalapa near the border with Honduras. We collected *P. angustifolius* on *Pinus oocarpa*, *Pinus tecunumanii* Equiluz & J. P. Perry, and *Pinus caribaea* var. *hondurensis* (Senecl.) Barr. et Golf.; and *P. pinicola* on *Pinus caribaea* var. *hondurensis*, *P. tecunumanii*, and *P. oocarpa* (Department Nueva Segovia, Figs. 1 and 2). *Psittacanthus pinicola* has been reported to occur in the extensive *Pinus caribaea* var. *hondurensis* populations in eastern Nicaragua (Kuijt 1987; Mathiasen et al. 2003) and we examined three herbarium specimens from this region (Fig. 2, populations 17–19). We have not observed *P. pinicola* in Guatemala, but we anticipate that eventually it will be found there because it is common in the Mountain Pine Ridge region of western Belize only a few km east of Guatemala (Fig. 2, populations 2–6).

We have now collected *P. angustifolius* from nearly every Department in Honduras, and although it is widely distributed there, it is only common in Department Francisco Morazan (Fig. 1). Although we conducted additional surveys in Guatemala in March 2006, we still have only found three populations of *P. angustifolius* in central Guatemala (Department Baja Verapaz), but we expect there are many more populations in that general region, particularly in the Sierra de las Minas. Furthermore, *P. angustifolius* probably occurs in western Guatemala because it is found in Chiapas, Mexico (Fig. 1) and its pine hosts are common in western Guatemala. However, our surveys in western Guatemala have not detected it. We have observed *P. angustifolius* in El Salvador (Mathiasen et al. 2003) and we also examined a specimen of *Psittacanthus* at EAP collected from El Salvador which was labeled as *P. schiedeanus*, but the leaves and flowers of the specimen clearly indicated it was *P. angustifolius*. Therefore, we have included a second location for this taxon in north-central El Salvador in Fig. 1 (population 9). Our surveys in Chiapas, Mexico, in September 2006, also failed to uncover additional populations of *P. angustifolius* in the pine forests there. This mistletoe mainly occurs in north-central Chiapas near the villages of Jitotol and Pueblo Nuevo, but we have found one population of it near the village of Ocosingo several kilometers southeast of Jitotol (Fig. 1, population 4). It has also been reported in southwestern Chiapas, but we have not observed it there (Kuijt unpublished). Thus far, we have not observed *P. angustifolius* in Belize, but our surveys there have mainly been in the Mountain Pine Ridge region and not in the extensive *Pinus caribaea* var. *hondurensis* populations at lower elevations near the coast. It is probable that once these coastal pine forests are surveyed more intensively, many additional populations of *P. pinicola* will be found in them, and *P. angustifolius* may be discovered there as well.

The effects these mistletoes have on their pine hosts warrants further research. We have observed many dead pines infected with *P. angustifolius* in Honduras, Guatemala, and Nicaragua, so this mistletoe is associated with premature mortality of severely infected trees. Although there have been a few studies documenting that *P. angustifolius* is associated with reduced growth of severely infected *Pinus oocarpa* in Honduras (Lezama and Melgar 1999; Howell and Mathiasen 2004; Howell et al. 2005), no studies have been conducted on the effects of *P. pinicola* on its pine hosts. However, our observations in the Mountain Pine Ridge region of Belize suggest that *P. pinicola* is also associated with premature mortality of severely infected *Pinus caribaea* var. *hondurensis*, and it probably causes growth reductions of severely infected trees as well. The effect of *P. angustifolius* on the growth of pines other than *P. oocarpa* has not been investigated. Because *Psittacanthus angustifolius* has been reported to occur on oaks (Kuijt unpublished), we have specifically searched for it on oaks in Guatemala, Honduras, Nicaragua, and Chiapas, Mexico. Thus far, we have not found it parasitizing this genus.

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