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NEW SPECIES OF *WALTHERIA* (HERMANNIEAE, BYTTNERIOIDEAE, MALVACEAE[1]) FROM PARAGUAY, ARGENTINA, AND VENEZUELA, AND TWO NEW RECORDS FOR PARAGUAY

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ABSTRACT: Saunders, J. G. 2005. New species of *Waltheria* (Hermannieae, Byttnerioideae, Malvaceae) from Paraguay, Argentina, and Venezuela, and two new records for Paraguay. *Darwiniana* 43(1-4): 201-211.

Waltheria carmensarae, a homostylous species from northeastern Argentina, southeastern Paraguay, and central Venezuela, and *W. procumbens*, a distylous species from northeastern Paraguay, are newly described and illustrated. Both species share along with some other species of *Waltheria* sect. Waltheria and all of sect. Stegowaltheria an elongate-plumose stigma, adaxial petals with raised succulent midribs, petals adnate to the stamen tube for more than 0.8 mm in length, and a capsule with hardened endocarp only at the apex. *Waltheria carmensarae* resembles the distylous species *W. preslii*, endemic to coastal Guerrero and Oaxaca, Mexico, whereas *W. procumbens* appears to be close to *W. albicans*, primarily from Brazil where distylous, with scattered homostylous and distylous distributions in Paraguay, Venezuela, and Mexico, or exclusively homostylous in Argentina. Pollen morphology is first described for *W. carmensarae* and Kohler's description for *W. prostrata* is repeated for the new species *W. procumbens*. A regional key is included for all Argentinian and all Paraguayan species of *Waltheria*. *Waltheria operculata* (sect. Stegowaltheria) is newly reported for Paraguay and *W. albicans* (sect. Waltheria) first appears with specimens cited for Paraguay.

Keywords: *Waltheria*, Hermannieae, Byttnerioideae, Malvaceae s.l., Argentina, Paraguay, Venezuela, Pollen morphology.

RESUMEN: Saunders, J. G. 2005. Especies nuevas de *Waltheria* (Hermannieae, Byttnerioideae, Malvaceae) de Paraguay, Argentina y Venezuela, y dos nuevas citas para Paraguay. *Darwiniana* 43(1-4): 201-211.

Se describen e ilustran por primera vez *Waltheria carmensarae*, especie homostila del nordeste de Argentina, sureste de Paraguay y centro de Venezuela, y *W. procumbens* especie distila del nordeste de Paraguay. Ambas especies comparten los siguientes caracteres con algunas especies de la sect. Waltheria, y con todas las especies de la sect. Stegowaltheria: estigmas elongado-plumosos; láminas de los pétalos con nervios primarios proximalmente prominentes (succulentos) en el haz; pétalos adnatos al tubo estaminal por más de 0,8 mm de long.; cápsulas con el endocarpo endurecido apicalmente. *Waltheria carmensarae* es afín a *W. preslii*, especie heterostila endémica del oeste de México (Guerrero, Oaxaca), mientras que *W. procumbens* lo es a *W. albicans*, principalmente de Brasil, siendo allí heterostila, mientras que en Venezuela, Paraguay y México es homostila o heterostila, y en Argentina exclusivamente homostila. Se describe por primera vez la morfología del polen de *W. carmensarae*. Se hace notar que la descripción de la morfología del polen de *W. procumbens* fue publicada previamente como *W. prostrata*. Se incluye una clave regional de las especies de *Waltheria* para Argentina y Paraguay. *Waltheria operculata* (sect. Stegowaltheria) es registrada por primera vez en Paraguay, y se citan por primera vez ejemplares de *W. albicans* (sect. Waltheria) de Paraguay.

Palabras clave: *Waltheria*, Hermannieae, Byttnerioideae, Malvaceae s. l., Argentina, Paraguay, Venezuela, Morfología del polen.

[1] Hermannieae, including *Waltheria*, formerly in the Sterculiaceae, are now placed in the Byttnerioideae basal to the Grewioideae in an expanded Malvaceae (Bayer & Kubitzki, 2003).

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Following monographic and floristic studies of *Waltheria* (Saunders, 1993, 1995 a, 1995 b, 2005), including one for the flora of Paraguay (Saunders, in prep.) two new glandular species with prostrate habit from savannas (s.l.) are described. Both species are assigned to *Waltheria* sect. Waltheria Linnaeus as presently circumscribed and within this section, are allied to the species described as having elongate-plumose (distended-plumose) stigmas described in Saunders (1993) that also includes sect. Stegowaltheria K. Schum. The elongate-plumose stigma type is quantitatively defined here to possess branches (0.2)0.3-0.3-0.5(0.6) mm long that are dispersed along a stylar column for 0.8-3.0 mm in length. All its present members share a petal claw adherant to the base of the staminal filament tube for 0.8-3.0 mm in length combined with a capsule possessing a hardened endocarp, that is osseous or corneous, interiorly, present only at the capsule apex, and not found below 1 mm in length from the apex. The adaxial petal lamina midvein is slightly to very raised basally in fresh flowers and sinuous in rehydrated flowers. These species are vested on the adaxial surface of their widest bracts with the shorter trichome layer consisting of simple or simple with 2-seriate trichomes, proportions varying, and stellate short trichomes that are absent or rare adaxially, but common on the abaxial surface.

1. **Waltheria carmensarae** J. G. Saunders, sp. nov. TYPE: Argentina. Corrientes: Dpto. San Cosme, Paso de la Patria, en médano, 27° 13' S, 58° 34' 60'' W, 45 m, 24-IV-1990. *C.L. Cristóbal & J.G. Saunders 3213* (holotype, CTES; isotypes, A, BR, CEPEC, CTES, G, K, F, FCQ, LE, LL, LPB, M, MA, MBM, MEXU, MICH, MO, NY, P, PR, SI, US). Fig. 1.

A W. preslii similis floribus homostylis parvioribus et capsulibus parvioribus atque bracteis petalis seminibus formarum diversarum differt.

Entirely procumbent vine, suffruticose, rarely fruticans, with mainstems 0.6-1.5 m long radiating from a xylopodia to 3 cm diam. Stems rarely terete and woody to tips, but usually flexuose, internodally decurrent and compressed for 6-10 internodes below apices, herbaceous parts abundantly glandular, 0.2-0.3 mm long, capitula red or yellow, prominent to the stellate-tomentulose layer. Leaves spirally arranged, laminas 0.7-5.0(7.0) cm long, 1.7-3.6 (5.5) cm wide, ovate to widely ovate, or ovate-elliptic, at times shallowly 3- 5-lobulate, thin, flat, apices broadly obtuse to rounded, bases rounded to subcordate, margins later shallowly dentate-mucronate with tooth sides concave at times, glandular protruding, adaxial surface stellate-pubescent, some stellate rays longer and acropetal, abaxial surface densely stellate-tomentose not obscuring surface; adaxial surface with finest veins scarlet or reddish, visible at surface, with above-surface scarlet or reddish accretions below stellate trichomes; petioles 0.5-1.5 cm long, 1.0-2.0 mm wide, glandular-prominent and tomentulose; stipules 3.5 - 11 mm long, 0.2-0.9 mm wide, linear-triangular to narrowly triangular. Inflorescences axillary, cymose glomerules secund, to 2.5 cm diam., "peduncles" to 8 cm long. Bracts unequal in form, 4 around flower pair of the primary cyme, the central bracts fused slightly up to halfway, the widest bract 2.0-3.0 mm wide, narrowly ovate or narrowly elliptic, apex entire or denticulate, 5-7 nerved, other bracts oblanceolate or lanceolate, 0.7-2.0 mm wide, fewer-nerved, adaxial surface sparsely pubescent from 2-seriate and fewer simple trichomes 0.2-0.4 mm long, setulose and setose with many simple hairs to 1.2 mm long, mostly stellate-puberulent and glandular-capitate on abaxial surface, margins setose up to apex. Flowers sessile, homostylous, ca. 5-8 mm in diam.; calyx turbinate, lobed less than halfway, calyx tube 2.3-3.0 mm long, puberulent inside, calyx lobes 1.7-2.7 mm long, base shallowly triangular with 2 or more pairs of arched secondary veins, multi-aereolate, apices acuminate. Petals 5.0-8.0 mm long, 0.9-2.2 mm wide, yellow to yellow-orange; membranous lamina narrowly obtriangular, adaxial surface densely papillose, above claw sparsely pilose, at times stellate on other face or ciliate at apex, midvein only slightly raised; claw 1.1-2.2 mm long, adherant to stamens for 1.3-1.9 mm; stamens 2.5-4.3 mm long, filament tube 2.0-3.6 mm long; anthers 0.5-0.8 mm long; pistil 3.4-4.7 mm long, ovary apex sericeous, stigma elongate-plumose, with stigmatic column 1.1-1.5 mm long, stigmatic branches 0.4-0.5 mm long. Capsule oblong-obovoid, 2.5-3.2 mm long, 1.4-2.0 mm wide, apex apiculate, tomentose, few sessile glandular hairs below, only apex outwardly chartaceous and inwardly with thin corneous endocarp extending ca. 0.4 mm from apex, below which both the interior and exterior are membranous-

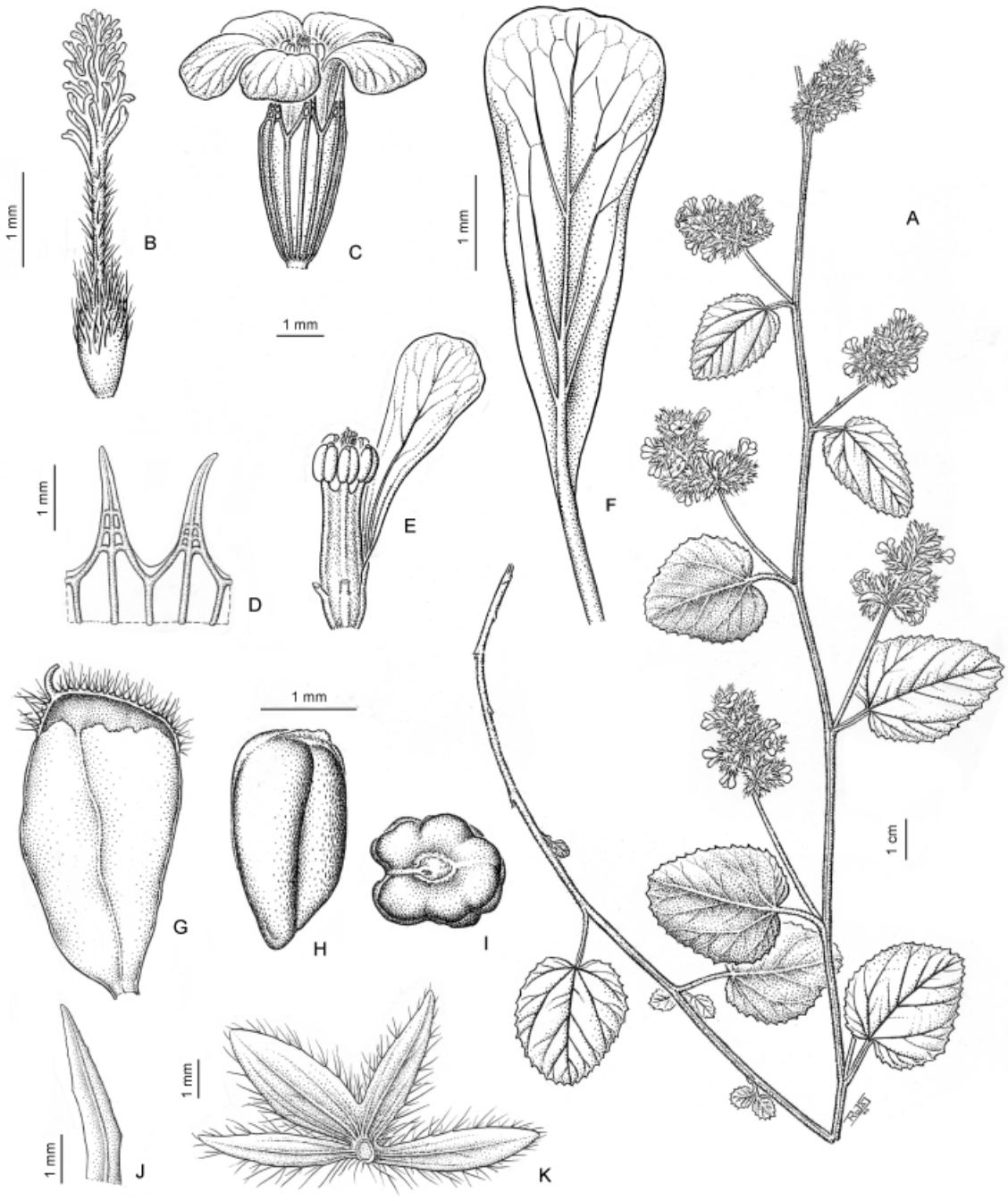

Fig. 1.- *Waltheria carmensarae.* A: flowering branch. B: pistil. C: flower, homostylous. D: upper calyx tube and lobes, adaxial view. E: androecium with one petal and four petal bases, emergent stigma apex. F: petal lamina and claw, adaxial. G: capsule halved, adaxial view. H: seed, lateral view. I: seed, apical view. J: stipule, adaxial view. K: bracts, abaxial view. Drawn by Francisco Rojas. A-K, *Cristóbal & Saunders 3213* (CTES).

transluscent down to an outwardly chartaceous base, dorsally loculicidally dehiscent. Seed 1, oblong-ovoid, 2.0-2.3 mm long, 1.2-1.5 mm wide, apex not apiculate, in lateral view the the posterior elliptic, in apical view contour elliptic, 5-lobed, cuticle foveate, testa smooth, dark brown.

Pollen: homostylous: reticulate, apertures 3-5 (average 3.8 for N=160) zonocolporate or with apertures above equator, colpus index [polar axis/ colpus length] 2.4, grains 46.5 µm x 47.3 µm, shape index P/E=0.98, colpi 26.8 µm x 2.9 µm, exine ca. 1.8 µm in diam., tectum ca. 0.8 µm in diam., bacula ca. 0.6 µm in diam., nexine ca. 1.5 µm in diam., lumina ca. 1.5 µm in diam., muri ca. 0.2 µm in diam., ora 12.3 µm long (N=14), 12.9 µm wide (N=21) (N=25 for *Cristóbal & Saunders* 3213 CTES).

Phenology and floral visitors: Flowering September through June, peaking March-April. Flowers are matinal, closing from 10:30 a.m. to 12 p.m. Floral visitors observed included *Augochloropsis* (Halictidae) and numerous *Apis mellifera* (*Saunders & Palacios* 3460).

Distribution, habitat and ecology: Northeastern Argentina (Corrientes) along the coast of the Paraná River near Ituzaingó, Paso de la Patria and Estancia Las Tres Marias, extending into Paraguay on Isla Yacyretá and at Paso de Patria. In southern Corrientes ocurring along the coast of the Uruguay River at Paso de los Libres and Bonpland. One collection is disjunct to Venezuela, associated with the middle Orinoco River near Agua Blanca from "very sandy soil in *Trachypogon-Curatella-Byrsonima* savanna". Other populations are recorded to be from "palmares de *Butia yatay* var. *paraguayensis*" that is characteristic of the "campos" district of the "selva galeria paranense", savannas, "matorrales" bordering "selva galeria uruguayensis", "campos altos arenosos", in deep riverine sand dunes (medanos), loose river sand on river banks, or in very sandy loam. Apparently a primary successional species in riverine dunes. Ocurring up to 70 m elevation. (Fig. 3 A, B).

Paratypes

ARGENTINA. **Corrientes.** *Dpto. Empedrado*: El Sombrero [27° 41' 60 S, 58° 46' 0 W], Ea. "Las Marías" , 5-IV-1979, *Cabral 113* (CTES); Estancia "Las Tres Marías", now "Cabaña Los Orígenes", Ahoma Creek km 1001, 4 km S of El Sombrero, road to Empedrado, 5-IV-1979, *Ferrucci 96* (CTES, TEX); Estancia "Las Tres Marías", by the Paraná River, 24-IV-1956, *Pedersen 3898* (C, CTES, NY); *Dpto. Ituzaingó*: Pueblo Cerconias [-27.5667, -56.7333], va. Ituzaingó, 23-III-1946, *Ibarrola 4350* (CTES, LIL); Isla Apipé Grande, Puerto San Antonio [27° 31' 0 S, 56° 43' 60 W, 46 m], vic. cemetario, 10-XII-1973, *Krapovickas et al. 24218* (CTES, TEX); Costa del Río Paraná, 3-II-1976, *Krapovickas & Cristóbal 29162* (CTES*);* Ruta 12 pasando 5 km Villa Olivari, camino a Ituzaingó, 70 m, 19-III-1981, *Legname, López & Serrano 8146* (LIL); Isla Apipé, Pto. San Antonio, 19-XI-1976, *Schinini 13813* (CTES); Ituzaingó [27° 36' 0 S, 56°40' 60 W, 62 m], 31-XII-1944, Schwarz 459 (NY, non LIL); *Dpto. Paso de los Libres*: Paso de los Libres [29° 43' 0 S, 57° 4´ 60 W, 24 m], 11-I-1945, *Ibarrola 2039* (LIL, U, US); Bonpland [29° 49' 0S, 57° 25' 60 W, 57 m], costa Río Uruguay, 21-I-1945, *Ibarrola 2149* (CTES, LIL, NY); Paso de los Libres, 27-III-1964, *Krapovickas & Cristóbal 11295* (TEX); Paso de los Libres, Laguna Mansa, 19-II-1972, *Krapovickas & Cristóbal 21716* (CTES, TEX); Estancia "El Recreo", 21 km E de Bonpland, costa río Uruguay, 19-II-1979, *Schinini et al. 17357* (CTES, TEX); *Dpto. San Cosme*: Paso de la Patria, 20-III-1975, *Eskuche 3471* (CTES, SI); Paso de la Patria, 12-V-1985, *Nicora 8692* (SI); Paso de la Patria, 5 blocks W of mainstreet, type locality, 17-III-2005, *Saunders & Palacios 3460* (SI); Paso de la Patria, 25-VI-1972, *Schinini & Pueyo 4818* (CTES); Paso de la Patria, 19-IX-1971, *Tressens et al. 136* (CTES, TEX); Paso de la Patria, 19-X-1974, *Tressens 725* (CTES).

PARAGUAY. **Itapúa**. Yacyretá Dam Island Reserve, western area, 27° 26' 55" S, 56° 49', 23" W, 25-X-1999, *Zardini & Rodríguez 51651* (CTES, SI). **Ñeembucú.** Paso de Patria, 10-XII-1950, *Schulz 7700* (CTES, LIL, TEX).

VENEZUELA. **Bolívar**. 46 km NE of Río Aro along highway 19 between Caicara and Ciudad Bolívar, 60 m, [vic. Agua Blanca, 7 ° 43' 60 N, 63° 54' 60 W], 25-X-1973, *Davidse 4494* (MO).

*Waltheria carmensarae´*s autapomorphy, seen at higher magnifications on adaxial leaf surfaces, consists of red areas below stellate trichomes, surrounded by the finest veins also red and highly visible at the surface. It most resembles *W. preslii* Walpers from coastal rather than riverine sand dunes in Western Mexico, where endemic to Guerrero and Oaxaca. *Waltheria carmensarae* differs from *W. preslii* by its glandular vs. non-glandular stems and leaf margins, differently shaped widest

bract (Fig. 1 K) that is narrowly elliptical with an acute apex rather than broadly elliptical with an obtuse or rounded apex (singular to *W. preslii*), its seed with an oblong rather than a rounded or elliptical posterior, and its homostylous flowers much smaller than 12-15 mm in diam., only 5-8 mm in diam. Its capsules are shorter, only 2.5-3.2 mm long vs. 3.5-4.7 mm long. Furthermore, its petals are triangular, with the midvein only slightly raised rather than very raised basally on an obdeltate lamina.

Both species share a whorled, prostrate, protense vine-like habit, though *W. preslii* is twice as long, and possession of xylopodia, but are most similar in their leaves. Both have short, ovate-elliptic to widely ovate leaves with obtuse to rounded apices, sparsely vested in age with the surface visible abaxially, and shallowly dentate-mucronate teeth with concave sinuses in older leaves. Whereas those of *W. carmensarae* are tomentulose, those of *W. preslii* are hirsute, not red-spotted, with finest veins more submerged.

The Venezuelan collection of *W. carmensarae* differs from the Argentinian-Paraguayan populations by being fruticose with stems straighter and more terete apically, a paler red vein and contrasting spot surface coloration on adaxial leaves, and glandular hairs slightly longer.

This fourth species of *Waltheria* referred to for Argentina (Cristóbal, 1998) has been named to honor both Doctora Carmen L. Cristóbal, prominent neotropical Sterculiaceae expert, and her colleague, Lic. Sara G. Tressens, a former student of the genus *Waltheria*. Carmen directed my attention to this species in the herbarium, first took me to see it in the field, and shared valuable opportunities and herbarium resources. Sara, prior to focusing on floristic studies, provided many annotations for the genus that, in my experience, have often been very insightful and helpful in understanding its species in South America.

2. **Waltheria procumbens** J.G. Saunders & Soria, sp. nov. TYPE: Paraguay. Amambay: "*In arenosis in regione cursus superioris fluminis Apa. Iter ad Paraguariam septentrionalem*," Nov. 1901-1902, *Dr. E. Hassler 7842* (holotype, G 8718-2; isotypes, A, C, G 8718-1, LIL, MICH, MO, MPU, NY, S, W; not seen BM, cited Kohler ,1976). Fig. 2.

Per staturam perparvum et folios heteromorphas et stipulas triangulares atque nervaturam loborum calyces propriam insignis.

Small, prostrate shrub or subshrub with 6-10 radiate mainstems to 40 cm long, lacking xylopodia, with taproot 12 cm x 0.7 cm. Stems densely woody near base, for most of length 1 mm wide and internodally decurrent, only compressed at tips, vestiture sparsely stellate-pubescent, and very glandular, with red- or yellow-capitate hairs 0.2-0.3 (0.5) mm long above most stellate ones. Leaves spirally arranged, laminas 4-48 mm long, 3-29 mm wide, variable along plant, widely elliptic, broadly ovate to narrowly ovate, often 5-7-lobulate, apices obtuse to rounded, bases rounded to subcordate, margins dentate or serrate-serrulate, glandular-prominent, subglabrous often black-stained or black-spotted on both sides but not red-spotted below stellate trichomes, adaxial surface variable for trichome type, often sparsely short sericeous or setulose by mostly simple, 2-seriate trichomes to 1 mm long, differing in other leaves with stellate trichomes common, abaxial surface stellate-pubescent, both sides with glandular-capitate hairs to 0.7 mm long; smallest veins visible, reddish, with costal vein thickened at tooth apices; petioles 0.2-0.8 mm wide, glandular layer prominent, abaxial apex alate laterally on both sides; stipules subpersistent, distalmost ones triangular, 2-4 x 0.7-1.3 mm, 3-5 parallel-nerved prominently on abaxial surface. Inflorescences axillary, 5-25 mm x 8-13 mm, cymose, glomerules secund, on shoots to 3.5 cm long, 0.8 mm wide; primary cyme with four bracts subtending flower pair. Bracts essentially free, the widest bract elliptic to broadly ovate, entire or denticulate, 1.4-1.8 mm wide, brochidodromous, 3-5-nerved, with dark accretions visible as striations between nerves, the other ones oblanceolate or lanceolate, 0.7-0.9 mm wide, fewer nerved, adaxial surface subglabrous with sparse simple and 2-seriate trichomes 0.2-0.3 mm long, the apex with many sub-sessile glandular hairs, and sparsely setulose, trichomes to 0.5 mm long, on veins, marginal setae less than 1 mm long, and long only basally, abaxial surface stellate-puberulent and setose toward margins. Flowers sessile or pedicellate to 0.2 mm long, showy, distylous, ca. 7-12 mm in diam. Calyx turbinate, lobed less than halfway, tube 2.5-2.8 mm long, base inside with unconcealed annular nectaries ca.

0.8 mm long, lobes 1.0-1.8 mm long with 1 pair to 2 close pairs of arched secondary veins bearing a short upward-directed spur, and adaxially midrib very prominent, resinous in fruit. Petals 4.8-8.8 mm long, 1.0-3.9 mm wide, luteous, membranous; laminas obtriangular, essentially glabrous, bases adaxially pubescent, simple hairs, abaxially with minute, appressed stellate trichomes, apical margins with a few scattered minute simple and 2-seriate trichomes, basal adaxial midvein raised, claw distinct, 1-1.6 mm long, and adherant to stamens for 0.7-1.5 mm in length. Thrum flowers with stamens 4.3-5.2 mm long, with stamen tube 1.0-1.3 mm long, free filaments 2.6-3.4 mm long, anthers 0.5-0.9 mm long; pistil 3-3.4 mm long, on stalk 0.4 mm long; ovary 0.8-1 long, 0.2-0.5 mm wide, style 0.8-0.9 mm long; stigmas elongate-plumose, 1.1-1.3 long, 0.5-0.8 mm wide with ca. 40 branches to 0.4 mm long, stigmatic column 1.0-1.3 mm. Pin flowers similar to thrums except stamens 2.2 mm long, free filaments 0.5 mm long, pistil 5.4 mm long, style 2.7 mm long, and stigma to 1.7 mm long. Capsule obovoid to obconical, 2-2.5 mm long, 1.2-1.8 mm wide, apex apiculate, sessile glandular hairs dense near base outside, interior with a well-demarcated short, subosseous endocarp 0.4 mm long at the apex, but absent below the apex, instead with a membranous wall extending nearly to the base, dorsally loculicidally dehiscent. Seed 1, 1.8-2.0 long, 1.1-1.3 mm wide, subobovoid, in lateral view obtuse at apices, with a conical projection at base, in apical view 5-lobed, the anterior 3 at times angulate, the anteriormost 3 prominent, posterior lobes reduced, testa obscurely to minutely verrucate, lustrous, brown-black.

Pollen: **thrum**: spinulose, apertures 5-(6) (average 5.1), zonocolporate, colpus index 6.0, 43 µm x 47 µm, P/E=0.94, colpi 7 µm x 2.5 µm, exine 2.8 µm in diam., tectum 0.4 µm in diam., bacula 0.8 µm in diam., nexine 1.5 µm in diam., spinules 1.4 µm long, 1.5 µm in diam., ora 4.5 µm long x 7.5 µm wide [*Hassler 7842* S! data from Köhler (1976), reported as *W. prostrata* K. Schum., that corresponds to *Hassler 7842* S!, Köhler, pers. comm.]; **pin**: reticulate, apertures 3 (average 3.0), zonocolporate, colpus index 1.4, 32 µm x 32 µm, P/E 1.00, colpi 23 µm long, exine 1.9 µm in diam., tectum 0.6 µm in diam., bacula 0.7 µm in diam., nexine 0.6 µm in diam., lumina 2.0 µm in diam., muri 0.4 µm in diam., ora 3.7 µm long x 11.0 µm wide [*Hassler 7842* BM, not seen, reported as *Waltheria prostrata* K. Schum. in Kohler, 1976].

Phenology: Flowering October-November, February-March. Flowers presumably matinal.

Distribution, habitat and ecology: Northeastern Paraguay, department of Amambay, endemic to the district of Bella Vista, occurring on the upper rapids of the Apa River (locality not mapped), Bella Vista, the upper Aquidaban River at Estancia Santa Teresa, situated midway between Arroyos Negla and Napeque, and eastward near Charagua at Estancia San Victor. Occurring in sand deposits in cerrado contiguous with Brazilian "cerrado" in "campo" or "prado con rodales de bosquete", at elevations up to 200 m. (Fig. 3 C).

Paratypes

PARAGUAY. **Amambay**. *Dtto. Bella Vista*: A pocos km de Bella Vista [22° 7’ 60’’ S, 56° 31’ W] en dirección a San Carlos, 12-II-1982, *Casas & Molero 6238* (NY); Potrero Guaraní, 12 km SE de Administración, Ea. Santa Teresa [ca. 16 km SW by road of Ea. Zapallo, 22° 37’ 26’’ S, 56° 38’ 5’’ W], 20-III-1991, *Soria 4458* (CTES; FCQ not seen); Potrero Toro, Estancia San Victor [ca. 16 km W along road 3 km south of Charagua from Bella Vista—Yby Yau, 22° 37’ 60’’ S, 56° 28’ W], 25-X-1991, *Soria 4930* (CTES; FCQ not seen).

*Waltheria procumbens´*s autapomorphy is its short, upwardly directed vein spur above its paired secondary vein arches in calyx lobe bases (Fig. 2 G). That and the combination of triangular distalmost stipules and heteromorphic leaves differently vested in most cases delimit the species. It has basal leaves with different size and shape but more importantly, different adaxial vestiture than more distal stem leaves. The basal leaves are smaller, often widely elliptic or widely ovate, more often with rounded apices, seldom lobed or acutely tipped, and usually with only simple or few-branched trichomes (*Hassler 7842* has just a few leaves with this type) on the adaxial surface. Upper stem leaves are larger, often 5-7 assymetrically lobulate, ovate to broadly ovate, at times narrowly ovate at stem tips, and more often rounded-obtuse or acute at tips. Vestiture of these leaves on the adaxial surface is usually mixed stellate and simple, or rarely, mostly stellate (*Hassler 7842*).

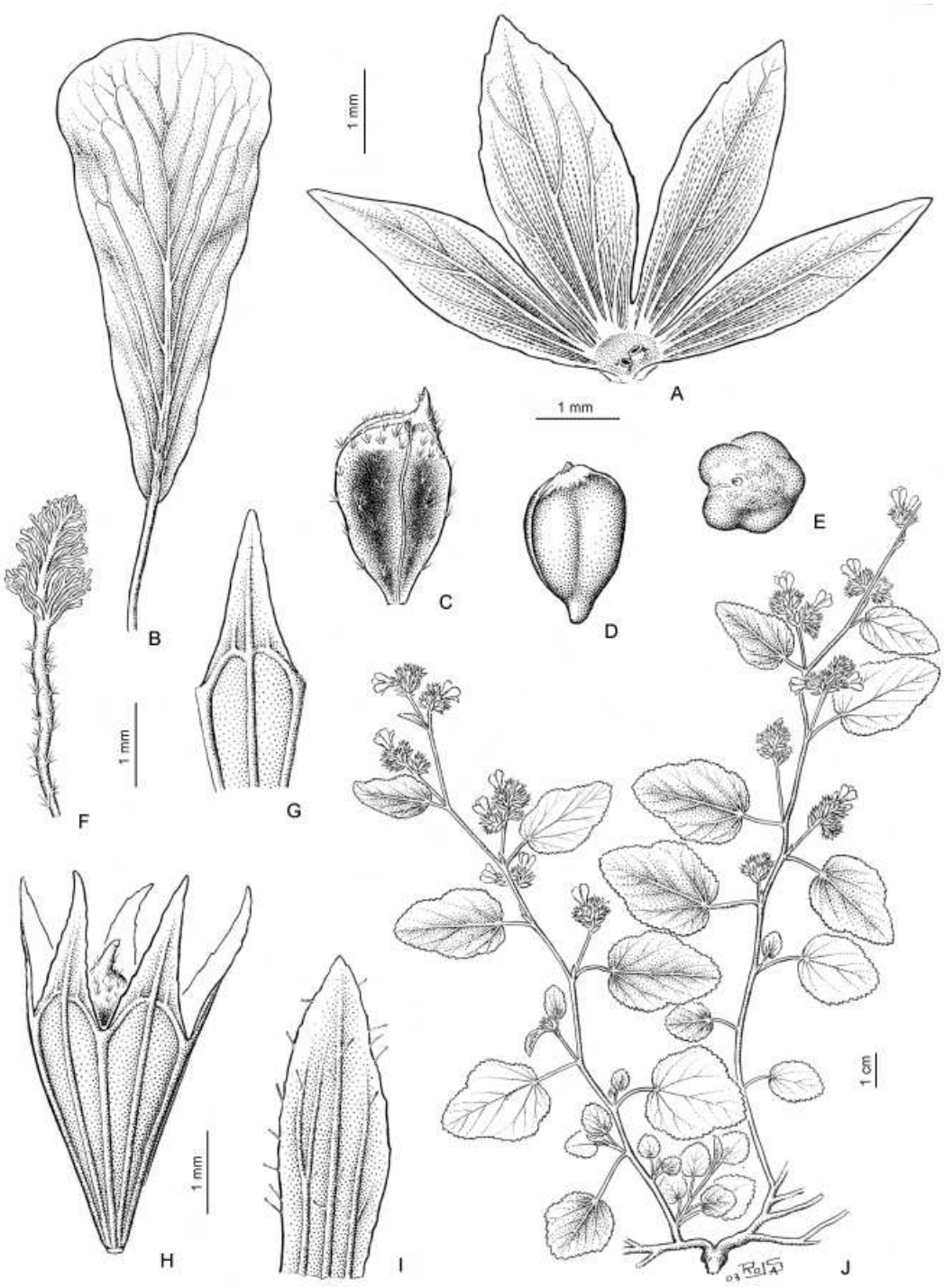

Fig. 2.- *Waltheria procumbens.* A: bracts, adaxial face. B: petal lamina and claw, adaxial face. C: capsule, lateral view, with darker seed visible. D: seed, lateral view. E: seed, apical view. F: style and stigma of pin flower, a few stigmatic branches removed in front. G: upper calyx tube and lobe, one segment, without hairs drawn, adaxial surface. H: fruiting calyx without hairs drawn, and capsule apex. I: stipule, abaxial view, with only gland-tipped hairs drawn. J: flowering branch, prostrate, petals closed. Drawn by Francisco Rojas. A-J, from *Hassler 7842* (G).

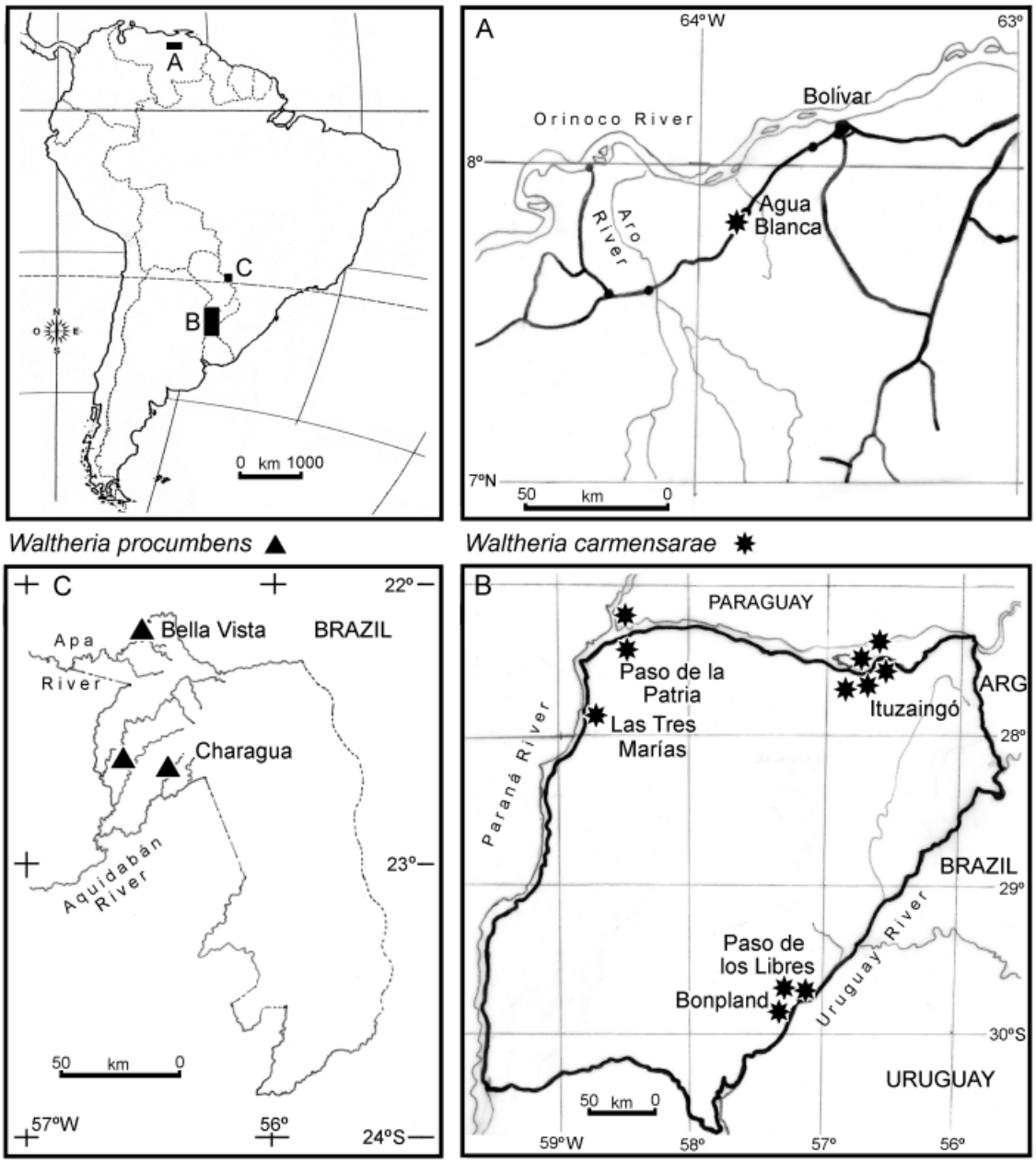

Fig. 3.- Geographical range and distribution of *Waltheria carmensarae* (A, B) *and W. procumbens* (C). A: Venezuela, northern Bolívar state. B: Argentina, Corrientes province. C: Paraguay, Amambay department.

Waltheria procumbens is closest to *W. albicans* Turczaninow, primarily from Brazil, where distylous (a few homostylous collections in Venezuela, Paraguay, Argentina, and a few distylous collections in Mexico, Colombia, Venezuela, Guyana, Bolivia and Paraguay). *Waltheria procumbens* shares with *W. albicans* similar calyx lobe venation with single or double but closely compressed secondary vein arches, and hirsutulous adaxial petals. *Waltheria procumbens* is distinguished from *W. albicans* by its more lobed rather than rounded seed shape, the presence of the short spur above the paired arches in each calyx lobe, and its triangular stipules rather than linear-triangular or

ovate-demidiate stipules. Its seed in apical view is unequally 5-lobed, the anterior 3 lobes more extended and 1-3 of them often angulate, the most anterior lobe always prominent, with posteriormost lobes indented. *Waltheria albicans*, in contrast, has a seed in apical view rounded, lobes obscure, the anterior margin rounded, and the posterior lobes as extended as adjacent anterior ones.

REGIONAL KEY AND NEW RECORDS

Since only four of the eight species now found in Paraguay were included in the last Brazilian revision (Schumann, 1886), where *Waltheria* is most diverse, and since only three of the eight Paraguayan species were treated for Argentina (Cristóbal, 1998), to facilitate identification of the new species a new regional key is provided prior to the rest of the Flora of Paraguay treatment. This requires further explanation of two range extensions into Paraguay from Brazil. One, *Waltheria operculata* Rose (sect. Stegowaltheria), occurs in Concepción (*Zardini & Leoginho 53927*, CTES), and in Alto Paraguay (*Fiebrig 1382*, G), and is newly reported for Paraguay. The other, *Waltheria albicans* Turcz., has been only briefly mentioned as present in Paraguay, in the Chaco, (Cristóbal, 1998 citing Saunders, 1995a) during the discussion of Cristóbal´s first report of *W. albicans* for Salta, Argentina. Here it is registered with specimen citations to occur in the province of Chaco (*Schinini & Bordas 15088*, pin, CTES), Nueva Asunción (*Brunner 1628*, pin, PY) and Boquerón (*Vanni et al. 2133*, homostylous, CTES; *Vanni et al. 2192*, CTES; *Vanni et al. 2478*, thrum, CTES). All four species now known from Argentina coincide with those presented in the regional key for Paraguay. *Waltheria albicans*, when homostylous (see above), and *W. indica* L. s.l., always homostylous, apparently hybridize in Paraguay, and the key below includes the criteria and measurements for Paraguayan specimens used to separate them. Distylous *W. albicans* in Brazil is more clearly differentiated from *W. indica* by its more herkogamous flowers, large obdeltate petals and long stigmatic column.

Semi-natural key to all 8 Waltheria species in Paraguay and to all 4 spp. in Argentina (only with W. communis, W. indica, W. albicans, W. carmensarae)

1. Capsule operculate (lower portion rarely tardily loculical) with a short calyptrate indehiscent operculum with osseous endocarp becoming free from membranous longer portion; annual herb; stems strigose throughout from only simple trichomes to 1.5 mm long that are hyaline, rigid, appressed, straight above base; stipules demidiate-ovate or demidiate-cordiform, broad (most 2-4 mm) ..... *W. operculata* Rose

1. Capsule loculicidal; perennials, hemicrytophytes, suffrutescent herbs, subshrubs, shrubs; stem apices at least vested by stellate trichomes, or stellate and glandular hairs, stipules not as above, if stem trichomes almost all simple subapically, then hirsute, not appressed, flexible, bent, and also with stipules linear or linear-triangular (*W. communis* in part) 2

2(1). Leaves woolly-tomentose on both sides, later moderately dense adaxially; most petioles ≥ 2.6(-5.0) mm wide; leaves 1-3 nodes below basalmost inflorescences (in sterile portion) 10-18 cm wide, very widely depressed cordiform to very widely depressed ovate (L:W Ratio 0.6-1.0:1); pin staminal tube 0.5-0.6 mm long (0.4 m tall, "campis siccis or combustis", rare, endemic to vic. Caaguazu, Paraguay) ……..... *W. macrophylla* Hassl.

2. Leaves otherwise vested; petioles ≤ 2.0(2.5) mm wide; leaves 0.3-7.5(9.0) cm wide, orbicular, elliptical, obovate, ovate, cordiform, rarely very widely ovate (L:W Ratio 2.7-1.0:1.0); pin or homostylous flower stamen tube 1.0-5.3 mm long. .....……..... 3

3(2). Capsule bivalvate into two equal parts, opening completely along locular suture; pin flowers with stigma long-exserted, thrum flowers with anthers long-exserted, and both with penicillate stigmas; inflorescences nearly always terminal (axillary in Cordillera, Pres. Hayes); basal stipules filiform, flexuose, in fertile region linear-triangular, firm ..... *W. communis* A. St.-Hil.

3. Capsule dorsally loculicidal, splitting only along apical suture; if stigma or anthers well exserted then stigma not penicillate, rather distended-plumose; inflorescences axillary; stipules triangular, narrowly triangular to linear, firm .....…..... 4

4(3). Stems without glandular-capitate hairs present ..... *W. indica* L., s.l. (in part)

4. Stems with glandular-capitate hairs present 5

5(4). Leaf apices acuminate; stems pilose or hirsute by their dense red and yellow, long and short glandular-capitate hairs that are viscose and dirty from globular exudates and from particles sticking to them, hairs to 1.2 mm long; flowers 8-14 mm diam.; petal claws adnate to stamen tube for (2.1)2.6-2.9 mm in length; seeds circumferally sulcate (mucro-truncate) at apex; flowers distylous ..... *W. viscosissima* A. St.-Hil.

5. Leaf apices rounded, obtuse, or acute; stems not glandular-pilose or glandular-hirsute, clean glandular-capitate hairs without exudates; flowers 3-8 mm in diam.; petal claws attached for 0.2-2 mm to stamen tube; seeds rounded, obtuse or truncate at apex 6

6(5). Stems completely procumbent or prostrate; leaf adaxial surface usually red-spotted below stellate trichomes, finest veins red and at the surface, or often either surface black-stained; petioles, stems of new growth densely glandular with only short-glandular trichomes 0.2-0.3(0.5) mm long that are more obvious and often exceeding short stellate trichomes 7

6. Stems erect or mostly decumbent, declining, scandens, or juvenile stems or some stems prostrate; adaxial surface not as above, concolorous, or similar but ochre-spotted, veins more submerged; petioles, stems with glandular trichomes interspersed among stellate trichomes, not with most protruding above short stellate ones, the glandular ones usually long and short 8

7(6). Stems short, to 0.4 m long; flowers distylous; leaves subglabrous, sparsely setulose by mostly simple trichomes or sparsely stellate-pubescent above, surface often black-stained; petal laminas hirsutulous at adaxial base; calyx 4-4.3 mm long; distalmost stipules triangular ..... *W. procumbens* J. G. Saunders

7. Flowering stems long, 0.6-1.5 m long; flowers homostylous; leaves tomentulose, only stellate trichomes, surface usually red-spotted; petal laminas pilose at adaxial base; calyx 4.5-6 mm long; stipules narrowly triangular to linear-triangular ..... *W. carmensarae* J. G. Saunders

8(6). Usually decumbent, variably partially erect or partially prostrate, early flowering juveniles prostrate; four bracts around flower pairs unequal, widest one ovate; inflorescence pedunculate, peduncles (1-)3-10 cm long; petals 4.8-9.0 mm x (1.0)1.5-3.8(4.5) mm, lamina obdeltate or obtriangular, apex truncate, subglabrous, a few simple or 2-seriate trichomes at apical margins; claws adherant to stamen tube for 0.7-1.2(1.6) mm long; calyx nectaries dense, annular, exposed for 0.2-0.7 mm inside above receptacle, acute between veins; capsule endocarp thinly corneous for 0.4-1.0 mm long from apex; stellate trichomes on adaxial leaves usually 2-8 rayed (rarely 13); flowers usually distylous, rarely homostylous ..... *W. albicans* Turcz.

8. Always erect; bracts around flower pairs subequal, lanceolate to linear, rarely one narrowly ovate; inflorescences sessile, subsessile or pedunculate to 3.5 cm; petals 3-4(4.3-4.7) mm x 0.5-1.2 mm, lamina obovate, elliptic, oblong rarely obtriangular, apex usually rounded, rarely truncate, vestiture usually more than above but variable, at times hirsute on upper half adaxially, abaxially and apical margin densely stellate; calyx nectaries obscure usually; petal claws adherant to stamen tube for 0.2-0.8 mm; capsule endocarp thinly to thickly corneous for ca. halfway, ca. 0.8—2.0(2.5) mm in length from the apex; stellate trichomes on adaxial leaves usually 8-12 rayed, (rarely 5-9 or 13-18); flowers always homostylous ..... *W. indica* L., s.l.

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Holmgren et al. (1990): A, ARIZ, B, BAB, BBS, BH, BHCB, BKL, BM, BR, C, CAS-DS, CAY, CEPEC, CTES, DAV, DNA, E, F, FCQ, G, GH, GUA, HAL, HB, INPA, JE, K, KW, LE, LIL, LL, LPB, M, MA, MBM, MEXU, MICH, MO, MPU, MSC, NY, P, PR, R, RB, S, SI, SING, SP, SPF, TEX, TI, U, UCR, UFMT, UPCB, UPS, US, W, and WIS. This study represents part of a doctoral dissertation partially funded by NSF-DIS grant BSR-880089, a Billie Turner Fellowship Award, an Alexopoulus Memorial Scholarship Award, a University of Texas Graduate School Fellowship Award, Dr. Cyrus L. and Amelia Lundell, and gifts from Ralph and Dorris Saunders.

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