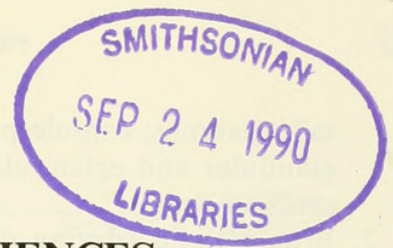


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THREE NEW SPECIES OF  
*JUSTICIA* (ACANTHACEAE) FROM PANAMA

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**ABSTRACT:** Three new species of *Justicia*, *J. fortunensis*, *J. veraguensis*, and *J. readii*, are described from Panama. The three species are illustrated and their known distributions are mapped. A key to these and a related species in Panama, *J. refractifolia*, is provided. A chromosome number of  $n = 14$  is reported for *J. fortunensis*. With 23 species now known from Panama, *Justicia* is the largest genus of Acanthaceae in that country.

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INTRODUCTION

The Acanthaceae of Panama comprise 109 species in 34 genera (Durkee 1988). *Justicia* is the largest and taxonomically most complex genus of Acanthaceae with between 420 (Mabberley 1987) and 600 or so (Graham 1988) species worldwide. Durkee (1988) noted the occurrence of 21 species of *Justicia* in Panama. Recent explorations in the species-rich montane regions near Fortuna Dam and on Cerro Tute in western Panama have resulted in the collection of two undescribed species of *Justicia*. Another species, previously known only from Cerro Jefe, and treated under the name of a species from the Old World, is recognized as new and its range within Panama is expanded.

These three species share several features in

common with *J. refractifolia* (Kuntze) Leonard of Costa Rica and Panama. All four have axillary and terminal inflorescences of conspicuously and densely bracteate spikes with the bracts and corollas less than 20 mm long. These characters distinguish this group of species from all other Panamanian *Justicia*. A key to these four species is presented below.

1. Young stems pubescent with whitish to light brown trichomes (and bracts not drying dark red); calyx pubescent with eglandular trichomes; filaments pubescent.
2. Bracts dark pink (often drying brownish); corolla 8-10 mm long, externally pubescent with glandular and eglandular trichomes; filaments proximally pubescent with eglandular trichomes, dis-



- tally glabrous; capsule pubescent with glandular and eglandular trichomes; seeds smooth ..... *J. fortunensis*
2. Bracts green (drying dark green or brown); corolla 10–17 mm long, externally pubescent with eglandular trichomes; filaments pubescent with glandular trichomes throughout length; capsule pubescent with eglandular trichomes; seeds roughened with minute rounded protrusions ..... *J. refractifolia*
  1. Young stems glabrous or pubescent with golden trichomes (if trichomes light brown or straw-colored as sometimes in *J. readii*, then bracts drying dark red); calyx pubescent with glandular and eglandular trichomes; filaments glabrous.
  3. Young stems glabrous; bracts drying pale to dark greenish; bractlets ovate-elliptic to elliptic to oblanceolate to obovate; calyx 5–6 mm long; corolla 10–13 mm long, externally pubescent with glandular and eglandular trichomes; seeds smooth ..... *J. veraguensis*
  3. Young stems evenly covered with a dense layer of (flexuose to) antrorse to antrorsely appressed golden (to light brown or straw-colored) eglandular trichomes; bracts drying dark red; bractlets linear-lanceolate to linear to linear-elliptic; calyx 7.5–10 mm long; corolla 15–19 mm long, externally pubescent with eglandular trichomes; seeds papillose to verrucose ..... *J. readii*

Although Leonard (1958) recognized more than 70 species of *Justicia* in Colombia and Durkee (1986) treated 27 species from Costa Rica, none of the taxa from these adjacent regions appears to be conspecific with the three species newly described below. *Justicia* is the largest genus of Acanthaceae in Panama with 23 species now known from the country.

***Justicia fortunensis* sp. nov.**

(Fig. 1)

TYPE.—PANAMA. Chiriquí: vicinity of Fortuna Dam, along trail across valley of Río Hornito, 12 March 1988, *T. Daniel, F. Almeda, and G. McPherson* 5550 (Holotype: CAS!; isotypes: DUKE!, FI, GH!, K!, MICH!, MO!, NY!, PMA!, US!).

Suffrutex vel frutex usque ad 1 m altus. Caules juniores trichomatibus eglandulosis antrorsis (vel retrorsis) 0.2–0.5 mm

longis in 2 lineis dispositis pubescentes. Folia petiolata, laminae lanci-ellipticae vel ovato-ellipticae vel ellipticae, 45–152 mm longae, 10–56 mm latae, 2.1–5-plo longiores quam latiores. Inflorescentia spicata dense bracteata, rhachis trichomatibus eglandulosis pubescens. Bractae atroroseae saepe in sicco brunneolas late ellipticae vel subcirculares vel obovatae 7–13(–17) mm longae 6–11.5 mm latae. Bracteolae ellipticae. Calyx 4.5–6.5 mm longus extus eglandulosus. Corolla 8–10 mm longa extus glandulosa. Stamina 2.8–3 mm longa filamentis pubescentibus. Stylus 4.5–5 mm longus. Capsula 10 mm longa extus glandulosa. Semina 2–3 mm longa 2–2.5 mm lata laevia.

Perennial herb to shrub to 1 m tall. Young stems subquadrate to quadrate, pubescent with antrorse (or retrorse), whitish to light brown (and with conspicuous darker brown septae), eglandular trichomes 0.2–0.5 mm long, mostly concentrated in 2 decussate lines, older stems becoming glabrate. Leaves petiolate, petioles to 14 mm long, pubescent like young stems, blades lance-elliptic to ovate-elliptic to elliptic, 45–152 mm long, 10–56 mm wide, 2.1–5 times longer than wide, acuminate to long-acuminate at apex, acute to attenuate at base, surfaces sparsely pubescent with cauline type trichomes along major veins, otherwise glabrous. Inflorescence of pedunculate, densely bracteate spikes to 60 mm long, 10–20 mm in diameter near midspike, borne singly (or sometimes 2) in axils of distal leaves, peduncles to 45 mm long, pubescent like stems, rachis more or less evenly pubescent with straight to flexuose to antrorse, eglandular trichomes 0.1–0.4 mm long. Bracts dark pink (basal pair rarely somewhat leaflike and partly green), drying pinkish or brownish, broadly elliptic to subcirculate to obovate, 7–13(–17) mm long, 6–11.5 mm wide, rounded or obtuse (and often apiculate) to acute at apex, either abruptly constricted or tapering into a short (to 3 mm long) petiole at base, abaxial surface pubescent with prominent or inconspicuous, straight to flexuose eglandular and stipitate glandular trichomes to 0.5 mm long, margin prominently ciliate with coarse, conspicuously multi-celled, eglandular trichomes to 1.4 mm long. Bractlets elliptic, 6–12 mm long, 1.8–4 mm wide, gradually tapering into a petiole at base, pubescent like bracts. Calyx 4.5–6.5 mm long, 5-lobed, lobes dark pink (at least distally), divided nearly to base of calyx, lanceolate to subulate, 0.5–0.8 mm wide, pubescent with eglandular trichomes. Corolla white to very pale pink, 8–10 mm long, externally pubescent with stipitate glandular and eglandular trichomes 0.1–0.3





FIGURE 1. a–d, *Justicia fortunensis* (Daniel et al. 5550). a, Habit; b, Bract; c, Bract, bractlets, calyx, and corolla; d, corolla with stamens. e–h, *Justicia readii* (Read et al. 85-6b). e, Habit; f, Bract; g, Bracts, bractlet, calyx, and young corolla; h, corolla with stamens.



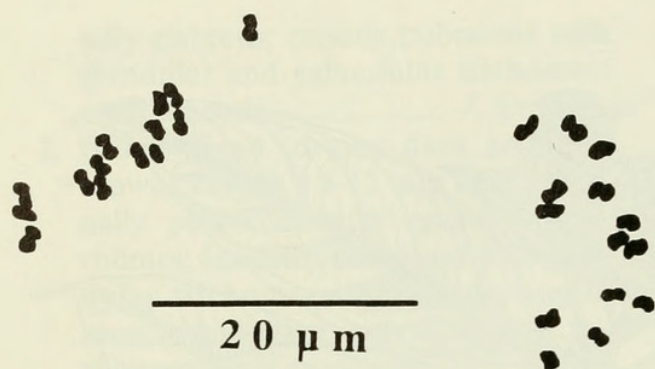


FIGURE 2. Camera-lucida drawing of meiotic chromosomes of *J. fortunensis* (Daniel et al. 5500,  $n = 14$ ) at metaphase II.

mm long, tube 4–5.5 mm long, internally densely pubescent, upper lip triangular, internally rugulate, 3.5–4 mm long with 2 lobes 0.4–0.7 mm long, lower lip 4–4.5 mm long with 3 elliptic lobes 3–3.5 mm long, 2–3.5 mm wide, central lobe larger than lateral lobes. Stamens attached near apex of tube, 2.8–3 mm long, exerted up to 2 mm from mouth of corolla, filaments 1.5–2 mm long, pubescent with eglandular trichomes proximally, glabrous distally, thecae superposed, the upper 1.4–1.5 mm long, the lower 1.5–1.8 mm long (including a blunt basal appendage to 0.2 mm long), pollen diporate (to subdicolporate) with trema region traversed by 2 rows of 6–7

insulae. Style 4.5–5 mm long, distally glabrous, proximally pubescent with upward pointing, eglandular trichomes. Capsule 10 mm long, pubescent with glandular and eglandular trichomes 0.1–0.3 mm long, stipe 4 mm long, head 6 mm long. Seeds 4 per capsule, flattened, subcircular to subelliptic in outline, 2–3 mm long, 2–2.5 mm wide, surface smooth. ( $n = 14$ , Daniel et al. 5550, Fig. 2)

**DISTRIBUTION AND PHENOLOGY.**—Known only from Pacific slopes of the Cordillera Central in western Panama (north-central Chiriquí) in the watershed of the Río Chiriquí (Fig. 3). Plants occur in cloud forests at elevations from about 1025 to 1250 m. Flowering: January–April and August; fruiting: January–April.

*Justicia fortunensis* is not readily identifiable with any subgeneric taxa using the keys and descriptions provided by Graham (1988). It has pollen ("Type 5," Fig. 4) like that found in five sections recognized by Graham. The chromosome number reported here for the type is the most commonly encountered number in the genus and occurs in various subgeneric taxa (Daniel and Chuang 1989; Daniel et al. 1984, 1990).

The Fortuna Dam area, the only region from which this species is known, has received considerable attention by plant collectors in the last

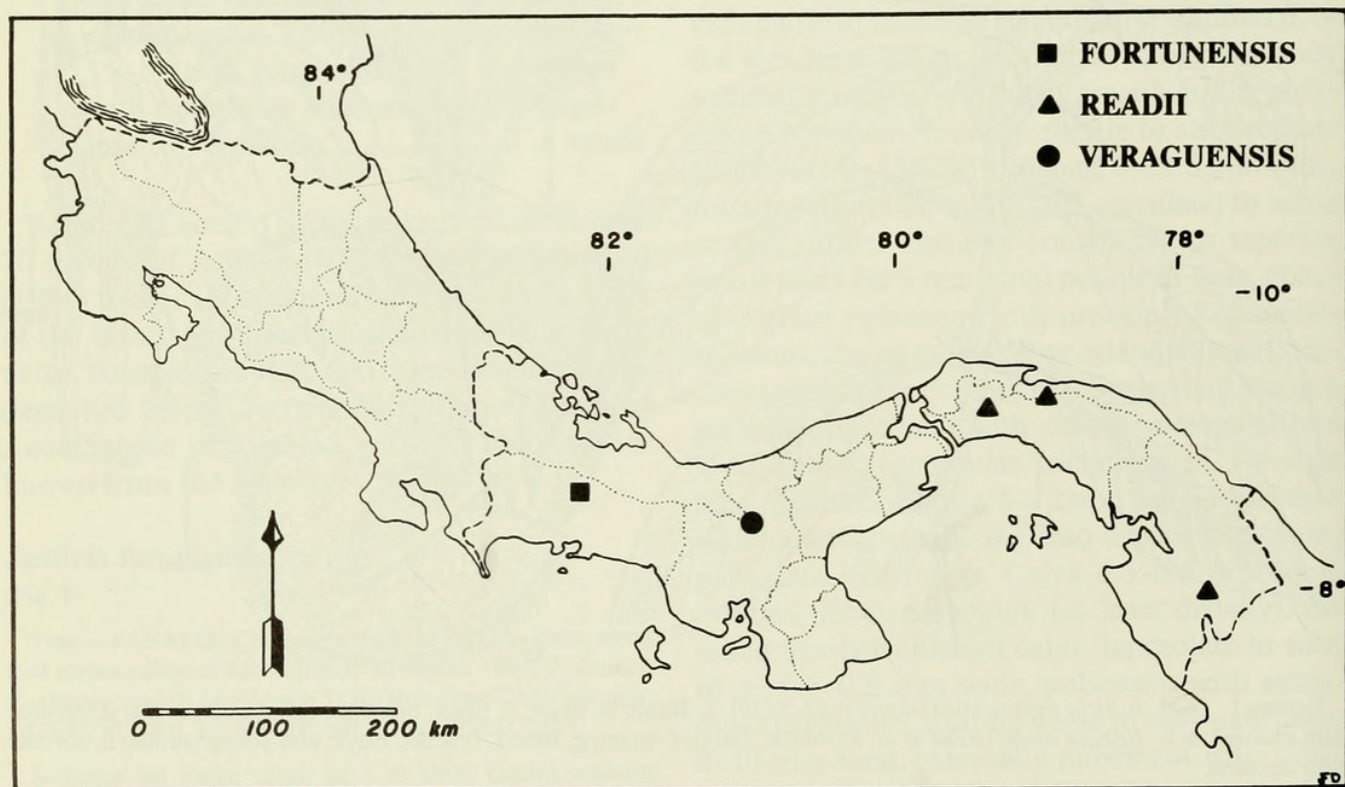


FIGURE 3. Map showing distribution of *Justicia fortunensis*, *J. readii*, and *J. veraguensis*.



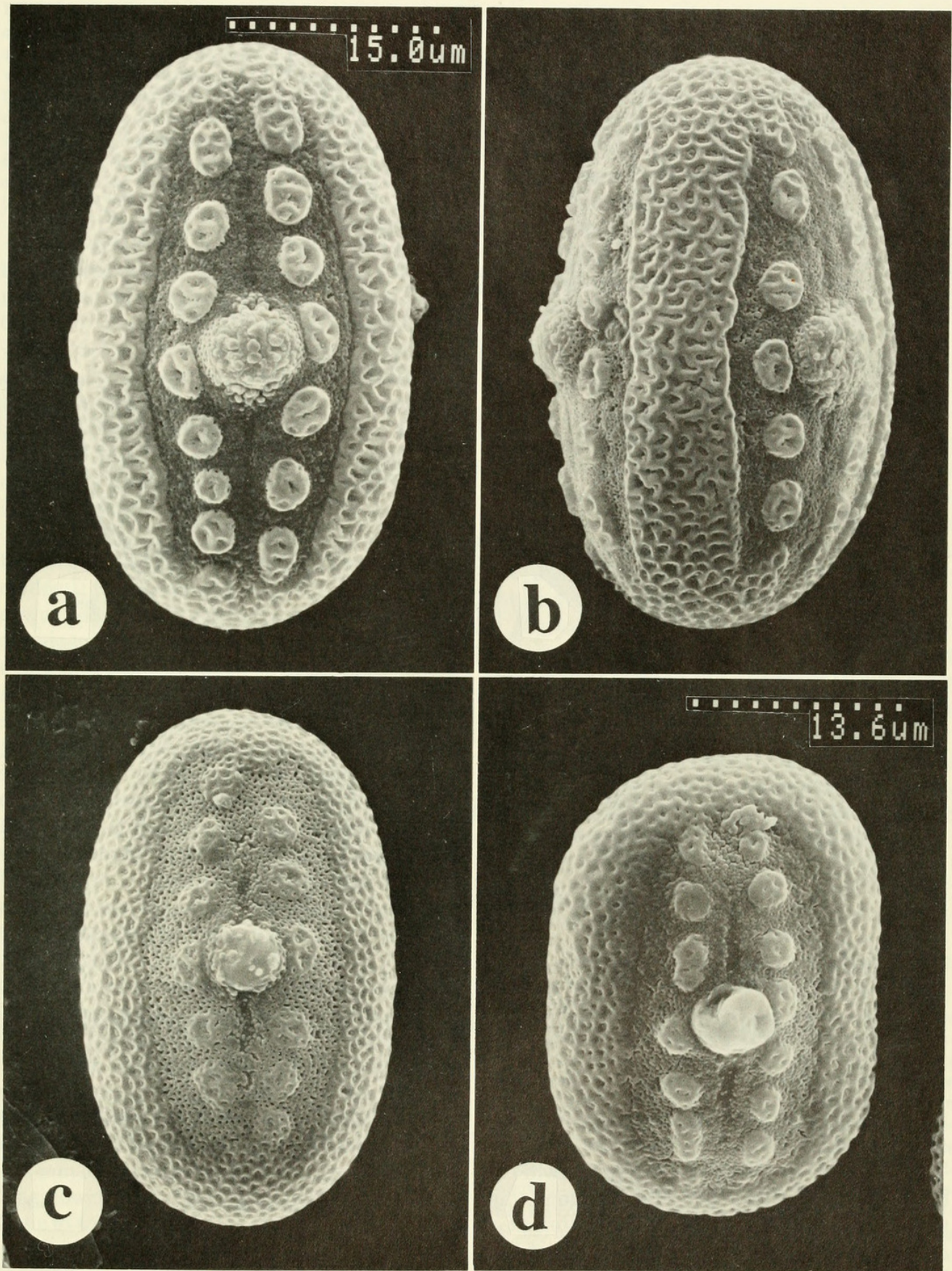


FIGURE 4. Scanning electron micrographs of pollen of *Justicia*. a, *J. readii* (Read et al. 85-6b), view of "trema region"; b, *J. readii* (Read et al. 85-6b), view between 2 "trema regions"; c, *J. veraguensis* (Croat 34153), view of "trema region"; d, *J. fortunensis* (Daniel et al. 5550), view of "trema region."





FIGURE 5. *Justicia veraguensis* (Croat 34153). a, Habit; b, Bract; c, Bractlets, calyx, and gynoecium; d, Corolla with stamens.

few years and has yielded a wealth of new taxa (Dwyer 1985).

**PARATYPES.**—PANAMA. Chiriquí: Edwin Fabrega Dam and Reserve in Fortuna along trail to Río Hornito above Los Planes, *F. Almeda et al.* 6320 (CAS, MO, PMA, US); W side of Río Hornito, *W. D'Arcy* 16003 (MO); La Fortuna hydroelectric project, along Chiriquí River, *B. Hammel* 2292 (MEXU); between Los Planes de Hornito and Fortuna Lake, 8°41'N, 82°13'W, *R. Hampshire & C. Whiteford* 701 (BM); ca. 5 km

E of Fortuna Dam, along trail crossing Río Hornito, 8°45'N, 82°15'W, *S. Thompson* 5012 (CAS).

***Justicia veraguensis*, sp. nov.**

(Fig. 5)

**TYPE.**—PANAMA. Veraguas: Cerro Tute, above Santa Fe beyond Escuela Agrícola Inter-americana, 1.8 mi beyond fork in rd., 5 April 1976, *T. Croat* 34153 (Holotype: NY!).

Frutex usque ad 2 m altus. Caules juniores glabri. Folia petiolata, laminae ovato-ellipticae vel ellipticae 65–165 mm longae 21–63 mm latae 2.6–3.4-plo longiores quam latiores.



Inflorescentia spicata dense bracteata, rhachis trichomatibus eglandulosus et plerumque glandulosus pubescens. Bractae in sicco subviridulae vel atroviridulae obovatae vel late ellipticae vel subcirculares vel deltatae 8–13 mm longae 6–8.5 mm latae. Bracteolae ovato-ellipticae vel ellipticae vel oblanceolatae vel obovatae. Calyx 5–6 mm longus extus glandulosus. Corolla 10–13 mm longa extus glandulosa. Stamina 5.5–6 mm longa filamentis glabris. Stylus 8 mm longus. Capsula 9–11 mm longa extus glandulosa. Semina 3–3.3 mm longa 2.7–3.7 mm lata laevia.

Shrub to 2 m tall. Young stems quadrate, glabrous, older stems glabrous. Leaves petiolate, petioles to 50 mm long, glabrous, blades ovate-elliptic to elliptic, 65–165 mm long, 21–63 mm wide, 2.6–3.4 times longer than wide, acuminate at apex, acute to subattenuate at base, surfaces glabrous. Inflorescence of axillary and terminal, pedunculate, densely bracteate spikes to 65 mm long, 13–21 mm in diameter near midspike, peduncles to 15 mm long, glabrous or pubescent in 2 lines with retrorse eglandular trichomes to 0.3 mm long, rachis pubescent with straight to flexuose eglandular and glandular (sometimes not evident) trichomes 0.1–0.3 mm long. Bracts drying pale to dark greenish, obovate to broadly elliptic to subcirculate to deltate, 8–13 mm long, 6–8.5 mm wide, rounded to acute at apex, sessile or petiolate (petiole to 2 mm long), constricted and/or tapering at base, abaxial surface pubescent with straight to flexuose eglandular and glandular trichomes 0.1–0.3 mm long or becoming glabrate, margin ciliate with trichomes like those of abaxial surface and with an overstory of flexuose eglandular trichomes to 1.2 mm long. Bractlets ovate-elliptic to elliptic to oblanceolate to obovate, 6–10 mm long, 1.7–2.7 mm wide, tapering and often petiolate at base, pubescent like bracts. Calyx 5–6 mm long, 5-lobed, lobes divided nearly to base of calyx, lanceolate, 0.7–1.7 mm wide, pubescent like bracts. Corolla white (to greenish white) with purplish markings, 10–13 mm long, externally pubescent with flexuose eglandular and glandular trichomes 0.1–0.3 mm long, tube 6–6.5 mm long, internally glabrous, upper lip triangular, internally rugulate, 4–7 mm long, emarginate with lobes 0.2–0.3 mm long, lower lip 4–7 mm long with 3 broadly elliptic to subcirculate lobes 2.5–4 mm long, 2–4.5 mm wide, central lobe larger than lateral lobes. Stamens attached near apex of tube, 5.5–6 mm long, exerted up to 5 mm beyond mouth of corolla, filaments 4.5–5.2 mm long, glabrous, thecae superposed, the upper 1.2–1.5 mm long, the lower 1.7–2 mm long (including a basal spur

0.3–0.4 mm long), pollen diporate (to subdiporate) with trema region traversed by 2 rows of 6–7 insulae. Style 8 mm long, distally glabrous, proximally pubescent with eglandular trichomes. Capsule 9–11 mm long, pubescent with glandular and eglandular trichomes 0.1–0.2 mm long, stipe 3.5–4 mm long, head 5.5–7 mm long. Seeds 4 per capsule, flattened, subcircular in outline, 3–3.3 mm long, 2.7–3.7 mm wide, surface smooth.

**DISTRIBUTION AND PHENOLOGY.**—Known only from the mountains of Veraguas in western Panama. The type and one paratype were collected on the Pacific slopes of Cerro Tute in the Cordillera Central of northern Veraguas (Fig. 3). We have not been able to determine the exact location in Veraguas of the other paratype; however, T. Croat (personal communication) suggests that the Río Segundo Brazo is the second river along the road to the lowlands on the Caribbean slope of Cerro Tute. Plants occur on forested slopes and on rocks in watercourses at elevations from 630 to 1200 m. Flowering: March–April and September; fruiting: April.

*Justicia veraguensis* exhibits a suite of characters that precludes its placement into any of the sections recognized by Graham (1988). It has pollen (Fig. 4) similar to that of *J. fortunensis*, which is undoubtedly a close relative.

**PARATYPES.**—PANAMA. Veraguas: 5 mi W of Santa Fe on rd. past Escuela Agrícola Alto Piedra, R. Liesner 852 (GH, MO); Río Segundo Brazo, P. Maas & R. Dressler 1660 (F, U, US).

### *Justicia readii*, sp. nov.

(Fig. 1)

**TYPE.**—PANAMA. Panamá: Cerro Jefe, 5 January 1972, J. Dwyer 9500 (Holotype: MO!; isotype: NY!).

Frutex usque ad 1.5 m altus. Caules juniores trichomatibus eglandulosus aureis (vel pallidis brunneolis vel stramineis) (flexuosis vel) antrorsis vel appressis 0.4–2 mm longis aequaliter pubescentes. Folia petiolata, laminae ellipticae vel obovatae 45–185 mm longae 17–78 mm latae 2.3–3.8-plo longiores quam latiores. Inflorescentia spicata dense bracteata, rhachis trichomatibus glandulosus et eglandulosus pubescens. Bractae virides in sicco atrovinosae obovatae vel subcirculares vel ellipticae 8–16 mm longae 4.5–11.5 mm latae. Bracteolae lineares-lanceolatae vel lineares vel lineares-ellipticae. Calyx 7.5–10 mm longus extus glandulosus. Corolla 15–19 mm longa extus eglandulosa. Stamina 5–6.5 mm longa filamentis glabris. Stylus 11–16 mm longus. Capsula 9–12.5 mm longa extus glandulosa. Semina 2.3–2.6 mm longa, 2.3–2.5 mm lata papillosa vel verrucosa.

Shrub to 1.5 m tall. Young stems subquadrate to quadrate, densely and evenly pubescent with



(flexuose to) antrorse to antrorsely appressed, golden (to light brown or straw-colored), eglandular trichomes 0.4–2 mm long, older stems remaining pubescent. Leaves petiolate, petioles to 30 mm long, pubescent like stems, blades elliptic to obovate, 45–185 mm long, 17–78 mm wide, 2.3–3.8 times longer than wide, acute to acuminate at apex, acute to attenuate at base, mid-vein pubescent like stems, surfaces sparsely pubescent with similar trichomes. Inflorescence of axillary and terminal, pedunculate, densely bracteate spikes to 75 mm long, 12–21 mm in diameter near midspike, peduncles to 14 mm long, pubescent like stem, rachis pubescent with straight to flexuose (to antrorsely appressed, especially toward base of spike) eglandular and glandular trichomes to 1 mm long. Bracts green, drying dark red, obovate to subcirculate to elliptic, often somewhat asymmetrical, 8–16 mm long, 4.5–11.5 mm wide, rounded and sometimes apiculate to acute at apex, sessile, rounded or constricted and tapering (to subpetiolate) at base, abaxial surface pubescent with straight to flexuose glandular and eglandular trichomes 0.2–0.5 mm long (sometimes not persisting on older bracts), and usually with coarser, antrorse eglandular trichomes to 0.8 mm long as well, margin ciliate with flexuose eglandular (usually coarse) and glandular trichomes up to 2 mm long. Bractlets linear-lanceolate to linear to linear-elliptic, 8–13 mm long, 1.5–2.1 mm wide, tapering little, if at all, and sessile at base, pubescent like bracts. Calyx 7.5–10 mm long, 5-lobed, lobes divided nearly to base of calyx, subulate, 0.5–0.8 mm wide, pubescent with glandular and eglandular trichomes. Corolla whitish to lavender, 15–19 mm long, externally pubescent with flexuose eglandular trichomes to 0.6 mm long, tube 9–12 mm long, internally glabrous, upper lip triangular, internally rugulate, 4.5–8 mm long, emarginate with lobes 0.2–0.3 mm long, lower lip 5–7.5 mm long with 3 subelliptic lobes 2–4.5 mm long, 1.6–2.8 mm wide, central lobe larger than lateral lobes. Stamens attached near apex of corolla tube, 5–6.5 mm long, exerted up to 5.5 mm beyond mouth of corolla, filaments 4–5 mm long, glabrous, thecae superposed, the upper 1.2–1.5 mm long, the lower 1.5–2 mm long (including a basal spur 0.2–0.3 mm long), pollen triporate (to subtricolporate) with trema region traversed by 2 rows of 7 insulae. Style 11–16 mm long, distally glabrous, proximally pubescent with

eglandular trichomes. Capsule 9–12.5 mm long, pubescent with glandular and eglandular trichomes 0.1–0.4 mm long, stipe 3.5–6 mm long, head 5–6.5 mm long. Seeds 4 per capsule, flattened, subcircular in outline, 2.3–2.6 mm long, 2.3–2.5 mm wide, surface papillose (when immature) and papillose to verrucose (when mature).

**DISTRIBUTION AND PHENOLOGY.**—Cloud forests of eastern Panama (Panamá, San Blas, and Darién) at elevations from 500 to 1300 m (Fig. 3). Flowering November–January; fruiting: December–January.

The type and most other collections of this species have golden, antrorsely-appressed cauline trichomes to 0.8 mm long, relatively small leaves (blades 45 to 90 mm long, 17 to 31 mm wide with petioles to 17 mm long), and relatively short spikes (to 55 mm long) with small bracts (8–12 mm long, 4.5–7 mm wide). Four collections (*Dressler 3221*, *Folsom et al. 6296*, *Maas & Dressler 677*, and *Mori & Kallunki 3424*) differ most conspicuously from those specimens resembling the type by having light brown to straw-colored, flexuose to antrorse-appressed cauline trichomes to 2 mm long, larger leaves (55 to 185 mm long, 18–78 mm wide with petioles to 30 mm long), and somewhat longer spikes (to 75 mm long) with larger bracts (11 to 16 mm long, 5–11.5 mm wide). Although these two forms are readily recognizable, the general overlap in the character states noted above and the occurrence of both in the same region (i.e., Cerro Jefe) suggests that they be treated as a single taxon at this time.

*Justicia readii* also cannot be classified in Graham's (1988) scheme. It has trilaterally symmetric pollen ("Type 2," Fig. 4) which is characteristic of Graham's section *Tyloglossa* of Africa and Arabia. Species in this section differ from *J. readii* by their inflorescence structure and bract form. In spite of the obvious difference in pollen, *J. readii* is more similar to *J. fortunensis* and *J. veraguensis* than to any other species in Panama.

Durkee (1978) treated this species as *J. adhatoda* L., a widely cultivated species native from the Indian subcontinent to southeastern Asia. *Justicia adhatoda*, which is not presently known from Panama, can be distinguished from *J. readii* by its longer (23–30 mm) corollas; larger (12–34 mm long and 7–12 mm wide) and eglandular bracts that do not dry dark red; linear-elliptic,



eglandular, and wider (1.5–2.3 mm) calyx lobes; longer (3.5–4.5 mm) thecae, both of which bear basal spurs; and bilaterally symmetric pollen.

*Justicia readii* has been rather well collected on Cerro Jefe, a mountain northeast of Panama City that has been much visited since it became readily accessible to plant collectors in the mid-1960's (Dwyer 1967, 1985). It is not surprising that the species was recently collected along the relatively new El Llano-Cartí Road in the Serranía de San Blas. There is a continuous ridge system linking Cerro Jefe with the Serranía de San Blas. The southeasternmost station for this species, in the Serranía de Pirre in Darién, is rather isolated from the other known occurrences.

PARATYPES.—PANAMA. Darién: ridgetop area N of Cerro Pirre, between Cerro Pirre top and Rancho Plástico, *J. Folsom et al.* 6296 (MO). Panamá: Cerro Jefe, along main rd. before turn-off to summit, *T. Croat* 13054 (MO); La Eneida, region of Cerro Jefe, *R. Dressler* 3221 (MO); Cerro Jefe, *J. Dwyer & A. Gentry* 8489 (MO); near top of Cerro Jefe to 1 mi. beyond, *A. Gentry et al.* 3440 (MO); La Eneida, Cerro Jefe region, *P. Maas & R. Dressler* 677 (MO); 5–10 km NE of Altos de Pacora, "Campamento Quatro," Gorgas Memorial Labs yellow fever research camp, *S. Mori & J. Kallunki* 3424 (MO, NY); Cerro Jefe, near jct. of rds. to Cerro Jefe and Altos de Pacora, *S. Mori et al.* 3776 (MO); rd. from Cerro Jefe to Cerro Azul, *E. Tyson* 5306 (MO); Cerro Jefe between Cerro Azul and La Eneida, ca. 15 mi NE of Panama City, *R. Wilbur et al.* 15541B (DUKE, MO). San Blas: Serranía de San Blas, Nusagandí along El Llano-Cartí Rd., *R. Read et al.* 85-6B (US).

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#### RESUMEN

Se describen e ilustran tres especies nuevas de *Justicia* de Panamá: *J. fortunensis*, *J. veraguensis*, y *J. readii*. Se presenta un mapa que muestra la distribución de cada una de las especies. Las tres especies nuevas parecen tener afinidades con *J. refractifolia* y una clave de estas cuatro especies es presentada. Se reporta un número de cromosomas de  $n = 14$  para *J. fortunensis*. Con 23 especies en el país, *Justicia* es el género más grande de Acanthaceae en Panamá.

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