

connate basally, in oblong groups arranged sequentially more or less end to end and spiralling along length of rachis, adjacent groups separated by a brief gap, each group spiralling ca. half-way around the main axis, subtended by a rachis bract; rachillae bracteoles 1.3–13.0 mm long, 0.1–1.2 mm wide. Flowers 4.4–6.0 mm long, (3.0–) 3.8–4.6 mm in diameter; pedicel 0.7–1.5 mm long; floral bracteole 1.3–4.5 mm long, 0.3–0.8 mm wide; receptacle 0.9–1.5 mm long; sepals 3.7–5.3 mm long, connate basally to $\frac{1}{2}$ their length; petals 3.4–4.2 mm long, 3.8–6.0 mm wide, usually revolute and/or undulate apically; filaments 3.4–4.3 mm long, connate basally $\frac{1}{2}$ – $\frac{3}{4}$ their length; stamen tube 2.0–3.0 mm long, 0.9–2.1 mm in diameter; anthers 1.8–2.5 mm long, 0.7–1.0 mm wide; ovary 0.7–1.5 mm long, 0.7–1.4 mm in diameter; stigmas+styles 2.7–3.5 mm long. Inflorescence a dense, very compacted mass of fruits. Fruit ca. 2.0 cm long, ca. 1.3 cm in diameter, ellipsoidal; seed 1.5–1.6 cm long, 1.1–1.2 cm in diameter, ellipsoidal.

Distribution (Fig. 21). Confined to a small area of Caribbean lowland wet forest in eastern Costa Rica, just south of Tortuguero National Park. Within this area *Cryosophila cookii* is restricted to low-lying lands having very wet soil most of the year, yet never seasonally inundated for lengthy periods; ca. sea level only.

ADDITIONAL SPECIMENS EXAMINED. **Costa Rica.** LIMÓN: along Costa Rica Hwy 32 (Siquirres–Limón), ca. 200 m SSE of bridge over Río Hondo (48.2 km W of intersection with Costa Rica Hwy 36 S to Bribri at Limón), 10°05'N, 83°22'W, *Evans 131*, (MICH), *Evans 132*, (CAS, MICH, NY, US), *Evans 162* (BH, F, MICH, MO); near San Geraldo–La Aurora rd, ca. 1 km NW of San Geraldo, 10°19'N, 83°32.5'W, *Evans 133* (BH, F, INB, MICH, MO); ca. 200 m W of San Geraldo centro, 10°19'N, 83°32.5'W, *Evans & Solano 206* (MICH, US).

The inflorescence of *C. cookii* with its characteristic densely fastigiata rachillae spiraling around the main axis makes it the most distinctive species of *Cryosophila*. Its large size and extremely spiny trunk are also diagnostic. The type specimen appears to have had uncharacteristically small leaves and a similarly small inflorescence.

Nearly all of the original forest in which *C. cookii* presumably once occurred has been converted to cattle pastures or banana plantations. Extrapolating from estimates of present population density of *C. cookii* and the amount of original forest remaining in the presumed historical range of the species, I suspect the total adult population to number only about 100, with perhaps only a small fraction occurring inside Tortuguero National Park, which for the most part lacks suitable habitat for *C. cookii*.

3. *Cryosophila grayumii* R. Evans, sp. nov.—TYPE: COSTA RICA. Puntarenas: NE slope of Fila de Cal, ca. 15 m down from Ciudad Neily–San Vito de Coto Brus rd, 8.2 km N of Ciudad Neily, 08°41'N, 82°56'W, 580 m, 19 Sep 1989, *Evans 174* (holotype: MICH!; isotypes: BH! INB! MO!).

Common names: *bijagua*, *bijagua real*, *palma real*.

A congeneribus laminis plantarum maturarum minus divisis differt; sectiones totae laminae, praeter sectiones centrales, plerumque indivisae et nunquam omnino divisae. Axis principalis inflorescentiae 21.0–47.0 cm longus, bractee pedunculatae

2–3, prope basim rhachidis inflorescentiae rami principales usque ad 3.8 cm longi et rhachillae usque ad 3.4 cm longae.

Solitary or very rarely multistemmed palm. Trunk 0.7–4.9 m long, usually arching upward, sometimes decumbent or erect, 5.0–8.8 cm DBH, armed with root-spines usually distributed more or less equally along length of trunk, sometimes densest proximally and thinning distally; internodes (0.5–) 0.8–1.6 (–2.0) cm long. Root-spines 0–ca. 20 (–ca. 100) per 10 cm of trunk, most to ca. 10 (avg. ca. 2–4) cm long, occasional outliers to ca. 25 cm long, unbranched or once-branched, usually descending; basal adventitious roots usually growing into the soil, usually similar morphologically to root-spines above, sometimes longer and more often branched, forming a cone to ca. 0.25 m high and ca. 0.5 m in diameter. Leaves (9–) 14–24 (–32), 3–10 distal to leaf through which youngest inflorescence emerges, additionally 0–6 (–11) marcescent; petiole 0.41–2.19 m long, 0.65–1.05 cm wide, hastula 0.7–1.0 (–1.2) cm long, 1.0–1.4 (–1.6) cm wide, 0.9–1.7 (–2.1) times as wide as long, very broadly to depressed-triangular, subpointed to more or less pointed, briefly bifid apically; blade 0.120–0.180 mm thick, adaxial surface dull, abaxial surface silvery pubescent; central segments (45.0–) 56.0–79.5 cm long; marginal segments (38.5–) 46.5–66.0 (–69.5) cm long, ca. $\frac{3}{4}$ – $\frac{7}{8}$ as long as central segments; central abaxial split to within (0.5–) ca. 1.0 (–2.0) cm of base, dividing blade into two more or less equal halves of (18–) 21–23 (–25) segments each; primary adaxial splits usually only slightly less deep than central abaxial split [inner splits ($\frac{7}{8}$ –) nearly to base], dividing each half into 4–5 (–6) sections of (1–) 3–7 (–8) segments each, with the central sections containing (5–) 6–7 (–8) segments each, the middle 2–3 (–4) sections of each half containing 3–4 (–7) segments each, and the marginal sections containing (2–) 4–5 (–7) segments each; secondary adaxial splits of central sections $\frac{1}{5}$ – $\frac{1}{2}$ (– $\frac{4}{5}$) to base; sections almost never fully divided; central section of each half almost always partially divided, all other sections usually undivided; widest segment (2.1–) 2.4–2.9 (–3.2) cm wide at its widest; longitudinal girdered veins usually 20–30 per half-segment, inconspicuous, 0.3–1.0 (–1.4) mm apart; longitudinal ungirdered veinlets 0–1 (–2) between adjacent veins, the larger superficially indistinguishable from veins, 0.2–0.6 mm apart; irregular transverse veins connecting lateral veins (or larger lateral veinlets) short, inconspicuous. Inflorescences with (1–) 2 (–3) orders of branching, each ascending at emergence through split petiole base, then arching or deflected (usually) or continuing to ascend; primary axis 21.0–47.0 cm long, (0.49–) 0.66–1.12 cm in diameter; peduncle 13.5–33.5 cm long; prophyll 10.0–20.0 cm long, 2.0–3.5 cm wide; peduncular bracts 2–3, 7.5–19.0 (–22.0) cm long, broadly ovate to ovate; internodes between peduncular bracts averaging (4.5–) 6.5–13.8 cm long; rachis 6.0–16.0 cm long, $\frac{1}{4}$ – $\frac{3}{8}$ of total inflorescence length; rachis bracts 12–18 (–22), deciduous, but some persistent past anthesis, the basal bracts very broadly ovate to ovate, 7.0–12.0 cm long; first-order branches to 3.8 cm long near base of rachis, shorter toward apex; rachillae to 3.4 cm long near base of rachis, shorter toward apex; rachillae bracteoles 1.9–7.3 (–19.3) mm long, 0.1–0.8 (–1.6) mm wide. Flowers (3.0–) 3.3–4.5 (–4.8) mm long, (2.0–) 2.5–3.8 (–4.1) mm in diameter; pedicel 0.2–1.1 mm long; floral bracteole 0.7–2.5 mm long, 0.2–0.7 mm wide; receptacle 0.4–0.9 mm long; sepals (2.4–) 2.9–4.4 mm long, connate basally to $\frac{1}{2}$ their length; petals 2.4–3.3 (–3.9) mm long, (2.4–) 2.6–3.7 (–3.9) mm wide; filaments 2.3–3.0 (–3.5) mm long, connate basally ($\frac{1}{6}$ –) ca. $\frac{1}{2}$ (– $\frac{1}{6}$) their length; stamen tube (0.8–) 1.1–1.7 (–2.0) mm in diameter; anthers (1.2–) 1.4–1.7 (–2.0) mm

long, 0.4–0.9 mm wide; ovary (0.7–) 1.0–1.6 mm long, (0.4–) 0.5–0.9 mm in diameter; stigmas+styles 1.2–2.3 (–2.8) mm long. Infructescence a dense, compact mass of fruits with first-order branches obscured and indistinguishable. Fruit 1.2–2.0 cm long, 1.0–1.6 cm in diameter, usually ovoidal, sometimes spheric-ellipsoidal to more or less spheroidal; seed 0.7–1.6 cm long, 0.7–1.3 cm in diameter, usually ovoidal to spheric-ellipsoidal, sometimes more or less spheroidal.

Distribution (Fig. 22). Known only from the Pacific slope of Costa Rica: scattered on slopes along the Fila Costeña in the south and a single more northerly disjunct population in the lower Cordillera de Tilarán; 100–650 m.

ADDITIONAL SPECIMENS EXAMINED. **Costa Rica.** PUNTARENAS: S slope of Fila Retinto, ca. 1.5 km NNW of Palmar Norte, 08°58'N, 83°27.5'W, *Evans et al.* 124 (BH, MICH, MO, US), *Evans et al.* 125 (MICH), *Evans* 182 (DUKE, F, INB, MO), *Evans & Grayum* 241 (CAS, EAP, MICH, NY), *Evans & Grayum* 242 (GH, MICH); NE slope of Fila de Cal, down from Ciudad Neily–San Vito de Coto Brus rd, 8.2 km N of Ciudad Neily, 08°41'N, 82°56'W, *Evans* 121 (MICH), *Evans* 122 (MICH), *Evans* 123 (MICH), *Evans* 134 (MO), *Evans* 135 (MICH), *Evans* 136 (MICH), *Evans* 172 (F, NY, US), *Evans* 173 (CAS, MICH, PMA), *Evans et al.* 181 (COL, JAUM, MICH), *Evans & Schmidt* 233 (MICH); along Costa Rica Hwy 2 (Interamerican Hwy, San Isidro–Palmar Norte) paralleling the Río Grande de Térraba at Km 240, ca. ½ km SW of the bridge over Río (Quebrada) Disciplina, 9.5 km E of Palmar Norte, 08°57'N, 83°19.5'W, *Evans & Grayum* 245 (BH, CAS, MICH, US), *Evans & Grayum* 246 (MICH, MO); NE slope above Río Guacimal, E of rd from Interamerican Hwy to Monte Verde, ca. 12 km (by rd) SSW of Monte Verde, 10°15'N, 84°50'W, *Evans & Haber* 1312 (MO); margins of Río Térraba, Km 216, Route 2, *Gómez P.* 19701 (MEXU, MO); northeastern slopes of Fila de Cal, between San Vito de Coto Brus and Ciudad Neily, 08°41'N, 82°56.5'W, *Grayum & Hammel* 5652 (CAS); Cantón de Buenos Aires, along Carretera Interamericana near Km 240, in canyon of Río Grande de Térraba, ca. 0.5 km toward Palmar Norte from Quebrada Disciplina crossing, 08°57'N, 83°19.5'W, *Grayum & Schmidt* 10108 (MICH, MO); Río Guacimal, slope and ridge on S side of river, José Rojas's farm, 10°15'N, 84°50'W, *Haber et al.* 11336 (MICH, MO).

Cryosophila grayumii is characterized by the fewest number of peduncular bracts (2–3) in the genus. The leaf blade, which is less frequently secondarily divided than in other species of *Cryosophila* (see fig. 11), is also diagnostic. Inflorescences of *C. grayumii* have the shortest first-order branches and rachillae in the genus, and *C. grayumii* and *C. nana* have inflorescences and leaves typically smaller than other species of *Cryosophila*.

Cryosophila grayumii can be found syntopically with *C. guagara* on Fila Retinto. Whereas *C. guagara* is common throughout the Golfo Dulce area to ca. 500 m or more, *C. grayumii* is restricted to limestone slopes. Within its specialized habitat, *C. grayumii* is common. This habitat is very limited in Costa Rica, where the forests are rapidly disappearing. There may be a few more remote undiscovered populations of *C. grayumii*, but even if so, the species must be considered endangered. A search for *C. grayumii* in Panama near the Costa Rican border east of the Fila de Cal population was unsuccessful. Future searches in Panama are also very likely to be unsuccessful, since almost no suitable habitat for this species remains in the country.

This species is named for Michael H. Grayum, long-time student of Costa Rican botany, who collected the first flowering material of it.

4. *Cryosophila guagara* Allen, *Ceiba* 3: 174. 1953.—TYPE: COSTA RICA. Puntarenas: near Tinoco station, area between Río Esquinas (at Piedras Blancas) and Palmar, sea level, 29 Oct 1952, *Allen* 6602 (holotype: EAP!